FINAL

Species at Risk Act
Management Plan Series

Management Plan for the Steller Sea Lion (*Eumetopias jubatus*) in Canada

Steller Sea Lion

January 2011

About the *Species at Risk Act* Management Plan Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is "*to manage species of special concern to prevent them from becoming endangered or threatened*."

What is a species of special concern?

Under SARA, a species of special concern is a wildlife species that could become threatened or endangered because of a combination of biological characteristics and identified threats. Species of special concern are included in the SARA List of Wildlife Species at Risk.

What is a management plan?

Under SARA, a management plan is an action-oriented planning document that identifies the conservation activities and land use measures needed to ensure, at a minimum, that a species of special concern does not become threatened or endangered. For many species, the ultimate aim of the management plan will be to alleviate human threats and remove the species from the List of Wildlife Species at Risk. The plan sets goals and objectives, identifies threats, and indicates the main areas of activities to be undertaken to address those threats.

Management plan development is mandated under Sections 65–72 of SARA (http://www.sararegistry.gc.ca/approach/act/default_e.cfm).

A management plan has to be developed within three years after the species is added to the List of Wildlife Species at Risk. A period of five years is allowed for those species that were initially listed when SARA came into force.

What's next?

Directions set in the management plan will enable jurisdictions, communities, land users, and conservationists to implement conservation activities that will have preventative or restorative benefits. Cost-effective measures to prevent the species from becoming further at risk should not be postponed for lack of full scientific certainty and may, in fact, result in significant cost savings in the future.

The series

This series presents the management plans prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as plans are updated.

To learn more

To learn more about the *Species at Risk Act* and conservation initiatives, please consult the SARA Public Registry (http://www.sararegistry.gc.ca).

Management Plan for the Steller Sea Lion (*Eumetopias jubatus*) in Canada [Final]

January 2011

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PREFACE

The Steller Sea Lion is a marine mammal, and is under the responsibility of the federal government. The Minister of Fisheries and Oceans is a "competent minister" for aquatic species under the *Species at Risk Act* (SARA). Since Steller Sea Lion are located in the Gwaii Haanas National Park Reserve and Haida Heritage Site, Pacific Rim National Park Reserve, and Gulf Islands National Park Reserve, administered by the Parks Canada Agency, the Minister of Environment is also a "competent minister" under SARA for individuals occurring on lands and waters under the administration of the Parks Canada Agency. The *Species at Risk Act* (SARA, Sections 65-66) requires the competent ministers to prepare management plans for species listed as special concern, in cooperation and consultation with affected and interested parties. The Steller Sea Lion was listed as a species of special concern under SARA in July 2005. The development of this management plan was led by Fisheries and Oceans Canada – Pacific Region, in cooperation and consultation with many individuals, organizations and government agencies, including the Parks Canada Agency (Appendix III).

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this plan and will not be achieved by Fisheries and Oceans Canada and the Parks Canada Agency or any other party alone. This plan provides advice to jurisdictions and organizations that may be involved or wish to become involved in activities to conserve this species. In the spirit of the Accord for the Protection of Species at Risk, the Minister of Fisheries and Oceans and the Minister of Environment invites all responsible jurisdictions and Canadians to join Fisheries and Oceans Canada and the Parks Canada Agency in supporting and implementing this plan for the benefit of the Steller Sea Lion and Canadian society as a whole. The competent ministers will report on progress within five years.

RESPONSIBLE AGENCIES AND JURISDICTIONS

Fisheries and Oceans Canada
Government of British Columbia
Environment Canada
Parks Canada Agency

AUTHOR

The DFO Technical Team prepared this document for Fisheries and Oceans Canada (DFO).

ACKNOWLEDGMENTS

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scientific and technical advice on Steller Sea Lion movements, distribution and abundance which supported the completion of this document.

STRATEGIC ENVIRONMENTAL ASSESSMENT

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Management planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that management plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats. The results of the SEA are incorporated directly into the management plan itself, but are also summarized below.

Through the development of this plan numerous factors that jeopardize or have potential to jeopardize the management of this population were evaluated and are presented. Principal among the anthropogenic factors or threats are competition with fisheries and chemical contaminants. Environmental variability limiting prey availability is also of concern in terms of long-term impacts to population health. In some cases these factors threaten the populations; in other cases they affect the designated habitat. It was concluded that some threats can be mitigated through the use of existing legislation, policies and programs and, in fact, there are numerous examples of mitigation measures that are currently employed. However, in other cases the threat and/or the potential mitigation measure(s) require further research or evaluation before recommendations on specific actions or activities can be formulated. The general type of research, evaluation and approaches for mitigation are presented in this management plan.

Through the course of implementing actions, specific activities for management, recovery and mitigation will be evaluated and detailed for these populations along with an evaluation of effects and costs for each activity or measure. Therefore, taking into account the general nature of the recommendations for new mitigation to manage this population and that many of the recommendations to protect habitat fall under existing legislation and policies, this plan will not entail any new significant adverse environmental effects.

EXECUTIVE SUMMARY

The Steller Sea Lion is the largest member of eared seals and a relatively long-lived and slow reproducing species. The scientific name (*Eumetopias jubatus*) means having a broad forehead and a mane, a reference to the prominent ruff of coarse hair that mature males develop on their necks and chests which resembles a lion's mane.

All sea lions are remarkably agile on land due to their ability to rotate their hind flippers forward and prop themselves up on their foreflippers. Steller Sea Lions can climb steep rocks and are often found many metres above the sea surface; they tend to be highly gregarious while on land and pack close together in dense breeding colonies (rookeries) or on non-breeding haulouts. Steller Sea Lions typically haul out on a regular basis, they sometimes spend many days or several weeks at sea without coming ashore and can sleep in the water, usually in groups called rafts.

This species is trans-boundary in its distribution and research and management are currently conducted by Canadian and U.S. governments, as well as private organizations and independent researchers. There are four active breeding sites within British Columbia, one of which has recently been re-established after having been eradicated by predator control programs in the 1920s. The Scott Islands rookery is now the second largest breeding aggregation in the world, and B.C. currently supports approximately 33% of the total Eastern Population of Steller Sea Lion. Steller Sea Lions in B.C. are currently breeding at all known historic rookeries, and populations have grown well past known peak historic levels.

Based on estimated pup production during the last range-wide survey in 2002, the total size of the Eastern Population is estimated to between 46,000 to 58,000 animals. Abundance in Canadian waters was estimated to be 20,000-28,000 based on the most recent survey in 2006 (DFO 2008). During breeding season, the congregation of animals at the four Canadian breeding sites makes the B.C. population vulnerable to human disturbance and catastrophic events, which has the potential to affect a significant proportion of the population.

Limiting factors are the natural processes that limit population size or growth, whereas threats (both natural and anthropogenic) have caused, are causing, or may cause harm, death or behavioural changes to a species at risk or the destruction, degradation and/or impairment of its habitat to the extent that population-level effects occur. Steller Sea Lions are limited by bottom-up processes that affect prey availability and accessibility, and by top-down processes that affect predation rates. The most significant threats identified for Steller Sea Lions are competition with fisheries, and environmental variability limiting prey availability. Toxic spills and chronic chemical contamination are also of moderate concern for long-term impacts to population health. Further research will assist in clarifying these threats.

Steller Sea Lions in Canada are listed under the *Species at Risk Act* as 'special concern' meaning they are considered a wildlife species that could become threatened or endangered because of a combination of biological characteristics and identified threats. This management plan has two goals. First, to ensure that anthropogenic threats from Canadian sources do not cause unsustainable population declines, contraction of current range or number of breeding sites in

Canada. A second goal of this plan is to encourage support for, and contribution to an environment where research and monitoring of Steller Sea Lions in B.C. contributes to achieving an improved global knowledge of the Eastern Pacific Population. Six high priority actions have been identified to address the threats of greatest concern (Table 3), and 20 ongoing actions beneficial to conservation and understanding of the species are also listed. Six additional actions are listed to identify new efforts useful for management of the population. Participation of interested parties in listed actions is encouraged and will contribute to implementation of this plan and conservation of this species in Canada. Synchronization of activities recommended for protection, management and research will facilitate a multi-species approach to marine mammal conservation in B.C., and allow for effective use of available resources.

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1. SPECIES INFORMATION

1.1. Species Assessment Information from COSEWIC

Date of Assessment: November 2003

Common Name (population): Steller Sea Lion

Scientific Name: *Eumetopias jubatus*

COSEWIC Status: Special Concern

Reason for Designation: There are only three[1] breeding locations in British Columbia. Although the population is increasing, they are sensitive to human disturbance while on land. Threats include the possibility of acute oil spills. There are unexplained declines in other populations to the north and west of British Columbia.

Canadian Occurrence: British Columbia, Pacific Ocean

COSEWIC Status History: Designated Not at Risk in April 1987. Status re-examined and designated special concern in November 2003.

[1]*Since the 2003 COSEWIC designation, a fourth location has been re-classified as a breeding site.*

1.2. Description and Biology

The Steller Sea Lion is the largest member of the eared seals, or sea lions and fur seals (Order Carnivora, Superfamily Pinnipedia, Family Otariidae; Rice 1998). Other common names used in Canada include Steller's sea lion, northern sea lion and *lion de mer de Steller*. Some First Nations names for sea lion include; tukuk or tukuk^{w} (tuk^{w}ašt meaning dried sea lion) in Nuu-chah-nulth Barkley Sound dialects (BSDWG 2004), in Kwakiutl sea lion are referred to as tl'íx̲7en (Grubb 1977), and in the Haida language, k̲íit or k̲íidaay (Lawrence 1977). The scientific name (*Eumetopias jubatus*) means having a broad forehead and a mane, a reference to the prominent ruff of coarse hair that mature males develop on their necks and chests, from which is also derived the name 'lion'.

Steller Sea Lions exhibit significant sexual dimorphism, with adult males (bulls) attaining a length of up to 3 m and weighing 400-800 kg, although at the start of the breeding season the largest males can weigh over 1,100 kg. Mature males develop massive muscular necks and chests, and robust heads with flatter snouts than those of females. Adult females (cows) are noticeably smaller, averaging 2.2 m and 200-300 kg (Mathisen et al.. 1962; Thorsteinson and Lensink 1962; Orr and Poulter 1967; Winship et al.. 2001).

When dry, the fur of adults and juveniles are pale yellow to light brown, darkening to chocolate brown on their hindquarters and near their flippers, which are black and bare-skinned. Steller

Sea Lions may appear greyish white when wet. Steller Sea Lion fur is comprised of short coarse hairs, which is moulted annually between late June and early December, depending on the age class (Scheffer 1964). Pups are born with a thick blackish-brown lanugo that is moulted between 3-6 months of age.

All sea lions are remarkably agile on land due to their ability to rotate their hind flippers forward and prop themselves up on their foreflippers. Steller Sea Lions can climb steep rocks and are often found many metres above the sea surface; they tend to be highly gregarious while on land and generally pack close together in dense breeding colonies (rookeries) or non-breeding haulouts (Schusterman 1981; Loughlin et al. 1987). Although Steller Sea Lions typically haul out on a regular basis, they sometimes spend many days or several weeks at sea without coming ashore (Olesiuk and Jeffries, unpublished data), and can sleep in the water, usually in groups called rafts.

Breeding colonies (called rookeries) are used by sexually mature sea lions (along with a few dependent young with their mothers) during the summer months. Steller Sea Lions have a polygynous mating system, in which bulls compete to establish territories and gain access to females; the ratio of cows to territorial bulls is generally about 10-15:1 (Gisiner 1985; Merrick 1987). Successful males will usually maintain their territory for an average of 40 days (range 20-68 days) without feeding (Gentry 1970). Most territorial males are 9-13 years old (Thorsteinson and Lensink 1962) and may hold a territory for several years in succession (range 1-7 years) (Gisiner 1985).

Females first ovulate at about 3-6 years of age. Females begin returning to rookeries in late May and give birth to a single pup within a few days of their arrival; most pups are born by early July (Gentry 1970; Edie 1977; Bigg 1985). Mothers nurse their pups on shore for about one week, before leaving on regular feeding trips that alternate one day at sea and one day on shore (Swain 1996). By about four weeks of age, pups can swim in the open ocean and mothers start moving them to nearby haulouts. Some pups continue to nurse into their third year, although most are weaned in their first or second years; some mothers may also nurse a newborn and yearling simultaneously (Sandegren 1970; Hood and Ono 1997; Milette and Trites 2003).

Use of breeding rookeries declines by late August and is at a minimum during January-April, although some animals continue to use them year-round as haulout sites (Bigg 1985). Outside of the summer breeding season, Steller Sea Lions use year-round haulouts as well as winter-haulouts that may be considerable distances from rookeries. Females with dependent young may stay at a single haulout or move their pups around between haulouts (Shusterman 1981; Loughlin et al. 1987).

1.3. Populations and Distribution

1.3.1. Global Range

Steller Sea Lions inhabit the cool-temperate and subarctic coastal waters of the North Pacific Ocean from the Channel Islands off southern California, north to the Bering Strait, and southwest along the Asian coast to Hokkaido, Japan (Fig. 1; Kenyon and Rice 1961; Loughlin et al. 1984; Loughlin et al. 1992). They presently give birth on 61 rookeries and rest at >300 haulouts across

this range. Steller Sea Lions are non-migratory, but may disperse considerable distances from breeding sites (Fisher 1981; Calkins and Pitcher 1982; Loughlin 1997; Raum-Suryan et al. 2002).

Worldwide, at least two populations of Steller Sea Lions are recognized based on genetic differentiation of mitochondrial DNA (which reflects maternal lineage): an Eastern Population (California to southeast Alaska) and a Western Population (Gulf of Alaska, Bering Sea, Aleutian Islands, and Russia) (Bickham et al. 1996). Separation of the two populations in North America is further supported by a phylogeographic analysis that considers such ancillary information as population trends, distribution, movements, and morphology (York et al. 1996; Loughlin 1997). However, recent genetic sampling indicates two newly established rookeries near the western edge of the Eastern Population may have been colonized by a mixture of Western and Eastern stock animals (O'Corry-Crowe et al. 2005). Female Steller Sea Lions in Asian waters (Kamchatka Peninsula, Kuril Islands and Okhotsk Sea) appear to be genetically distinct from the other populations (Baker et al. 2005) but there is greater gene flow for males (Hoffman et al. 2006). There is also some genetic evidence of geographic segregation among the shelf (Gulf of Alaska and Alaska Peninsula) and oceanic (Aleutian Islands) components of the western population (O'Corry-Crowe 2007).

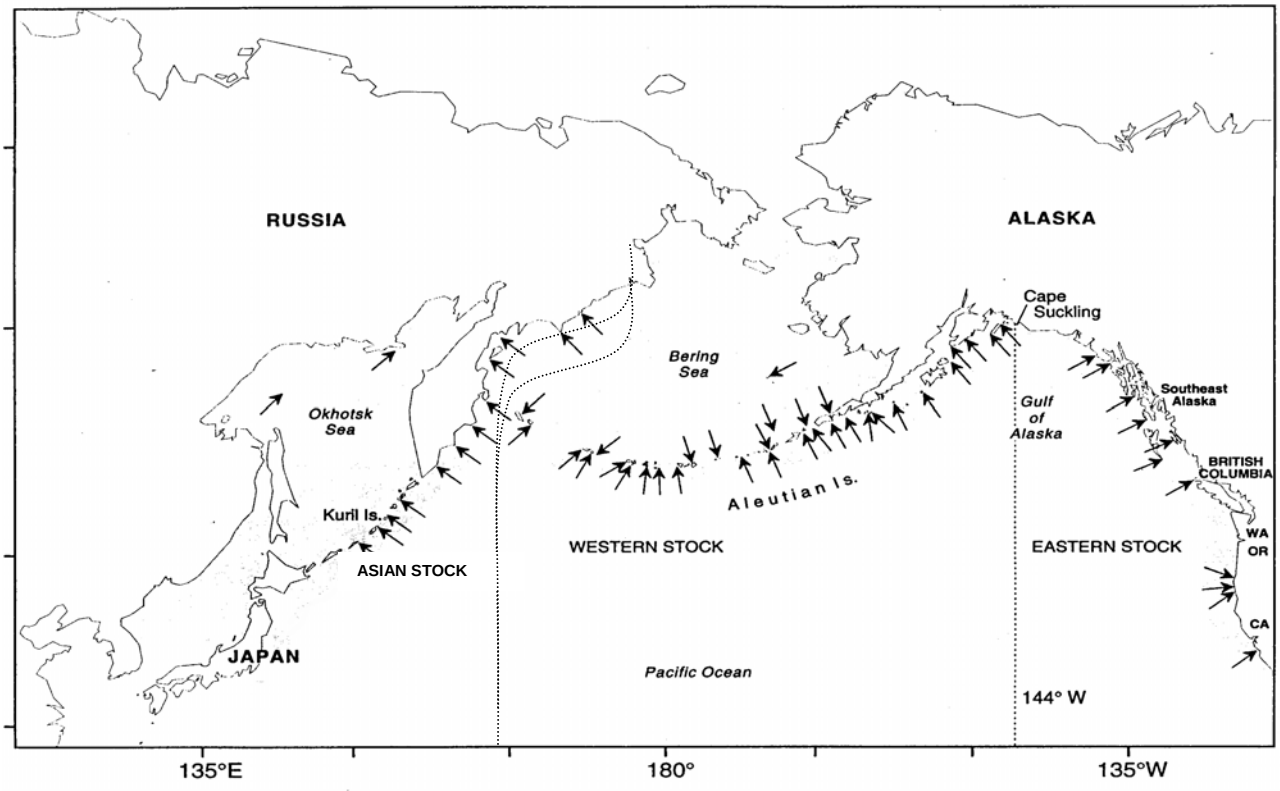

Figure 1. Worldwide range of the Steller Sea Lion. Arrows denote breeding rookeries and shaded areas denote the approximate non-breeding range of the species. The dashed line shows the separation between Asian, Eastern and Western stocks of Steller Sea Lions. (modified from Loughlin 1997 and Sease et al. 1999).

