COSEWIC
Assessment and Update Status Report

on the

Steller Sea Lion
Eumetopias jubatus

in Canada

SPECIAL CONCERN
2003

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC 2003. COSEWIC assessment and update status report on the Steller sea lion *Eumetopias jubatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 47 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Previous report:

Bigg, M.A. 1987. COSEWIC status report on the Steller sea lion *Eumetopias jubatus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 63 pp.

Production note: COSEWIC acknowledges Peter F. Olesiuk and Andrew W. Trites for writing the update status report on the Steller sea lion *Eumetopias jubatus* in Canada, prepared under contract with Environment Canada, overseen and edited by Hal Whitehead, COSEWIC Marine Mammals Specialist Subcommittee Co-chair.

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Également disponible en français sous le titre Rapport du COSEPAC sur la situation de l'otarie de Steller (*Eumetopias jubatus*) – Mise à jour.

Cover illustration:
Steller sea lion — Provided by Dr. Andrew Trites, University of British Columbia.

Catalogue No.CW69-14/365-2004E-PDF
ISBN 0-662-36726-X
HTML: CW69-14/365-2004E-HTML
0-662-36727-8

Recycled paper

COSEWIC
Assessment Summary

Assessment Summary – November 2003

Common name
Steller sea lion

Scientific name
Eumetopias jubatus

Status
Special Concern

Reason for designation
There are only three 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.

Occurrence
BC Pacific Ocean

Status history
Designated Not at Risk in April 1987 Status re-examined and uplisted to Special Concern in November 2003. Last assessment based on an update status report.

COSEWIC
Executive Summary

Steller Sea Lion
Eumetopias jubatus

Species information

The Steller sea lion (*Eumetopias jubatus* Schreber 1776) is the largest member of the family otariidae (Order Carnivora, Suborder Caniformia). Steller sea lions exhibit significant sexual dimorphism. Adult females average 2.1-2.4 m in length and weigh 200-300 kg. Adult males are noticeably larger, attaining a length of 2.7-3.1 m and weighing 400-800 kg. Pups are born from late May to early July and weigh 16-23 kg at birth.

Distribution

Steller sea lions inhabit the cool-temperate and subarctic coastal waters of the North Pacific Ocean from southern California, north to the Bering Strait, and south along the Asian coast to Japan. Two stocks of Steller sea lions are recognized based on genetic differentiation of mitochondrial DNA: an eastern population (California to southeast Alaska) and a western population (Gulf of Alaska, Bering Sea, Aleutian Islands, and Russia). Within Canada, Steller sea lions occur only in British Columbia and there are three main breeding areas: 1) off the northeastern tip of Vancouver Island (rookeries on Maggot, Sartine and Triangle Islands); 2) off the southern tip of the Queen Charlotte Islands (rookeries on the Kerouard Islands); and 3) off the northern mainland coast (rookeries on North Danger Rocks). Another breeding area off the central mainland coast (rookeries on Virgin, Pearl and Watch Rocks) was extirpated during the 1920s and 1930s by intense predator control programs. No new rookeries have been established in BC for over a century, but Steller sea lions have begun breeding at several new sites in Alaska.

At sea, animals are typically found within about 60 km of shore during summer, and can range over 200 km from shore in winter. Steller sea lions are non-migratory, but may disperse considerable distances from breeding sites.

Habitat

The terrestrial sites used by Steller sea lions include: 1) rookeries where animals congregate during May-August to give birth, mate, and nurse young pups; 2) year-round haulouts that are usually occupied continuously; and 3) winter haulout sites that are used less regularly and primarily during the non-breeding season. No new rookeries have been colonized in BC over the past century. Animals haul out on a regular basis throughout the year, and tend to be highly gregarious while on land with little or no physical separation between individuals.

Our understanding of how Steller sea lions use the aquatic environment is poor. In general, most Steller sea lions appear to feed over the continental shelf and along the shelf break. Animals are generally observed within 60 km of land and in water depths less than 400 m, but may venture several hundred kilometers offshore and occur off the continental shelf.

Biology

Steller sea lions are polygynous breeders. Females give birth to a single pup, which they typically nurse for just under a year, but may occasionally nurse up to 2-3 years. Longevity is about 14 years for males and 22 years for females, with a generation time of 10 years. Steller sea lions regularly haul out on established rookeries and haulouts between feeding trips. Preferred prey in BC includes herring, hake, sandlance, salmon, dogfish, eulachon, sardines, rockfish, flounder, skate, squid and octopus.

Population sizes and trends

Population increases have been observed in BC since Steller sea lions were protected in 1970. Abundance increased at an average of 3.2% annually, which has resulted in a doubling in the size of the breeding population. Most of this increase has occurred during the last two decades. A total of about 3,400 pups were born in BC in 2002. The total BC population inhabiting coastal waters during the breeding season is estimated at 18,400–19,700 individuals (which includes non-breeding animals associated with rookeries in southeast Alaska). The number of sexually mature individuals is about 7,600 (40% of the population).

Limiting factors and threats

Steller sea lions are threatened by shooting, incidental take in fishing gear, entanglement in debris, catastrophic accidents, environmental contaminants, and displacement or degradation of their habitat. They are also susceptible to fluctuating prey populations, predation by killer whales, and disease.

Special significance of the species

The Steller sea lion is the largest species of sea lion and the only otariid that resides year-round and breeds in Canadian waters. It is an important component of the coastal marine ecosystem, and contributes to a burgeoning eco-tourism industry. BC rookeries now represent two of the largest breeding aggregations in the world. As a result of recent declines in the western part of its range, where the species is considered to be endangered, and the implications this listing may have for commercial fisheries, the Steller sea lion has recently been the focus of much research into factors influencing populations. There may be potential for using apex predators like the Steller sea lion as an indicator species of coastal ecosystem status given their widespread distribution, long lifespan, and position near the top of the marine food chain.

Existing protection or other status designations

Since 1970, sea lions have been protected by various regulations enacted under the *Fisheries Act* and enforced by the Department of Fisheries and Oceans. The rookery at Cape St. James is protected under the National Parks Act, and the rookeries on the Scott Islands are part of a BC Ecological Reserve. The Steller sea lion was red-listed by the BC provincial government Conservation Data Centre. In the United States, the eastern stock, which occurs from California to southeast Alaska (including BC) is listed as *threatened*, and the western stock, which occurs in the Gulf of Alaska and Aleutian Islands is listed as *endangered* under the US *Endangered Species Act*.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species and include the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal organizations (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership, chaired by the Canadian Museum of Nature), three nonjurisdictional members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The committee meets to consider status reports on candidate species.

DEFINITIONS
(After May 2003)

Species	Any indigenous species, subspecies, variety, or geographically or genetically distinct population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.

** Formerly described as “Not In Any Category”, or “No Designation Required.”

*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

Environment Canada
Canadian Wildlife Service

Environnement Canada
Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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2003

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SPECIES INFORMATION

Name and classification

The Steller sea lion (*Eumetopias jubatus* Schreber 1776) is the largest member of the Family Otariidae (order–Carnivora, suborder–Caniformia, Kenyon and Scheffer 1955; Jefferson *et al.* 1994; Rice 1998). It was named after the German naturalist George Wilheim Steller who described the species in 1742 (Miller and Miller 1848). Other common names are Steller's sea lion, northern sea lion, Otarie de Steller (Fr), sivuch (Ru), todo (Jp), lobo marino de Steller (Sp), qawax (pronounced ka-wa by Aleut natives), and wiinaq (Alutiiq). Its scientific name means having a well-developed broad forehead (*Eumetopias*–Greek) and a mane (*jubatus*–Latin).

Description

Steller sea lions exhibit significant sexual dimorphism (Fiscus 1961; Mathisen *et al.* 1962; Thorsteinson and Lensink 1962; Orr and Poulter 1967; Calkins and Pitcher 1982; Loughlin and Nelson 1986; Calkins *et al.* 1998; Winship *et al.* 2001). Adult females (cows) average 2.1-2.4 m and 200-300 kg. Adult males (bulls) are noticeably larger, attaining a length of 2.7-3.1 m and weighing 400-800 kg, although the largest can weigh over 1,100 kg as they fatten prior to the start of the breeding season. Mature males develop a prominent 'mane' of course hair on their massive muscular necks and chests, from which they derive the name 'lion'. The shape of their heads tends to be more robust with a flatter snout than that of females.

Pups are born from late May to early July and weigh 16-23 kg at birth, with males weighing more on average than females. Pups are born with a thick blackish-brown lanugo that is moulted between 3-6 months of age (Scheffer 1964; Vania 1972).

Coloration of dry juveniles and adults is pale yellow to light tan, darkening to chocolate brown on their undersides and near their flippers (which are black and bare-skinned). When wet, Steller sea lions appear greyish white. Pelage of both sexes is comprised of short coarse hairs (Scheffer 1964). Steller sea lions undergo an annual moult shedding their entire pelage, but not the epidermis. Non-reproductive females appear to moult first, beginning as early as late June, and in other age-classes the process extends into early December (Vania 1972; Calkins and Pitcher 1982).

Adult vocalizations in air consist of deep-throated bellows and roars. Territorial males wheeze as part of their threat displays (Orr and Poulter 1967; Gentry 1970), and produce a loud guttural sound both in the air and underwater (Schusterman *et al.* 1970). Newborns tend to bleat like sheep.

Steller sea lions are capable of propping themselves on their foreflippers and rotating their hind flippers forward, rendering them remarkably agile on land. Animals can climb steep rocks and are often found many metres above the sea surface. Animals tend to be highly gregarious while on land and generally pack close together with little or no separation.

DISTRIBUTION

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 south along the Asian coast to Hokkaido, Japan (Fig. 1, Kenyon and Rice 1961; Loughlin *et al.* 1984; Loughlin *et al.* 1992). They give birth on 55-60 rookeries and rest at >300 haulouts. Steller sea lions are non-migratory, but may disperse considerable distances from breeding sites (Rowley 1929; Fisher 1981; Calkins and Pitcher 1982; Loughlin 1997; Raum-Suryan *et al.* 2002). Animals haul out on a regular basis throughout the year.

Worldwide, 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). More recent genetic analyses suggests the western population should be recognized as two distinct populations (Asia and Aleutians – Gulf of Alaska) (Bickham, unpubl. data). 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).

