

COSEWIC
Assessment and Update Status Report

on the

sea otter
Enhydra lutris

in Canada



SPECIAL CONCERN
2007

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA



COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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COSEWIC Assessment Summary

Assessment Summary – April 2007

Common name

Sea otter

Scientific name

Enhydra lutris

Status

Special Concern

Reason for designation

The species had been extirpated in British Columbia by the fur trade by the early 1900s, and was re-introduced from 1969-72. It has since repopulated 25-33% of its historic range in British Columbia, but is not yet clearly secure. Numbers are small (<3,500) and require careful monitoring. Their susceptibility to oil and the proximity to major oil tanker routes make them particularly vulnerable to oil spills.

Occurrence

British Columbia, Pacific Ocean

Status history

Designated Endangered in April 1978. Status re-examined and confirmed Endangered in April 1986. Status re-examined and designated Threatened in April 1996 and in May 2000. Status re-examined and designated Special Concern in April 2007. Last assessment based on an update status report.



COSEWIC Executive Summary

sea otter *Enhydra lutris*

Species information

The sea otter, *Enhydra lutris*, is the smallest marine mammal and the only member of the family Mustelidae to carry out all aspects of its life in the ocean. The sea otter relies on a layer of air trapped in its dense fur and a very high metabolic rate to survive in chilly seas. The integrity of the fur—and its ability to maintain an insulating layer of trapped air is maintained by intensive frequent grooming. Its powerful forelimbs are well adapted for foraging on benthic invertebrates and its hind limbs are modified to function as flippers for swimming. The genus has three recognized subspecies — *Enhydra lutris kenyoni*, *Enhydra lutris nereis* and *Enhydra lutris lutris*. *Enhydra lutris kenyoni* occurs in British Columbia, Canada.

Distribution

Sea otters are found in shallow coastal areas in the North Pacific and historically ranged from northern Japan to central Baja California, Mexico. As a result of an intensive maritime fur trade that commenced in the 1700s, sea otters were extirpated throughout much of their global range by 1911. Today, the sea otter occupies about one half to two thirds of its historical range (but declines in Western Alaska make this difficult to estimate). Sea otters were reintroduced to Checleset Bay, British Columbia from Alaska between 1969 and 1972, and presently occur along much of the west coast of Vancouver Island and along a small section of the central British Columbia coast. Sea otters were also reintroduced to Oregon, Washington and Southeast Alaska between 1965 and 1971. Most of the outer British Columbia coast was likely occupied by sea otters historically, and thus the current population occupies 25-33% of its estimated historical distribution.

Habitat

Sea otters occupy coastal areas from the intertidal to at least 50m depths. The extent of their habitat is defined by their ability to dive to the sea floor for food with most foraging dives to depths less than 40m. In British Columbia sea otters are typically most abundant in exposed coastal areas with shallow rocky reefs. During the winter months sea otters appear to move to more sheltered areas within their home ranges.

Biology

Females reach sexual maturity between 3 and 5 years of age, and all are reproductive by age 5. In contrast, males reproduce at 5 to 6 years of age when they become socially mature, although they may be sexually mature earlier. Females live to a maximum of about 20 years and males to a maximum of 15 years. Females give birth to a single pup at approximately 1-year intervals. Pups remain dependent on their mothers for the first 6 to 8 months. Sea otters prey on a variety of invertebrates, including species of bivalves, snails, urchins, chitons, crabs, and sea stars. In the Aleutian, Commander and Kuril Islands, sea otters are also known to eat demersal fish species.

Population sizes and trends

A survey in 2001 resulted in a count of 2,673 otters along the Vancouver Island coast and 507 on the central British Columbia coast for a total of 3,180 otters. On Vancouver Island the population growth rate was estimated to be 15.6% per year (1977 to 2004) based on a simple log-linear regression. A piece-wise regression which allows for an inflection in the log-linear trend showed that the initial rapid growth of 19.1% per year from 1977 to 1995 slowed to 8.0% per year from 1995 to 2004. This decline in the growth rate likely reflects parts of the population near the centre of the range reaching equilibrium densities along Vancouver Island, but other sources of mortality cannot be ruled out as at least a partial explanation for this decline. On the central British Columbia coast, the population growth rate was estimated to be 12.4% per year between 1990 and 2004. The sea otter population in British Columbia represents approximately 3 to 4% of the total global population.

Limiting factors and threats

In the absence of significant density-independent factors (e.g. predation), sea otter populations are thought to be regulated by food through density-dependent factors that affect juvenile survival. Sea otters were hunted by native peoples prior to European contact but were extirpated from most of their range as a result of the maritime fur trade of the 18th and 19th centuries. Aside from humans, predators include killer whales, sharks (in California), and bald eagles (preying primarily on pups). Threats and limitations to sea otter population growth include environmental contamination (particularly oil spills), entanglement in fishing gear and collision with vessels, illegal killing, disease and possibly human disturbance.

Special significance of the species

An important predator, the sea otter is considered a keystone species exerting strong effects on the structure and composition of the nearshore communities in which it evolved. Sea otters have endeared themselves to the public because of their “teddy-bear-like” appearance, their near brush with extinction, and their vulnerability to oil spills. For these reasons they are also of increasing interest to the wildlife-viewing tourism

industry in British Columbia. However, because sea otters feed on invertebrates and can control the abundance of many invertebrate species, conflicts have arisen wherever sea otters and commercial and subsistence invertebrate fisheries exist in California, Alaska, and British Columbia.

Existing protection

In Canada sea otters were federally listed as Threatened in 2003 and under the *Species at Risk Act* are protected from killing, harming, capturing, and harassing. Sea otters and their habitat are also protected from being hunted, trapped or killed under the *Fisheries Act* and by provisions in the *British Columbia Wildlife 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. Species designated at meetings of the full committee are added to the list. 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 for 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 entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* 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. Definition of the (DD) category revised in 2006.



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

**Update
COSEWIC Status Report**

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2007

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SPECIES INFORMATION

Name and classification

The sea otter, *Enhydra lutris*, is the second largest (by weight) member of the family Mustelidae. It is the only member of the genus *Enhydra*. Three subspecies in the genus are recognized based on skull measurements and mitochondrial DNA (Wilson *et al.* 1991; Cronin *et al.* 1996). *Enhydra lutris kenyoni* is thought to have ranged historically from the coast of Oregon to the Aleutian Islands; *Enhydra lutris nereis*, the southern sea otter, occurs along the California coast; and *Enhydra lutris lutris* ranges from the Kuril Islands to the Kamchatka Peninsula and the Commander Islands in Russia. *Enhydra lutris kenyoni* occurs in British Columbia.

Taxonomy

Class:	Mammalia
Order:	Carnivora
Family:	Mustelidae
Scientific name:	<i>Enhydra lutris</i>
Subspecies:	<i>Enhydra lutris lutris</i> (Kuril Islands/Kamchatka/Commander Islands) <i>Enhydra lutris kenyoni</i> (Aleutian Islands to Central Alaska/ reintroduced in Southeast Alaska, British Columbia, Washington) <i>Enhydra lutris nereis</i> (California)
Common names:	Sea Otter
French:	Loutre de Mer
Spanish:	Nutria del Kamchatka, Nutria Marina
Nuu-chah-nulth	K ^w ak ^w atl
Chinook trade jargon:	e-lak'-ha (http://www.tidepool.org/features/id.elakha.cfm)
Aleut:	Chngatux (http://www.alaskool.org/language/Aleut/Sea_Week.html)

Morphological description

Sea otters are sexually dimorphic. Adult males can reach weights of 46 kg and total lengths of 148 cm, whereas adult females can grow to 36 kg and reach lengths of 140 cm. At birth pups weigh 1.7-2.3 kg and are up to 60 cm in total length (Bodkin 2003). Sea otters in recently occupied habitat, where food is not limiting, are heavier (up to 28% for males and 16% for females) than animals in populations at or near equilibrium, where food is limiting (Bodkin 2003). Pelage in adults varies in shades of brown, although the fur may become progressively lighter with age creating a grizzled effect on the head, neck, chest and forelimbs (Estes 1980). Newborn pups have a light brown, or yellowish, woolly natal fur that is completely replaced by adult fur by 13 weeks (Payne and Jameson 1984).

Sea otters have hind feet that are flattened, with elongated digits, the fifth or outer digit being the longest. This adaptation allows an otter to swim efficiently while foraging underwater or while lying on its back on the surface. The dorso-ventrally flattened tail is used to scull and shift position while resting (Kenyon 1969) (Figure 1). Sea otters can attain surface swimming speeds of 1 to 1.5 km/h (Kenyon 1969). Rates of travel during foraging dives range up to >5 km/h (Bodkin *et al.* 2004). On land sea otters are clumsy and awkward (Estes 1980).