1.3.2. Canadian Range

Within Canada, Steller Sea Lions occur only in British Columbia and constitute part of the Eastern Population (Bickham 2000). There are four main breeding areas in B.C.: the Scott Islands off the northwest tip of Vancouver Island, with rookeries situated on Triangle Island and the small islets off Beresford and Sartine Islands; the second area at Cape St. James off the southern tip of the Queen Charlotte Islands, with rookeries situated on the Kerouard Islands; and a third area off Banks Island on the northern mainland coast, with rookeries situated on North Danger Rocks (Figure 2).

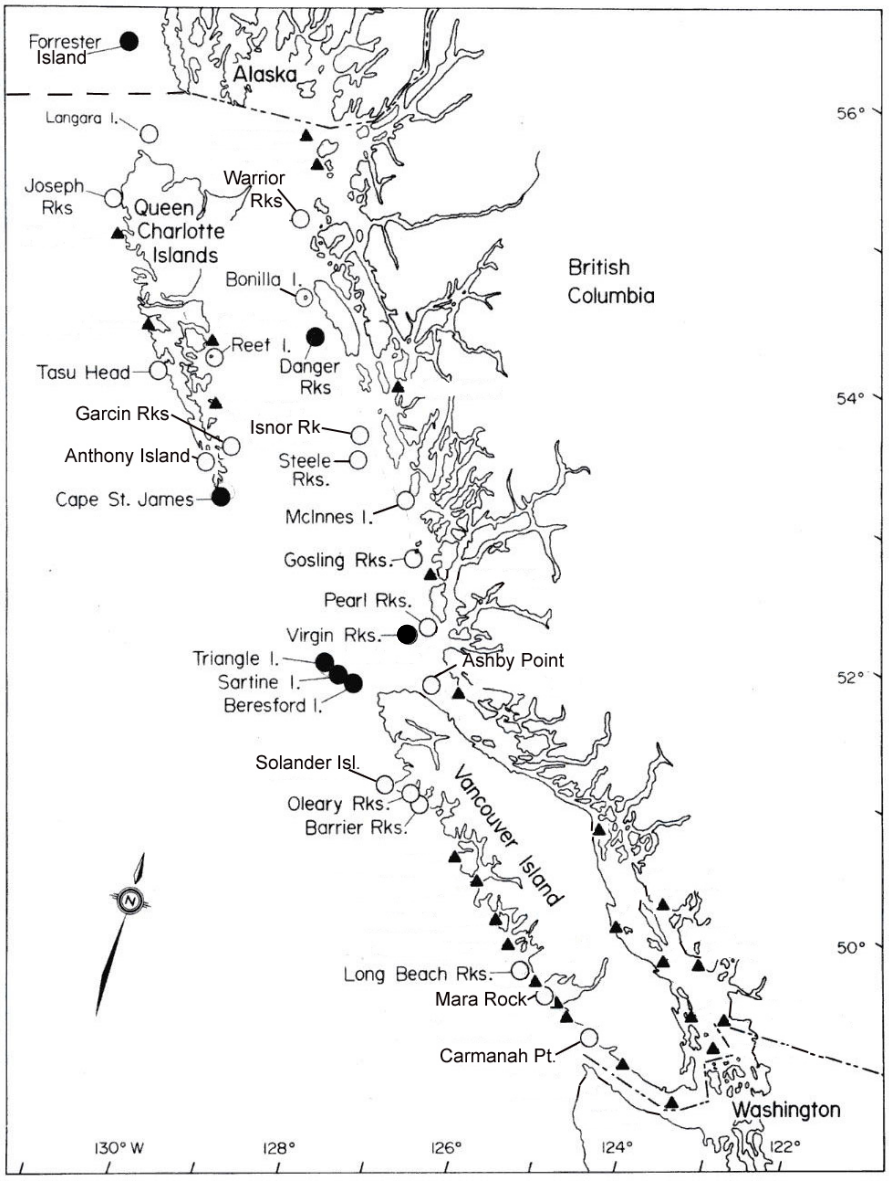

Figure 2. Geographic location of Steller Sea Lion rookeries (●), year-round haulout sites (○) and major winter haulout sites (▲) in British Columbia. Also indicated is the major rookery on Forrester Island, Alaska. Updated from Bigg (1985) (DFO unpublished data).

The fourth breeding area was historically located off the central mainland coast on the Sea Otter Group, with rookeries situated on Virgin, Pearl and possibly Watch Rocks, but this breeding aggregation was extirpated by intense predator control programs during the 1920s and 1930s and had subsequently been used as a haulout by non-breeding animals (Bigg 1985). An increasing number of pups have been born on Virgin and Pearl Rocks in recent years and based on the 2006 abundance survey the site was reclassified as a rookery (Figure 2). In addition to the four breeding sites, there are about twenty-three haulout sites distributed mainly along the exposed outer coast that are used continuously throughout the year, as well as numerous winter sites used on a seasonal or irregular basis.

The offshore distribution of Steller Sea Lions is not well defined. In general, most Steller Sea Lions appear to feed within about 60 km of shore during summer, and can range over 200 km from shore in winter (Kenyon and Rice 1961; Merrick and Loughlin 1997). They appear to feed over the continental shelf and along the shelf break (Kajimura and Loughlin 1988). Steller Sea Lions captured in B.C. and fitted with satellite tags ranged widely along the B.C. coast, but rarely ventured more than 50 km from shore (Olesiuk and Jeffries, unpublished data).

1.3.3. Global Population Trends

Between the late 1950s and 1970s, overall abundance of Steller Sea Lions in the North Pacific (range-wide: Japan to California) was believed to have been stable at about 250,000-300,000 individuals (Kenyon and Rice 1961; Loughlin et al. 1984). Abundance subsequently declined to about 116,000 by 1989, 97,500 by 1994-95, and 95,000 by 1999-2002.

The drop in overall abundance of Steller Sea Lions was attributable to declines in the western part of their range. Historically, the Western Population (Russia to Gulf of Alaska) was much larger than the Eastern Population (southeast (SE) Alaska to California), and accounted for roughly 90% of total abundance between the 1950s and 1970s (Kenyon and Rice 1961; Loughlin et al. 1984; Trites and Larkin 1996). The decline appears to have begun in the eastern Aleutian Islands in the mid-1960s, and spread to the western Aleutian Islands and Gulf of Alaska in the late 1970s. Numbers dropped precipitously during the 1980s, and continued at a much slower rate through the 1990s (York et al. 1996). By 1999-2002, the Western Population was estimated to have numbered about 50,000 individuals (Burkanov 2000; Sease and Stinchcomb 2003), a decline of about 80% from levels present during the 1950s to 1970s. The precipitous decline of the Western Population has made the Steller Sea Lion one of the most intensively studied marine mammals in the world (see NMFS 1992, 2008; Loughlin 1998; Hunter and Trites 2001; Dalton 2005).

Predator control programs in B.C., Washington, Oregon (Rowley 1929) and California (Pearson and Verts 1970) during most of the 20th century (1900 – 1970) resulted in the Eastern Population of Steller Sea Lions becoming severely depleted by the time the species was protected under the *Fisheries Act* in Canada in 1970 and under the *Marine Mammal Protection Act* in the U.S. in 1972.

Steller Sea Lions were not known to breed in SE Alaska during the early 1900s and were not subjected to major control programs. The first rookeries became established in SE Alaska during the 1930s or 40s when the intense killing had begun in southern parts of the range, and the

species appears to have flourished in the 1950s and 60s even as breeding populations were reduced in B.C. While predator control programs were underway, dispersal of breeding females from rookeries in B.C. may have contributed to the rapid expansion of new rookeries established in SE Alaska (Calkins et al. 1999; Pitcher et al. 2003, 2007), and dispersal patterns appear to have changed over time. Forrester Island accounted for much of the growth until the early 1980s, but its growth rate has subsequently slowed, and newly established rookeries in central-northern SE Alaska as well as other rookeries in B.C. have accounted for much of the more recent growth (Pitcher et al. 2007).

In contrast to the Western Population, the Eastern Population has been growing in recent years (DFO 2008; Olesiuk unpublished data; Calkins et al. 1999; Pitcher et al. 2003, 2007). In 2002, the Eastern Population was estimated to number about 46,000 – 58,000 individuals (Pitcher et al. 2007), compared with approximately 45,000 Steller Sea Lions in western Alaska (Angliss and Outlaw 2007) and 16,000 in Asia (Burkanov and Loughlin 2007).

1.3.4. Canadian Population Trends

Historical counts of Steller Sea Lion rookeries in B.C. date back to the early 1900s, and provide an index of the size of the Canadian breeding population (Bigg 1984, 1985; DFO 2008). It is estimated that about 14,000 animals (all ages, including pups) were present on rookeries in 1913-19 (Fig. 3), which was prior to any large-scale kills. Steller Sea Lions in Canada and neighbouring waters were subjected to predator control programs during most of the 20th century.

Prior to the species being protected in the 1970s, the Canadian government conducted intensive culls of Steller Sea Lions at rookeries, for the mandated purpose of protecting salmon fisheries (Figure 4). Limited commercial harvests were also conducted for hides and for mink food. Numbers on rookeries in B.C. had been reduced to 4,550 by 1961 and 3,390 animals (including 940 pups) by the time the first aerial survey was conducted in 1971. Thus Steller Sea Lions in B.C. were depleted to about one-quarter of their historic size by predator control and commercial harvesting (Bigg 1985; DFO 2008).

Assessments of the abundance, distribution and status of Steller Sea Lions in B.C. were initiated in the 1970s and 1980s (Bigg 1984, 1985, 1988) and continue to the present day (DFO 2008; Olesiuk et al. unpublished data). Province-wide aerial surveys have been conducted in B.C. at 4-5 year intervals since the species was protected under the *Fisheries Act* in 1970 from targeted harvest, or culling. Surveys are conducted during a brief time window between late June and early July, representing the period by which most pups have been born, but most are still too young to have begun to disperse from rookeries (Bigg 1985; DFO 2008).

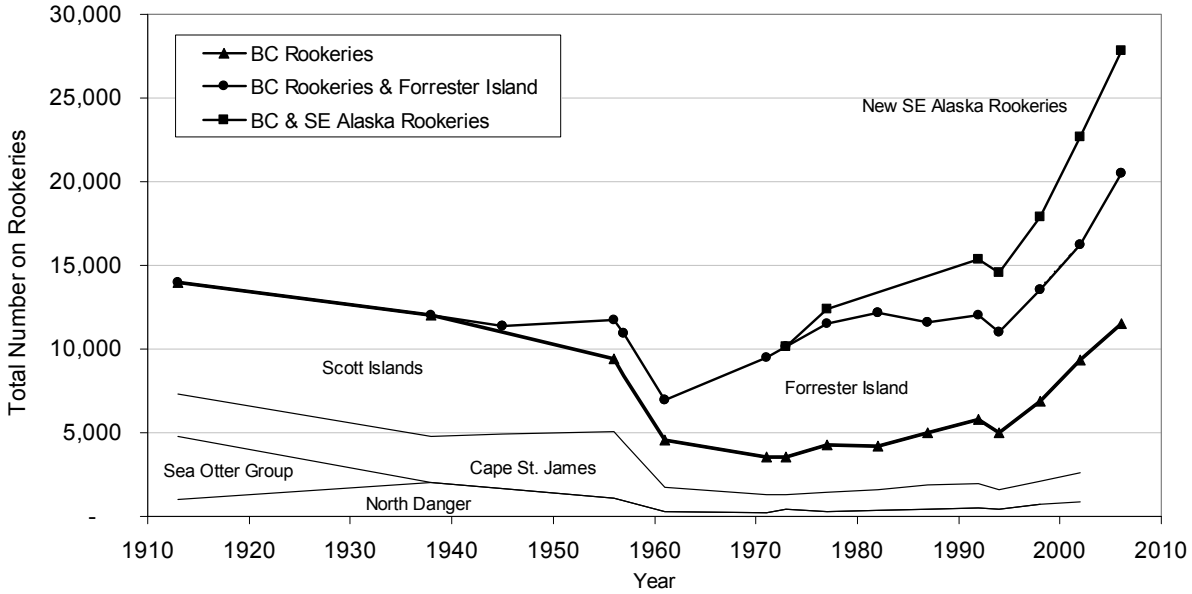

Figure 3. Historic trends in total numbers of Steller Sea Lions (pups, juveniles and adults) on breeding rookeries in B.C. (▲—▲), Forrester Island, Alaska (●—●), and other new rookeries in SE Alaska (■—■). The thin blue lines show the distribution of animals among main breeding areas in B.C. (modified from Bigg 1985 and Olesiuk et al. 2008).

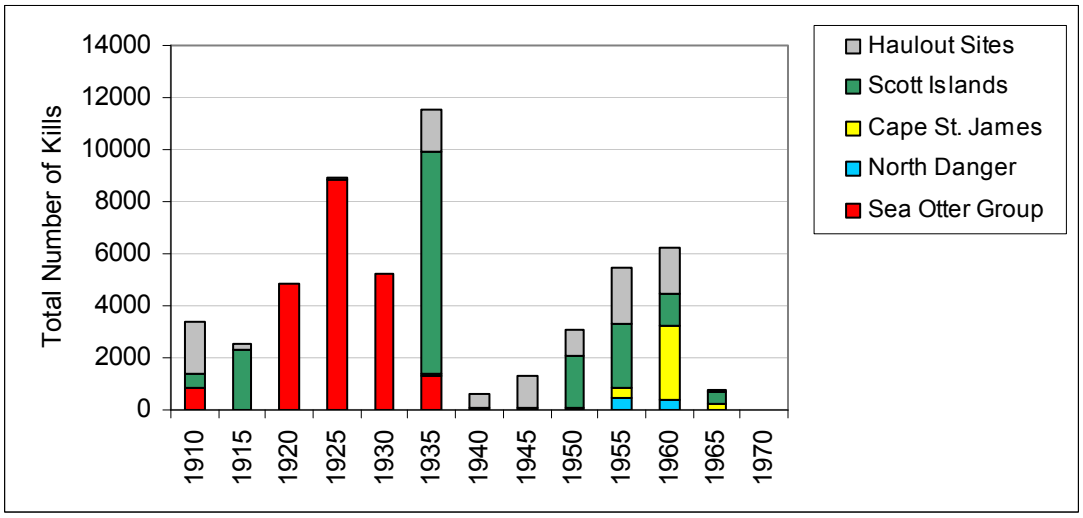

Figure 4. Total numbers of Steller Sea Lions reported to have been killed in B.C. as part of control programs and commercial harvests during 1913-70. Data have been grouped and totalled into 5-year periods, and are colour-coded by major breeding area. Comparison with Figure 3 shows the impact these kills had on populations. (Data from Bigg 1984).

B.C. aerial surveys indicate that numbers of pups and non-pups on rookeries increased at a mean rate of 3.5% and 3.9% per annum respectively, which has resulted in a tripling in the size of the breeding population since the early 1970s (Figure 5) (DFO 2008). Similar trends have been observed on neighbouring rookeries to the south in Oregon and to the north in SE Alaska (Figure 5), which combined constitute 90% of the Eastern Population (Brown and Reimer 1992; Calkins et al. 1999; Pitcher et al. 2007). This indicates that the increase in Canada represented real population growth, and not merely a local shift in distribution (Pitcher et al. 2007).