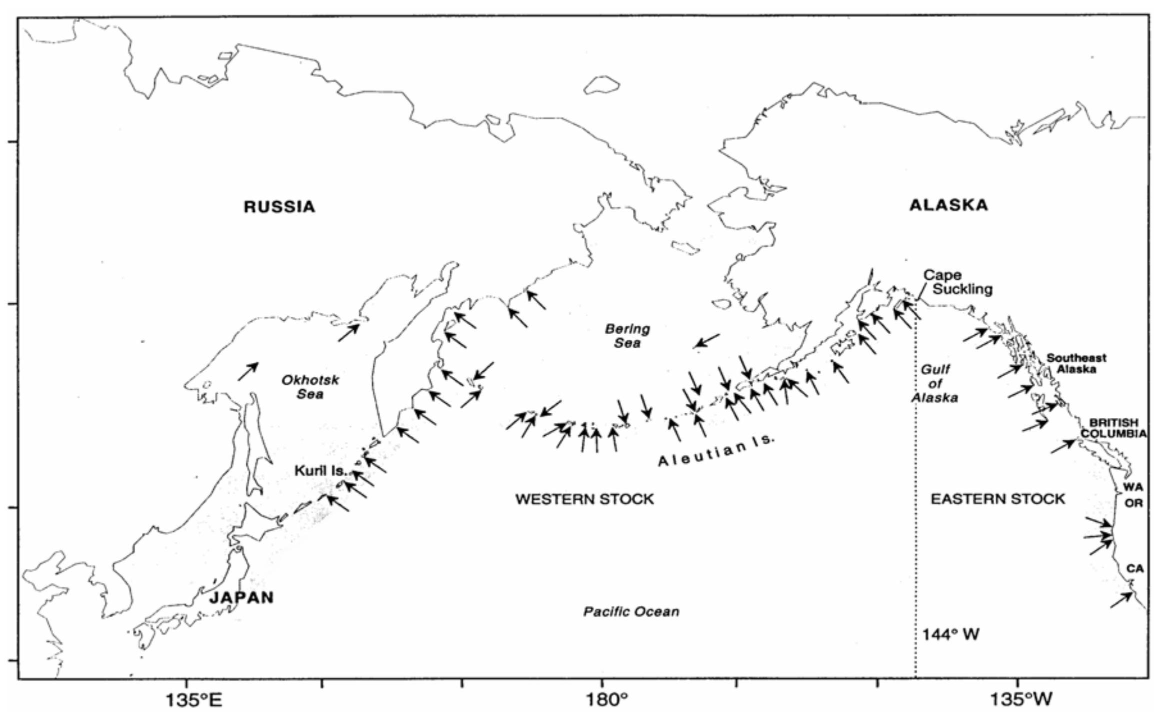


Figure 1. Worldwide range of the Steller sea lion. Arrows denote breeding rookeries and shaded areas the approximate range of non-breeding range. The dashed line shows the separation between the eastern and western stocks of Steller sea lions. (modified from Loughlin 1997 and Sease *et al*. 1999).

Canadian range

Within Canada, Steller sea lions make up part of the eastern population (Bickham 2000), and occuronly occur in British Columbia (Fig. 1). There are three main breeding areas: 1) the Scott Islands off the northwest tip of Vancouver Island, with rookeries situated on the Scot Islands (Triangle, Beresford and Maggot Islands); 2) at Cape St. James off the southern tip of the Queen Charlotte Islands, with rookeries situated on the Kerouard Islands; and 3) off Banks Island on the northern mainland coast, with rookeries situated on North Danger Rocks. A fourth breeding area was once 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 following intense predator control programs during the 1920s and 1930s (Bigg 1985). In addition to these breeding sites, there are about 21 haulout sites distributed mainly along the exposed outer coast that are used continuously on a year-round basis, 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).

HABITAT

Habitat requirements

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 and primarily 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. In most cases animals continue to use rookeries as haulout sites throughout the year, albeit in much reduced numbers.

Steller sea lions are extremely traditional in the sites they use to give birth and mate. Studies of marked individuals indicate that 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 breeding areas currently used in BC all appear to have been well established at the turn of the century when the first sea lion survey was conducted (Newcombe and Newcombe 1914), and have been used continuously despite the disturbances caused by predator control programs and commercial harvests (Pike and Maxwell 1958; Bigg 1985; Olesiuk 2003). No new rookeries have been colonized in BC, or for that matter throughout other parts of their North Pacific range, with the exception of Southeast Alaska and Gulf of Alaska where some haulouts became rookeries.

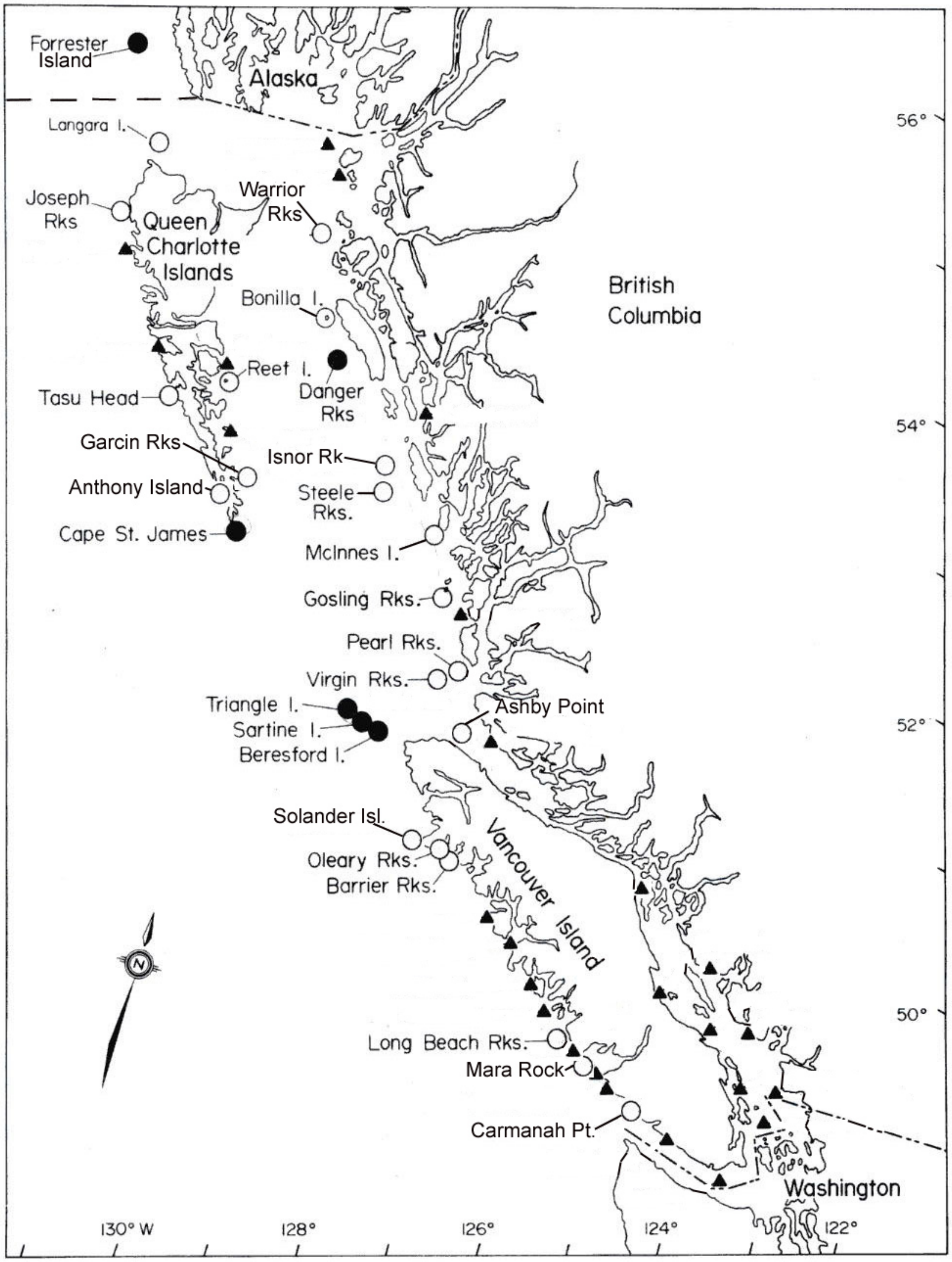


Figure 2. Geographic location of Steller rookeries (●), year-round haulout sites (○) and major winter haulout sites (▲) in British Columbia (and Forrester Island, Alaska). Updated from Bigg (1985)(1985) based on Olesiuk (2003)(2003).

One of the most striking features of rookeries is their remoteness and generally the absence of terrestrial predators such as wolves and bears. Steller sea lions propagate on some of the most isolated, barren outcroppings in the North Pacific Ocean. They appear to be located in regions that have relatively high currents, high salinity, low surface temperatures and shallow waters—which presumably reflects high ocean productivity and hence optimum feeding areas (Ban *et al.,* unpublished data). Essential haulout features seem to be relatively flat terrain, accessibility, and protection from swell and waves (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 capable of going to sea will use lower and more exposed areas. The rookeries in BC are comprised of rocky ledges, except in recent years when increasing numbers of animals began breeding on the gravel beaches along the eastern (leeward) side of Triangle Island (Olesiuk, unpublished data).

The 21 year-round haulout sites in BC are generally situated in exposed areas along the outer coast, and are comprised of rocky islets and ledges. Approximately half of them were noted 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. As populations have increased in BC, some sites formerly used mainly during winter (see below) have been occupied more continuously, and have been re-classified as year-round haulouts (Olesiuk 2003).

Use of winter haulouts appears to be more fluid than year-round sites. Most 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 logbooms, floats, jetties and docks. Animals 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 (Kenyon and Rice 1961). This behaviour often occurs in groups and is referred to as rafting. Animals typically lie at the surface with their flippers extended into the air, with their snouts occasionally breaking the surface as the animals breathe (Olesiuk and Bigg 1988). In the southern part of BC, winter haulouts are often shared with adult- and subadult-male California sea lions (*Zalophus californianus*) (Hancock 1970; Brenton 1977; Bigg 1985).