Figure 1. Sea otter (*Enhydra lutris*). Photo by B. Gisborne.

The sea otter's powerful forelimbs are well adapted for grooming and obtaining invertebrate prey. They are not used for swimming (Kenyon 1969). A loose pouch of skin at the axilla (armpit) of each forelimb is used carry prey to the surface where it is consumed (Estes 1980). Rather than the shearing teeth typical of most carnivores, sea otters have bunodont molars adapted for crushing hard-shelled invertebrate prey (Riedman and Estes 1990).

Sea otters have little body fat. They maintain an exceptionally high metabolic rate and rely on a layer of air trapped in their dense fur for insulation. The fur consists of an outer layer of protective guard hairs and a fine dense underfur of approximately 100,000 hairs per cm² (Kenyon 1969). Sea otters groom frequently to maintain the integrity of their fur and its ability to hold a layer of trapped air for insulation (reviewed in Riedman and Estes 1990).

Genetic description

Sea otters in British Columbia have suffered through at least two genetic bottlenecks, the initial global bottleneck brought about by the species' near extinction as

a result of the maritime fur trade of the 18th and 19th centuries, and a second bottleneck caused by introducing a small number of animals to British Columbia.

As a result of the fur trade, the total range-wide population had been reduced, by 1911, to less than 2,000 animals, approximately 1-2% of its pre-exploitation size (Kenyon 1969). As a result of this bottleneck, genetic diversity among extant sea otter populations is significantly lower than pre-fur trade sea otters, with a loss in modern sea otters of at least 62% of the alleles and 43% of the heterozygosity compared to the pre-fur trade population (Larson *et al.* 2002a).

Sea otters are believed to have been extirpated from British Columbia by 1929 (Cowan and Guiguet 1960). They were reintroduced to British Columbia between 1969 and 1972, from Amchitka and Prince William Sound, Alaska, and were also reintroduced during the same period to unoccupied habitat in Southeast Alaska, Washington and Oregon. All reintroductions were successful except in Oregon (Jameson *et al.* 1982). With respect to this second bottleneck resulting from translocation of small numbers of animals, genetic studies suggest there is no significant difference in the amount of genetic variation between remnant (experienced one bottleneck) and translocated (experienced two bottlenecks) populations of sea otters (Bodkin *et al.* 1999; Larson *et al.* 2002b). Loss of genetic diversity among successfully reintroduced populations may have been largely avoided, at least among populations that arose from not less than 20 to 30 animals, because the bottleneck occurred for a relatively short time and there was rapid population growth (in the absence of food limitations) (Bodkin *et al.* 1999; Larson *et al.* 2002b).

In 1989, females with pups were first reported on the central British Columbia coast more than 235 km away from the reintroduced population on Vancouver Island (British Columbia Parks 1995). The origin of these otters was unknown (Watson *et al.* 1997), but recent genetic analysis of 18 sea otter samples from the central British Columbia coast in 2003 revealed 2 mtDNA haplotypes consistent with otters from Amchitka and Prince William Sound, suggesting otters on the central British Columbia coast are descendents of reintroduced Alaskan otters (Barrett-Lennard, pers. comm. 2003). Sea otters in Southeast Alaska and Washington State are of the same origin (Bodkin *et al.* 1999; Larson *et al.* 2002b).

There is only one population or designatable unit of sea otters in British Columbia.

DISTRIBUTION

Global range

Sea otters occur in shallow coastal areas in the North Pacific (Figure 2). Prior to the fur trade of the 18th and 19th centuries, sea otters ranged from northern Japan to central Baja California, Mexico (Kenyon 1969). Commercial exploitation commencing in the 1740s led to near extinction of the species (Kenyon 1969). By 1911, when sea

otters were protected under the International Fur Seal Treaty, the population was composed of only 13 remnant groups. Several of these, including those in the Queen Charlotte Islands, declined to extinction (Kenyon 1969). The last substantiated reports of sea otters in British Columbia come from two accounts of single animals shot off the west coast of Vancouver Island in 1929 and 1930 (Cowan and Guiguet 1960; The Province Newspaper, June 29, 1931). Presently, the sea otter occupies about one half to two thirds of its historical range throughout the Pacific. A range is given here because the declines in Western Alaska make this difficult to assess. Sea otter populations that have re-established naturally after exploitation extend from the Gulf of Alaska westward through the Aleutian Archipelago to the Kamchatka Peninsula and the Kuril Archipelago and along the California coast. Reintroduced sea otter populations extend through Southeast Alaska, British Columbia and Washington (Estes 1990). About 5-10% of the current (2004) total range of sea otters is in Canada.

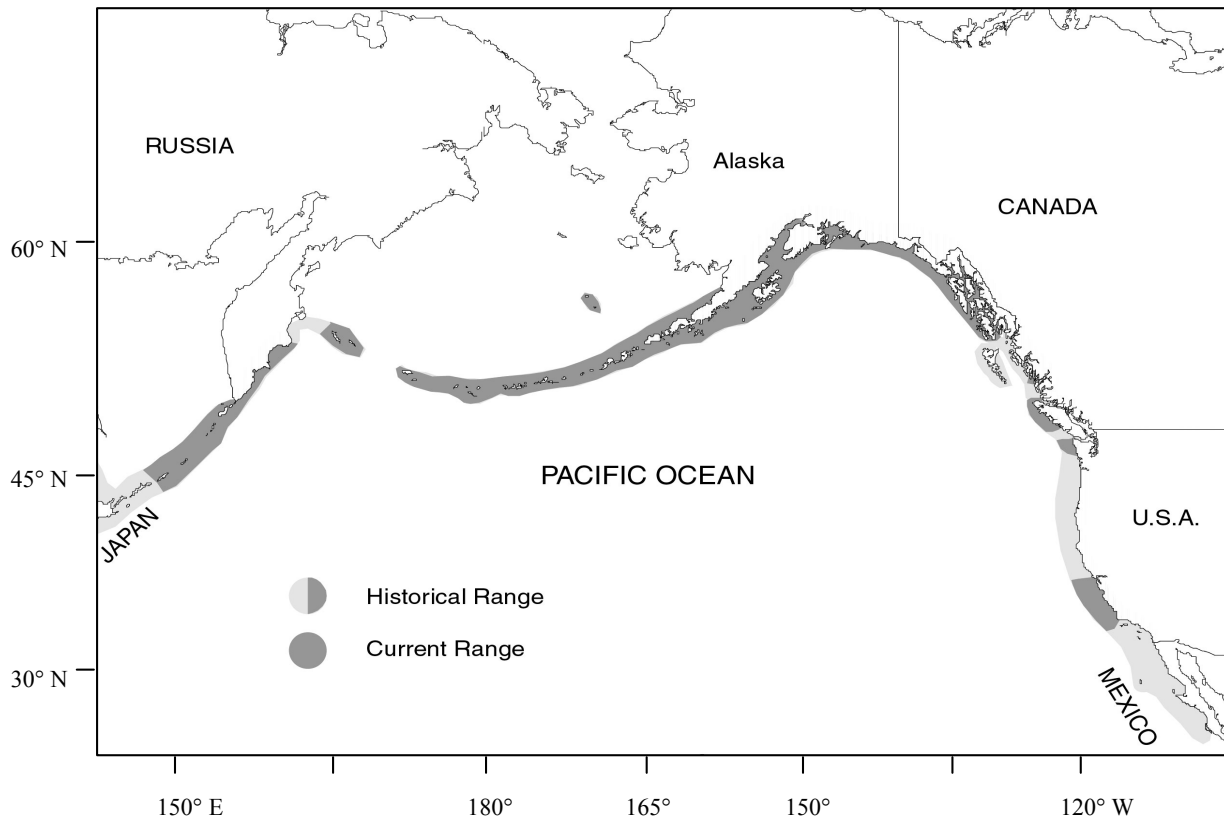


Figure 2. Historical and current global range of all three subspecies of sea otters.