Based on estimated pup production during the last range-wide survey in 2002, the total size of the Eastern Population is estimated to be between 46,000 to 58,000 animals, with about one-third (33% of pups and 34% of non-pups) occurring in Canadian waters. Abundance in Canadian waters was estimated to be 20,000-28,000 based on the most recent survey in 2006 (DFO 2008).

1.4. Requirements of the Steller Sea Lion

The needs of Steller Sea Lions can be partitioned between the time they spend on land when they come ashore to rest and reproduce, and the time they spend at sea where they travel and forage. The species is gregarious while on land, and animals gather at traditional rookeries and haulout sites, some of which have been used for over a century. Steller Sea Lions forage on a variety of prey items, primarily small or medium-sized schooling fish, and foraging habitat varies in relation to prey distribution and abundance.

1.4.1. Habitat and Biological Requirements

Terrestrial Habitat
The terrestrial sites used by Steller Sea Lions in British Columbia generally fall into three distinct categories: 1) rookeries where animals congregate during May-August to give birth, mate, and nurse pups; 2) year-round haulouts that are usually occupied continuously; and 3) winter haulout sites that are used less regularly, mainly during the non-breeding season (Bigg 1985). Rookeries generally have peripheral haulout sites associated with them that are occupied mainly by non-breeding males and juveniles during the breeding season. In most cases animals continue to use rookeries as haulout sites throughout the year, albeit in much reduced numbers.

Steller Sea Lions exhibit high site fidelity for breeding and birthing. Studies of marked individuals indicate that most females tend to return to their rookeries of birth, and will return faithfully to a single rookery each year (Raum-Suryan et al. 2002). The three main breeding colonies in B.C. were all well established when the first sea lion survey was conducted in 1970 (Newcombe and Newcombe 1914), and have been used continuously despite disturbances caused by predator control programs and commercial harvests (Pike and Maxwell 1958; Bigg 1985; Olesiuk unpublished data). The fourth breeding site in the Sea Otter Group was eradicated by predator control programs, although sea lions continued to use the site as a non-breeding haulout. Pupping has resumed at the site, and based on pup counts during the 2006 survey, the site was recently reclassified as a rookery.

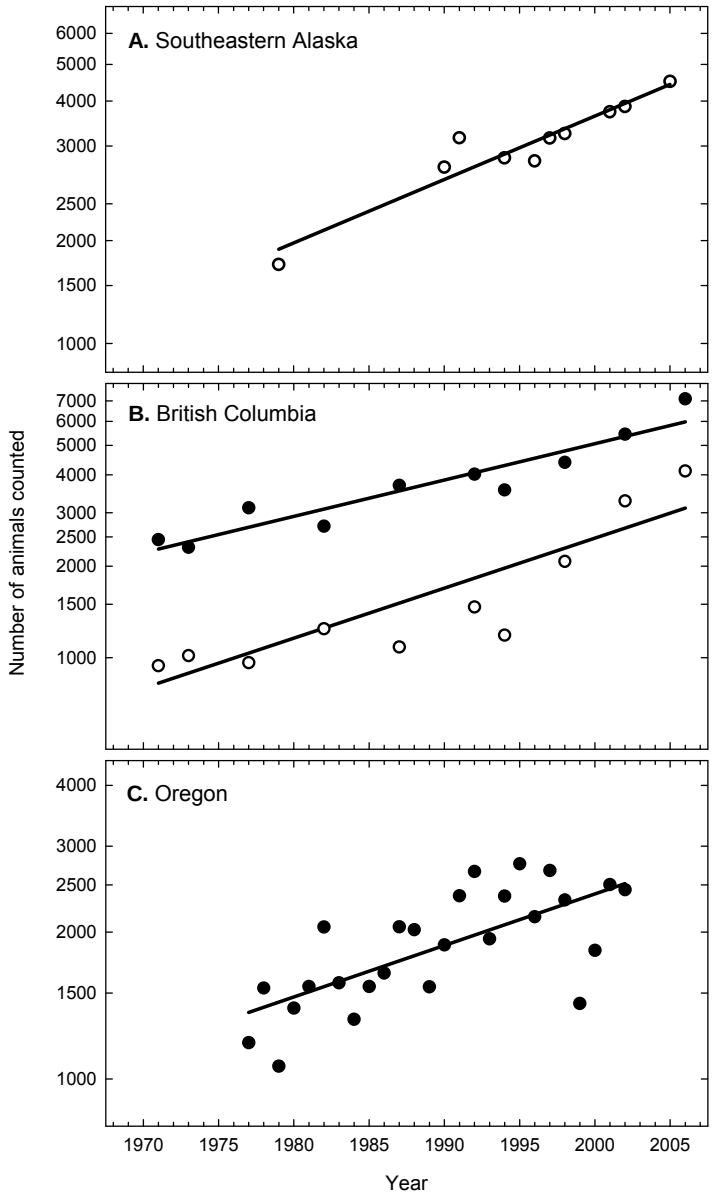

Figure 5. Recent trends in counts of Steller Sea Lion pups (○) and non-pups (●) on rookeries in a) southeast Alaska; b) British Columbia; and c) Oregon (updated from Pitcher et al. 2007).

Although Steller Sea Lions generally return to breed on their natal rookery, there may also be some exchange between neighbouring rookeries (Calkins and Pitcher 1982, 1996). Of 31 females branded as pups on Forrester Island, several were observed to have given birth at other rookeries, including 400 km away at Cape St. James (Raum-Suryan and Pitcher 2000; Raum-Suryan et al. 2002).

Terrestrial habitats for Steller Sea Lions comprise some of the most isolated, barren outcroppings in the North Pacific Ocean. Haulouts are typically located in regions that have relatively high

currents, high salinity, low surface temperatures and shallow waters, presumably reflecting high ocean productivity and hence optimum feeding areas (Ban et al., unpublished data). Essential haulout features seem to include relatively flat terrain, accessibility, protection from swell and waves, and absence of terrestrial predators such as bears and wolves (Edie 1977). Sea lions use protected areas during storms, and wet areas during extremely hot weather (Edie 1977). Access to high ground is also important for whelping, although older animals that are capable of going to sea will use lower and more exposed areas. Rocky ledges are preferred breeding substrate in B.C. rookeries, although increasing numbers of animals have recently begun breeding on the gravel beaches along the eastern (leeward) side of Triangle Island (Olesiuk, unpublished data).

The twenty-three year-round haulout sites in B.C. are generally situated in exposed areas along the outer coast, and are comprised of rocky islets and ledges. Approximately half of the sites were noted to exist during the first surveys in 1913 (Newcombe and Newcombe 1914), while about one-quarter appear to have been colonized since aerial surveys were initiated in the early 1970s. Year-round haulout sites are widely distributed in B.C., and provide sea lions with habitat for resting all along the outer coast. Steller Sea Lions can also rest in the water during storms or heavy swells when haulouts are awash, or when they are near concentrations of prey without suitable nearby haulouts; this rafting behaviour often occurs in groups (Kenyon and Rice 1961; Olesiuk and Bigg 1988).

Many winter haulouts are situated in protected areas, such as the Strait of Georgia, Strait of Juan de Fuca and Queen Charlotte Strait. In addition to natural substrates, wintering haulouts include log booms, floats, jetties and docks. In southern B.C., winter haulouts are often shared with subadult and adult male California sea lions (*Zalophus californianus*) (Hancock 1970; Brenton 1977; Bigg 1985).

Prey Requirements and Marine Habitat

Over 50 species of fish and invertebrates have been identified in the diets of Steller Sea Lions (Wilke and Kenyon 1952; Pike 1958; Spalding 1964; Pitcher 1981; Kastelein et al. 1990; Sinclair and Zeppelin 2002). In British Columbia, preferred prey appears to include small or medium-sized schooling fishes, such as herring, hake, sandlance, salmon, dogfish, Eulachon and sardines, and bottom fish such as rockfish, flounder and skate (Pike 1958; Spalding 1964; Olesiuk and Bigg 1988, Trites and Olesiuk, unpublished data). In addition to fish, squid and octopus are sometimes consumed, but their importance was likely exaggerated in earlier studies because cephalopod beaks likely accumulate in stomachs over extended periods (Bigg and Fawcett 1985). Crabs, mussels, clams and other invertebrates are occasionally recovered in stomachs and scats, but these may represent secondary prey that had been consumed by the prey species eaten by sea lions. Steller Sea Lions have also been observed to prey on gulls (O'Daniel and Schneeweis 1992) and other pinnipeds, including neonate fur seals (Gentry and Johnson 1981) and harbour seals (Pitcher and Fay 1982, E. Mathews, University of Alaska, Juneau AK, pers. comm.). Predation on other pinnipeds seems quite uncommon, but may be locally significant.

Prey requirements of Steller Sea Lions vary seasonally and with age and sex, and depend on the type and quality of prey (Perez 1994; Rosen and Trites 1999, 2000b,c). Bioenergetic models predict that daily food requirements for Steller Sea Lions in the wild are approximately 15-20 kg

for mature females and 30-35 kg for mature males (Winship et al. 2002). For females, these daily energy requirements represent about 14% of body weight for a 1 year old and 7% for a mature individual. Mean consumption in the SE Alaska population was estimated at 17 kg per individual per day (Winship and Trites 2003). Sea lions that consume more low fat fishes such as gadids require significantly more prey than those that consume fattier fishes such as herring (Trites and Donnelly 2003; Winship and Trites 2003).

There is relatively poor understanding of how Steller Sea Lions use their aquatic habitat At sea, Steller Sea Lions are commonly seen alone, or in groups of several animals (Bonnell et al. 1983). Animals feeding on small schooling fishes appear to feed co-operatively in groups of up to 100 animals that dive and surface in synchrony (Fiscus and Baines 1966; Loughlin et al. 1983; Loughlin and DeLong 1983; P. Olesiuk, Fisheries and Oceans Canada – Pacific Region, Science, pers. comm.). Foraging appears to occur primarily at night based on satellite telemetry (Loughlin et al. 1998; Loughlin et al. 2003) and diurnal haul out patterns (Withrow 1982; Higgins 1984; Milette 1999), but can vary seasonally depending on the type of prey consumed (Olesiuk and Jeffries, unpublished data). Steller Sea Lions can dive to depths of at least 310 m (Andrews 1999) and stay submerged for over 8 minutes (Swain and Calkins 1997), with most dives in the range of 15-50 m and lasting 1.5-2.5 min (Merrick and Loughlin 1997; Swain and Calkins 1997; Loughlin et al. 1998; Andrews 1999; Swain 1999).

Animals are generally observed within 60 km of land and in water depths less than 400 m, but may venture several hundred kilometres offshore and occur off the continental shelf (Kenyon and Rice 1961; Merrick and Loughlin 1997). Telemetry and branding studies have shown that animals are highly mobile, and may travel hundreds of kilometres and utilize numerous haulout sites over the course of a few weeks or months (Merrick and Loughlin 1997; Loughlin et al. 1997, 2003; Raum-Suryan et al. 2002). Steller Sea Lions captured and tagged in B.C. have been subsequently tracked up to 1,700 km, ranging north to Alaska or south to California (Calkins 1981; Fisher 1981; Loughlin, pers. comm.; Olesiuk, unpublished data). Steller Sea Lions also occasionally venture into freshwater (Jameson and Kenyon 1977; Roffe and Mate 1984; Beach et al. 1985). In B.C., sea lions are occasionally seen rafting as far as 35 km upriver (Olesiuk, unpublished data). Steller Sea Lions also congregate in estuaries during autumn to feed on pre-spawning salmon and at the mouth of the Fraser River in spring when Eulachon are running (Bigg 1985; Bigg et al. 1990, Olesiuk unpublished data). Major wintering areas of sea lions off southern Vancouver Island have shifted, presumably in relation to changes in distribution of pre-spawning herring (P. Olesiuk, pers. comm.).

Foraging trips tend to be more localized during the summer breeding season (<20 km) than during other times of the year (60-160 km). (Bonnell et al. 1983; Merrick and Loughlin 1997). In summer, reproductive females are confined to foraging within commuting distance of rookeries, as they must regularly return to attend pups. In contrast, non-breeding animals during summer and all animals during the non-breeding season (September-May) are more flexible and movements are likely related to the availability of forage fish. Foraging ranges of immature non-breeding animals appear intermediate to the summer and winter foraging ranges of adults (Merrick and Loughlin 1997).

1.4.2. Ecological Role

The Steller Sea Lion is the largest species of otariid and the only one that resides and breeds year-round in Canadian waters. The species occupies a niche intermediate to the inshore distribution of harbour seals (*Phoca vitulina*) that generally occupy more protected waters, and the pelagic distribution of northern fur seals (*Callorhinus ursinus*) that generally occur over the continental shelf and along the shelf break. The role of seals and sea lions in complex marine ecosystems remains poorly understood and studies are required to assess the contribution of the Steller Sea Lion in large and complex ecosystems (Beverton 1985; Bowen 1997; Merrick 1997; Trites 1997).

Due to the recent declines in Alaska, the British Columbia rookeries at the Scott Islands and Cape St. James now represent the second and sixth largest breeding aggregations in the world. Based on overall pup production in 2002, B.C. supports about 16% of the world's population and about 33% of the Eastern stock (another 31% occurs in southeast Alaska within 50 km of the Canadian border). Steller Sea Lions are widely perceived to be an important component of the coastal marine ecosystem, and contribute to the eco-tourism industry.

Steller Sea Lions are top marine predators. In SE Alaska, Steller Sea Lions are estimated to consume about 140 million kg of fish annually (Winship and Trites 2003); assuming a similar diet, the B.C. population would consume another 110 million kg annually. In comparison, the total annual commercial fish landing in B.C. has averaged about 185 million kg over the last decade (DFO 2007). Basic knowledge of seasonal and regional feeding habits of sea lions in B.C. are still lacking, and much of the information that does exist has been collected anecdotally as part of other studies. As Steller Sea Lions recover from predator control programs and harvests, it is likely that prey resources will ultimately limit sea lion populations, but it remains unclear to what extent sea lions themselves might limit their prey populations.

Steller Sea Lions also compete with other marine predators, including other species of pinnipeds, whales, seabirds, sharks and flatfish (Livingston 1991; Tamura and Ohsumi 2000; Wespestad et al. 2000; NMFS 2001; Gallucci et al. 2006). Over the last century, competition with California sea lions (*Zalophus californianus*) has increased dramatically (Lowry and Maravilla-Chavez 2005), which could adversely affect Steller Sea Lions. California sea lions appear to have displaced Steller Sea Lions from traditional rookeries in the Channel Islands off California, and have extended their non-breeding range north into B.C. (Bigg 1988; P. Olesiuk pers. comm.) and occasionally as far as Alaska (Maniscalco et al. 2004). California sea lions migrating along the coast of Oregon appear to displace Steller Sea Lions (Mate 1975); the two species often share the same winter haulout sites (P. Olesiuk pers. comm.) and consume the same prey species (Olesiuk and Bigg 1988).

Steller Sea Lions are an important prey species for Transient Killer Whales (also called transients), (Morton 1990; Baird and Dill 1995; Ford et al. 1998; Matkin et al. 2007; Wade et al. 2007), which may selectively prey on pups and juveniles (Barrett-Lennard et al. 1995). Transient Killer Whales are listed under the *Species at Risk Act* [SARA] as threatened, and could be vulnerable to fluctuations in their prey species. In B.C. and adjacent waters, Steller Sea Lions were found to be the second most important prey for transients (Ford et al. 1998), and a survey of the entire northeast Pacific Ocean reported Steller Sea Lions to be the sixth most commonly

observed prey of these whales (Wade et al. 2007). Large sharks may also prey on Steller Sea Lions in the southern part of their range (Stroud 1978; Ainley et al. 1981) and sleeper sharks are a potential sea lion predator in Alaska (Sigler et al. 2006).

Steller Sea Lions may have the potential for serving as an indicator of the general status of coastal marine ecosystems. The species is widely distributed in coastal waters, has a long life-span, congregates on rookeries where breeding populations can be readily censused, and occupies a position near the top of the marine food chain. The recent declines in the Western Population of Steller Sea Lions in Alaska are now widely believed to be associated with broader ecosystem processes that are not well understood; this demonstrates that the ability to monitor Steller Sea Lion populations far exceeds our understanding of the complex ecological processes that regulate these apex predators. As populations in B.C. and neighbouring waters have now recovered past historic high levels, natural population regulatory mechanisms might become a factor governing the status of Steller Sea Lion populations.