Our understanding of how Steller sea lions use their aquatic habitat is poor. Animals are generally observed within 60 km of land and in water depths less than 400 m, but may venture several hundred kilometers offshore and occur off the continental shelf (Kenyon and Rice 1961; Merrick and Loughlin 1997). Steller sea lions also occasionally venture into freshwater (Jameson and Kenyon 1977; Roffe and Mate 1984; Beach *et al.* 1985). In BC, sea lions often congregate in the lower Fraser River during the spring eulachon run (Bigg 1985), and 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 (Bigg *et al.* 1990).

Trends

The first rookery abandoned following the culls of 1913-1915 may have been Watch Rock where a dozen pups were counted in 1913 (Bigg 1985). By 1938, control programs had extirpated the two other rookeries that formed the Sea Otter Group—Virgin Rocks and Pearl Rocks (Fig. 2). Few predator control kills were conducted in the following decade. However, substantial kills were made by the Canadian air force and navy in the 1940s during practice bombings on the remaining breeding populations (Pike and Maxwell 1958; Bigg 1985). Predator control and commercial harvesting resumed during 1956-66 and further reduced the BC population (Bigg 1985; Olesiuk 2003). No further attempts have been made to eradicate Steller sea lions since they were protected in 1970 under the *Fisheries Act*. Pupping has not resumed at the eradicated rookeries since culling stopped, and no new rookeries have been established in BC since the first census was made in the early 1900s.

The range of the Steller sea lion crosses the international boundaries with the United States. Breeding populations occur in California and Oregon, but not in Washington State. In Southeast Alaska, no rookeries were known to occur during the early part of the 1900s. However, animals began breeding at Forrester Island, situated about 25 km north of the BC-Alaska border, shortly after control programs were initiated in BC. Rowley (1929) mentioned, without giving a date, that a rookery existed there in the late 1920s with 50-100 animals, and Imler and Sarber (1947) reported a count of 350 in August 1945. The Forrester Island rookery increased dramatically, with 2,500 animals present by 1957 (Mathisen and Lopp 1963), and now constitutes the largest breeding aggregation in the world. Given the close proximity of this rookery to the BC border, it is difficult to separate BC from SE Alaska when assessing population trends. Steller sea lions also established new rookeries in Southeast Alaska at the Hazy Islands in about 1985 and White Sisters Island in 1992, and more recently have begun pupping at Graves and Baili Rocks (Calkins *et al.* 1999; Pitcher *et al.* 2003).

Habitat protection/ownership

Management of marine mammals in Canadian waters is a federal responsibility. Since 1970, Steller sea lions have been protected by various regulations enacted under the *Fisheries Act* and enforced by the Department of Fisheries and Oceans (DFO). Although fish habitat—including by definition sea lion habitat—is generally protected under the *Fisheries Act*, the breeding rookeries at the Scott Islands, as well as several haulout sites within this archipelago, have also been designated as Ecological Reserves under the BC *Ecological Reserves Act*. The rookery at Cape St. James was also once an Ecological Reserve, but became part of Gwaii Haanas National Park Reserve when it was created in 1987 under the federal *National Parks Act*. The Gwaii Haanas Park Reserve is co-managed by the federal government and the Haida Nation, and legislation was recently passed that will formally allow the creation of a marine component to the reserve. Thus 2 of the 3 existing breeding areas are protected (only Danger Rocks is not). Extraction of resources is not permitted, and visitation is restricted through the issuance of permits. DFO also recently began establishing a series of Marine Protected Areas (MPA) under the new *Oceans Act* introduced in 1996. One of the first two pilot MPAs to be established on the Pacific coast of Canada was Race Rocks, in part because it was recognized as an important winter haulout for Steller and California sea lions.

BIOLOGY

General

The earliest accounts of Steller sea lions were provided by Scammon (1874), Allen (1880), Elliot (1882) and Rowley (1929)—but because they were not commercially harvested and specimens were unavailable, little was learned about their general biology until the 1960s. More recent overviews have been provided by Schusterman (1981), Loughlin *et al.* 1987, Hoover (1988) and Loughlin (1998; 1999). The Steller sea lion is currently one of the most intensively studied marine mammals in the world (see NMFS 1992; Strick 1993; Hunter and Trites 2001).

In British Columbia, the first study of Steller sea lions was conducted by Newcombe and Newcombe (1914) and Newcombe *et al.* (1918). Although the species was subjected to major control programs during the first half of the 20th century, little research was done until G. Pike and colleagues examined specimens from commercial harvests during the 1960s (Pike and Maxwell 1958; Pike 1961; Spalding 1964a, b). Behavioral studies were initiated during the 1970s at rookeries and haulouts by H.D. Fisher and his students (Harestad and Fisher 1975; Brenton 1977; Edie 1977; Harestad 1977; Fisher 1981). Assessments of the abundance, distribution and status of Steller sea lions in BC were conducted during the 1980s (Bigg 1984, 1985, 1988) and 1990s (Olesiuk 2003; Olesiuk *et al.* 2003).

Life cycle

Only sexually mature Steller sea lions return to rookeries (along with a few dependent young with their mothers). Bulls are the first to arrive in early May to compete with other mature males and establish territories (Gisiner 1985). Pregnant females begin arriving on rookeries during the latter half of May and give birth to a single pup within a few days of their arrival (Gentry 1970). Mothers will stay on shore with their pups for about 1 week before leaving on regular feeding trips that average 1 day and are followed by 1 day on shore (Higgins 1984; Merrick 1987; Hood and Ono 1997; Milette and Trites 2003). Copulations usually occur prior to the first feeding trip.

Pups are precocious—they have open eyes and can crawl at birth. They begin to enter tide pools and inter-tidal areas at about 2 weeks of age, and swim in the open ocean starting at about 4 weeks of age when mothers begin moving their pups from the rookeries to nearby haulouts (Sandegren 1970; Gentry 1974). By the end of August, few animals remain on the rookeries.

Year-round haulouts are used by immature animals, non-pregnant adults and females nursing pups from previous summers that do not return to the rookeries. Some bulls also use summer haulouts and establish territories, and occasionally breed with mature females (Trites, unpubl. data). Outside of the summer breeding season, Steller sea lions use year-round haulouts as well as winter-haulouts that may be considerable distances from their rookeries. Females with dependent young may stay at a single haulout or may move their pups to any number of haulouts. Average length of feeding trips by lactating females in winter is about 2 days, followed by 1 day on shore (Trites and Porter 2002). Haulouts are not restricted to any single age or sex class during the non-breeding season. However, sea lions without dependent young may spend extended time at sea between visits to shore.

Reproduction

Steller sea lions have a polygynous mating system that appears to be synchronized throughout the entire range (Bigg 1985). Males may begin producing sperm by 3-7 years of age (Calkins and Pitcher 1982), but only those holding territories are known to mate. 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). The ratio of cows to territorial bulls is generally about 10-15:1 (Pike and Maxwell 1958; Merrick 1987). Successful males will usually maintain their territory for an average of 40 days (20-68 days) without feeding (Gentry 1970). The advantages of larger body size in acquiring and defending territories, and in providing energy and possibly water reserves during tenure, probably accounts for the sexual dimorphism in body size in Steller sea lions (Fisher 1958; Repenning 1976).

Females ovulate first at about 3-6 years of age. Following fertilization, embryonic development is suspended for about 3 months until implantation occurs in September or October (delayed implantation), resulting in a gestation period of about 8-9 months (Vania and Klinkhart 1967; Calkins and Pitcher 1982). The majority of mature females conceive each year, but the rate of reproductive failure and abortion appears to be high. Pitcher *et al*. (1998) reported that 97% of females sampled in the Gulf of Alaska were pregnant during early gestation, but that pregnancy rates declined to 67% and 55% during late gestation in the 1970s and 1980s respectively. Pregnancy rates have not been estimated for Steller sea lions in BC.

The lactation period is extremely long for a pinniped species. A few pups have stayed with their mothers for 3 years, although most are believed to wean sometime prior to their first birthday (Calkins and Pitcher 1982; Trites *et al*. 2001). In some cases, females on rookeries may nurse both a newborn and a yearling.

Survival

Besides humans, the main predators of Steller sea lions are killer whales (Morton 1990; Baird and Dill 1995; Ford *et al.* 1998), which may selectively prey on pups and juveniles (Barrett-Lennard *et al.* 1995). Large sharks may also prey on Steller sea lions in the southern part of their range (Stroud 1978; Ainley *et al.* 1981). Bears have been observed and may prey upon pups on rookeries in Russia (T. Loughlin, National Marine Mammal Laboratory, Seattle, WA, pers. comm.).

Mortality of pups during the first month of life generally appears to be high and influenced by factors such as storms (Pike and Maxwell 1958; Orr and Poulter 1967). The principle cause of death for pups is drowning—not because they are not able to swim, but because they are not able to get back out of the water (Orr and Poulter 1967; Edie 1977). Being bitten, tossed or trampled by older animals takes a toll on pups, as does being abandoned or separated from their mothers (Orr and Poulter 1967; Gentry 1970; Sandegren 1970; Sandegren 1976).

Juvenile mortality is difficult to estimate due to potential sampling biases, but appears to be fairly high for both sexes. Calkins and Pitcher (1982) and York (1994) estimated that about 48% of females and 26% of males survived to 3 years of age. Mortality rates are significantly lower for adults (~10-15% per year for females, and ~13-25% for males). Higher mortality rates for males results in a progressively skewed sex ratio favouring females. The oldest animals aged from the wild were about 18 years for males and 30 years for females (Calkins and Pitcher 1982). However, longevity (defined at the 99^{th} percentile of known aged individuals) is about 14 years for males and 22 years for females (Trites and Pauly 1998). It should be noted that the only life tables available were derived from specimens collected in the Gulf of Alaska just prior to major population declines (see *Population Sizes and Trends*), and life history and population parameters (e.g., life expectancy, generation time) may vary with status of populations. 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).

Life tables for Steller sea lions (Calkins and Pitcher 1982; Trites and Larkin 1992; York 1994) indicate that the average age of sexually mature females (generation time) is about 10 years, and that the number of mature individuals (males and females) capable of reproduction is about 40% of the total population (all ages, including pups).