Canadian range

Sea otters were extirpated from British Columbia by 1929 (Cowan and Guiguet 1960). A total of 89 sea otters were reintroduced to Checleset Bay, British Columbia from Alaska, 29 from Amchitka Island in 1969, 14 from Prince William Sound in 1970,

and 46 from Prince William Sound in 1972. Until 1987, sea otters occupied only two locations along the west coast of Vancouver Island, Checleset Bay and Bajo Reef off Nootka Island, 75 km southeast of Checleset Bay (Figure. 3). By 1992, the range of the population extended continuously along Vancouver Island from Estevan Point northwest to Quatsino Sound (Watson *et al.* 1997). By 2004, sea otters along Vancouver Island ranged from Vargas Island, in Clayoquot Sound, northward to Cape Scott and eastward to Hope Island in Queen Charlotte Strait.

In 1989 females with pups were reported near the Goose Islands on the central British Columbia coast indicating establishment of sea otters in the area (British Columbia Parks 1995). By 2004, sea otters on the central British Columbia coast ranged continuously from the southern end of the Goose Group, northward through Queens Sound to Cape Mark at the edge of Milbanke Sound (Figure 3), Single otters are periodically reported outside the continuous range.

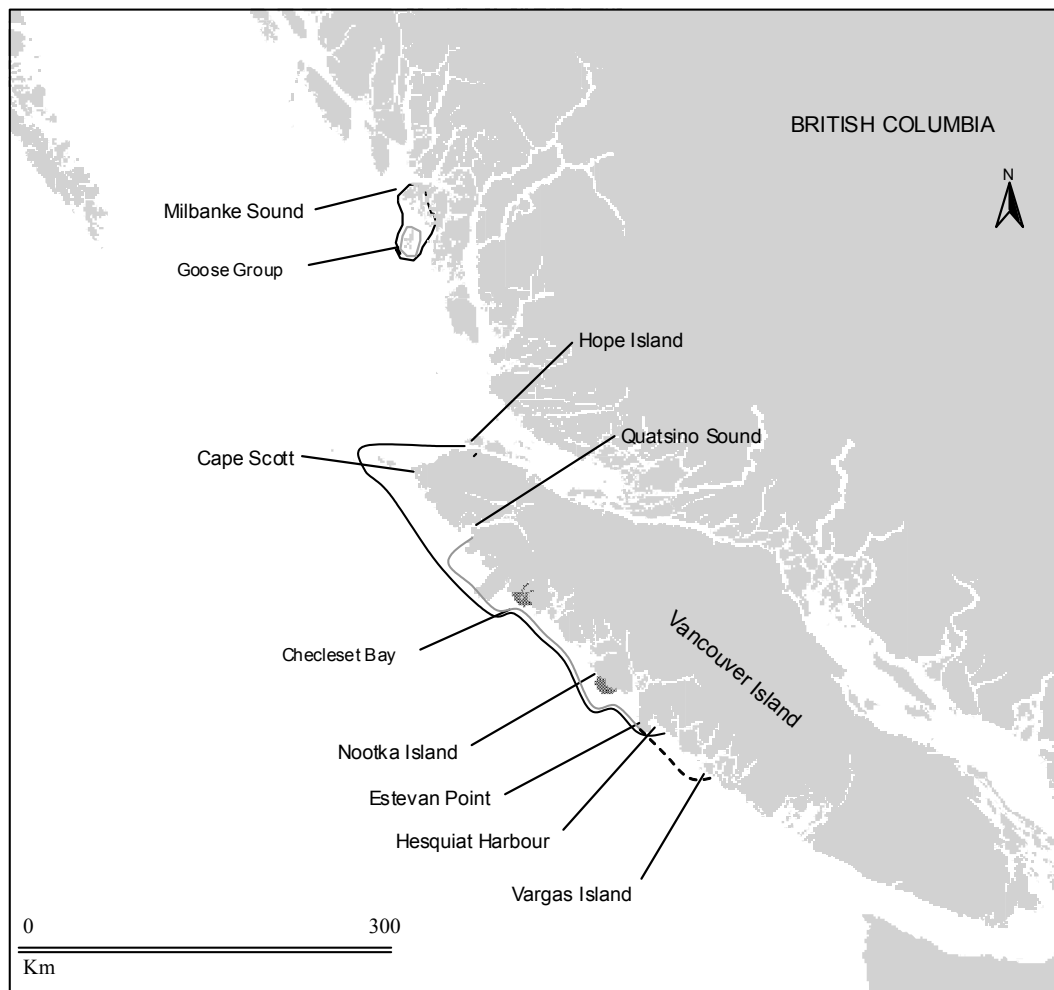


Figure 3. Distribution of sea otters in British Columbia and place names mentioned in the text regarding range. Shaded areas on Vancouver Island represent range in 1977. Grey line represents the range by 1995, black line the range by 2001 and the dashed line, range expansion on Vancouver Island in 2004.

Based on the type of habitat currently occupied by sea otters in British Columbia, Washington and Alaska, much of the British Columbia coast was probably occupied by sea otters historically, although sea otters may have been rare in the numerous, deep, coastal fjords common along the coast. The current population occupies 25-33% of its historic distribution in British Columbia

HABITAT

Habitat requirements

The extent of sea otter habitat is defined by their ability to dive to the sea floor for food. Sea otters occur within 1-2 km of shore but can also be abundant far from shore in areas where water is less than 40 m deep (Riedman and Estes 1990). When present, kelp beds are often used habitually as rafting sites (Loughlin 1980; Jameson 1989). Kelp beds are also used for foraging and are important, though not essential, habitat components. Soft-bottom communities that support clam species are also very important foraging habitat for otters and can sustain high densities of otters (Kvitek *et al.* 1992; Kvitek *et al.* 1993).

In British Columbia, sea otters occupy exposed coastal areas with extensive rocky reefs and associated shallow depths along the west coast of Vancouver Island and the central British Columbia coast, but weather and sea conditions may influence habitat use. Sea otters tend to occur in these exposed areas during periods of calm weather, but within their home ranges, may aggregate inshore during inclement weather, particularly during winter (Morris *et al.* 1981; Watson 1993). Sightings of otters in inlets and areas that would seem to offer some protection from storms tend to be more common in winter than in spring and summer (Dunlop *et al.* 2003; Stewart pers. comm. 2005; Osborne, pers. comm. 2006).

BIOLOGY

Life cycle and reproduction

Female sea otters reach sexual maturity at 3 to 5 years (Bodkin *et al.* 1993; Jameson and Johnson 1993) with all females being reproductive by age 5 (Monson *et al.* 2000a). Males reproduce at 5 to 6 years of age, although they may be sexually mature earlier (Riedman and Estes 1990; Bodkin *et al.* 1993). Females have a higher survival rate than males (Siniff and Ralls 1991) and live 15 to 20 years, whereas males live only 10 to 15 years (Riedman and Estes 1990). Although mating and pupping can occur year-round, distinct peaks in pupping in spring are noted in some populations including British Columbia (Watson 1993; Bodkin 2003). Sea otters are polygynous with males forming pair bonds consecutively with several females. Sea otters segregate by sex in spatially separate areas (Riedman and Estes 1990). Breeding-age males leave male areas and establish exclusive breeding territories in female areas during the summer and fall, after which they rejoin male rafts (Garshelis and Garshelis 1984; Jameson 1989). Females produce a single pup at approximately 1-year intervals (Siniff and Ralls 1991; Bodkin

et al. 1993). Twins are rare. Birth occurs in the water (Kenyon 1969; Jameson and Bodkin 1986; Jameson and Johnson 1993). Annual estimates of birth rates (pups/adult) in British Columbia range from 0.12 to 0.33 and are similar to Alaska (0.30 pups/adult) and California (0.20 pups/adult) (Watson 1993; Watson *et al.* 1997).

A sea otter pup weighs 1.4 to 2.3 kg at birth (Riedman and Estes 1990). Pups remain dependent on their mothers for 6 to 8 months after which they are weaned (Payne and Jameson 1984; Jameson and Johnson 1993). Pre-weaning mortality is about 40% in California and 15 to 25% in Alaska (Siniff and Ralls 1991; Riedman *et al.* 1994). In general, pre-weaning mortality is higher in populations nearing equilibrium density than in growing populations (Monson *et al.* 2000a).

Diet and foraging

Sea otters feed on a wide variety of benthic invertebrates (e.g. clams, sea urchins etc.) with some variation in diet evident among individuals, among regions and according to population status (Estes *et al.* 1981; Estes *et al.* 2003a). In recently occupied rocky habitats, large easily-accessible prey such as sea urchins are consumed. As the abundance of preferred prey is reduced, the diet of the sea otter population diversifies to include a larger array of invertebrate species including various species of bivalves, snails, chitons, crabs, sea stars and even fish (Estes *et al.* 1981). Demersal fish are important prey in some parts of the Aleutian, Commander and Kuril Islands (Estes and VanBlaricom 1985; Watt *et al.* 2000). Prey species preference, at least in female otters, appears to be learned and is transmitted maternally (Estes *et al.* 2003a). Most foraging occurs in depths of 40 m or less, although otters are capable of foraging to depths of 100 m (Estes 1980; Riedman and Estes 1990; Bodkin *et al.* 2004). Foraging dives last from 50 seconds to more than 3 minutes (reviewed in Riedman and Estes 1990). Prey is consumed at the surface. Sea otters use rocks or other hard objects to break open hard-shelled prey.