1.4.3. Limiting Factors

Limiting factors are the natural processes that limit population size or growth. Steller Sea Lions are inherently a relatively long-lived and slow-reproducing species. The maximum productivity level has not been determined for this species, but it is likely low. For U.S. stock assessments, a theoretical maximum growth rate of 12% is generally assumed for pinnipeds. While this may be appropriate for phocids (e.g. Olesiuk et al. 1990; Olesiuk 1999; Bowen et al. 2003), otariids generally exhibit lower survival rates, and expanding populations have not attained that level of productivity. For instance, severely depleted populations of California sea lions sustained exponential growth rates of only about 6.1% (Lowry and Maravilla-Chavez 2005) and northern fur seals about 8.6% per year (York, pers. comm. cited in Angliss and Outlaw 2007). Recovering Steller Sea Lion populations along the west coast of North America have sustained growth recovery rates of only about 3.1% per annum and have exhibited no signs of density dependence as populations increased, but it is not known whether this represents the maximum intrinsic rate of increase for the species or whether some stressor has been inhibiting recovery throughout this region for the past 40 years (Pitcher et al. 2007). Regardless, the productivity of Steller Sea Lions is probably lower than other pinnipeds, making it less resilient to perturbations and stresses, taking longer to recover from such impacts.

The low productivity of Steller Sea Lions can be attributed to a combination of low reproductive potential and high mortality. Most otariids, including California sea lions and northern fur seals, wean their young at a few months of age, and tend to reproduce annually. In contrast, Steller Sea Lions often continue to nurse their young into the second or third year (Pitcher et al. 2003). Since lactating females are less likely to carry fetuses to term, the extended period of parental care typically results in longer intervals between consecutive births and overall reduced reproductive performance (Pitcher et al. 1998).

Mortality of newborn pups (< 1 month) is high (Pike and Maxwell 1958; Orr and Poulter 1967). Juvenile mortality is difficult to estimate due to potential sampling biases, but appears to be high, with about 48% of females and 26% of males surviving to three years of age (Calkins and Pitcher 1982; York 1994). The higher mortality rates for males' results in a progressively skewed sex ratio favouring females. Mortality rates are significantly lower for adults (~10-15%

per year for females, and ~13-25% for males). The principle cause of death for pups is drowning due to limited swimming abilities at this age preventing them from hauling out of the water or steering in strong tidal currents (Orr and Poulter 1967; Edie 1977). Being bitten, tossed or trampled by older animals, and being abandoned or separated from their mothers also contributes to pup mortality (Orr and Poulter 1967; Gentry 1970; Sandegren 1970; Sandegren 1976). In marine mammals, density dependence is generally thought to be expressed primarily in the parameters that affect reproductive rates, especially of younger animals (i.e., age at first reproduction, fecundity rates, and juvenile survival) (Eberhardt 1985; Fowler 1987). Juvenile mortality has been implicated as the main driver in the steep declines of the Western Population in the 1980s (York 1994), with reduced adult female natality and survival playing a lesser role (Holmes and York 2003). The slower decline in the 1990s may be attributable to improved juvenile and adult survival, although natality rates appear to have continued to drop (Holmes and York 2003). The ratio of pups to non-pups provides an index of relative birth and survival rates. The surprisingly high ratio of non-pups to pups observed in surveys along the west coast of North America suggests that reduced juvenile survival (as opposed to increased natality rates) may have been an important factor influencing growth of the Eastern Population (Pitcher et al. 2007).

The factors that ultimately limit Steller Sea Lions and other marine predators can be broadly categorized as bottom-up processes mediated by the availability and quality of prey, and top-down processes mediated by predators (including direct kills by humans).

Prey Availability and Quality

Steller Sea Lion populations are ultimately limited by the availability of suitable prey. A shift in the quality of diets from fatty fishes (i.e. herring) to low-fat fishes (i.e. walleye pollock) has been implicated in the decline of Steller Sea Lions in the Gulf of Alaska and Aleutian Islands (Alverson 1992; Alaska Sea Grant 1993; DeMaster and Atkinson 2002; Trites and Donnelly 2003). Controlled-feeding studies have shown that sea lions, particularly young animals, consuming large amounts of low-fat prey such as pollock, may be unable to maintain body mass (Rosen and Trites 2000c; Azana 2002). In the wild, these young animals would typically still be dependent on their mothers, who may have difficulty meeting the high energetic costs associated with lactation (Winship et al. 2002; Pitcher et al. 2003). Therefore, availability of high quality prey near rookeries appears to be a potentially important limiting factor.

Diversity of the diet has been shown to be inversely correlated with the severity of declines of the Western Population in the Gulf of Alaska, with the steepest declines occurring in areas with the least diverse diet (Merrick et al. 1997). Diversity of the diet in the increasing Eastern Population appears to be high (Trites et al. unpublished data). Reduced rates of body growth (Calkins et al. 1998), and a direct correlation between body condition and the proportion of animals maintaining late-term pregnancies (Pitcher et al. 1998) provides further evidence of nutritional stress during the steep declines in the Western Population observed during the 1980s (NMFS 2008).

The acute impacts that reduced prey availability can have on pinnipeds is evident from the abrupt declines in California sea lion and northern fur seal pup production on San Miguel Island

coinciding with El Niño events (DeLong and Antonelis 1991; Melin and DeLong 1994; Melin et al. 1996; Melin and DeLong 2000).

Steller Sea Lions also consume many of the same prey resources sought by other predators, including humans (McAlister and Perez 1976; Kajimura and Loughlin 1988; Fritz et al. 1995; Wada 1998; Trites et al. 1999); selective-fishing by humans can cause changes in fish stocks (Pauly et al. 1998).

Predation

The question as to whether top-down forcing as a result of predation by Transient Killer Whales could also limit sea lion populations has garnered much attention in recent years. In 1992, a killer whale stranded in Prince William Alaska had 14 flipper tags from Steller Sea Lion pups in its stomach. While data on predation rates are lacking, simulation models have shown that Transient Killer Whales could potentially have a significant impact on Steller Sea Lion populations, and in particular could inhibit the recovery of depleted populations (Barrett-Lennard et al. 1995).

Maniscalco et al. (2007) estimated that killer whales consumed 3-7% of the Steller Sea Lion population in Kenai Fjords annually, and 11% of pups born at their main study site on Chiswell Island, which could be significant for a species with such an inherently low rate of productivity. Preliminary calculations indicate that even if killer whale predation accounted for all natural mortality, the net annual production of Steller Sea Lion populations in B.C. and the entire Eastern Population could only support roughly 26 and 77 killer whales respectively (Olesiuk, unpublished data).

1.5. Threats

There are several threats which may affect this population in British Columbia. Threats (both natural and anthropogenic) have caused, or are causing, or may cause harm, death or behavioural changes to a species at risk or the destruction, degradation and/or impairment of its habitat to the extent that population-level effects occur.

The effects of threats are often difficult to distinguish from one another, or from natural limiting factors. For example, exposure to contaminants may render animals more susceptible to natural diseases, and disturbance of sea lions at haulout sites and rookeries may displace them into the water, making them more vulnerable to predation by killer whales. In addition, because animals concentrate at a limited number of breeding sites, they may be more vulnerable to both catastrophic accidents, or localized threats affecting early survival (e.g. localized prey depletion from fishing or disturbance).

Section 1.5.1 provides a tabular summary of the risk assessment rating threats in terms of population-level impacts to Steller Sea Lions. The ‘current level of concern’ and ‘mitigation potential’ for each threat is identified (Table 1). These assessments allow for prioritisation of recommended management and other actions to prevent this population from becoming

threatened or endangered, and provide an indication of the mitigation feasibility for a threat. Definitions of the terms used for rankings are available in Appendix I (Table 4).

Section 1.5.2 provides detailed descriptions of twelve historic, current and potential threats to the Steller Sea Lion population in B.C., as well as the uncertainties surrounding population level effects. This text provides the background information used to determine the overall level of concern for the impact of each threat to the Eastern Population (Table 1).

Although there is considerable uncertainty regarding the total impact of threats on Steller Sea Lions in Canadian waters, the continued growth of the local Steller Sea Lion population suggests it is currently within sustainable limits. However, with a population growth rate of about 4.5% per annum, a relatively small increase in human-induced mortality could become an important factor if conditions for Steller Sea Lions deteriorate, or if combined with other threats.

1.5.1. Threat Classification

Threats were assessed based on their current likelihood of occurrence and severity of impact on the B.C. population. In addition, the certainty of an effect on the B.C. population was incorporated into the assessment to provide a measure of confidence in the rating of current 'level of concern' and to provide an indication of areas where further monitoring or study may be useful in addressing uncertainties or knowledge gaps. Where certainty of effect on the population is not demonstrated, weight of scientific evidence for other pinnipeds or marine mammals may be deemed adequate to contribute to the assessment of the level of concern for a threat.

The mitigation potential column (Table 1) refers to the likelihood that measures (future or existing) will adequately mitigate or prevent negative effects to the population. It should be noted that the current level of concern column reflects the concern for impacts from a threat at this time, and future assessments may result in levels of concern that differ from those presented here. Therefore, the importance of long-term monitoring of the population cannot be overstated.

Table 1. Summary of Threat Classifications and Mitigation Potential for listed identified threats to the Eastern Pacific Steller Sea Lion population. Mitigation potential refers to the likelihood that measures (future or existing) may mitigate or prevent negative effects to the population. This assessment is a current view of the state of threats to the population, and as such assessment ratings may change over time. Asterisk (*) denotes naturally occurring threats to the population (i.e. limiting factors whose effects can be increased by human activities).

Threat		**Most vulnerable age class**	**Limiting factors which are likely to be affected**	**Severity of population-level impact**	**Uncertainty of Effect**	**Current Level of Concern**	**Mitigation Potential**
Prey Reduction	Fisheries Competition	Juveniles Reproductive Females	Prey availability Direct impact: Survival Chronic prey limitation may result in decreased reproductive rates	Potentially High	Medium	**Moderate, potentially High**	High
	Environmental Change and Variability (e.g. Regime Shift)*	Juveniles Reproductive Females	Prey availability Potential for altered distribution Occurrence of natural diseases Direct impact: Survival Chronic prey limitation may result in decreased reproductive rates	Potentially High	Medium	**Moderate, potentially High**	None, if due to natural fluctuation Low, if due to anthropogenic effects on climate
Environmental contaminants	Un-regulated Persistent Organic Pollutants (POPs) e.g. PBDEs	Pups, Adult Females	Prey quality Increased susceptibility to disease Impaired reproductive rates	Moderate	Medium-High	**Moderate**	Low-Medium
	Regulated POPs e.g. DDT	Pups, Adult Females	Prey quality Increased susceptibility to disease Impaired reproductive rates	Moderate	Medium-High	**Low - Moderate**	Low -Medium
Disturbance	Physical disturbance when on terrestrial habitat	Pups on rookeries	Pup survival Territorial and breeding behaviours	Low, at haulouts Moderate, at rookeries	Medium-High	**Low -Moderate**	High
	Acoustic disturbance when in aquatic habitat	All	Habitat use (i.e. displacement from feeding areas) Foraging success Chronic prey limitation may result in decreased reproductive rates	Likely Low	Medium	**Low**	High

Threat	**Most vulnerable age class**	**Limiting factors which are likely to be affected**	**Severity of population-level impact**	**Uncertainty of Effect**	**Current Level of Concern**	**Mitigation Potential**
Toxic Spills	Pups Adult Females, at rookeries during breeding season	Habitat use Direct impact: Survival	Low Moderate for Scott Island and Cape St. James rookeries	Medium-High	**Low -Moderate**	Low-Medium
Incidental take - fisheries and aquaculture	Unknown	Direct impact: Survival	Low	High	**Low**	Medium
Entanglement in marine debris	Juveniles and Sub-adults	Foraging success Direct impact: Survival	Low, potentially severe effects on individual animals	Medium	**Low**	Medium
Illegal kills	Juveniles and Adults	Direct impact: Survival	Unknown	High	**Low**	Medium
Predation by Killer Whales*	Pups, Juveniles and Adults	Direct impact: Survival	Potentially High	Medium	**Low**	None
Predator control programs	Historically affected all age classes Currently not applicable	Direct impact: Survival	Historically High Currently Low	Low	Historically High **Currently Negligible**	High
First Nations harvest	All	Direct impact: Survival	Low	High	**Negligible**	High
Disease and Parasitism*	All	Effects can be enhanced by synergistic effects of threats Direct impact: Survival Reduced reproductive rates	Unknown	Medium-High	**Unknown**	Low

1.5.2. Description of Threats

Prey Reduction - Fisheries Competition
Steller Sea Lions consume many of the same prey resources exploited by other predators, including humans (McAlister and Perez 1976; Kajimura and Loughlin 1988; Fritz et al. 1995; Wada 1998; Trites et al. 1999). Commercial harvesting can deplete local abundance and availability of prey (Lowe and Fritz 1997; Fritz and Brown 2005), and harvesting surplus production on a continual basis could affect resilience and amplify the effects of natural prey fluctuations. Because nursing females are restricted to foraging within commuting distance of rookeries during the first few months after giving birth, prey availability around rookeries may be critical in ensuring successful early survival of pups and their nursing mothers.

It is now widely acknowledged that the decline of the Western Population of Steller Sea Lions was, to at least some extent, driven by a change in diet resulting in reduced body growth, birth rates and ultimately survival (Calkins and Goodwin 1988; Calkins et al. 1998; Pitcher et al. 1998; see review by Trites and Donnelly 2003). However, debate continues over the relative influence of fluctuations in environmental conditions and regime shifts that may be the result of global warming, as well as the effects of whaling and commercial fisheries (Pascual and Adkinson 1994; Fritz and Ferrero 1998; Pauly et al. 1998; Trites et al. 1999; Rosen and Trites 2000a; Shima et al. 2000; Benson and Trites 2002; Fritz and Hinkley 2005; Trites et al. 2006; Trites et al. 2007). For additional, prey information see “Environmental Change and Variability’.

There are several commercial fisheries that target important known summertime prey species of Steller Sea Lions in British Columbia: sardine, herring, hake, salmon and groundfish. All are currently managed to prescribed catch levels, which are believed to be sustainable. Steller Sea Lion are known to feed on a variety of prey species, and it is not known whether limitations in one prey species alone may limit population growth. Overall prey availability and regional species composition may be altered by natural or anthropogenic factors, and fisheries management will need to balance the needs of a continually growing Steller Sea Lion population with that of fisheries. The non-summer diet of Steller Sea Lions is poorly understood, and as information becomes available, additional species may be identified as important components of the year-round diet of Steller Sea Lions in B.C.

The potential for mitigation of this threat is high (Table 1) as fisheries extractions may be managed directly through Fisheries and Oceans Canada. However, as Steller Sea Lions and their prey are trans-boundary species, adequate mitigation may require additional collaboration and cooperation with U.S. fisheries management.

Given the unrestrained, exponential growth of the Steller Sea Lion population during the last 45 years, competition for prey with commercial fisheries does not appear to have had an effect on the population, leaving moderate concern for impacts. Reduced availability of a high quality prey supply has had a demonstrated negative effect on Steller Sea Lion in the Western Population (Calkins and Goodwin 1988; Calkins et al. 1998; Pitcher et al. 1998; see review by Trites and Donnelly 2003), and prey requirements will continue to increase as the Eastern population continues to grow. Therefore, there is some concern for potential population-level impacts in the future in future in(Table 1). This illustrates the importance of continued monitoring of fisheries, ocean conditions, and the clarification of seasonal prey requirements to forecast any

increase in competition with fisheries for prey resources. All of this may assist in development and application of appropriate management measures.

Prey Reduction - Environmental Change and Variability

The degree of natural ecosystem change (which often occurs in discrete steps termed 'regime shifts') is dependent on a number of factors, many of which are poorly understood and the causes of which are not always apparent. While regime shifts may be forced by global climate change affecting oceanographic processes (e.g. changes in ocean temperatures, or species distribution), shifts may also occur through processes such as decadal oscillations or El Niño events. Fishing can also cause changes in fish stocks and functioning of marine food webs (Pauly et al. 1998).

As mentioned in 'Limiting Factors', climate change and large-scale regime shifts can affect biota throughout the North Pacific (Sinclair et al. 1994; Beamish and Bouillon 1993; Sinclair et al. 1996; Anderson et al. 1997; Anderson and Piatt 1999; Hare et al. 1999; McFarlane et al. 2000; Benson and Trites 2002), and such changes may affect Steller Sea Lion prey distribution within B.C. and range-wide (NMFS 2008). Increases in ocean temperatures resulting from global climate change might be expected to shift the distribution of Steller Sea Lions northward (NMFS 2008), and indeed the species has been disappearing from the southernmost part of their breeding range on both the North American and Asian coasts (Pitcher et al. 2007; Burkanov and Loughlin 2007). The centre of distribution of the breeding population on the west coast of North America has shifted northward from the Columbia River (46.0ºN) in the 1920s to central B.C. (51.5ºN) by 2002 (Pitcher et al. 2007).