Physiology

Food requirements vary with the type and quality of prey (Perez 1994; Rosen and Trites 1999, 2000b, c). Captive sea lions fed a mixed diet of various fishes consume an average 10-12 kg per day for full-grown females and 20 kg per day for full-grown males (Kastelein *et al*. 1990; Perez *et al*. 1990). However, bioenergetic models predict that daily food requirements for Steller sea lions in the wild (which are more active, reproduce and tend to consume a lower quality diet) are closer to 15-20 kg for mature females, and 30-35 kg for mature males (Winship *et al*. 2002). For females, daily energy requirements are about 14% of body weight for a 1 year old and 7% for a mature individual. Sea lions that consume higher proportions of 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).

Steller sea lions are capable of diving to depths of at least 310 m (Andrews 1999) and staying 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). Diving capabilities are developed during the first year of life. Pups aged less than one month dive to a maximum depth of 10 m, but this increases to nearly 100 m by 5 months of age, and to over 200 m by 10 months of age (Merrick and Loughlin 1997; Rehberg *et al*. 2001).

Movements/dispersal

Steller sea lions generally return to breed on their natal rookery, although there may be some exchange between neighbouring rookeries (Calkins and Pitcher 1982, 1996). At least one animal branded as a pup on Forrester Island in southeast Alaska was subsequently seen 400 km away with a newborn pup on the Cape St. James rookery (Raum-Suryan and Pitcher 2000). In some cases, rookeries are augmented by breeding females from other rookeries, as evident from the rapid expansion of several new rookeries monitored in southeast Alaska since the 1980s (Calkins *et al.* 1999; Pitcher *et al.* 2003).

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*. 1998, 2003; Raum-Suryan *et al*. 2002). An individual tagged as a pup at Sugarloaf Island in the Gulf of Alaska was resighted 4 years later in Douglas Channel on the central BC coast, a near-shore distance of roughly 1,700 km (Loughlin, pers. comm.; Olesiuk, unpublished data). Conversely, animals tagged as pups on Cape St. James have been observed as subadults on Cape St. Elias in Prince William Sound, Alaska, a near-shore distance of about 1,500 km (Calkins 1981; Fisher 1981). Numbers of animals using year-round haulout sites is fairly constant throughout the year, but numbers on winter sites decline during the May-August breeding season as animals move to rookeries (Bigg 1985).

Although considered non-migratory, there are well-defined seasonal movements in certain parts of their range. Following the breeding season, both Steller and California male sea lions have been observed to migrate north along the Oregon coast (Mate 1975), coinciding with a sharp increase in the number of animals wintering off southern Vancouver Island (Bigg 1985).

Prior to weaning, dependent young (ages 0-3 yrs) appear to stay relatively close to haulouts while their mothers forage at sea (Trites and Porter 2002). Once weaned, young males appear to disperse more widely than females and have been seen many hundreds of kilometres from their natal rookeries (Raum-Suryan *et al.* 2002). However, both males and females appear to return to their rookeries of birth as they mature sexually.

Animals on rookeries tend to haul out more during daylight hours, with peak numbers occurring on land between 10:00 and 18:00 (Withrow 1982; Higgins 1984; Milette 1999). No apparent diurnal haulout pattern has been recorded during winter when daylight is significantly reduced (Porter 1997). A number of environmental factors correlate with and may affect haul out behaviour. These include sea state, air temperature, wind speed and direction, fog and cloud cover, barometric pressure, swell height and tide level (Withrow 1982; de Blois 1986; Kastelein and Weltz 1990; Porter 1997; Calkins *et al.* 1999). Such factors are likely more important on haulout sites, which tend to be more exposed and offer less protection, than on rookeries.

At sea, Steller sea lions are commonly seen as individuals or in groups of several animals (Bonnell *et al.* 1983). However, 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; Olesiuk, pers. obs.; Loughlin and DeLong 1983). 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). Incidental takes during fishing operations are also most prevalent from 20:00 to 05:00 (Loughlin and Nelson 1986).

Foraging is more localized during the breeding season. In contrast, seasonal movements of animals during the non-breeding season (September-May) are much wider and are likely related to distribution of forage fish. Major wintering areas of sea lions off southern Vancouver Island shift in relation to changes in distribution of pre-spawning herring. Sea lions also congregate in estuaries in autumn when salmon are spawning and at the mouth of the Fraser River in spring when eulachon are running (Bigg 1985; Bigg *et al.* 1990, Olesiuk unpub. data). Foraging trips of satellite-tracked adult females in Alaska have averaged about 17 km during summer, compared to 153 km during winter (Merrick and Loughlin 1997). Off the coast of California, Steller sea lions were concentrated within 1-13 km (mean 7.0 km) of rookeries during summer and were seen less frequently compared to autumn when they were up to 7-59 km offshore (mean 28.2 km) (Bonnell *et al.* 1983). Foraging ranges of immature non-breeding animals appear intermediate to the summer and winter foraging ranges of adults (Merrick and Loughlin 1997).

Nutrition and interspecific interactions

Over 50 species of fish and invertebrates have been identified in the diets of Steller sea lions (Wilke and Kenyon 1952; Pike 1958; Spalding 1964b; Pitcher 1981; Sinclair and Zeppelin 2002). Regionally, diet appears to vary according to which prey are locally and seasonally most abundant or accessible. Preferred prey appear to be small or medium-sized schooling fishes, which in BC include species such as herring, hake, sandlance, salmon, dogfish, eulachon and sardines (Pike 1958; Spalding 1964b; Olesiuk and Bigg 1988, Trites and Olesiuk, unpubl. data). Bottom fish, such as rockfish, flounder and skate, can also be important dietary items (Trites and Olesiuk, unpubl. data). In addition to fish, squid and octopus are sometimes consumed, but their importance was probably exaggerated in earlier studies because cephalopod beaks may 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.

A shift in 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). Large-scale shifts in climatic and oceanic conditions can affect the dynamics of marine organisms (Benson and Trites 2002), as can selective- or over-fishing (Pauly *et al.* 1998), both of which could affect the quantity or quality of Steller sea lion prey. 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). Thus, interactions between climate, fisheries and prey may significantly influence the nutritional status and ultimately the survival of Steller sea lions.

Adaptability

Observations over the past century suggest that it is unlikely that a rookery will be recolonized if all the breeding animals are killed or forced to leave. Instead it appears that year-round haulouts can become rookeries if sufficient numbers of pregnant females successfully give birth there. This has been observed at several sites in southeast Alaska and one in the Gulf of Alaska, but nowhere else (Calkins *et al*. 1999). Given the rigidness and traditional nature of breeding sites, along with the sensitivity of sea lions to disturbance (Lewis 1987; Porter 1997), it seems unlikely that new rookeries could be established with human intervention. Steller sea lions have been successfully born and/or raised in captivity (e.g., Hardervijk Dolphinarium Holland, Vancouver Aquarium Marine Science Centre), but it is unclear whether such individuals could survive on their own if released in the wild. Recolonization of BC, if ever needed, would likely only occur through immigration from rookeries in Oregon or southeast Alaska.

Steller sea lions can tolerate a wide range of air and water temperatures. They consume wide groups of prey, ranging from bottom fish to midwater schooling species. Thus they should be reasonably adaptable to periodic changes in the quality and quantity of prey available. However, Steller sea lions tend to continue frequenting sites for many years after prey appear to have shifted distribution (Olesiuk, pers. obs.). Thus, changes in prey abundance associated with different oceanic regimes may influence the carrying capacity of Steller sea lions.

POPULATION SIZES AND TRENDS

Between the late 1950s and 1970s, overall abundance of Steller sea lions in the North Pacific (range-wide: California to Japan) 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 (Braham *et al*. 1980; Merrick *et al*. 1987; Loughlin *et al*. 1992; Trites and Larkin 1996; Sease *et al*. 1999; Burkanov 2000; Olesiuk 2003; Pitcher *et al*. 2003; Sease and Stinchcomb 2003).

The drop in overall abundance of Steller sea lions was attributable to declines in the western part of their range. Historically, the western population (Gulf of Alaska to Russia) was much larger than the eastern population (California to southeast Alaska), 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 eastern population of Steller sea lions (California to southeast Alaska) was historically much smaller than the western population, accounting for roughly 10% of total abundance between the 1950s and 1970s (Kenyon and Rice 1961; Loughlin *et al*. 1984; Trites and Larkin 1996). However, in contrast to the western population, the eastern population has been growing in recent years (Calkins *et al*. 1999; Olesiuk 2003; Pitcher *et al*. 2003). In 2002, the eastern population was estimated to have numbered about 45,000 individuals (Pitcher *et al*. 2003), almost the same size as the once more abundant western population.

To understand the present status of Steller sea lions in BC, it is important to put it in context of the historical kills and management actions that significantly affected abundance and distribution (Bigg 1985). Between 1913 and 1969, an estimated 49,100 sea lions were destroyed in predator-control programs, and another 5,700 animals were taken in commercial harvests (Fig. 3). The most intensive culling occurred at Virgin and Pearl Rocks in the Sea Otter Group. In an attempt to protect the Rivers Inlet salmon fishery, federal fishery officers visited these two rookeries annually during mid-June (1923-1939) and shot as many breeding animals as possible before landing and clubbing pups, most of which were too young to escape into the water. A total of about 20,000 animals (including 7,000 pups) were killed. These kills essentially eliminated new recruitment to the rookery, and pup production declined from about 1,200 pups when the control program was initiated to fewer than 10 by the time it had ended. Virgin and Pearl Rocks have not been used as a rookery since the culls. Pupping has occurred there only sporadically, although the sites are used as haulout sites.

Once the Sea Otter Group rookeries were extirpated, control programs were directed toward the Scott Islands, where about 7,500 animals (including 2,800 pups) were killed during 1936-39. There was some attempt to commercially harvest animals for hides, but this proved to be uneconomical. Large-scale culls were suspended during World War II, although the Canadian air force and navy may have killed significant numbers of animals during bombing practices. However, no records exist of the magnitude of these kills (Bigg 1985). Several individuals are known to have hunted pups on the Scott Islands during the early 1950s, in a scheme in which they removed and altered their snouts and fraudulently claimed harbour seal bounties (Olesiuk, unpub. data). Predator control kills resumed during 1956-66 and included not only the Scott Islands, but for the first time the rookeries at Cape St. James and North Danger Rocks. During this period, about 11,600 animals were killed, including approximately 5,000 animals that were commercially harvested for mink food, but again this venture proved to be economically unfeasible. In addition to predator control and commercial harvests, 764 animals were reportedly killed from 1913-69 for research.