Physiology

The sea otter has little body fat and relies on a layer of air trapped in its dense fur and metabolic heat production to stay warm. The sea otter metabolic rate is 2.4 to 3.2 times higher than those of similar-sized terrestrial carnivores (Costa 1978; Costa and Kooyman 1982). To fuel internal heat production, free-ranging sea otters consume the equivalent of more than 20% of their body weight in prey per day (Costa 1978; Costa 1982).

Dispersal/migration

Sea otters are non migratory and show great site fidelity, although seasonal movements and occasional long-distance movements of individuals may occur (Garshelis 1983; Jameson 1989). Sea otters occupy relatively small overlapping home ranges varying in size from a few to 10s of kilometres of coastline (Loughlin 1980; Garshelis *et al.* 1984; Jameson 1989). Population range expansion typically occurs when males move *en masse* from the periphery of the occupied range into previously

unoccupied habitat. Females gradually occupy the areas vacated by males (Loughlin 1980; Garshelis *et al.* 1984; Wendell *et al.* 1986; Jameson 1989).

Adaptability

Sea otters in British Columbia are typically wary of humans, and rafts of sea otters are difficult to approach and are easily disturbed by boat traffic. Females with pups are most sensitive to disturbance. However, where sea otters are routinely exposed to boats or are adjacent to inhabited areas they seem to habituate to disturbance (e.g. Woolfenden 1995). In terms of foraging, sea otters demonstrate a range of techniques for obtaining and feeding on a wide variety of species that may be available within their physiological dive depth limit (reviewed in Riedman and Estes 1990).

Sea otters are adapted to a wide range of water temperatures. The northern range limit of otters appears to be the southern extent of pack ice, which excludes otters from foraging areas. The southern range limits are poorly understood, but appear to be associated with the southern extent of coastal upwelling and the 20-22 °C isotherm (Estes 1980, Bodkin 2003). Changes in water temperature may thus affect the future global range of sea otters.

POPULATION SIZES AND TRENDS

Search effort

The first census of sea otters in British Columbia was conducted in 1977. Between 1977 and 1987, surveys were made mainly by fixed-wing aircraft with some counts conducted from boats (Bigg and MacAskie 1978; Morris *et al.* 1981; MacAskie 1987; Watson *et al.* 1997). Most of the sea otter range has been surveyed annually since 1988 by boat or helicopter, although there were gaps in survey coverage from 1996 to 2000 (Watson 1993; Watson *et al.* 1997). Most population surveys from 2001 to 2004 were led by Fisheries and Oceans Canada, although portions of the west coast of Vancouver Island were also surveyed in 2002 and 2004 by biologists with the Nuu-chah-nulth Fisheries (Nichol *et al.* 2005; Dunlop *et al.* 2003; Dunlop pers. comm. 2006). These surveys are direct counts that provide measures of relative abundance for trends in population growth.

Abundance

Global

Sea otters were hunted by indigenous peoples of the North Pacific prior to European contact, but it was the maritime fur trade commencing after 1741 that drove the species to the brink of extinction. Prior to the fur trade the total range-wide population of sea otters is estimated to have been 150,000 to 300,000 otters, although some authors suggest the number may have been even larger (Kenyon 1969; Johnson

1982). By 1911, the world population numbered fewer than 2,000 animals scattered amongst 13 remnant colonies (Kenyon 1969). Since protection in 1911, sea otter populations have been recovering. Some from remnant colonies, others as a result of reintroductions made in the late 1960s and early 1970s. Until the early 1980s the bulk of the global population (~ 165,000 animals) occurred in the Aleutian Islands (55,100 to 73,700 individuals) (Calkins and Schneider 1985). However, dramatic declines in the Aleutian Islands started in the mid-late 1980s (Estes *et al.* 1998; Doroff *et al.* 2003). The most recent total population estimate (North America and Russia) of about 126,000 otters dates from the late 1990s (Gorbics *et al.* 2000). However, the global population is now likely lower than this estimate because this estimate was made while the decline in Western Alaska was underway. The continued decline in the Aleutian Islands to 8,742 individuals (CV = 0.215) in 2000 led to sea otters in Western Alaska being listed as Threatened in 2005 under the *US Endangered Species Act* (USFW 2006).

Canada

The size of the population of sea otters in British Columbia prior to commercial exploitation is unknown, but there is evidence that they were abundant. As many as 55,000 sea otter pelts were landed in British Columbia between 1785 and 1809. It is difficult to determine the geographic source of these pelts but at least 6,000 came from the west coast of Vancouver Island (Fisher 1940; Rickard 1947; Mackie 1997). Some pelts landed in British Columbia may have been from Washington, Oregon and Southeast Alaska. By 1850, sea otters in Canada were considered commercially extinct, and they may have been ecologically extinct (and ceased to function as a keystone species) earlier than this (Watson 1993).

Although 89 sea otters were reintroduced to British Columbia in 3 translocation efforts (1969 to 1972), many did not survive and the initial population may have declined to as few as 28 animals (Estes 1990). An aerial survey in 1977 resulted in a count of 70 otters in 2 locations on the west coast of Vancouver Island. In 1995, boat surveys resulted in a count of 1,522 sea otters, of which 1,423 occurred along the west coast of Vancouver Island and 99 occurred along the central mainland coast in the Goose Islands (Bigg and MacAskie 1978; Watson *et al.* 1997). Surveys in 2001 resulted in a count of 2,673 otters along the Vancouver Island coast and 507 on the central British Columbia coast for a total of 3,180 otters (Nichol *et al.* 2005). Surveys were also made in 2002, 2003 and 2004, but some segments of the range were missed in each year. Using interpolation to estimate numbers of otters in the missed segments (which represented less than 10% of each annual count) resulted in population estimates of 2,369 in 2002 (a decline from 2001), 2,809 in 2003 and 3,185 in 2004 (Nichol *et al.* 2005).

Trends

North America

Following protection in 1911, sea otter populations began recovering. Remnant colonies in western and central Alaska and in California began recovering without

intervention. Populations in southeast Alaska, British Columbia, and Washington were established by translocating sea otters from the remnant populations in Alaska.

Population growth is highly variable among sea otter populations. Reintroduced populations in Washington, British Columbia and Southeast Alaska were successful, whereas attempts to reintroduce sea otters to Oregon in 1970 and 1971 failed (Jameson *et al.* 1982). Once established, all of the translocated populations (except Oregon) increased initially at 17-20% per year, likely as a result of abundant invertebrate prey, which increased when sea otters were extirpated. Population growth seems to be more variable in remnant populations (Table 1).

Table 1. Recent population estimates and range of growth rate estimates reported over time by region in North America.

Region	Most Recent Population Size	Year of Population Estimate	Status	Growth rates*	Source
California	2,735	2005	remnant	-5% to 7%	Estes 1990, USGS 2005
Washington	814	2004	reintroduced	20.6% to 8.2%	Estes 1990; Jameson and Jeffries 2004
British Columbia	3,200	2001	reintroduced	18.6% to 8 - 15.6%	Watson <i>et al.</i> 1997; Nichol <i>et al.</i> 2005
Southeast Alaska Southeast Alaska Yakutat Bay N. Gulf of Alaska	12,600	1994-1996	reintroduced	17.6% to ~ 12%	Estes 1990; USFW 2002c
Central Alaska N. Gulf of Alaska Prince William Sound Cook Inlets/Kenai Fjords	16,552	1996, 1999, 2002	remnant	stable	USFW 2002a
Western Alaska Aleutian Islands N. Alaska Peninsula S. Alaska Peninsula, offshore S. Alaska Peninsula, shoreline S. Alaska Peninsula, Islands Unimak Island Kodiak Archipelago Kamishak Bay	41,500	2000-2002	remnant	Increasing to - 17.5%	USFW 2002b; Doroff <i>et al.</i> 2003

* Range of annual growth rate values reported over time from each region. Values for each region are presented in approximate chronological order from early to most recent estimates.