The acute impacts that reduced prey availability can have on pinnipeds is evident from the abrupt declines in California sea lion and northern fur seal pup production on San Miguel Island coinciding with El Niño events (DeLong and Antonelis 1991; Melin and DeLong 1994; Melin et al. 1996; Melin and DeLong 2000). A regime shift that alters prey abundance from a high to low energy prey species (e.g. herring to gadids) may affect sea lion vital life history parameters (Trenberth 1990; Springer 1998; Benson and Trites 2002; Trites et al. 2007), resulting in population decline.

Currently, the Steller Sea Lion population in B.C. has exceeded historic peak abundance levels. As populations continue to grow, and prey requirements increase, Steller Sea Lions may become more susceptible to prey shortages. The concern for impacts on population viability from regime shift or climate change is moderate. However, should extreme ecosystem changes occur that result in decreased prey availability, there may be high concerns for population level effects. The high uncertainty regarding occurrence and effects of single regime shift events, or the effects of chronic long-term alterations in ocean conditions (i.e. through global climate changes) indicates that monitoring of the population is prudent. Clarification of seasonally important prey may assist in forecasting impacts to occurrence and distribution of prey species resulting from regime shift.

Environmental Contaminants – Persistent Organic Pollutants

Persistent environmental contaminants such as organochlorine pesticides (e.g. DDT), polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated

dibenzofurans (PCDFs) and polybrominated diphenyl ethers (PBDEs) bioaccumulate in marine food chains. The magnification of such chemicals with increasing position in the food web predisposes many marine mammals to becoming highly contaminated.

In some cases, levels of persistent environmental contaminants have been associated with adverse health effects in free-ranging pinnipeds. Field studies suggest linkages between contaminant levels and reproductive impairment (Helle 1976a,b; Addison 1989), premature births (DeLong et al. 1973; Gilmartin et al. 1976; Martin et al. 1976), birth defects (Arndt 1973), skeletal deformities (Bergman et al. 1992), suppression of the immune response (Mos et al., 2006) and disruption of vitamin A and thyroid hormone physiology (Tabuchi et al. 2006, Mos et al. 2007). Captive feeding studies of harbour seals have also demonstrated deleterious effects of persistent contaminants on the reproductive, immune and endocrine systems (Brouwer et al.. 1989; de Swart et al.. 1994; Ross et al. 1995; Reijnders et al. 1986; Ross et al. 1996). Results in many of these studies are consistent with the pattern of effects in PCB- or dioxin-exposed laboratory animals (Ross et al. 1997; Ross 2000).

Nursing pups are exposed to particularly high levels of contaminants because fat-soluble chemicals such as PCBs are readily transferred through their mothers' lipid-rich milk (Hickie et al. 2005). While most persistent contaminants are not likely to cause acute toxicity, they are considered to be endocrine disrupting compounds ('hormone mimics'; Colborn et al. 1993). As such, they may alter the normal growth and development of exposed animals. In addition, effects may not be notable until a stressful co-factor is implicated, such as a fasting period or period of food shortage which may increase the mobilization of fat-soluble chemicals or add to the stress upon the immune system (Jepson et al. 2005). An additional example might be the introduction of a new virus to a naïve pinniped population, in which contaminant-associated toxicity may cause an increase in vulnerability, virus transmission, disease severity and/or mortality (Ross 2002).

As has been shown in other marine mammals, contaminant concentrations in Steller Sea Lions (predominantly organochlorines) are linked to age and gender. The highest concentrations are found in old males, while females transfer much of their burden to their pups during lactation (Lee et al. 1996). Barron et al. (2003) found that PCB levels in Steller Sea Lions appeared to be declining in the Gulf of Alaska in recent years and that current levels are not a threat, but concentrations of PCB in the 1980s were higher in Steller Sea Lions than in any other pinniped and could have posed a health risk.

In B.C., there have been few systematic studies of contaminant levels in Steller Sea Lions, although studies have recently been initiated to evaluate PCBs and PBDEs. PCB, dioxins, furans and organochlorine pesticides are considered to be regulated, 'legacy' contaminants as a result of national and international restrictions on their use, production and/or by-production. However, many new, unregulated chemicals are considered as 'emerging' concerns. These include the flame retardant PBDEs, which are doubling every four years in the environment (Hites 2004; Ross 2006). Because PBDEs resemble PCBs, it is likely that PBDEs will be increasingly recognized as a threat to the health of wildlife, including Steller Sea Lions.

This weight of evidence regarding effects and persistence of regulated and unregulated pollutants on Steller Sea Lions leaves concern for effects to the population viability. As the environmental

presence and overall usage of emerging, unregulated persistent organic pollutants (POPs) is increasing, the level of concern for this threat is moderate[1], while concern for regulated, legacy contaminants is deemed low to moderate (Table 1). However, one might expect the population to be more susceptible during periods of prey limitation and nutritional stress, when lipids with their high concentrations of contaminants are mobilized. As uncertainties on the level of toxic loading in Steller Sea Lions in B.C. remain, monitoring of this threat and mitigation of sources of pollution are recommended.

Though point sources of contamination can be regulated and monitored, potential to implement mitigation measures for this threat is rated low-medium, due to the difficulty in mitigating or managing non-point sources and long-range airborne transport of contaminants. Additionally, sources of contamination that originate in Canada may be mitigated, whereas for contamination that may originate in international waters, the mitigation potential is very low from a Canadian management perspective.

Disturbance on and around Terrestrial Habitat

Repeated disturbances of breeding or haulout sites by aircraft, boats, pedestrians, construction, or fishing activities (e.g. geoduck and urchin dive fisheries) can lead to animals temporarily leaving haulouts and rookeries (Sandegren 1970; Calkins and Curatolo 1980; Johnson et al. 1989; Brown 1997) and can eventually lead to permanent abandonment (Pike and Maxwell 1958; Kenyon 1962).

Vessel disturbance of pinnipeds at haulouts can reflect a suite of influences, including vessel type and number, speed, and distance from animals (Henry and Hammill 2001; Szaniszlo 2005). Interestingly, self propelled vessels (such as kayaks) are demonstrated to elicit behavioural responses from pinnipeds on haulouts (Henry and Hammill 2001), possibly due to these disturbance stimuli illustrating perceived predation risk (Deecke et al. 2002; Frid and Dill 2002). Nonetheless, Steller Sea Lions at winter feeding sites often habituate to chronic disturbances, and some haulout sites are located in high traffic areas close to major urban centres such as Vancouver and Victoria (Bigg 1985; P. Olesiuk pers. comm.). Acute noise disturbances, such as blasting or demolition, near haulouts may result in stampeding of Steller Sea Lions, resulting in pronounced, localized (as opposed to population-wide) disturbances.

Although habituation to human activities may occur at haulouts, Steller Sea Lions are vulnerable to disturbances on rookeries. Human intrusion onto rookeries during breeding season (e.g. to census animals, capture pups for tagging or branding) appears to be highly disruptive and often causes animals to escape into the water or to nearby haulouts (Lewis 1987; Scordino 2006; Olesiuk, unpublished data). Disturbances can result in increased pup mortality due to drowning, trampling or separation of pups from mothers. Recovery times of haulout sites from disturbances such as scat collections is highly variable, ranging from as little as a few hours to as much as a couple of weeks (Kucey 2005; J. Etzkorn, Carmanah Lighthouse, B.C., pers. comm.), but disturbance of rookeries may persist over a number of years (Olesiuk, unpublished data). Additionally, disturbance may have energetic costs for both pups and mothers, should feeding or nursing opportunities be disrupted.

[1] Regulated and unregulated contaminants of concern are listed in Appendix II.

Breeding site fidelity is another factor in disturbance of rookeries. During the control programs conducted prior to 1970, some breeding animals were likely displaced to other rookeries, but the majority of sea lions continued to return to sites that had been heavily disturbed for many consecutive years. At the Sea Otter Group rookery, in spite of intense annual culls, animals continued to use the rookery for 17 years before the colony was completely eradicated. Thus, Steller Sea Lion reproductive biology may not have the plasticity to adapt to disturbances near breeding colonies.

As mentioned above, severity of population level impact is low for haulouts, but moderate for disturbance to rookeries due to site fidelity, potential energetic costs for mothers and pups, and pup survival (Table 1). The mitigation potential for management of this threat is high. At present, access to rookeries is strictly monitored and permits are required for entry onto a known rookery site. Vessel disturbance of pinnipeds is managed via guidelines for viewing marine mammals. Based on the criteria listed above, level of concern for disturbance is rated low to moderate. It should be noted that U.S. regulation maintains a 3 mile no-entry zone surrounding rookeries (in western Alaska), further illustrating the sensitive nature of rookery disturbance.

Acoustic Disturbance in Aquatic Habitat

Operations related to oil and gas exploration, alternative energy development (e.g. wind and wave energy), and other resource extraction (e.g. methyl hydrates) have the potential to disturb animals as they produce both chronic (i.e. from vessel or construction activities) and acute (i.e. seismic surveys) underwater noise.

Acoustic disturbance such as explosions, seismic or military tactical sonar noise may cause displacement of animals from feeding areas, and disrupt foraging behaviour. Canadian seismic surveying standards assist in mitigation of this threat. The Statement of Canadian Practice with respect to the Mitigation of Seismic Sounds in the Marine Environment set out minimum standards that must be met during marine seismic surveys in all non-ice covered marine waters in Canada (http://www.dfo-mpo.gc.ca/oceans-habitat/oceans/im-gi/seismic-sismique/statement-enonce_e.asp). As Steller Sea Lions are able to surface or exit the water to avoid acute noise stress, the concern for acute noise disturbance at feeding sites is low. However, there is currently interest in expansion of offshore fossil fuel exploration and extraction activities, and as such, assessment of this threat should be ongoing as new information on occurrence and frequency of activities in relation to Steller Sea Lion rookeries and feeding areas becomes available. Continued review of development and exploration proposals will ensure that Steller Sea Lion habitat requirements are considered in sustainable development plans.

Chronic noise stress in important foraging areas and near rookeries could have a long-term effect on Steller Sea Lion vital rates and body conditions; however, given the remote locations of rookeries at present, concern remains low (Table 1). Consideration for the placement of industrial developments near rookeries should assist in mitigation of this potential chronic threat. General increase in vessel traffic (motorized and self-propelled) along the B.C. coast has increased the number and frequency of visits to haulout areas. Such in-water acoustic (or visual) disturbance from vessel activity may contribute to increased energetic cost should foraging be disrupted on a long-term scale. Mitigation potential for underwater acoustic disturbance, particularly surrounding rookeries, is high given the National Parks and Provincial Ecological

Reserve protection surrounding two of the rookeries, and potential review and revision of guidelines and protocols for acute noise disturbance of marine mammals.

Toxic Spills

Sea lions may be impacted by catastrophic accidents such as toxic spills (St. Aubin 1990), although the impact on a population-wide scale has rarely been established. The main threat is likely through contact with heavy oil accumulations when the source of the spill is near important habitats such as rookeries and haulout sites, and to a lesser degree from absorption through the skin, incidental ingestion of oil directly or through feeding, exposure to vapours, and partial fouling of pelage from fresh oil (Smith and Geraci 1975; Engelhardt et al. 1977; Engelhardt 1987; St. Aubin 1990). Sea lions are insulated by a subcutaneous layer of blubber, so oiled fur does not interfere with thermoregulation. Steller Sea Lions with tar lodged in their throats or around their lips, jaw and neck have been observed in Alaska (Calkins and Pitcher 1982).

During the 1989 Exxon Valdez oil spill (EVOS) in Prince William Sound, oil did not persist on the coats of Steller Sea Lions for as long as it did on harbour seals (Calkins et al. 1994a), but sea lions were observed in the vicinity of the oil spill and metabolites in the blood showed they had been exposed to hydrocarbons. Premature births were more common and pup production was somewhat lower in the year following the spill, but limited data prior to EVOS and the ongoing population decline in the area made it difficult to assess the statistical significance of the impact (Calkins et al. 1994b; Loughlin et al. 1996).

Several Steller Sea Lions with small patches of oiled fur were observed during the Nestucca spill that spread along the west coast of Vancouver Island in 1988 (Harding and Englar 1989). Because the population is widely dispersed along the entire B.C. coast, the potential threat of accidental spills is one of local depletion, as opposed to impacting the entire population. However, a spill affecting a rookery during the breeding season could result in a significant population-level impact. Considering that over 70% of pup production in B.C. occurs on the Scott Islands, an oil spill in that area during the breeding season could have a significant impact on breeding animals.

As a population-wide impact has been illustrated to be unlikely, concern for catastrophic spills affecting the population has been rated low (Table 1). However, given that a spill near a rookery (e.g. Scott Islands) during breeding season might impact a large proportion of animals at once, an additional moderate concern is applied for impacts to rookeries during breeding season (Table 1). As spills are accidental, the timing and locations of spill events are difficult to predict. There are currently Canadian regulations and measures to minimize the risk of accidental spills (e.g. *Transportation of Dangerous Goods Act*) and mitigate effects through remediation of habitat and other measures. The potential for mitigation of this threat is considered low to medium due to the inherent difficulty in, and low success of, post-spill clean-up measures (Graham 2004), particularly in isolated, remote areas.

Incidental Take in Fishing or Aquaculture Gear

Steller Sea Lions are killed incidentally in various fisheries (particularly drift gillnet fisheries for salmon), and there is incomplete fisheries observer coverage to adequately monitor by-catch levels. Animals can get trapped in trawl nets or caught (entrapped) in drift and gill nets, and ultimately drown (Loughlin and Nelson 1986). Unfortunately, once an animal is entangled the potential for rescue or rehabilitation is extremely low, from both a technical and practical standpoint. Annual by-catch in U.S. waters in recent years has been estimated at about 25 animals per year (Loughlin and York 2000; Angliss and Outlaw 2007). No such estimates are available for fisheries in B.C.

Rates of entrapment in finfish aquaculture installations are currently reported via voluntary means in the Pacific Region, which may limit the information regarding these types of interactions. Information from voluntary reporting between 2004 and 2008 indicates only one animal was positively identified as a Steller Sea Lion (drowned as a result of entrapment) and another 12 pinnipeds could not be identified to species[1].

Accuracy in reporting of species identification has not been determined. However voluntary industry-based training is conducted. Implementation of standardized, voluntary reporting mechanisms is also being pursued to promote improved reporting and documentation of these occurrences. This will result in future improvements regarding information on entrapment rates of Steller Sea Lions in aquaculture gear. At present, there are no aquaculture facilities in Alaska, therefore there are no data available for comparison with incidental take of Steller Sea Lions elsewhere.

Improved reporting on marine mammal entanglements and entrapments by aquaculture operators has led to increased reporting on incidences, however this does not necessarily reflect an increase in number of incidents overall. The level of concern is rated low for this threat, based on the current population estimates for the Steller Sea Lion in B.C. (Table 1). However, proactive measures including siting of aquaculture operations away from haulouts, gear modification (both fisheries and aquaculture), and all reasonable non-lethal means of control at aquaculture sites, to minimize risks of entanglement or entrapment is being used. Methods should be continually reviewed and revised to minimize lethal interactions.

Entanglement in Marine Debris

The increasing prevalence of synthetic debris (net fragments, plastic bags and packing bands, etc.) is a growing problem worldwide and has been implicated in the declines of other species of pinnipeds (Fowler and Merrell 1986; Fowler 1988). Debris such as net fragments and packing bands can get caught around the necks of sea lions, leading to abrasion or cutting deeply into tissue as animals grow. Steller Sea Lions occasionally take fish from troll gear, and it is not uncommon to see animals that have swallowed hooks and are hooked internally with salmon flashers dangling from their mouths. Unfortunately, rescue or rehabilitation of animals entangled in marine debris is usually neither technically, nor practically feasible.

[1] The vast number of pinniped entanglements (110 out of 170) can be attributed to shark guards used at one site, and these have since been removed (DFO unpublished data).

Entanglement rates for Steller Sea Lions in Alaska have been estimated at about 0.07% for adults, with packing bands and net debris being the most common material (Calkins 1985; Mate 1985; Loughlin et al. 1986; Stewart and Yochem 1987; Fowler 1988). On recent research surveys in B.C., approximately 0.2% of animals counted had either debris around their necks or fishing gear hooked in their mouths or throats (Olesiuk, unpublished data). However, as Fowler (1988) noted, much of the debris found at sea or washed ashore may be too large for an animal to transport, so the observed rate of entanglement could represent a small fraction of numbers actually being entangled and drowned at sea. Entanglement of pups and yearlings has not been observed, and it is unclear whether these age groups are able to avoid debris or whether entanglement of smaller animals results in 100% fatality. The marine debris documented to cause entanglements results mainly from lost fishing gear. Modifications to fishing gear may reduce the risk of harmful entanglements and should be considered a potential for successful mitigation of this threat.