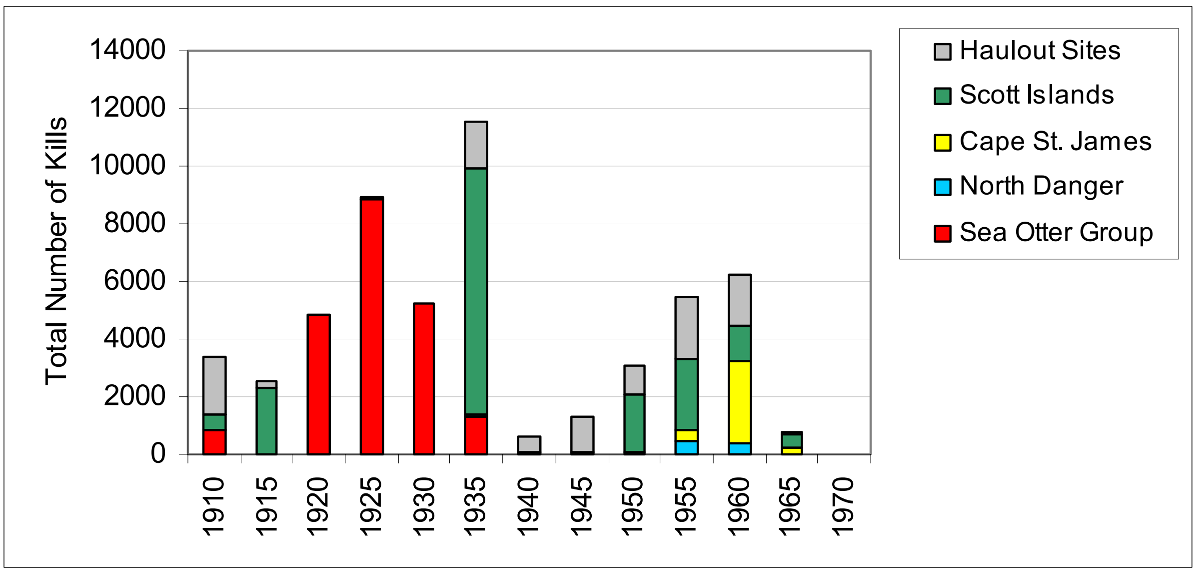


Figure 3. Total numbers of Steller sea lions reported to have been killed in BC as part of control programs and commercial harvests during 1913-70. Data have been grouped and totaled into 5-year periods, and are colour-coded by major breeding area. Comparison with Figure 4 shows the impact these kills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

Bigg (1984; 1985) compiled historical sightings and counts of Steller sea lions during the period 1892-1984, which he used to reconstruct historic trends in numbers of breeding animals on rookeries. His analysis meticulously considered the likely reliability of observations, the timing of counts in the context of the life history of Steller sea lions, and the potential effect of disturbance. Bigg (1985) concluded that control programs and commercial harvests had depleted breeding populations, and estimated that the BC rookeries were inhabited by about 14,000 animals (all ages, including pups) when the first counts were made in 1913-16 (Figure 4). The extirpation of the Sea Otter Group rookeries, concurrent with a slight increase in numbers breeding on the Scott Islands, resulted in an overall reduced population of about 12,000 by 1938. By 1956, numbers on rookeries had been further reduced to about 8,900-9,400 sea lions (including 2,850 pups) (Pike and Maxwell 1958; Bigg 1985). The population declined sharply with the resumption of predator control and commercial harvesting during 1956-66. Numbers on rookeries in BC had been reduced to only about 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 BC were depleted to about one-quarter of their historic size by predator control and commercial harvesting (Bigg 1985; Olesiuk 2003). It should be noted that the subjectivity involved in interpreting the earlier counts precludes any formal statistical analysis of historic population trends.

Aerial survey procedures for counting Steller sea lions were developed in the mid-1960s (Mathisen and Lopp 1963) and have been standardized since the early 1970s (Mate 1977; Withrow 1982; Bigg 1985; Olesiuk *et al*. 1993). Typically, oblique 35 mm photographs are taken from a small fixed-wing aircraft as it circles a haulout or rookery during the breeding season. The censuses provide an index of relative abundance because some animals are always foraging at sea and are missed. Surveys in BC are conducted during the last week of June and first week of July, which represents the time by which most pups have been born, but most are still too young to have begun to disperse from rookeries (Olesiuk 2003). In recent years, high-resolution vertical medium-format photography has been used, particularly to census pups (Snyder *et al*. 2001; Olesiuk 2003). Life tables provide an estimate of the ratio of pups to older age-classes, and thereby a means to estimate the total population size (Calkins and Pitcher 1982; Loughlin *et al*. 1992; Trites and Larkin 1996; Sease *et al*. 1999; Olesiuk 2003). It should be noted, however, that the only life tables available were derived from specimens collected in the Gulf of Alaska just prior to major population declines, and the multipliers to estimate total population size might vary with status of populations.

Aerial surveys have been conducted in BC at 4-5 year intervals since the species was protected in 1970. The surveys indicate that numbers of pups and non-pups on rookeries both increased at a mean rate of 3.2% annually, which has resulted in a doubling in the size of the breeding population since the early 1970s (Figure 5, Appendix 1 and 2) (Olesiuk 2003). However, most of the increase appears to have occurred since the 1982 survey for non-pups, and the 1987 survey for pups. Overall, the number of animals on rookeries in BC has increased to about 8,900, which represents about 65% of the animals present prior to the large scale kills (Figure 4). Total pup production in BC in 2002 was estimated at about 3,300 – 3,600 (Olesiuk 2003; Olesiuk *et al.* 2003). Applying corrections for animals at sea and missed during surveys, the total number of Steller sea lions inhabiting coastal waters of BC during the breeding season was estimated at about 18,400 – 19,700 individuals (all ages, and including non-breeding animals associated with rookeries in southeast Alaska) (Olesiuk 2003).

As noted previously, population trends in BC are difficult to separate from those in SE Alaska due to the large rookery that has become established on Forrester Island just north of the BC-Alaska border. Steller sea lions were not known to breed in SE Alaska during the early 1900s, so the 14,000 animals on BC rookeries represented the total breeding population for BC and SE Alaska. However, while control programs were underway in BC, animals began to breed at Forrester Island. The numbers of breeding animals increased dramatically from fewer than 100 in the early 1900s, to approximately 2,400 animals (including 1,100 pups) by 1961, and 6,160 animals (including 2,370 pups) by 1973 (Bigg 1985). This represented a mean annual growth rate of 6% in pup production, but the rate of increase fell during the 1980s and pup production on Forrester Island was stable during the 1990s (Calkins *et al.* 1999). However, at about the same time Forrester Island stabilized, animals began to establish new rookeries further north in SE Alaska (Calkins *et al.* 1999), and the growth rate on BC rookeries accelerated (Olesiuk 2003). The combined breeding population in BC and SE Alaska has thus sustained a fairly steady growth rate of about 2.4% since the 1960s, resulting in almost a 3-fold increase in abundance (Olesiuk 2003), and is now about 50% above the abundance level of the early 1900s prior to any large scale kills (Figure 4).

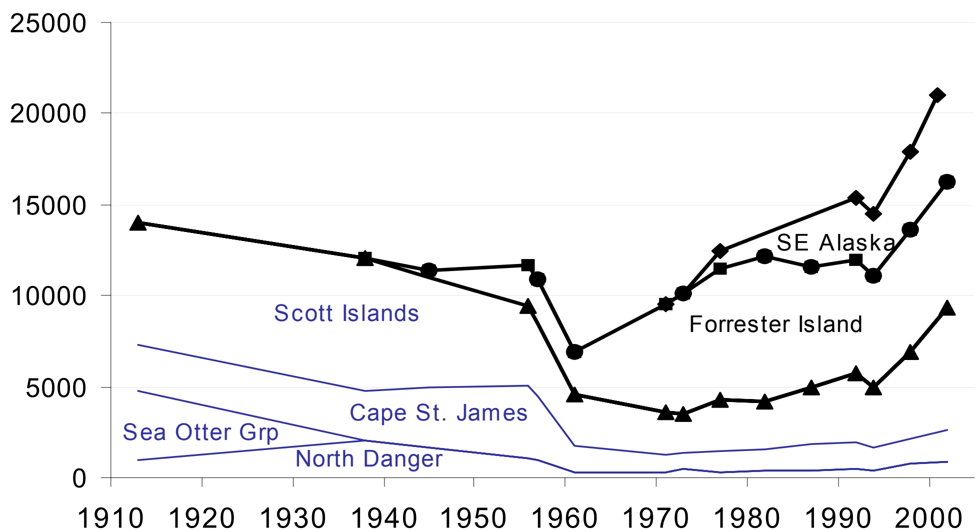
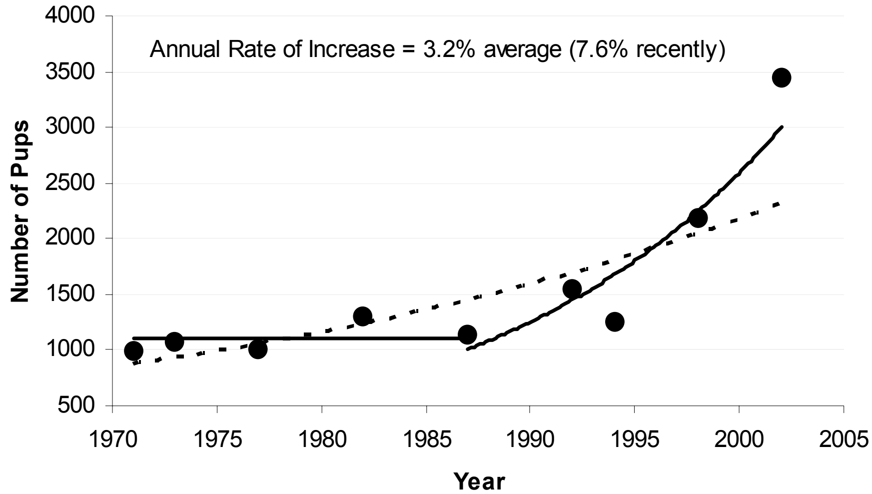


Figure 4. Historic trends in total numbers of Steller sea lions (pups and non-pups) on breeding rookeries in BC (●), Forrester Island, Alaska (▲), and other new rookeries in SE Alaska (■). The thin lower lines show distribution among main breeding areas in BC. Pup counts made from 35 mm slides were adjusted by a factor of 1.05 for BC rookeries and 1.25 for Forrester Island, to account for pups that were obscured in the oblique photographs (see Olesiuk *et al*. 2003) (modified from Bigg 1985).