The California population has undergone periods of growth (5-7% per year) and declines (-5% per year). Declines in the 1970s were partially attributed to entanglement in sunken gill nets (Estes 1990; Estes *et al.* 2003b; USFW 2003). Mortality is high in this population, with disease and anthropogenic factors considered to be contributing causes (Estes *et al.* 2003b). In Alaska, the Prince William Sound sea otter population declined following the *Exxon Valdes* oil spill of 1989. It has not increased appreciably since 1994 (13,234 CV = 0.198; 1999 population estimate) and is not thought to be at its pre-spill level (USFW 2002a). Remnant populations in the Aleutian Islands increased following protection in 1911 and represented about 80% of the world population by the 1960s (Kenyon 1969; USFW 2002b). The population increased up until the early 1980s with estimates of 55,100 to 73,700 sea otters. However, a steep decline of 17.5% per year starting in the mid- to late 1980s reduced the population in the Aleutian Islands to 8,742 (CV = 0.215) by 2000 (Calkins and Schneider 1985; Estes *et al.* 1998; USFW 2002b; Doroff *et al.* 2003). A decline has also been detected along the Alaska Peninsula and Kodiak Archipelago (USFW 2002b). Predation by mammal-eating killer whales has been suggested as the most likely cause of the sea otter decline in the Aleutian Islands. Seals and sea lions, likely the preferred prey of killer whales in the Aleutian Islands have drastically declined in abundance in Western Alaska and Estes *et al.* (1998) hypothesize that with the decline of pinnipeds, killer whales have switched to preying on sea otters.

Canada

Watson *et al.* (1997) estimated population growth to be 18.6% per year from 1977 to 1995 on Vancouver Island. Since 1995, the growth rate on Vancouver Island appears to have slowed. A simple log-linear regression applied to counts from 1977 to 2004 resulted in a rate of 15.6% per year along Vancouver Island. A piece-wise regression which allowed for an inflection in the log-linear regression provided a slightly better fit and estimated the growth from 1977 to 1995 to 19.1% per year, and then 8.0% per year from 1995 to 2004 (Nichol *et al.* 2005) (Figure 4).

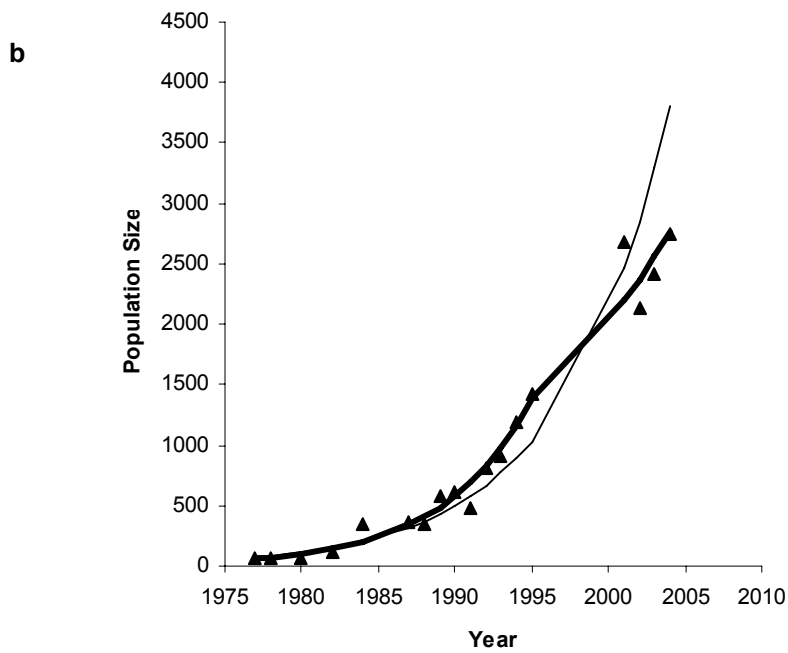
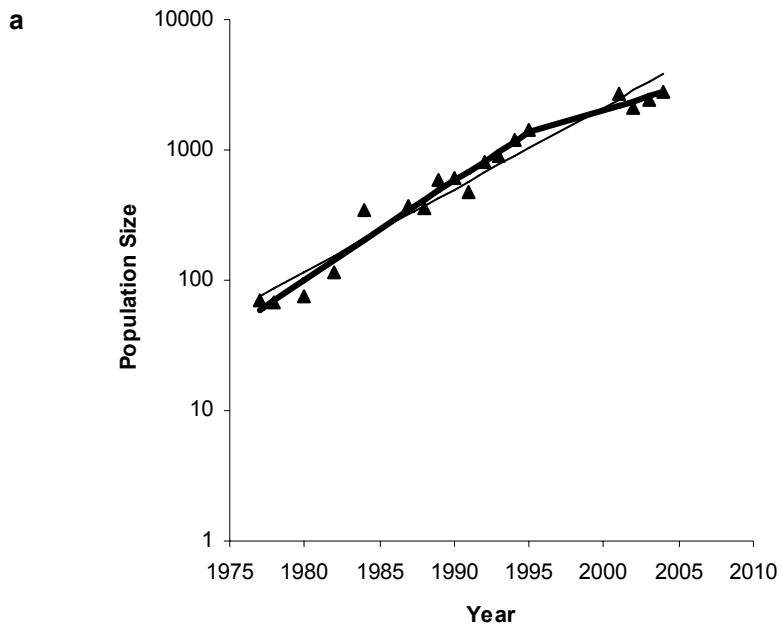


Figure 4. Trend in sea otter population on Vancouver Island. A) Thin line – simple log-linear regression (growth 15.6% per year, $r^2 = 0.950$, $n = 18$). Thick line – piece-wise regression (growth 19.1% per year until 1995 and 8.0% per year from 1995 to 2004, $r^2 = 0.975$, $n = 18$). B) The same trends presented on an ordinal scale. From Nichol *et al.* (2005).

In the absence of density-independent factors such as predation (e.g. in Western Alaska), sea otter populations are thought to be regulated by food through density-dependent processes that result in elevated juvenile mortality. As the number of sea otters in an area increases and food becomes limiting, otter density in the area is maintained at equilibrium (K) through mortality and emigration (Estes 1990). Rapid initial growth rates of 17-20% ($\sim r_{max}$ for the species) and a subsequent slowing of growth as parts of the population reached equilibrium are typical of reintroduced sea otter populations (Estes 1990). Some parts of the population near the centre of the range on Vancouver Island have been at equilibrium since the mid-1990s and additional areas are now at or nearing equilibrium, suggesting density-dependence may at least in part explain the reduced population growth rate on Vancouver Island (Watson *et al.* 1997; Nichol *et al.* 2005). However, counts from 2001-2004 may have been affected by survey conditions which were generally poorer than from 1988-1995, and other factors, such as a mortality event or illegal shooting, may also have contributed to the decline in growth rate.

Surveys on the central British Columbia coast started in 1990 following a sighting in 1989 of females with pups in the Goose Islands (British Columbia Parks 1995; Watson *et al.* 1997). A simple log-linear regression indicates the population on the central coast grew at 12.4% per year between 1990 and 2004 (Nichol *et al.* 2005) (Figure 5). This estimated rate of growth seems low given the amount of unoccupied habitat available. Nichol *et al.* (2005) were unable to explain this low growth rate but noted that the fit of the regression was poor compared to the Vancouver Island regression.

Rescue effect

Sea otter populations adjacent to British Columbia exist in both Washington State and southeast Alaska. However, in the event of a catastrophic incident such as an oil spill, with widespread effects on the Canadian sea otter population, movement and colonization by sea otters from either Washington State or Southeast Alaska (whose populations are presently below K) would be unlikely. Dispersal of adults from adjacent populations, below equilibrium density, is unlikely because of the limited movement, high site fidelity and small home ranges that sea otters have (Jameson 1989, Bodkin *et al.* 2002). Colonization of adjacent unoccupied area generally occurs when sea otters in an occupied area approach equilibrium density and male sea otters move *en masse* into unoccupied habitat. The females follow once the males have moved on (Loughlin 1980; Garshelis *et al.* 1984; Jameson 1989).

The pattern of population recovery following the *Exxon Valdez* Oil Spill was studied at two island sites in Prince William Sound. Population growth at oiled and unoled sites resulted from internal reproduction and immigration of juveniles and not from the widespread redistribution of adults from other parts of Prince William Sound (Bodkin *et al.* 2002).