The severity of a population-wide impact on Steller Sea Lions as a result of entanglement in marine debris is unknown, however as entanglements have been recorded, it is evident that this threat affects some proportion of the population. Further research may be necessary to address knowledge gaps on the rate of entanglements and their effect on a population-wide scale. Currently, the level of concern regarding entanglement in marine debris is low (Table 1).

Illegal Kills

Illegal and undocumented killing of Steller Sea Lions is likely to occur in B.C., particularly since the species is perceived to have a negative impact on fish stocks and is known to depredate fishing operations. Several cases of illegal kills have been documented (DFO unpublished data), and mortality may also occur outside of the legal parameters assigned to permit holders (e.g. for predator control or subsistence harvest). However, data on these activities are currently lacking, and incidents that occur in remote locations are inherently more difficult to document or monitor. In some remote areas, fishing operations are located near rookeries and haulouts, and further exacerbating the interaction between fisheries and sea lions is the conditioning of pinnipeds to dumping sites for offal and other fish remnants.

The extent of illegal killing of pinnipeds is poorly understood and the impact of such activity at a population-level is unknown. However, given the recent abundance estimates for Steller Sea Lion in B.C. (DFO 2008), it is unlikely that this threat currently impacts population viability (Table 1). Mitigation of this threat requires outreach and communication with affected parties, and education on modification of some practices (e.g. dumping offal, habituation of animals to fishing gear), and increased monitoring and enforcement around Steller Sea Lion haulouts and rookeries. As such there is moderate potential for successful mitigation of this threat.

Predation by Killer Whales

As outlined in ‘Limiting Factors’, killer whales are an important predator having the potential to limit Steller Sea Lion populations. Predation rate on Steller Sea Lion may be increased due to synergistic effects with other threats or limiting factors. The potential for altering predation rate by killer whales due to environmental variability, changes in prey availability (i.e. increased distance required for foraging excursions), or increased incidence of disease may increase the

impact of this natural threat on the population viability of Steller Sea Lions in B.C. Impacts on other killer whale prey, such as harbour seals, could result in a shift in killer whale diet and increased predation on sea lions. Disturbances that cause animals to enter the water or move to other sites could also increase exposure to killer whales. Additionally, an increasing trend in population growth for Transient Killer Whales (Ford et al. 2007) indicates that there is potential for the predation rate to increase. Simulation models have shown that Transient Killer Whales could potentially have a significant impact on Steller Sea Lion populations, and in particular could inhibit the recovery of depleted populations (Barrett-Lennard et al. 1995). Preliminary calculations indicate that even if killer whale predation accounted for all natural mortality of Steller Sea Lions, the net annual production of the Steller Sea Lion population in B.C., and the entire Eastern Population could only support roughly 26 and 77 killer whales respectively (P. Olesiuk, unpublished data). This suggests there are also other sources of mortality for these sea lions.

As the Steller Sea Lion population is currently experiencing uninhibited population growth, and alternative prey such as harbour seals are also at high levels, concern for predation-induced population decline is at present minimal (Table 1). Given that mitigation measures for predator-prey interactions are extremely unlikely, monitoring of both the Steller Sea Lion and Transient Killer Whale populations will assist in determining long-term trends in abundance and distribution of both of these species within B.C., and range-wide.

Predator Control Programs

For most of the 20th century, the main factor limiting Steller Sea Lions along the west coast of North America was predator control programs. In B.C., government predator control programs eradicated a major rookery on the Sea Otter Group by the late 1930s, and numbers of sea lions breeding at the remaining rookeries had been reduced to about one-quarter of historic levels by the late 1960s (Bigg 1985). In Washington, the state government offered a bounty payment for Steller Sea Lion kills, and abundance along the Washington coast fell from several thousand in the early 1900s to fewer than a hundred by the late 1940s. Large bounty kills were also made in Oregon in the 1920s (Pearson and Verts 1970), and harassment and killing by bounty hunters and fisherman also reduced abundance of Steller Sea Lions and apparently eliminated several breeding sites in California (Rowly 1929). The Eastern Population of Steller Sea Lions had been severely depleted by the time the species was protected under the *Fisheries Act* in Canada in 1970 and the *Marine Mammal Protection Act* in the U.S. in 1972. The only portion of the Eastern Population range that escaped large culls was southeast Alaska, where there are no records of the species breeding or being abundant in the early 1900s.

From 1990 to 2003, legal predator control at finfish aquaculture operations in B.C. constituted one of the largest known sources of human-induced mortality for Steller Sea Lions in the North Pacific (Angliss et al. 2001; Jamieson and Olesiuk 2001). Quarterly reports filed by licence holders indicate that a total of 362 Steller Sea Lions plus 21 sea lions for which species could not be identified, were killed from 1990 (when the first permits were issued) up to 2003. The number of Steller Sea Lions killed annually was initially low (averaging less than 10), but escalated in the late 1990s and peaked at 91 in 1999 (Jamieson and Olesiuk 2001), likely as a result of a shift in winter distribution of sea lions from Barkley to Clayoquot Sound (P. Olesiuk pers. comm.). In 2004, license conditions were modified to remove Steller Sea Lions from the

permits to eliminate the use of lethal control for this species due to the COSEWIC designation of this species as special concern. However, many of the 100 or so salmon farms currently operating in B.C. waters possess permits to use lethal means of control for harbour seals and California sea lions, and it is possible that Steller Sea Lions could be shot as a result of being mis-identified as one of these species. Given the low level of current reported kills, the level of concern for this threat is currently assessed as negligible (Table 1).

First Nations Harvest

Traditionally, Steller Sea Lions were hunted by aboriginal peoples in B.C. for use as a food source (Bigg 1985), and whiskers continue to be used on some traditional ceremonial garb. Use of sea lions by First Nations people appears to have declined during the 1800s and sea lion meat has not been an important dietary staple since the early 1900s (Bigg 1985). It is unknown whether subsistence harvesting prior to the 1900s regulated the Steller Sea Lion population in B.C.

Aboriginal hunting of Steller Sea Lions for subsistence and cultural purposes does occasionally occur in Canada, but harvest levels are unknown. First Nations people may hunt sea lions without a licence; nevertheless, Fisheries and Oceans Canada works with First Nations to encourage the use of Communal Licences with harvest limits to ensure removals do not exceed sustainable limits. Given that there are no commercial harvest licences issued for Steller Sea Lions in B.C., and there is very limited subsistence harvest of Steller Sea Lions, the level of concern associated with harvesting is rated as negligible (Table 1). Continued communication with First Nations groups interested in harvesting pinnipeds will assist in assessing future level of concern for population-scale impacts due to harvest.

Disease and Parasitism

Steller Sea Lions in both B.C. and Alaska have exhibited positive screenings for several pathogens (Calkins and Goodwin 1988; Sheffield and Zarnke 1997; Burek et al.. 2003, 2005; Lambourn et al.. 2006), and in general parasites are common to the species (Dailey and Hill 1970, Dailey and Brownell 1972, Fay and Furman 1982, Shults 1986, Gerber et al.. 1993; all cited in NMFS 2008). Although parasites and diseases may have little impact on otherwise healthy animals, effects could become significant if combined with other stresses (Haebler and Moeller 1993). Anthropogenic stressors can also increase the incidence of disease, or introduce foreign pathogens into the population.

Pathogens and diseases from terrestrial sources or exotic species are a concern in terms of exposure of the population to new biological contaminants. Sewage outflow, storm-water and agricultural runoff may play important roles as vectors for pathogens or disease, as do multi-species rehabilitation-reintroduction programs that include pinnipeds.

Mitigation of terrestrial sources of pathogens and exposure to exotic species affecting marine mammals will assist in reducing the risk of transmission of foreign diseases to the Steller Sea Lion population in B.C. Measures to minimize the risk of exposure of rehabilitated pinnipeds to pathogens carried by terrestrial mammals may decrease the likelihood of transmission of disease to pinniped populations. Further, management of sources of outflow and runoff may assist in mitigating this threat. However, given the high degree of uncertainty regarding disease effects,

the primary action is to address knowledge gaps on terrestrial sources of pathogens and their potential effects on Steller Sea Lions.

1.5.3. Cumulative or Synergistic Effects of Threats and/or Limiting Factors

The effects of threats and limiting factors can be difficult to distinguish from one another, making conclusions regarding causes of population decline often difficult to ascertain. Although there is considerable uncertainty as to the total impact of threats on Steller Sea Lions in Canadian waters, the continued growth of the local Steller Sea Lion population suggests it is currently within sustainable limits, and individual or combined effects of threats and limiting factors are not prominent enough to force population decline, or to limit population growth. Nevertheless, with a population growth rate of less than 5% per annum, a relatively small increase in human-induced mortality could become an important factor if conditions for Steller Sea Lions deteriorate, or if combined with other threats. Therefore the importance of targeted research programs addressing knowledge gaps, and long-term monitoring of the population and of identified threats cannot be overemphasized.

1.6. Actions Already Completed or Underway

1.6.1. Management

Harvest Controls
The conservation and management of Steller Sea Lions in Canada falls under the authority of the *Fisheries Act* (1985), more specifically the Marine Mammal Regulations (1993) of that Act. With the exception of First Nations peoples, no person can fish for or disturb any marine mammal, unless explicitly authorized by a licence. Under s.6, First Nations people may hunt sea lions without a licence for food, social or ceremonial purposes; however, the use of Communal Licences with harvest limits is common, to ensure removals do not exceed sustainable limits.

Since 1970, the management approach for pinnipeds in British Columbia has not provided for commercial harvest or culls. The only licences issued that allow for killing of sea lions have been to protect stocks at fish farms and herring impoundments from predation. Limited harvests are permitted of “nuisance animals” as defined in the Marine Mammal Regulations (a licence is required under section 26.1(1)(c)), and harvests are monitored to ensure removals are within sustainable levels. In response to Steller Sea Lions being COSEWIC-designated as special concern in 2003, predator control nuisance seal licences issued under section 26.1(1)(c)), since 2004 have prohibited the killing of Steller Sea Lions.

Protection from Disturbance
Section 7 of the Marine Mammal Regulations (*Fisheries Act*) prohibits the disturbance of marine mammals, unless authorized by a fishing licence or scientific licence. Proposed amendments to these regulations would also provide specific protection from some forms of disturbance such as swimming with, or feeding marine mammals. In addition, guidelines (*Be Whale Wise*: Marine Mammal Viewing Guidelines for Boaters, Paddlers and Viewers, 2006) have been established to address disturbance from close approaches whether on land or sea, and are often followed for pinniped viewing. Management and educational programs, for the purposes of achieving

compliance with the guidelines, have been implemented for the ecotourism industry (e.g. Pacific Whale Watch Association Best Management Practices (http://pacificwhalewatch.org/) and the public). Furthermore, the Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment was developed as a national code of conduct in response to public concerns over the potential impacts of seismic surveys on marine life.

Protection of Habitat

The *Fisheries Act* (ss. 35, 36) contains provisions for habitat protection and prevention of pollution of marine mammal habitat. The Steller Sea Lion breeding colonies at Triangle and Beresford Islands are located within Anne Vallee (Triangle Island) and Beresford Island Ecological Reserves, respectively. These reserves were established in 1971 by the Province of British Columbia to protect biodiversity. Ecological reserves are closed to entry except as authorized by permit. Environment Canada (Canadian Wildlife Service) is leading a federal government initiative to establish a Marine Wildlife Area (MWA) in the Scott Islands, which will fulfill objectives of the *Species at Risk Act* by protecting habitat for several nationally listed species at risk, including Steller Sea Lions.

The Steller Sea Lion breeding colony at Cape St James is located within the Gwaii Haanas National Park Reserve and Haida Heritage Site, jointly administered by the Parks Canada Agency and the Council of the Haida Nation. Gwaii Haanas National Marine Conservation Area (NMCA) in the southern Queen Charlotte Islands is proposed under the *Canada National Parks Act and National Marine Conservation Areas Act* to extend 10 km offshore from Gwaii Haanas National Park Reserve and Haida Heritage Site potentially protecting marine habitat for Steller Sea Lion in the area. NMCAs are managed for sustainable use, and protected from industrial activities such as marine dumping, mining, and oil and gas exploration and development.

Numerous Steller Sea Lion haulouts around B.C. are also protected within National or Provincial Parks, such as Pacific Rim and Gulf Islands National Park Reserves, Race Rocks Ecological Reserve, and others.

Department of National Defence (DND) 'Maritime command order: marine mammal mitigation procedures' (DND 2007), mitigates disturbance from tactical sonar use by the Canadian military. The *Canadian Environmental Protection Act*, Polybrominated Diphenyl Ethers Regulation (July 2008) has recently been passed in Parliament. This regulatory tool restricts manufacture and use of several types of PBDEs in Canada, and is a first step toward long term reduction in environmental toxic effects from PBDEs. Additionally, the *Canada Shipping Act*, Regulation for Prevention of Pollution from Ships and for Dangerous Chemicals addresses marine pollution and debris. These codes of practice and regulatory tools may assist in mitigation of effects to Steller Sea Lion habitat.

Following the coming into force of SARA in 2003, several marine recovery strategies and management plans for 'at-risk' marine mammals have been developed. These documents include recommended actions for recovery, protection and management of listed marine mammal species. In a larger context, these management actions may also benefit Eastern Pacific Steller Sea Lions in B.C. Please refer to Section 4.0 'Associated Plans' for specific recovery strategies

and management plans with actions relevant to the protection and management of Steller Sea Lions in B.C.

1.6.2. Enforcement

Fisheries and Oceans Canada, Conservation and Protection Branch responds to, as necessary, and investigates reports of unauthorized lethal take (including attempts) and disturbance to all marine mammals, in the course of general operations. Targeted enforcement of disturbance is focusing on whale oriented viewing, but also addresses the disturbance of pinnipeds, especially when hauled out near populated areas. However, these activities do not significantly overlap with Steller Sea Lion distribution.

Information to assist enforcement and response to incidents is collected by the Marine Mammal Response Program (1-800-465-4336). These initiatives provide information on pinniped incidents, and provide capacity for response actions on a case-by-case basis.

1.6.3. Population Assessment

Given the trans-boundary distribution and high mobility of Steller Sea Lions, population assessments need to be coordinated among jurisdictions. This is especially true for B.C. and southeast Alaska, as the largest breeding aggregation of Steller Sea Lions on Forrester Island is situated less than 50 km north of the international border. Following a recommendation of the National Marine Fisheries Service (NMFS) Steller Recovery Plan (NMFS 1992), effort has been made to standardize census techniques (Olesiuk et al. 2008) and coordinate survey schedules between each state and province (DFO 2008), culminating in the first comprehensive assessment of Eastern Population over its entire range (Pitcher et al. 2007).

1.7. Knowledge Gaps

Key knowledge gaps for Steller Sea Lions in B.C. include diet composition and annual prey requirements, both by age class and by season. The seasonal abundance and distribution of prey species is also poorly understood, as are potentially important foraging areas. As such, the spatial and temporal distribution of fisheries may become increasingly important as these knowledge gaps are addressed and our understanding of Steller Sea Lion feeding ecology is expanded.

Several natural limiting factors are currently poorly understood. In some cases, there are research programs addressing these uncertainties, but results are so far unavailable or inconclusive. Information on key vital rates of Steller Sea Lions are required to determine age and sex specific fecundity and survival rates, age at weaning, and age of first reproduction that regulate population productivity. Further genetic samples of the population within B.C. may foster an increased understanding of dispersal among rookeries, and the genetic makeup of individuals re-colonizing the rookery on the Sea Otter Group.

Seasonal changes in diet or prey requirements are at present unclear for the Steller Sea Lion population in B.C. Of particular uncertainty is their diet outside of the breeding season. Several studies on the summer diet of Steller Sea Lions have indicated that forage fish, such as herring, sandlance and sardines, as well as other mid-sized schooling fishes such as salmon, hake and rockfish (see `Prey Requirements` section) may be important dietary components (Pike 1958; Spalding 1964; Olesiuk and Bigg 1988, Trites and Olesiuk, unpublished data). Additionally studies to address the distribution of these prey will assist in identifying important geographic feeding areas (particularly adjacent to rookeries), and temporal or geographic areas having potential for fisheries interactions.

The importance of killer whale predation as a limiting factor remains somewhat uncertain. While predation by transients is significant, the specific importance of different sex and age classes of sea lions in the diet of transients is unknown. Increasing knowledge of the seasonal distribution of Transient Killer Whales and their diet will assist in determining the degree to which predation regulates Steller sea lion population growth in B.C.