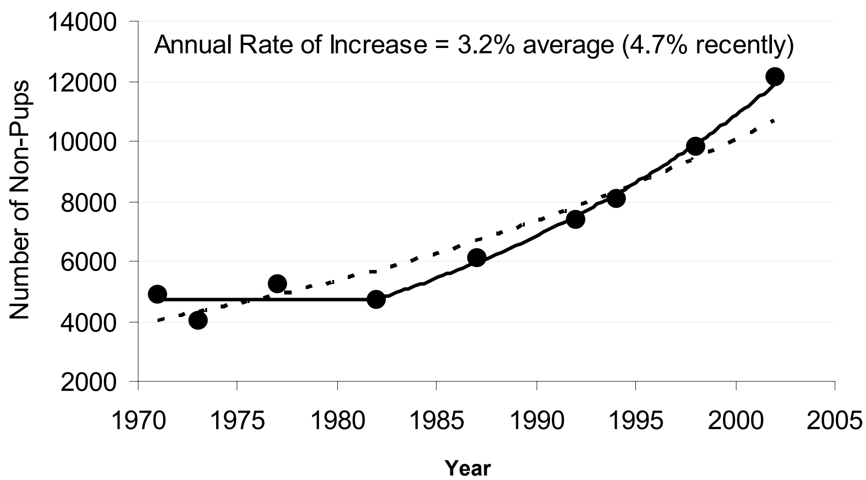


Figure 5. Recent trends in the numbers of A) non-pups (rookeries and haulout sites) and B) pups (rookeries) counted during aerial surveys of sites in British Columbia between 1971-2002. Dashed lines show overall average trends, whereas solid lines allow for a change in the population growth rate. Pups counts have been inflated by a factor of 1.05 to account for those obscured in oblique 35 mm photographs (Olesiuk *et al.* 2003).

Steller sea lions do not breed in Washington, although the occasional pup has been born at haulout sites (S. Jeffries, Washington Department Fish and Wildlife, Tacoma, WA, pers. comm.). The relatively small rookeries in Oregon also appear to be increasing slowly, and have doubled in size since the 1970s (Brown and Reimer 1992; Angliss *et al.* 2001). In contrast, numbers of Steller sea lions have been stable in northern California, and declined in southern California, since the 1960s.

LIMITING FACTORS AND THREATS

There are two broad categories of factors limiting Steller sea lions. The first can be grouped as anthropogenic threats such as shooting, incidental take in fishing gear, entanglement in debris, catastrophic accidents, environmental contaminants, and displacement or degradation of their habitat. The second category of threats includes naturally fluctuating prey populations, predation by killer whales, and disease.

For most of the 20th century, the main factor limiting Steller sea lions was undoubtedly killing by humans. Nowhere was the intentional destruction of Steller sea lions more intense than in British Columbia. Although relatively small numbers of kills still occur for predator control at salmon farms and spawn-on-kelp operations, and unknown numbers are taken incidentally in fisheries, harvested by natives for subsistence, or killed illegally, the recent recovery of populations implies that current levels of kills are within sustainable limits.

Aboriginal hunting of Steller sea lions does occasionally occur, but harvest levels are unknown. Use of sea lions by First Nations people appears to have declined during the 1800s and sea lion meat has not been a mainstay of their diet since the early 1900s (Duff 1977; Bigg 1985). In Alaska, household surveys indicate that about 350 Steller sea lions have been taken annually in recent years, but mostly in the northern part of their range. Less than 1% of the harvest originates from southeast Alaska (Wolfe 1997; Wolfe and Hutchinson-Scarbrough 1999; Loughlin and York 2000), an area which is probably more indicative of native harvesting levels in BC.

Steller sea lions are also killed incidentally in various fisheries, particularly drift gillnet fisheries for salmon, but there are presently few programs in BC to monitor bycatch levels. Animals can get trapped in trawl nets or entangled in drift and gill nets, and ultimately drown. Annual deaths in US waters are estimated at about 30 animals per year (Loughlin and York 2000; Angliss *et al*. 2001). Steller sea lions occasionally take fish from troll gear, and it is not uncommon to see animals that are hooked in the stomach with salmon flashers dangling from their mouths. Illegal and undocumented killing undoubtedly occurs in BC as many fishermen continue to consider sea lions to be a nuisance and perceive them as having a negative impact on fish stocks.

Predator control at fish farms in BC constitutes the largest known source of fishery-related mortality for Steller sea lions in the North Pacific (Angliss *et al*. 2001; Jamieson and Olesiuk 2001). Most of the 90 or so salmon farms currently operating in British Columbia waters possess permits to shoot pinnipeds. Quarterly reports filed by licence holders indicate that a total of 316 Steller sea lions and another 21 sea lions not identified to species were killed from 1990-2000. Numbers of Steller sea lions killed annually were low (averaging less than 10) up to the mid-1990s, but escalated and peaked at an estimated 91 in 1999 (Jamieson and Olesiuk 2001). This increasing trend, and the expected expansion of fish farms in BC and the associated killing of sea lions that might come with it, is cause for concern. Another 13 Steller sea lions were killed under special permit during 1983-85 for research to examine seasonal changes in body condition and composition of males (Olesiuk and Bigg 1987).

Another anthropogenic factor that may limit Steller sea lion populations is displacement from or degradation of essential habitat. Repeated disturbances of breeding or haulout sites by aircraft, boats, pedestrians, construction, and fishing activities can lead to animals temporarily leaving haulouts and rookeries (Sandegren 1970; Calkins and Curatolo 1980; Johnson *et al*. 1989; Brown 1997) and eventually to permanent abandonment (Pike and Maxwell 1958; Kenyon 1962). Nevertheless, Steller sea lions at winter feeding sites often habituate to such disturbances, and some haulout sites are located in high traffic areas close to major urban centres such as Vancouver and Victoria (Bigg 1985; Olesiuk, unpub. data).

Environmental contaminants such as heavy metals, organochlorines (e.g., DDT, dioxins and furans) and polychorinated biphenyls (PCBs) bioaccumulate through marine food chains. High levels in marine mammal tissues have been implicated with reproductive impairment (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 (de Swart *et al*. 1994; Ross *et al*. 1995; Ross *et al*. 1996) and disruption of endocrine function (Brouwer *et al*. 1989). Nursing pups tend to be particularly susceptible since high doses of fat-soluble contaminants may be transferred through their mothers' milk. Such contaminants are now ubiquitous in wildlife (Risebrough 1978), making it difficult to establish cause-and-effect relationships. Moreover, deleterious effects may only be manifested during periods of nutritional stress, when fat reserves are used and contaminants are mobilized, making it difficult to separate contaminant-related effects from other stresses. As has been shown in many other animals, contaminant concentrations in Steller sea lions (predominantly organochlorines) accumulate with age. The highest concentrations are in old males, while females transfer most of their loads to their pups during lactation (Lee *et al*. 1996). Contaminant levels have not been examined in Steller sea lions in BC. New chemicals are likely being introduced to the marine environment, which have not yet even been identified or can be detected, and the potential toxic effects of these are obviously unknown.

Sea lions can also be impacted by catastrophic accidents such as chemical and oil spills (St. Aubin 1990), although the impact on populations has rarely been established. The main threat is likely through contact with heavy oil accumulations when the source of the spill is near critical habitats such as rookeries and haulout sites, and to a lesser degree from absorption through 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; Englehardt 1987; St. Aubin 1990). Sea lions are insulated by a subcutaneous layer of blubber, so oiled fur does not interfere with thermoregulation (Kooyman *et al*. 1976). In other species, heavy fouling in thick oil can impede swimming and result in drowning (Geraci and St. Aubin 1980), but light contamination and light-viscosity oil usually wears off within several days (Geraci and Smith 1976). During their detailed investigations in Alaska, Calkins and Pitcher (1982) reported seeing sea lions with tar lodged in their throats or around their lips, jaw and neck. Interestingly, during the Exxon Valdez oil spill (EVOS) in Prince William Sound, oil did not persist on the coats of Steller sea lions as long as it did on harbour seals (Calkins *et al*. 1994a). Nevertheless, 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), but rumours of large numbers of completely fouled animals were almost certainly California sea lions, which have a black pelage and share the same haulout sites (Olesiuk, unpublished data). Because Steller sea lion populations are widely dispersed along the entire BC coast, the potential threat of oil and chemical spills is one of local depletion, particularly at rookeries during the breeding season, as opposed to impacting the entire population. Nevertheless, considering that over 70% of pup production in BC occurs on the Scott Islands, an oil spill in that area during the pupping season could have a significant impact.

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 necks, eventually leading to abrasion or cutting deeply into tissue as animals grow. In Steller sea lions, entanglement begins to occur at 2 to 4 years of age (entanglement of pups and yearlings has not been observed), and entanglement rates 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). However, as Fowler (1988) has 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 at haulouts could represent a small fraction of numbers actually being entangled and drowned at sea. Although entanglement can lead to what is surely a slow and excruciatingly painful death for individual animals, it does not appear to pose a threat to the overall viability of Steller sea lion populations.

Environmental factors may also play a role in limiting Steller sea lion populations, either directly or indirectly through changes in their prey or by increasing their susceptibility to disease. Storms can lead to pups being washed from rookeries (Edie 1977), and El Niño events have led to abnormally high incidences of mortality in California (Allen *et al*. 1999). With the focus on climate change, researchers are beginning to appreciate that the environment fluctuates, and are noting evidence of decadal-scale oscillations that affect the biota of the North Pacific (Benson and Trites 2002).