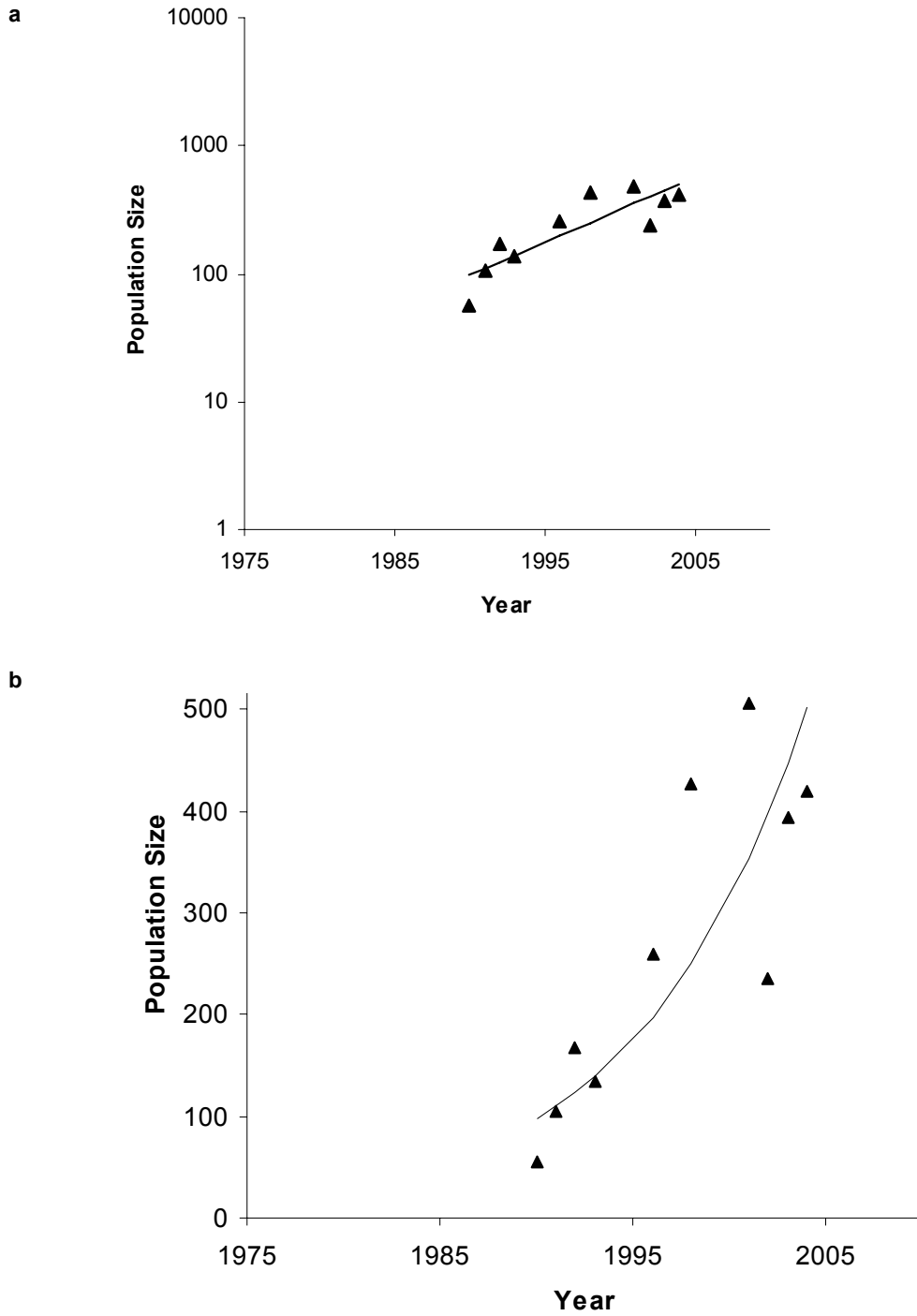


Figure 5. Trend in sea otter population growth on the central mainland coast. A) The line represents simple log-linear regression (growth 12.4% per year from 1990 to 2004, $r^2 = 0.737$, $n = 10$). B). The same trend presented on an ordinal scale. From Nichol *et al.* (2005).

LIMITING FACTORS AND THREATS

Sea otters were hunted for subsistence by indigenous people throughout the North Pacific, but the maritime fur trade of the 18th and 19th centuries resulted in extirpation of the sea otter from much of its range. Sea otter populations have been recovering since then, from surviving remnant populations, and from reintroduced animals from surviving remnant stocks. In general the availability of habitat and food is thought to be the primary factor limiting growth in sea otter populations, although predation is presently the principal factor in Western Alaska (Riedman and Estes 1990; Estes 1990; Estes *et al.* 1998; Doroff *et al.* 2003).

Predation

Aside from humans, predators include bald eagles, *Haliaeetus leucocephalus*, (Sherrod *et al.* 1975), killer whales *Orcinus orca* (Riedman and Estes 1990; Estes *et al.* 1998), and, sharks (at least in California); Ames and Morejohn 1980). Eagles scavenge adult carcasses and prey on live sea otter pups. In the Aleutian Islands, sea otter pups comprise 5 to 20% (by frequency) of the eagle diet during the pupping season (Anthony *et al.* 1999). Sources of mortality have not been studied in British Columbia, but pup carcasses found at eagle nests suggest that eagle predation may be a significant source of pup mortality (Watson *et al.* 1997).

Although there are some anecdotal accounts of killer whales pursuing sea otters in British Columbia, there is no evidence that such predation is a significant source of mortality (Watson *et al.* 1997). Unlike in Western Alaska, populations of pinnipeds are considered abundant in British Columbia and southeast Alaska (Trites *et al.* *In Press*), thus a sea otter population decline as a result of killer whale predation seems unlikely. However, it is important to note that the sea otter decline observed in the Aleutian Islands, proposed to be from killer whale predation, is unprecedented in the current knowledge of sea otter populations, and occurred in a very short period of time (<15yrs). One of the challenges to sea otter conservation is accurately estimating population size and thus detecting population trends (Bodkin 2003). It is because of the high variance typical of sea otter counts that the decline in the Aleutian Islands was not detected for almost 10 years and even then hotly debated. Bodkin (2003) suggests that sea otters may be regulated by new and different factors (which are poorly understood) as they attain equilibrium densities.

Disease

Exposure to a variety of diseases has been documented in sea otters in Alaska, Washington, California and British Columbia (Thomas and Cole 1996; Reeves 2002; Lance *et al.* 2004; Gill *et al.* 2005; Shrubsole *et al.* 2005). Thus far, disease-caused mortality does not appear to be a threat in most otter populations with the exception of California. In California, 40% of the beach-cast carcasses were animals that died from disease and diseases appear to be affecting high numbers of prime-age animals, which may be a major factor explaining the low observed rate of population growth (Thomas

and Cole 1996; Estes *et al.* 2003b). The emergence of infections from *Toxoplasma gondii* and *Sarcocystis neurona* (two pathogens found in humans and terrestrial mammals), for which sea otters are not considered a normal host, is of particular concern in California (Thomas and Cole 1996; Estes *et al.* 2003b). In California the presence of *T. gondii* and *S. neurona* in the marine environment may be linked to domestic sewage and urban and agricultural runoff that transports these pathogens into coastal waters where they infect prey species consumed by sea otters (Lafferty and Gerber 2002; Miller *et al.* 2002; Kreuder *et al.* 2003).

Since 2000, sea otter beach-cast carcasses have been examined to determine cause of death in Washington State (Lance *et al.* 2004). In 2000, one of 6 animals died from dual infection with *T. gondii* and *S. neurona*. In 2002, 1 of 8 animals examined died from infection with *S. neurona* and 6 died from infection with *Leptospirosis*. In 2004, 2 of 3 animals examined had died of infection from *S. neurona* and 1 from Canine Distemper (CDV) (the first reported case of CDV in sea otters), although 81% of 32 live-captured sea otters in 2000 and 2001 tested seropositive for exposure to morbilliviruses such as CDV (Lance *et al.* 2004).

In British Columbia, beach-cast carcasses are rarely retrieved because of scavenging by eagles, bears and wolves and the remoteness of the sea otter range. However, in 2006 one animal from the west coast of Vancouver Island died from infection with *S. neurona* (Raverty pers. comm. 2006). Among 42 animals live-captured on the British Columbia coast in 2003 and 2004, 8 were seropositive for morbilliviruses and 2 tested positive for *T. gondii* (Shrubsole *et al.* 2005).