Anthropogenic threats affecting sea lions in North America that require further clarification include:

- The effects of research activities such as disturbances at haulouts and especially rookeries and hot-branding on pup survivorship
- Baseline levels of chemical and biological pollutants in the B.C. population
- The significance of specific fishing and aquaculture gear types (e.g. troll vs. seine nets) in terms of risk of entanglements
- The spatial and temporal distribution of fisheries with respect to important sea lion haulouts and rookeries, as well as the frequency of fisheries interactions, illegal kills or entanglement incidents

2. MANAGEMENT

2.1. Goal

There are two goals of this management plan.

1. *To ensure that anthropogenic threats from Canadian sources do not cause unsustainable population declines, or a contraction of the current range or number of breeding sites in Canada.*
2. *Support for, and contribution to, an environment where research and monitoring of Steller Sea Lions in B.C., contributes to achieving an improved global knowledge of the Eastern Pacific Population*

The Eastern Pacific Steller Sea Lion population continues to exhibit population growth, with no evidence of having reached carrying capacity. It can be expected that at some point the population growth of this prey-dependent species will level and fluctuate in response to natural changes in prey abundance. The role of Canadian management of this species is to protect the

population within Canada from anthropogenic sources of mortality that are unsustainable. As there are gaps in our understanding of this species' ecology and population dynamics, along with impacts of identified threats, a key component of achieving the first goal will be to address knowledge gaps.

This species is trans-boundary in its distribution, and research and management are currently conducted by Canadian and U.S. governments, as well as private organizations and independent researchers. The second goal of this management plan recognizes that management initiatives and research are most effectively conducted in a coordinated and collaborative manner with all parties, where feasible.

2.2. Objectives

Population Objectives

P1 *Maintain a viable population and prevent the population from declining to levels at which it would be considered at risk of extinction.*

Distribution Objectives

D1 *Maintain the annual usage of all three main rookeries and support the establishment of the fourth breeding site as a permanent rookery.*

D2 *Maintain the number and utilization of existing haul-outs in British Columbia to ensure a widespread distribution along the B.C. coast.*

Maintenance of the abundance and distribution of Steller Sea Lions in B.C. over the next three generations will ensure that this population is protected within Canada. Protection for known haulout sites and rookeries will ensure that required terrestrial habitat is available throughout the coast. As the population has sustained an increasing trend for over four decades and is currently above known historic peak levels, monitoring data will contribute to the detection of declining population trends, or significant contraction in distribution.

Research and Monitoring Objectives

Research and monitoring objectives for this management plan focus on priority needs as follows:

R1 *Conduct range wide population assessments through coordinated Canadian and U.S. surveys, where feasible.*

R2 *Contribute to, and foster an improved understanding of Steller Sea Lion biology and habitat requirements in B.C.*

R3 *Support, foster and contribute to research addressing knowledge gaps regarding identified (Table 1) and unidentified threats to this population.*

R4 *Determine total cumulative levels of human-caused annual mortalities for Steller Sea Lions in B.C. that can be sustained.*

Research should focus on key knowledge gaps for this species, listed in 'Knowledge Gaps', and those regarding the effects of the threats identified in this management plan.

Presently, population surveys within B.C. are typically conducted every four years. As Steller Sea Lions range across both the northern and southern Canadian-U.S. boundaries, an emphasis on coordination of these surveys is necessary to generate a total population estimate for the Eastern Pacific Steller Sea Lion population. This in turn will increase our understanding of the relative importance of the Canadian component of this population. More frequent monitoring, particularly at local breeding sites, will enhance our ability to detect and respond to population declines.

Research on foraging ecology is identified as a priority for research in Canada, including assessment for potential fisheries interactions. Additionally, programs to clarify vital rates, habitat utilization and fine-scale genetic makeup will assist in directing management and protection of this population in B.C.

Steller Sea Lions are susceptible to a number of human-induced sources of mortality. A better understanding of the current levels of human-induced mortality and their trends over time is necessary, and determination of sustainable thresholds of human-caused mortality (Obj. R4) will assist in monitoring population level effects. Steller Sea Lion populations have been growing in recent years, indicating that current levels of human-induced mortality are sustainable. However, this could change if conditions were to become less favourable for sea lions, in which case the mortalities could attenuate the rates of population growth or exasperate the magnitude of population fluctuations.

Management Objectives

Table 1 summarizes the assessment of threats to Eastern Pacific Steller Sea Lions, and presents the perceived mitigation potential for each threat. Analysis of severity, occurrence and causal certainty provided an overall level of concern for each threat in terms of impacts to this population's viability. Over the next ten years, the following management objectives aim to ensure that the threats currently of greatest concern do not impact the population or distribution of Steller Sea Lions in B.C., and to contribute to the conservation of this population throughout its range.

M1 *Promote international collaboration, independent research, education and outreach on management and conservation initiatives*
M2 *Minimize the exposure of Steller Sea Lions to pollutants*
M3 *Minimize the level of disturbance of Steller Sea Lions at rookeries during the breeding season*
M4 *Reduce the risk of catastrophic spills impacting Steller Sea Lions or their habitat in Canada*
M5 *Minimize the exposure of Steller Sea Lions to acute sound levels known to cause behavioural or physical harm in pinnipeds*

M6 *Minimize the likelihood of prey limitation caused by anthropogenic factors*

The population shows a continued increasing trend. Management objectives addressing threats of greatest concern aim to prevent undesirable population decreases and prevent significant alterations in distribution of Steller Sea Lions in B.C. Catastrophic spills, disturbance (i.e. at rookeries), and contaminants are considered to be the human-induced threats that require mitigation or management in order to meet the first goal of this management plan. The limitation of prey species through anthropogenic means is of concern. However specific information on Steller Sea Lion prey needs is lacking. Thus monitoring of prey supply and research will be the primary tool to assist in addressing the M6 objective.

The threats assessed at a low or unknown level of concern do not have specific objectives or new recommendations for mitigation; instead, knowledge gaps will be filled by opportunistic or cost-effective means, where feasible. Some threats impact individual sea lions, but do not constitute a population level effect. Where potential for effective mitigation of a threat is high (Table 1) and resources are available, it is prudent to manage and mitigate these threats when feasible.

2.3. Actions

The following non-prioritized actions support the objectives outlined in Section 2.2. Some of the actions listed below are currently underway (see Section 1.6 'Actions Already Completed, or Underway'), and have been identified in other recovery planning documents to date (See Section 4.0 'Associated Plans'). The synchronization of these listed activities for protection, management and research will facilitate a multi-species approach to marine mammal conservation in B.C., and allow for effective use of resources available. Actions have been recommended where implementation is deemed to be practical and feasible, and where they are most likely to result in successful protection of the Steller Sea Lion population in B.C.

Where responsibility for actions is determined to fall under Fisheries and Oceans Canada's jurisdiction, actions will be implemented directly as availability of funding and other resources permit. However, collaboration with other responsible agencies and organizations will be necessary to complete some actions. If responsibility for actions falls outside of the mandate of Fisheries and Oceans Canada, or outside of its jurisdiction, support for implementation of the action(s) and contribution to effort(s) will be a priority where feasible. Potential participating agencies and organizations and implementation timelines for each of the listed actions are presented in Section 3 (Table 3). Organizations currently involved in data collection on the Eastern Pacific population of Steller Sea Lions are listed in Appendix II.

2.3.1. Protection

1. To protect Steller Sea Lions from disturbance (physical and acoustic) at, or adjacent to, the four breeding sites, twenty-three year-round, and numerous winter haulouts in B.C.
    a. Continue to enforce the MMR and promote Be Whale Wise guidelines for marine mammal viewing, as well as relevant regulations for marine industrial development.

2. Continue enforcement of regulations for discarding debris[1], and develop new fishing gear standards for troll, seine and long line fisheries to reduce the risk of entanglement in marine debris and/or directly in fishing gear.

2.3.2. Management

3. Continue to manage fish resources and fisheries where there is overlap with Steller Sea Lion diet. Consider Steller Sea Lion dietary needs when changes to current fisheries management regimes occur for species known to be important to Steller Sea Lions in B.C.
4. Continue to review project proposals that include activities with potential to generate disturbance at haulouts or at rookeries, and provide project-specific advice for mitigation or avoidance with respect to Steller Sea Lion habitat needs.
5. While contaminants are listed as a threat to this population, the management of biological and chemical contamination falls under the jurisdiction of Environment Canada. The following actions are recommended to assist in reducing toxic loading of marine mammals and their habitat.
    a. Develop a DFO emergency response plan to identify marine mammal expertise required in spill response initiatives, when triggered.

    b. Develop a marine mammal-specific DFO operational manual to be included into existing catastrophic spill response plan(s)[2] to identify response protocols and data collection required for mitigation and monitoring of short and long-term effects to marine mammals and important habitat.

    c. Review management of point-sources of toxic pollution within known Steller Sea Lion habitat, to assess compliance with federal, provincial, and regional guidelines regarding thresholds for environmental contamination for the specific toxins listed in Appendix I.

6. Support low-impact research activities through permitting and range-wide coordination of trans-boundary research, as well as monitoring and assessment (Sections 2.3.3. and 2.3.4.) to address key knowledge gaps and clarify identified threats while minimizing the level of disturbance to animals. This will also ensure uniform and standardized data collection for population- and range-wide assessments and comparisons.
7. Strengthen measures to reduce the risk of entanglement of Steller Sea Lions in marine debris, aquaculture and fishing gear.
    a. Support the Marine Mammal Response Network (MMRN) to collect data in support of comprehensive understanding of the following threats: incidental by-catch, entanglement in marine debris, fishing and aquaculture gear.

[1] For example; *Canada Shipping Act*, Regulations for Prevention of Pollution from Ships and for Dangerous Chemicals.

[2] Include in the operational manual, measures outlined in the Fisheries and Oceans Canada 'Marine mammal incident response' manual and 'Sea otter oil spill response plan for Canada's Pacific coast' (draft).

b. Strengthen, support and foster, where feasible, the continued development of fisheries observer reporting standards and guidelines for marine mammal species identification and data collection to clarify the extent of fisheries interactions in terms of entanglement, by-catch, or depredation and to gather samples, where possible, and when required.

c. Continue to develop solutions to predator interactions and quarterly reporting on marine mammal kills at aquaculture sites, and continue the development of reporting requirements for marine mammal interactions at aquaculture sites. Of particular importance are accurate species identification, data collection, and temporal requirements for reporting of incidents.

d. Continue to work with the aquaculture industry to evaluate and develop best management practices for mitigating Steller Sea Lion depredation and subsequent entanglements (e.g. more effective predator net infrastructure).

e. Suggest alternative gear types to proactively minimize likelihood of entanglements in marine debris, and fishing and aquaculture gear. Of particular importance is the consideration of entanglement risk for predator nets, packing bands, and ingestion of hooks from trolling and long line gear. This action will assist in the continued evolution of guidelines, best management practices, regulations and standards.

8. Evaluate the risk to Steller Sea Lions in B.C. from catastrophic spills and acoustic and vessel disturbance that might result from lifting the moratorium on offshore fossil fuel exploration and extraction in B.C. Of particular concern are impacts to at-sea foraging success near year-round haulout and breeding sites in B.C.

2.3.3. Research on Steller Sea Lion Biology

The following areas are those that have been identified as a priority for research actions to address knowledge gaps surrounding species biology. Other potential areas for research efforts have been listed in previous sections of this management plan and should also be considered in the context of supporting those topics listed below.

9. Fisheries and Oceans Canada will support, contribute to and foster Steller Sea Lion research, by management of samples and data collected by non-governmental organizations and the public, including:

    a. Tissue samples from the B.C. Steller Sea Lion population for potential future genetic, pathogen and fatty acid research. This will assist in collection of genetics, and pathogen data to better understand the requirements and health of the B.C. population, and to facilitate range-wide comparisons.

    b. Brand re-sighting efforts and photographs of branded animals, where and when opportunity presents itself, to assist in addressing uncertainties in vital rates, movements of individuals and other knowledge gaps.

10. Fisheries and Oceans Canada will support, contribute to, and foster, where feasible, the following directed research actions to address key knowledge gaps for Steller Sea Lions.

a. Studies on foraging areas, and seasonal distribution of sea lions and their prey species to address uncertainties regarding prey availability near rookeries.

b. Studies addressing uncertainties regarding the diet of Steller Sea Lions outside of the breeding season.

c. Maintenance of database for brand re-sight data, to facilitate organization of data collected, and data sharing between researchers.

2.3.4. Research to Clarify Identified Threats

Fisheries and Oceans Canada will support, contribute to, and foster, where feasible, the following research actions to address knowledge gaps on threats to the population.

11. Assess current levels and trends in annual human-caused mortality that can be sustained by Steller Sea Lions under various conditions (to achieve the population objective).
12. Determine the diet of Steller Sea Lions (across all seasons) to assess the potential for fisheries competition for prey resources.
13. Investigate seasonal variation in significance of impacts from research-related disturbance at haulouts and rookeries to clarify the magnitude of this identified threat.
14. Gather information on entanglement rates observed during Steller Sea Lion research in B.C. to compile information on entanglement rates, gear types, and severity of entanglements, and explore and develop methods for disentangling animals.
15. Collect samples for analyses of toxin and pathogen loading in Steller Sea Lions, when feasible.
16. Conduct assessments of current sources of biological pollutants within known Steller Sea Lion habitat to assess the potential for population-level impacts. Of particular significance are agricultural sources of pollutants and rehabilitation programs.
17. Identification of significant non-point sources of toxic contamination within Steller Sea Lion habitat in B.C. Of particular importance are emerging contaminants and those sources in close proximity to rookeries and year-round haulouts.

2.3.5. Monitoring Population Status

18. Continue to support, and contribute to the coordination of range-wide aerial and vessel surveys, every four years.
19. Consider additional biennial rookery surveys to more closely monitor breeding populations.

2.3.6. Outreach and Communication

20. Foster improved communication networks to increase awareness of initiatives for Steller Sea Lion conservation and research.

a. Pro-actively build intra- and interagency networks for effective communication during catastrophic spill response to allow timely, effective and coordinated actions by responsible agencies and parties.

b. Support and contribute, where feasible, to trans-boundary and inter-jurisdictional collaboration on conservation initiatives to ensure a coordinated response to conservation of this population.

c. Ongoing media communications and promotion of the Marine Mammal Regulations and '*Be Whale Wise*: marine wildlife guidelines for boaters, paddlers and viewers' to reduce physical and acoustic disturbance at haulouts. This action will facilitate increased awareness of regulations and facilitate ease of enforcement measures.

d. Support, where feasible, independent education and awareness programs on:

- Significance of marine debris in entanglement of Steller Sea Lions.
- Measures to avoid or minimize depredation of commercial and sport fishing gear.
- The importance of reporting marine mammal incidents involving Steller Sea Lions to the DFO Marine Mammal Response Program (1-800-465-4336).
- Mitigation measures available to reduce chemical and biological contamination of habitat.

3. PROPOSED IMPLEMENTATION SCHEDULE

Fisheries and Oceans Canada encourages other agencies and organizations to participate in the conservation of Eastern Pacific Steller Sea Lion through the implementation of this management plan. The agencies in Table 2 have been identified as potential partners for implementing the recommended actions.

Table 3 summarizes those actions that are recommended to support the goals and objectives of this management plan. The activities implemented by Fisheries and Oceans Canada will be subject to the availability of funding and other required resources. Where appropriate, partnerships with specific organizations and sectors will provide the necessary expertise and capacity to carry out the listed action. However, this identification is intended to be advice to other agencies, and carrying out these actions will be subject to each agency's priorities and budgetary constraints. Organizations currently collecting data on Steller Sea Lion are listed in Appendix II.

Table 2. The management actions outlined in this plan are to be carried out, where and when appropriate, in partnership with the following organizations.

Organization	Acronym
Fisheries and Oceans Canada	DFO

Organization	Acronym
Marine Mammal Response Network	MMRN
Department of National Defence	DND
Environment Canada	EC
Parks Canada Agency	PCA
Transport Canada	TC
Natural Resources Canada	NRCan
Canadian Coast Guard Services	CCG
National Energy Board	NEB
First Nations	FN
B.C. Province	B.C. Prov
Ministry of Agriculture and Lands	MAL
Vancouver Aquarium Marine Science Centre	VAMSC
B.C. Cetacean Sightings Network	B.C. CSN
Pacific Salmon Commission	PSC
Straitwatch	Straitwatch
Universities having relevant research programs	Universities
U.S. National Marine Fisheries Service	NMFS
National Oceanic and Atmospheric Administration, National Marine Mammal Lab	NOAA
Oregon Department of Fish and Wildlife	ODFW
Washington Department of Fish and Wildlife	WDFW
Alaska Department of Fish and Game	ADFG
Pacific Whale Watch Association	PWWA
Environmental non-Governmental Organizations	ENGOs
North Pacific Marine Mammal University Consortium	NPMMUC
To be determined	TBD

Table 3. Proposed Implementation Schedule

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies[1]	Timeline
Protection					
1. Protect Steller Sea Lions from disturbance at breeding sites and haulouts					
a. Continue enforcement of MMR, promote regional guidelines	D1, D2, M3	L	Continued protection from disturbance; habitat degradation	CCG, DFO	Ongoing
2. Enforcement of regulations for discarding debris, develop new fishing standards	M2	L	Reduce entanglement risks	DFO, TC, Fishing industry	Ongoing
Management					
3. Consider dietary needs when changes to current fisheries management regimes occur	P1, M6	H	Prey limitation	DFO, Fishing industry	As changes to fisheries management occur
4. Review proposals with potential for disturbance at haulouts and rookeries, and provide advice	D1, D2, M3, M5	L	Acoustic and physical disturbance	DFO, DND, Industry, NRCan, NEB	Ongoing, enhance involvement where necessary
5. Manage and reduce input of chemical toxins, reduce toxic loading					

[1] Identification of government agencies and non-governmental organizations is intended to be advice and does not commit the agency or organization to implementing the listed action. Implementing actions will be contingent upon each organization's or agency's priorities and budgetary constraints.