Environmental shifts and fishing can both affect the abundance and availability of prey (e.g., Alverson 1992; Benson and Trites 2002), which in turn can affect both foraging behaviour and the population dynamics of pinnipeds (e.g., Trillmich and Ono

1991; Boyd *et al*. 1994), and ultimately determine the population levels that can be supported (carrying capacity) (Trites *et al*. 1997). Steller sea lions 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*. 1999b), but our understanding of the effects of marine mammal predation in marine ecosystems is inadequate to assess these interactions (Bowen 1997; Trites 1997; Trites *et al*. 1999a). One hypothesis suggests the decline of the western population of Steller sea lions was driven by a change in diet, which 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 natural fluctuations in environmental conditions, regime shifts, and anthropogenic effects that may be the result of global warming, whaling and commercial fisheries (Pascual and Adkinson 1994; Fritz and Ferrero 1998; Trites *et al*. 1999b; Rosen and Trites 2000a; Shima *et al*. 2000; Benson and Trites 2002).

Natural predators may also play a role in limiting populations, particularly when populations are at low numbers. It is generally thought that abundance of predators near the top of the food chain, such as Steller sea lions, is regulated mainly by bottom-up processes controlled by the availability of prey (Trillmich and Ono 1991; Boyd *et al*. 1994; Trites *et al*. 1997). However, it has recently been hypothesized that some populations may be limited by top-down processes, such as predation by killer whales (Estes *et al*. 1998). Although detailed data on killer whale predation rates are lacking, models show that predation by killer whales could be a significant source of mortality holding depressed populations of Steller sea lions in a predator pit (Barrett-Lennard *et al.* unpubl. data). The top-down hypothesis will require additional data on predation rates before it can be scientifically assessed.

Finally, disease may also play a role in limiting pinniped populations, especially at high densities (Harwood and Hall 1990; Lavigne and Schmitz 1990). Steller sea lions are host to a number of diseases including *Leptospira interrogans*, caliciviruses, *Chlamydia psittaci, Brucella* sp, morbilliviruses, influenza A, *Toxoplasma gondii*, phocid herpesviruses, canine parvovirus and canine adenoviruses 1 and 2 (see review by Burek *et al.* 2003). However, screening for diseases among Steller sea lions has not been conducted in BC.

SPECIAL SIGNIFICANCE OF THE SPECIES

Once considered vermin, the Steller sea lion is emerging as one of the most intensely studied marine mammals in the North Pacific, and is viewed by many as a symbol of a healthy marine ecosystem.

In 1991, the BC provincial government established the Conservation Data Centre (CDC) to list and track endangered and sensitive wildlife and ecosystems in BC. Since 1992, the CDC has maintained a red list for flagging species that may be threatened and endangered, and the blue list for vulnerable species. The Steller sea lion was red listed when the list was created, primarily on the basis of there being only three major breeding areas in BC, the total population numbering only about 10,000, and the lack of recovery of since the population culls (Cannings *et al*. 1999).

The Steller sea lion is the largest species of otariid and the only one that resides year-round and breeds in Canadian waters. With the recent declines in Alaska, the BC rookeries at the Scott Islands and Cape St. James now represent the 2nd and 6th largest breeding aggregations in the world. Based on overall pup production in 2002, BC supports about 16% of the world's population and about 33% of the eastern stock (and another 31% occurs in southeast Alaska within 25 km of the Canadian border). The Steller sea lion is widely regarded as an important component of the coastal marine ecosystem, and contributes to a burgeoning eco-tourism industry.

The role of Steller sea lions as a perceived threat to fisheries warrants mention. Over 50,000 Steller sea lions were destroyed and one breeding area eradicated in BC purportedly to protect the salmon fishery. The recovery of populations since they were protected in 1970 has renewed concerns over their impact on fish stocks and lobbies for control programs. Nevertheless, there is little evidence that Steller sea lion control programs had any beneficial effect on fisheries. Spalding (1964b) noted that salmon catches did not increase noticeably following the reduction of sea lion numbers on the Scott Islands. Indeed, the general understanding of the role of seals and sea lions in marine ecosystems remains poorly understood (Beverton 1985; Bowen 1997; Merrick 1997; Trites 1997). This is not to say that sea lions do not play an important role, but rather that our understanding of these large and complex ecosystems is presently inadequate. Surprisingly, basic knowledge of feeding habits of Steller sea lions in BC are still lacking, and much of the information that does exist has been collected anecdotally as part of other studies.

The Steller sea lion may have potential for serving as an indicator of the general status of inshore marine ecosystems. The species is widely distributed in coastal waters, has a long lifespan, congregates on rookeries where breeding populations can be readily censused, and occupies a position near the top of the marine food chain. One lesson that might be drawn from the recent declines in Steller sea lion populations in western Alaska, which are now widely believed to be the associated with broader ecosystem processes that are not understood, is that the ability to monitor Steller sea lion populations far exceeds our understanding of the ecological processes that regulate these apex predators. As populations in BC and neighbouring waters have now recovered to historic high levels, we might expect natural population regulatory mechanisms to assume an increasingly important role, and the potential for using Steller sea lions as an indicator species warrants further examination.

EXISTING PROTECTION OR OTHER STATUS

Management of marine mammals in Canadian waters is a federal responsibility. Since 1970, sea lions have been protected by various regulations enacted under the

Fisheries Act and enforced by the Department of Fisheries and Oceans (DFO). In the Pacific Region, which encompasses the entire Canadian range of Steller sea lions, protection was originally provided under Section 21 of the British Columbia Fishery (General) Regulations, which stipulated that: "*No person shall fish for, catch and retain, kill, disturb or molest an elephant seal, a harbour seal, a sea lion or a sea otter or have in possession any such seal, sea lion or sea otter or any portion thereof except under licence issued by the Minister".* Prior to being amended in 1984, however, the regulations also contained a provision giving blanket exclusion to commercially licensed fishermen, who were allowed to disturb or kill seals and sea lions to protect their gear and catch. However, the provision was not widely known, and although no statistics on such kills are available, discussions with fishermen suggest they were probably small.

In 1993, the regional regulations were superseded by the national Marine Mammal Regulations, which in Section 7 stipulated "*No person shall disturb a marine mammal except when fishing for marine mammals under the authority of these Regulations*". Section 5 further states that: "*Subject to section 6 (exclusion for natives), no person shall fish for marine mammals except under the authority of a licence issued under these Regulations or under the Aboriginal Communal Fishing Licences Regulations*". Section 6(1) allows that "*An Indian or Inuk other than a beneficiary may, without a licence, fish for food, social or ceremonial purposes for (a) seals…*". Since being enacted, the entire Pacific Region has been closed to commercial hunting of all marine mammals, including Steller sea lions.

In addition to protection from killing, Section 11 of the regulations stipulates that: "*No person, other than the holder of a licence to fish for marine mammals for experimental, scientific, educational or public display purposes issued under the Fishery (General) Regulations, shall (a) move a live marine mammal from the immediate vicinity in which it is found; or (b) tag or mark, or attempt to tag or mark, a live marine mammal in any manner.*" During the 1990s, three permits were issued to the North Pacific Universities Marine Mammal Consortium through the University of British Columbia to live-capture a total of 15 pups for captive studies. Six additional pups were captured in 2003.

Since being protected in 1970, small numbers of Steller sea lions have been killed in BC under special permits. In 1990, DFO began issuing permits to salmon farm sites on the west coast (mainly salmon farms, but also a few herring spawn-on-kelp operations and fish traps) that allowed them to shoot seals and sea lions that were interfering with their activities. Recently (Canada Gazette 2002), DFO published proposed amendments to the Marine Mammal Regulations that would create a new class of license for killing nuisance 'seals', which as defined in the regulations includes Steller sea lions. A nuisance 'seal' was defined as one that: "*a) represented a danger to fishing equipment despite deterrence efforts, or b) based on a scientific recommendation, represented a danger to the conservation of anadromous or catadromous fish stocks because it inflicts great damage to them along estuaries and in rivers and lakes during the migration of those species*".

The *Oceans Act* introduced in 1996 also provides protection for marine-mammal habitat by allowing for the creation of Marine Protected Areas to protect non-commercial species as well as threatened and endangered species. Indeed, one of the first two pilot MPAs to be established on the Pacific coast of Canada was Race Rocks, in part because it was recognized as an important winter haulout site for Steller and California sea lions. The breeding rookeries on the Scott Islands, as well as several haulout sites, have also been designated as ecological reserves under the B.C. *Ecological Reserves Act*. The rookery at Cape St. James was formerly also an ecological reserve, but that designation was supplanted when the Gwaii Haanas National Park Reserve was created under the federal *National Parks Act*. The Gwaii Haanas Park Reserve is co-managed by the federal government and Haida Nation, and legislation was recently passed that will formally allow the creation of a marine component to the reserve.

Management of marine mammals in the waters adjacent to BC is a US federal responsibility, and Steller sea lions are protected from disturbance and killing under the US *Marine Mammal Protection Act* of 1972. Due to the dramatic declines that have occurred in the western part of their range, the western population of Steller sea lions is considered to be *depleted* under the *MMPA*, and was listed as *endangered* in 1997 under the *U.S. Endangered Species Act* (62 US Federal Register 24345, 5 May 1977). Although similar declines have not been observed in the eastern part of their range, the eastern stock has nevertheless been listed as *threatened* in the US, primarily due to concerns that the declines would spread to the eastern stock (which have not occurred), and due to the preliminary nature of the genetic data used to separate the stocks at the time of the listing (which have since been reaffirmed). The listing of the western stock has prompted a number of management actions to protect Steller sea lion critical habitat, including the creation of 3 nautical mile no-entry zones around breeding rookeries, prohibition of groundfish trawling within 10-20 nm of certain rookeries, and spatial and temporal reallocation and in some cases closure of pollock and Atka mackerel fisheries. A recovery plan has been developed (NMFS 1992) and is currently being revised. There continues to be much controversy and debate over the necessity and effectiveness of such measures.