Marine biotoxins

Butter clams (*Saxidomus* spp.) and other bivalve species form an important component of sea otter diet, and can accumulate the biotoxin responsible for Paralytic Shellfish Poisoning (PSP) (Anderson 1994). A die-off of sea otters at Kodiak Island in 1987 was partly attributed to PSP poisoning (DeGange and Vacca 1989), suggesting that PSP may represent a source of mortality in sea otter populations. Research suggests that sea otters can detect toxic levels of PSP and may avoid feeding on prey items with toxic levels, unless other prey are not available (Kvitek and Bretz 2004). Domoic acid, a biotoxin produced by some species of diatoms and marine algae, can accumulate in filter-feeding invertebrates and fish. Domoic acid has been identified as the cause of several large die-offs of sea birds and sea lions in California as well as mortality in southern sea otters (Kreuder *et al.* 2003). The frequency of PSP and domoic acid events in British Columbia is monitored at least to the extent that it supports the commercial bivalve fisheries and shellfish aquaculture, but the effect of PSP or domoic acid on the British Columbia sea otter population is unknown.

Threats

Threats to sea otters include environmental contamination, entanglement in fishing gear and collisions with vessels, illegal killing, disease and possibly human disturbance.

Environmental contamination - oil spills

Oil is a significant threat to sea otters. It destroys the water-repellent nature of the pelage which eliminates the air layer, and reduces insulation by 70%. The result is hypothermia and death (Costa and Kooyman 1982; Williams *et al.* 1988). Once fouled, a sea otter grooms itself obsessively and stops feeding, resting and caring for young (Ralls and Siniff 1990). Furthermore as it grooms, the otter ingests oil and inhales toxic fumes which damages internal organs. Methods for cleaning and rehabilitating sea otters exist, but they are costly and the benefits at a population level are questionable (Estes 1991; Williams and Davis 1995).

Several behavioural characteristics predispose sea otters to oil exposure. Sea otters typically rest in sexually-segregated aggregations (rafts) of up to 200 animals, meaning that large numbers of otters can be oiled simultaneously. In addition, rafts of otters often form in or near kelp beds, which accumulate and retain oil (Ralls and Siniff 1990). Finally, otters may be chronically exposed to oil through ingestion of contaminated prey (e.g. mussels) long after the spill has occurred (Bodkin *et al.* 2002).

On December 23, 1988, the oil barge *Nestucca* was rammed by its tug and spilled 875,000 l of Bunker C oil into the water off Grays Harbor, Washington (Waldichuk 1989). Within 7 days, oil had spread northward to Cape St. James, Queen Charlotte Islands, and was observed throughout the entire British Columbia sea otter range. The spread of oil from this spill, which killed at least one sea otter in British Columbia, demonstrated the vulnerability of the British Columbia otter population to oil spills (Watson 1990). The *Nestucca* spill, which affected both the Washington State and British Columbia sea otter populations, suggests that in the event of a catastrophic oil spill, it is likely that adjacent otter populations will also be affected.

Tankers, barges, fuel tanks and bilges of marine vessels, shore-based fuelling stations and shore-based industries are the main sources of water-borne oil in British Columbia (Shaffer *et al.* 1990). In the early 1990s, there were 7,000 transits per year of freighters and tankers along the British Columbia coast. Of these, at least 1,500 were tanker trips to or from Alaska; each year more than 350 loaded tankers entered the Strait of Juan de Fuca (Burger 1992).

Risk models for southern British Columbia and Washington State, developed in the 1980s, predicted the following oil spill frequencies: spills of crude oil or bunker fuel exceeding 159,000 litres (1,000 barrels) could be expected every 2.5 years, and spills of any type of petroleum product exceeding 159,000 litres (1,000 barrels) could be expected every 1.3 years (Cohen and Aylesworth 1990). The actual frequency of large spills affecting British Columbia between 1974 and 1991 was fairly close to the predicted frequency (Burger 1992). In addition to large spills, small chronic spills are also of concern. Environment Canada tracks all spills of more than 1,113 litres (7 barrels). There are at least 15 such reportable spills annually along the west coast of Vancouver Island (Burger 1992). The effect of contamination from such small chronic spills on sea otter populations is not known.

The existing transport of oil along British Columbia's coast poses a significant threat to the British Columbia sea otter population because of its small size and limited distribution. A recent development proposal to deliver crude oil by tanker from Kitimat, British Columbia to Asia Pacific and California markets (Enbridge Inc. 2005) increases the probability of a significant oil spill occurring in British Columbia. There are also proposals to allow drilling for oil and gas in Hecate Strait and Queen Charlotte Basin, which could also increase the threat of oil spills (British Columbia Ministry of Energy, Mines and Petroleum Resources).

In the spring of 1989, the oil tanker *Exxon Valdez* ran aground in Prince William Sound, Alaska, spilling 42 million litres of crude oil. Nearly 1,000 sea otter carcasses were recovered, but estimates of total mortality ranged from 2,650 (Garrott *et al.* 1993) to 3,905 animals (DeGange *et al.* 1994). Subsequent studies of this spill illustrate the long-term impact of the oil. Population modelling showed decreased survival rates in all age-classes in the 9 years following the spill and indicated that the Prince William Sound sea otter population has not yet completely recovered (Monson *et al.* 2000b). As well, elevated levels of cytochrome P4501A, a biomarker for exposure to hydrocarbons, still occur in blood samples from otters in areas that were heavily oiled, suggesting continued exposure (Bodkin *et al.* 2002).

Controlled experiments on mink (*Mustela vison*) showed the effects of oil on reproduction in this mustelid. Female mink were fed low doses of crude and bunker C oil to simulate residue levels measured in invertebrates in Prince William Sound 4 years after the *Exxon Valdez* spill. These mink had significantly fewer kits/birth than controls. In addition, female kits born to exposed mothers had poorer survival to weaning, and those that survived had lower reproductive success than controls (Mazet *et al.* 2001).

Environmental contamination - other contaminants

Organochlorine contaminant levels have not been measured in British Columbia sea otters. However, polychlorinated biphenyls (PCB), organochlorine pesticides including DDT, and butyltin have been measured in sea otters from California, Washington and Alaska (Bacon *et al.* 1999; Kannan *et al.* 2004; Lance *et al.* 2004). PCBs concentrations were higher in Alaskan otters from the Aleutian Islands (309µg/kg wet weight) compared to otters from California (185µg/kg wet weight) and southeast Alaska (8µg/kg wet weight) (Bacon *et al.* 1999). Total DDT concentrations were highest in California sea otters (850µg/kg wet weight), compared to the Aleutian Islands (40µg/kg wet weight) and southeast Alaska (1µg/kg wet weight). The levels of PCBs measured in California and Aleutian sea otters is considered to be of concern since similar levels caused reproductive failure in mink, a closely related species (Risebrough 1984 *in* Riedman and Estes 1990). Although the levels of DDT measured in California sea otters were not considered to be exceptionally high when compared to other marine mammals (Bacon *et al.* 1999), reduced immune competence is a well-documented side-effect of contaminants in marine mammals and is considered a possible factor in the high rate of disease-caused mortality in the southern sea otter population (Thomas and Cole 1996; Reeves 2002; Ross 2002). Among a small sample of beach-cast carcasses

retrieved for contaminant analysis in California, those that died from infectious disease contained on average higher concentrations of butyltin compounds (components in antifouling paint), and DDTs than animals that had died from trauma and unknown causes (Kannan *et al.* 1998; Nakata *et al.* 1998).

Fishery conflicts

Sea otters can limit abundance of their prey, and influence the distribution and size of their prey (Morris *et al.* 1979; 1981; Breen *et al.* 1982; Watson 1993; Watson and Smith 1996). In the presence of sea otters, invertebrates are unlikely to reach commercially harvestable densities or sizes. In fact, in British Columbia commercial fisheries for subtidal invertebrates such as geoducks (*Panopea abrupta*), sea urchins (*Strongylocentrotus* spp.), sea cucumbers (*Parastichopus californianus*) and possibly Dungeness crab (*Cancer magister*) were likely made possible by the extirpation of sea otters combined with new diving technology and growing international markets (Watson and Smith 1996). Sea otters also affect the abundance and size of intertidal clam species, and affect subsistence, commercial and recreational harvests. As the range of sea otters has expanded concerns about the sustainability of invertebrate resources on the part of commercial, First Nations, and recreational harvesters have intensified and led to requests to regulate or control otter population growth.