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies[1]	Timeline
a. Develop DFO emergency response plan to identify marine mammal expertise required in toxic spill response	P1, M2, M4	LM	Effective, coordinated response for toxic spills	DFO, EC, CCG, PCA, B.C. Prov, TC	4 years
b. Marine mammal-specific DFO operational manual for toxic spill response	M2, M4	LM	Effective, coordinated step-wise response to toxic spills; standardized data collection; monitoring	DFO, EC, CCG, PCA, B.C. Prov, TC	4 years
c. Review management of point-sources of toxins listed in Appendix I	R3, M2	LM	Relevance of guidelines and thresholds for marine mammals, contaminant loading	EC, B.C. Prov, Municipalities, Industry	Ongoing
6. Support low-impact research	R1 to R4, M1, M3	H	Fostering independent/ non-DFO, low-impact research, trans-boundary collaboration, data sharing	DFO, ENGOs, NPMMUC, NMFS, ADFG, WDFW, ODFW, TBD	Ongoing
7. Strengthen measures to reduce entanglement risk					
a. Support MMRN initiatives	R3, R4	L	By-catch, entanglement (all types), incidental take	DFO, VAMSC, ENGOs, MAL, NPMMUC, PCA, CCG, TBD	Ongoing
b. Fisheries observer reporting standards and guidelines	R3, R4	M	Clarify extent of fisheries interactions	DFO, Fishing industry	3 years
c. Develop solutions to predator interactions, quarterly reporting	P1, R3, R4	L	Clarify extent of interactions at aquaculture sites; entanglement; predator control	DFO, Aquaculture industry	Ongoing
d. Develop and evaluate best management practices	P1, M2	L	Mitigate depredation and entanglements	DFO, Aquaculture industry	Ongoing
e. Alternative gear types (fishing, aquaculture)	P1, M2	M	Reduce entanglement risk; incidental take	DFO, Fishing and Aquaculture industry, VAMSC	Ongoing as new information becomes available
8. Determine risk associated with lifting of moratorium on offshore fossil fuel extraction	P1, D1, D2, R3, M2 to M5	LM	Determine associated risk regarding toxic spills; disturbance; potential impacts to foraging	DFO, EC, NEB, NRCan, B.C. Prov	Ongoing

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies[1]	Timeline
Research on Steller Sea Lion Biology					
9. Data collection:					
a. Collection of tissue samples	R2, R3, M1	L	Genetic, pathogen and fatty acid analysis	DFO, NMFS, ODFW, ADFG, WDFW, TBD	Opportunistically
b. Brand re-sighting; photographs of branded animals	R1, R2, R3, M1	M	Assist range-wide research efforts to assess vital rates; movements	DFO, NMFS, ODFW, ADFG, WDFW, TBD	Ongoing
10. Contribute, support, foster research on					
a. Important foraging areas, seasonal distribution	P1, R2, R3, M1, M6	H	Prey availability near rookeries during breeding season	DFO, PSC, WDFW, ADFGW, NMFS	Ongoing
b. Diet outside the breeding season	P1, R2, R3, M1, M6	H	Knowledge gaps re: seasonally important prey species; nutritional needs	DFO, PSC, WDFW, NPMMUC, NMFS, ODFW,TBD	Ongoing
c. Maintenance of brand re-sight database	R2, M1	M	Data sharing; data organization	DFO, ADFGW, ODFW, NMFS, NPMMUC	Ongoing
Research to clarify identified Threats					

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies[1]	Timeline
11. Assess sustainability of total human-caused mortality	P1, R4	M	Human-caused mortality levels	DFO, TBD	Ongoing
12. Assess potential for fisheries competition for prey resources	P1, R3, M6	H	Prey limitation; fisheries impacts	DFO, PSC, WDFW, NPMMUC	Ongoing
13. Determine seasonal variation in significance of research disturbance at haulouts and rookeries	D1, D2, R3, M3	LM	Significance of seasonal disturbances	NPMMUC, TBD	Ongoing
14. Gather information on entanglement rates observed by researchers	P1, R3, M1, M2	L	Entanglement rates in B.C.; gear types; severity of incidents	DFO, NMFS, ODFW, ADFG, WDFW, VAMSC, NPMMUC, TBD	Ongoing
15. Analysis of toxin and pathogen loading	P1, R3, M2	LM	Determine risk of impacts from toxins and disease	DFO, EC, B.C. Prov, MAL, TBD	Ongoing
16. Assess sources of biological pollutants	R3, M2	L	Determine potential for biological pollutant loading	Municipalities, Industry, TBD	Ongoing
17. Identify significant non-point source toxic contamination	R3, M2	LM	Emerging contaminants; toxic loading near rookeries and year-round haulouts	TBD	Ongoing
Monitoring population status					
18. Support, contribute to coordination of range-wide surveys, every four years	P1, D1, D2, R1, M1	H	Monitoring range-wide trends; effective, efficient data collection; foster data sharing	DFO, PCA, B.C. Prov, NMFS, ODFW, ADFG, WDFW, TBD	Ongoing (next survey in 2010)
19. Consider biennial rookery surveys	P1, D1, D2, R1, R2, M1	M	Monitor breeding populations	DFO, PCA, B.C. Prov, NMFS, ODFW, ADFG, WDFW, TBD	Conducted in 2008, next survey is funding dependent
Outreach and Communication					

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies[1]	Timeline
20. Foster improved communication networks					
a. Pro-actively build communication networks	M1, M2	M	Effective intra- and inter-agency communication catastrophic spill response	DFO, EC, CCG, B.C. Prov, VAMSC, Municipalities, ENGOs	3 years
b. Trans-boundary and inter-jurisdictional collaboration	All	M	Coordinated management and research efforts	DFO,PCA, NOAA, NMFS, NPMMUC, ENGOs	3 years
c. Ongoing media communications and promotion of the MMR and '*Be Whale Wise*'	M1	L	Awareness of guidelines, regulations; enforcement measures	DFO, B.C. CSN, VAMSC, Straitwatch, PWWA, TBD	Ongoing
d. Support, where feasible, independent education and awareness programs	M1, M2	L	Entanglement; marine debris; depredation; incident reporting; contamination of habitat	DFO, B.C. CSN, VAMSC, Straitwatch, PWWA, TBD	Ongoing

4. ASSOCIATED PLANS

The following are specific recovery plans and management plans that identify similar threats to marine mammals at-risk, and contain similar recommendations for mitigation of threats identified in this Management Plan for the Steller Sea Lion in Canada. Implementation of actions listed in this, and other plans will provide a multi-species and multi-jurisdictional approach to conservation of marine mammals on the west coast of North America.

- U.S. National Marine Fisheries Service. Recovery Plan for the Steller Sea Lion (*Eumetopias jubatus*). (NMFS 2008)
- Management Plan for the Offshore Killer Whale (*Orcinus orca*) in Canada [Final] (DFO 2009)
- Management Plan for the Eastern Pacific Grey Whale (*Eschrichtius robustus*) in Pacific Canadian Waters. [Draft] (DFO 2008b)
- Management Plan for the Pacific Harbour Porpoise (*Phocoena phocoena*) in Canada [Final] (DFO 2009b)
- Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada [Final] (DFO 2007c)
- Recovery Strategy for the Northern and Southern Resident Killer Whale (*Orcinus orca*) in Canada. [Final] (DFO 2008c)
- Recovery Strategy for the Sea Otter (*Enhydra lutris*) in Canada [Final] (DFO 2007b)

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6. APPENDIX I

Table 4. Details on Terms used for Assessment of Threats to the Eastern Pacific Steller Sea Lion Population.

TERMS	RATING	DEFINITIONS
Uncertainty	Low	Effect of threat is *causally linked* with decreased population viability and likely will result in failure to meet management plan objectives
	Medium	Effect of threat is *correlated* with decreased population viability and negatively impacts management plan objectives
	High	Negative effect of threat on population viability and/or management plan objectives is *assumed* or is plausible.
Severity	Negligible	Threat has no detectable effects on the population
	Low	Effects of threat are sublethal, potentially leading to short-term behavioural changes
	Moderate	Effects of the threat result in chronic physiological and/or behavioural changes (e.g. potential for long-term displacement from habitat)
	High	Effects of the threat are lethal
	Unknown	Available information is insufficient to gauge the degree to which the threat may affect the population viability
Mitigation Potential	Low	Implementation of measures to mitigate or prevent impacts on population viability, are not practical or are likely to be unsuccessful.
	Moderate	Implementation of measures to mitigate or prevent impacts on population viability are feasible, and are likely to be somewhat successful
	High	Implementation of measures to mitigate or prevent impacts on population viability are currently in place and future measures are likely to be very easy to implement, and are likely to be very successful.
	Unknown	Available information is insufficient to gauge whether mitigation of effects from the threat is possible.

Table 5. Persistent Organic Pollutants that may pose a risk to Steller Sea Lions. Table was obtained from the final Recovery Strategy for Resident Killer Whales in Canada (DFO 2008c).

Pollutant	Use/Source	Persistent	Bio-accumulate	Risk
DDT *Dichlorodi-phenyl trichloroethane*	pesticide used in some countries, banned in North America, persists in terrestrial runoff 30 years post-ban, enters atmosphere from areas where still in use	yes	yes	reproductive impairment, immunosuppression, adrenal and thyroid effects
PCBs *Polychlorinated Biphenyls*	electrical transformer and capacitor fluid, limited use in North America but enters environment from runoff, spills and incineration	yes	yes	reproductive impairment, skeletal abnormalities, immunotoxicity and endocrine disruption
Dioxins and Furans	by-product of chlorine bleaching, wood product processing and incomplete combustion. Mills less of a source now. Current sources include burning of salt-laden wood, municipal incinerators, and residential wood and wood waste combustion, in runoff from sewage sludge, wood treatment	yes	yes	thymus and liver damage, birth defects, reproductive impairment, endocrine disruption, immunotoxicity and cancer
PAHs *Persistent Polycyclic aromatic hydrocarbons*	by-product of fuel combustion, aluminum smelting, wood treatment, oil spills, metallurgical and coking plants, pulp and paper mills	yes	no	carcinogenic
flame retardants, esp. PBBs and PBDEs *Polybrominated diphenyl ethers*	flame retardants; in electrical components and backings of televisions and computers, in textiles and vehicle seats, ubiquitous in environment. 2/3 product PBDEs banned in Europe. Same two products withdrawn from North American marketplace in 2005, but one (deca) product still used globally.	yes	yes	endocrine disruption, impairs liver and thyroid
PFOs *Perfluro-octane sulfonate*	stain, water and oil repellent (included in Scotchgard until recently), fire fighting foam, fire retardants, insecticides and refrigerants, ubiquitous in environment	yes	yes but in blood, liver, kidney and muscle	promotes tumour growth
TBT, DBT *Tributyltin* *Dibutyltin*	antifoulant pesticide used on vessels	yes	yes	unknown but recently associated with hearing loss
PCPs *(Polychlorinated paraffins*)	flame retardants, plasticizers, paints, sealants and additives in lubricating oils	yes	yes	endocrine disruption
PCNs *Polychlorinated napthalenes*	ship insulation, electrical wires and capacitors, engine oil additive, municipal waste incineration and chlor-alkali plants, contaminant in PCBs	yes	yes	endocrine disruption
APEs Alkyl-phenol ethoxylates	detergents, shampoos, paints, pesticides, plastics, pulp and paper mills, textile industry found in sewage effluent and sediments	moderate	moderate	endocrine disruption
PCTs *Polychlorinated terphenyls*	fire retardants, plasticizers, lubricants, inks and sealants, enters environment in runoff	yes	yes	endocrine disruption and reproductive impairment

References: Primarily Grant and Ross 2002, but also Lindstrom et al. 1999, Hooper and MacDonald 2000, Kannan et al. 2001, Hall et al. 2003; Van deVijver et al. 2003, Rayne et al. 2004, Song et al. 2005.

7. APPENDIX II:

Organizations currently involved in research on Eastern Pacific Steller Sea Lions.

- Fisheries and Oceans Canada, Nanaimo, B.C.
    - Science Branch
    - Marine Mammal Response Network
- Parks Canada Agency
- Vancouver Aquarium Marine Sciences Centre, Vancouver, B.C.
    - Veterinary Department
    - Marine Mammal Rescue and Rehabilitation Department
- University of British Columbia
- U.S. National Oceanographic and Atmospheric Administration, Seattle, WA
- National Marine Fisheries Service
- Oregon Department of Fish and Wildlife
- Washington Department of Fish and Wildlife
- Alaska Department of Fish and Game
- Oregon State University
- B.C. Ministry of Agriculture and Lands, Abbotsford, B.C.
- Independent Researchers

8. APPENDIX III: Record Of Cooperation and Consultation

Eastern Pacific Steller Sea Lions are listed as a species of "special concern" on Schedule 1 of the *Species at Risk Act* (SARA). As an aquatic species, they fall under federal jurisdiction, and are managed by Fisheries and Oceans Canada (DFO) Suite 200 - 401 Burrard Street, Vancouver, B.C, V6C 3S4.

DFO brought together a small internal working group of technical experts from science and management to develop an initial draft of this management plan. A Steller Sea Lion Management Planning Technical Workshop was hosted in November of 2007 to provide a forum for the sharing of knowledge and expertise on Eastern Pacific Steller Sea Lions to support the drafting of the plan. A group of scientific and technical experts including independent researchers, environmental non-governmental organizations, and other governmental (federal and provincial) staff from both Canada and the United States participated in the workshop. An invitation letter was also sent to all coastal First Nations soliciting their participation in development of the management plan and at the technical workshop. This workshop was invaluable in assisting the DFO internal working group in drafting the Management Plan for Steller Sea Lions in Canada. Given that the population considered in this management plan frequents both Canadian and United States (U.S.) waters, bilateral government and non-government input and collaboration was sought.

A draft version of the management plan was posted to the DFO Pacific Region website for a 30-day public comment period from April 7 to May 12, 2008, and also included mail-outs to all coastal First Nations soliciting comments, follow-up emails were also sent. Consultations were web-based, and included an initial draft of the management plan, discussion guide and feedback form available online. In addition, a message announcing the development of the management plan, was sent to a marine mammal list serve (MARMAM) with a broad local and international distribution to marine mammal researchers and interested parties, and to a distribution list of whale-related contacts provided to DFO in recent years from environmental groups, non-governmental organizations, government agencies, and the eco-tourism sector.

Comments on the management plan were received from eight independent sources and from two government agencies: Environment Canada, and the Province of B.C. Processes for coordination and consultation between the federal and provincial governments on management and protection of species at risk are outlined in the *Canada-B.C. Agreement on Species at Risk* (2005). Natural Resources Canada, Department of National Defence, the Parks Canada Agency and Transport Canada provided no comments on the draft document. No feedback was received from mail-outs to First Nations.

Feedback from the public, government agencies and scientific experts has been carefully considered in the production of the final management plan. Peer review of the document was not considered necessary as applicable experts were in attendance at the Steller Sea Lion Management Planning Technical Workshop and were provided an opportunity to provide input through public consultation.

Fisheries and Oceans Canada Technical Team:

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Marilyn Joyce	Fisheries and Oceans Canada
Peter Olesiuk	Fisheries and Oceans Canada
John Ford	Fisheries and Oceans Canada
Graeme Ellis	Fisheries and Oceans Canada
Jake Schweigert	Fisheries and Oceans Canada
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Tatiana Lee	Fisheries and Oceans Canada
Joy Hillier	Fisheries and Oceans Canada
Jeff Grout	Fisheries and Oceans Canada
Linda Nichol	Fisheries and Oceans Canada
Robin Abernethy	Fisheries and Oceans Canada

Steller Sea Lion Management Planning Technical Workshop Participants:

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