SUMMARY OF STATUS REPORT

Steller sea lions are widespread in coastal waters off British Columbia, and breed at 3 major locations: off the northeastern tip of Vancouver Island (rookeries on Maggot, Sartine and Triangle Islands), off the southern tip of the Queen Charlotte Islands (rookeries on the Kerouard Islands), and on the northern mainland coast (rookeries on North Danger Rocks). Control programs and commercial harvesting between 1913-1968 depleted the BC population. However, they have made a slow recovery since being protected in 1970. Combining population estimates from BC and southeast Alaska (which are difficult to separate due to the large rookery situated just north of the border) suggests that Steller sea lions have exceeded historic 20th century peak levels by about 50%. Although small numbers (relative to historic kills) continue to be killed for predator control, illegally, incidentally in fishing gear, or for subsistence use, the growth of the Steller sea lion population implies that the current level of killing is within sustainable levels. Other anthropogenic threats such as disturbance, contaminants, oil spills and entanglement in debris may have localized impacts, but do not appear to threaten the entire population at this time. With the recovery of populations since 1970, it is anticipated that natural regulatory mechanisms such as fluctuations in prey availability, predation, disease and environmental factors such as El Niño events and decadal oscillations will play an increasingly important role in dictating future population levels.

TECHNICAL SUMMARY

Eumetopias jubatus
Steller sea lion Otarie de Steller
Range of Occurrence in Canada: British Columbia, Pacific Ocean

Extent and Area information	
• *Extent of occurrence (EO)(km²)*	>10,000 km^2
• *Specify trend in EO*	Stable
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)*	<10 km^2 (breeding sites)
• *Specify trend in AO*	Stable
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	3 main breeding areas (several rookeries at each)
• *Specify trend in #*	Stable
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Stable
Population information	
• *Generation time (average age of parents in the population)*	10 y (females)
• *Number of mature individuals*	40% of indigenous population (~7,600)
• *Total population trend:*	+3.2% per year (1971-2002)
• *% decline over the last/next 10 years or 3 generations*	
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	No
• *Specify trend in number of populations*	
• *Are there extreme fluctuations in number of populations?*	
• *List populations with number of mature individuals in each:*	
Threats (actual or imminent threats to populations or habitats) add rows as needed	
Shooting (illegal and licensed predator control), incidental take in fishing gear, entanglement in debris, catastrophic accidents, environmental contaminants, displacement or degradation of their habitat, fluctuating prey populations, predation by killer whales, and disease	
Rescue Effect (immigration from an outside source)	Low
• *Status of outside population(s):* **California, Oregon, Alaska and Russia**	Endangered/Threatened
• *Is immigration known or possible?*	Yes
• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	Probably
• *Is rescue from outside populations likely?*	Low likelihood
Quantitative Analysis	

Status and Reasons for Designation

Status: Special Concern	**Alpha-numeric code:** Met criteria for Threatened, D2, but was designated Special Concern because the population is increasing and there is a possible rescue effect.
Reasons for Designation: There are only three 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.	

Applicability of Criteria

Criterion A (Declining Total Population): Criteria not met. Population has increased since 1970.
Criterion B (Small Distribution, and Decline or Fluctuation): There is no evidence of decline or fluctuations.
Criterion C (Small Total Population Size and Decline): Criteria not met. The population is increasing.
Criterion D (Very Small Population or Restricted Distribution): Criteria D1 not met; number of mature individuals > 1,000. Criteria D2 Threatened is met; there are only 3 locations in Canada. Additional locations are in SE Alaska, Oregon, and California.
Criterion E (Quantitative Analysis): Not available

ACKNOWLEDGEMENTS

We thank David Lavigne, Tom Loughlin, Jane Watson and six other reviewers for their careful and thoughtful comments.

Funding for the preparation of this status report was provided by the Canadian Wildlife Service, Environment Canada.

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BIOGRAPHICAL SUMMARIES OF THE REPORT WRITERS

Peter Olesiuk is a Research Biologist with the Department of Fisheries and Oceans at the Pacific Biological Station in Nanaimo. Since 1989, he has served as Head of the Seal and Sea Lion Program in Pacific Region, except during 2001 when he took leave to serve as Principle Investigator for Alaska Department of Fish and Game's Harbor Seal Program in Alaska.

Mr. Olesiuk has been studying marine mammals in the North Pacific for over 20 years. His research has focused primarily on pinnipeds (harbour seals, Steller and California sea lions, northern fur seals), and involves surveys and population assessment, feeding habits and energetics, movements and behavioural patterns using telemetry and archival tags, and fisheries interactions. His work has been focused in British Columbia, but he has also conducted work throughout Alaska, and in Washington, Oregon and California. In addition to his work on pinnipeds, he has conducted research on whales and porpoises, and has had a longstanding interest in population biology of killer whales.

Dr. Andrew Trites is an Associate Professor at the University of British Columbia and Director of the Marine Mammal Unit at the UBC-Fisheries Centre. He is also the Research Director of the North Pacific Universities Marine Mammal Research Consortium, a member of the US Steller Sea Lion Recovery Team, and co-chairs the Marine Mammal Species Subcommittee for COSEWIC.

Dr. Trites has been studying marine mammals in the North Pacific for over 20 years. His current research is primarily focused on pinnipeds (Steller sea lions and northern fur seals), and involves captive studies, field studies and simulation modeling. Some of his work includes modeling the Bering Sea ecosystem, estimating the extent of competition between marine mammals and fisheries, and evaluating the junk-food hypothesis thought by many to explain the decline of Steller sea lions in Alaska. He trains students and collaborates with researchers specializing in other disciplines (such as nutrition, ecology, physiology and oceanography). His graduate students have worked on a variety of subjects including harbour seal genetics, killer whale / vessel interactions, Steller sea lion behavior, pinniped energetics, GIS mapping of marine mammal critical habitat, and predation on salmonids.

AUTHORITIES CONSULTED

None

COLLECTIONS EXAMINED

None.

Appendix 1. Number of non-pup Steller sea lions counted during province-wide breeding season surveys during 1971-2002.

Sites were classified as R-rookeries, Y-year-round haulouts, and W-winter haulouts, although in some cases site used appeared to change over the course of the study period. NS denotes the site was not surveyed and animals likely missed, and (NS) denotes the site was not surveyed but it was not expected that any animals were missed based on the preceding and proceeding surveys. ?- denotes the site was not known to exist, and could have been overlooked. The estimated number of animals missed (and the number of missed sites) is given near the bottom of the table.

Site Name	Type	28 June to 30 June 1971	29 June to 03 July 1973	27June to 30 June 1977	28 June to 01 July 1982	29 June to 03 July 1987	28 June to 03 July 1992	28 June to 01 July 1994	29June to 04 July 1998	02 July to 06 July 2002
CARMANAH PT	Y	0	NS	181	170	146	103	150	255	237
WOUWER ISL	W	0	0	0	0	0	0	0	0	31
MARA ROCK	W/Y	0	(NS)	0	3	0	0	41	87	296
LONG BEACH	Y	394	265	10	262	231	344	298	535	714
RAPHAEL PT	W	0	0	0	0	0	0	58	0	0
BARRIER ISLS	Y	NS	NS	105	153	149	274	290	843	585
O'LEARY ITS	Y	331	NS	200	85	60	81	14	74	2
SOLANDER ISL	W/Y	0	3	1	0	0	51	419	179	187
CAPE SCOTT	W	0	(NS)	1	0	1	42	68	0	0
MAGGOT ISL	R	418	416	627	442	550	511	371	245	456
BERESFORD ISL	R	71	6	24	100	124	164	119	5	147
SARTINE ISL	R	628	616	879	806	600	575	343	262	268
TRIANGLE ISL	R	550	375	570	376	1057	1603	1626	2540	2995
ASHBY POINT	W/Y	NS	82	4	1	210	3	226	225	519
BUCKLE GROUP	W								(NS)	47
VIRGIN ROCKS	Y	317	205	62	190	229	157	131	168	419
PEARL ROCKS	Y	100	81	276	23	128	126	98	199	467
GOSLING ROCKS	Y	106	NS	37	179	135	72	192	133	160
MCINNES ISL	Y	196	NS	45	0	0	109	241	163	25
STEELE ROCK	Y	NS	NS	85	150	7	35	137	227	101
ASHDOWN ISL	W	(NS)	(NS)	0	NS	NS	25	NS	0	(NS)
ISNOR	Y								0	72
N DANGER RKS	R	148	347	230	288	339	301	309	583	592
BONILLA ISL	Y	29	158	333	219	19	265	272	303	215
CHERNEY ISL	W								0	19
REEF ISL	Y	207	105	88	36	482	489	538	216	370
SKEDANS	W	0	(NS)	0	45	0	0	0	0	0
CAPE ST. JAMES	R	631	549	782	698	1021	867	797	763	982
S TASU HD	Y	76	NS	278	117	263	80	196	285	151
MORESBY ITS	W	(NS)	(NS)	(NS)	(NS)	0	3	115	65	2
CONE HD	W	(NS)	(NS)	(NS)	(NS)	0	70	21	1	131
JOSEPH ROCKS	Y	408	NS	399	366	309	327	397	601	696
LANGARA ISL	W/Y	6	NS	0	3	3	NS	0	217	3
ANTHONY ISL	Y	?	?	?	?	44	279	617	359	313
WARRIOR ROCKS	Y	?	?	?	?	?	416	2	282	588
GARCIN ROCKS	Y								?	329
Miscellaneous	-	1		2	1	2	4	5	3	3
Number Counted	-	4617	3208	5219	4713	6109	7376	8091	9818	12121
Missed (sites)	-	272(3)	831(9)	0(0)	13(1)	13(1)	2(1)	13(1)	0(0)	0(0)
Total Estimated	-	4889	4039	5219	4726	6122	7378	8104	9818	12121

Appendix 2. Number of Steller sea lion pups counted during province-wide breeding season surveys during 1971-2002.

Site Name	28 June to 30 June 1971	29 June to 03 July 1973	27June to 30 June 1977	28 June to 01 July 1982	29 June to 03 July 1987	28 June to 03 July 1992	28 June to 01 July 1994	29June to 04 July 1998	02 July to 06 July 2002
MAGGOT ISL	174	188	147	171	178	107	74	72	76
BERESFORD ISL	0	0	0	0	2	0	2	0	1
SARTINE ISL	163	273	309	409	176	253	62	148	146
TRIANGLE ISL	181	189	140	185	305	476	630	1211	2199
N DANGER RKS	86	93	64	74	54	148	84	144	219
CAPE ST. JAMES	337	272	303	404	367	484	333	484	635
Miscellaneous	0	0	0	2	2	0	1	4	5
Total British Columbia	941	1015	963	1245	1084	1468	1186	2073	3281
FORRESTER ISL	NS	2371	NS	2120	2073	NS	2073	2364	