Entanglement in fishing gear and collision with vessels

Sea otters have become entangled and entrapped in fishing gear in Alaska, California, Washington and Japan (Rotterman and Simon-Jackson 1988; USFWS 2003; Lance *et al.* 2004; Hattori *et al.* 2005). Sea otters were reportedly entangled and killed in salmon fisheries particularly in central and western Alaska during the 1970s and 1980s and there was some concern in the late 1980s that the numbers might be significant and increasing (Rotterman and Simon-Jackson 1988). High levels of sea otter mortality from entanglement in sunken gill nets in <30 m depths was a serious problem in California during the late 1970s and early 1980s. Restrictions on net fisheries within the sea otter range in California are now in place (USFWS 2003). In Washington State, the treaty gill net fishery is allowed to operate within the sea otter range. Entanglements and mortality are reported infrequently, but may increase as sea otters increase in abundance and range (Gerber and VanBlaricom 1998; Lance *et al.* 2004). Incidental mortality in trap fisheries for crab has been known to occur in California and Alaska, but no entrapments have thus far been reported in Washington State (Bodkin 2003; Lance *et al.* 2004).

The extent of accidental drowning of sea otters in fishing gear in British Columbia has not been investigated, although there appears to be limited geographic overlap between sea otters and net fisheries at this time except possibly in Queen Charlotte Strait. There is, however, considerable overlap between sea otters and the crab fishery and there are anecdotal reports of otters being drowned in commercial crab pots (J. Watson unpub.). As the sea otter range continues to expand, more overlap may be anticipated between sea otters and net and trap fisheries. The increase in shellfish

aquaculture may result in some interactions (e.g. entanglement in gear), and this may be a future consideration.

Incidents of collisions with vessels have not been investigated in British Columbia, but are reported from other regions. Vessel strike was the primary cause of death of 5 of 105 beach-cast carcasses examined between 1998 and 2001 in California (Kreuder *et al.* 2003). Vessel strikes are also reported from Alaska (Rotterman and Simon-Jackson 1988). In British Columbia, the occurrence or frequency of vessel strikes has not been investigated, although one incident of probable vessel strike mortality is reported by Watson *et al.* (1997). Although the significance of vessel strikes as a source of mortality is unknown for the British Columbia sea otter population, such incidents may increase as sea otters expand into more areas that are near human habitation.

Illegal killing

Illegal killing does occur in British Columbia and is reported to occur in other regions (Rotterman and Simon-Jackson 1988; Bodkin 2003). In other jurisdictions sea otters are shot both legally and illegally for their fur and in an effort reduce their effects on invertebrate stocks. There are no estimates of the magnitude of this source of mortality in British Columbia, but in 2005 and 2006 a total of at least 5 shot and skinned carcasses of sea otters were reported or recovered on Vancouver Island, which suggests that illegal killing may be an emerging threat (DFO unpubl.).

Human disturbance

Sea otters in British Columbia are typically wary of humans, and rafts of sea otters are often difficult to approach and are easily disturbed by boat traffic. Females with pups are most sensitive to disturbance; however, rafts of males routinely exposed to boat traffic seem to be able to habituate and single males are most tolerant of the presence of boats. Overall the impact of humans inhabiting the shoreline (noise and presence of people) or from operating boats in the vicinity of sea otters does not appear to be a major concern at this time. Certainly, observation from California, e.g. in Monterey Bay, indicate sea otters appear capable of habituating to human activity (e.g. Woolfenden 1995).

Emergent disease

Disease is a potential threat. In California, the high number of prime-age animal mortalities resulting from infection with *Toxoplasma gondii* and *Sarcocystis neurona* (pathogens thought to be terrestrial in origin) may be linked to sewage and agricultural runoff (Miller *et al.* 2003). These pathogens have been identified in the British Columbia sea otter population (Shrubsole *et al.* 2005; Raverty pers. comm. 2006).

SPECIAL SIGNIFICANCE OF THE SPECIES

Once on the verge of extinction, sea otters have made a remarkable recovery, largely because of protective legislation, an abundance of suitable unoccupied habitat, and successful reintroductions (Mason and MacDonald 1990). Although sea otter populations have demonstrated a capacity to recover, the dramatic declines in Western Alaska illustrate that populations can decline rapidly and unexpectedly.

Sea otters are considered a keystone species exerting significant ecological effects on nearshore marine communities and upon the life history of their prey (Estes and Palmisano 1974; Estes *et al.* 2005). They reduce grazing pressure by preying on herbivorous invertebrates, particularly sea urchins. This allows kelp to grow, thereby altering the community from one dominated by grazers with little kelp to one that supports kelp and associated communities of fish and invertebrates (Breen *et al.* 1982; Watson 1993; Estes and Duggins 1995). Research in the Aleutian Islands indicates that communities dominated by sea otters are up to 2 to 3 times more productive than systems without sea otters because of the kelp-derived carbon (Duggins *et al.* 1989), furthermore these communities support a greater abundance and diversity of fish species (Reisewitz *et al.* 2006).

The “teddy-bear-like” appearance of sea otters, their near brush with extinction, role in structuring rocky nearshore communities, historical importance, and their vulnerability to oil spills have endeared otters to the general public. Sea otters are of increasing interest to the wildlife-viewing tourism industry in Canada as people have become more aware of their presence on Canada’s west coast. Sea otters do well in captivity (although they do not breed well in captivity) and are popular in zoos and aquaria. Sea otters are the only mammals other than primates to use tools to break open hard-shelled invertebrate prey.

Sea otters feed on invertebrates and can control the abundance of many invertebrate species. As the sea otter population grows, controversy over sea otters and the availability of invertebrate stocks to First Nations, commercial and recreational harvesters will increase (Watson and Smith 1996).

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The *Fisheries Act* and the *Species at Risk Act* apply to sea otters in Canada. Under the *Species at Risk Act*, sea otters have been legally listed as *Threatened* since 2003 and are protected from killing, harming, harassing, capturing, and taking. Under the *Fisheries Act*, harvest and disturbance of sea otters are prohibited and there are provisions to protect sea otter habitat. In addition, new Marine Mammal Regulations in the *Fisheries Act* are being drafted to enhance protection to marine mammals from non-consumptive human activities. The British Columbia *Wildlife Act* and Regulations also provide a framework to protect sea otters from being hunted, trapped or killed. However, a limited Aboriginal harvest for food, social and ceremonial purposes may be considered where infringement on Aboriginal rights for conservation reasons cannot be

justified. Any such take of sea otters would have to be authorized pursuant to a licence under the *Fisheries Act* subject to advice that demonstrates to Fisheries and Oceans Canada that it would not jeopardize survival or recovery of the species.

The Checleset Bay Ecological Reserve, off the west coast of Vancouver Island, was established by the British Columbia provincial government in 1981. It is a provincially protected area that includes 33,321 ha of marine habitat (3% of the *Area of Occurrence* for the species in Canada) and is the only area explicitly designated to protect sea otter habitat (Jamieson and Lessard 2000). Presently there are invertebrate fishery closures designated by Fisheries and Oceans Canada for geoducks, horse clams, red and green urchins and sea cucumbers in the reserve.

Sea otters were first protected in 1911 under the International Fur Seal Treaty signed by the United States, Japan and Great Britain (for Canada). In the United States, protection for sea otters was consolidated under the *Marine Mammal Protection Act* (MMPA) of 1972. Under the MMPA, sea otters are protected from harassment, hunting, capturing, killing, or attempts to harass, hunt, capture or kill. Provisions within the MMPA allow Alaskan natives to hunt sea otters for subsistence purposes or for creating authentic articles of native handicraft and clothing. With special permits, otters may be taken for research, public display, photography for educational or commercial purposes, and incidental to commercial fisheries (USFW n.d.).

Sea otters in Canada were designated by COSEWIC as Endangered in April 1978. Status was re-examined and confirmed as Endangered in April 1986 and re-designated as Threatened in April 1996. A re-examination of status confirmed Threatened in May 2000. Status was re-examined in April 2007 and the species was designated as Special Concern.

The sea otter is listed by the British Columbia Conservation Data Centre as secure globally. However, it is on the Red List provincially and has received a provincial rank of S2 (S=provincial status 2=imperiled) because the population in British Columbia is small and has a restricted range, based on Watson *et al.* (1997) (British Columbia Conservation Data Centre 2005).

Sea otters in Washington State are listed as State Endangered under the Special Species Policy. However, only sea otters in California and in Western Alaska are listed nationally under the US federal *Endangered Species Act* (ESA). Under the ESA, California sea otters, subspecies *Enhydra lutris nereis*, and the Western Alaskan distinct population segment, subspecies *Enhydra lutris kenyoni*, are listed as Threatened (reviewed in Lance *et al.* 2004).

Sea otters are listed as Endangered by the IUCN because of an observed decline of as much as 90% in the past 10 years. This listing is a result of the drastic decline in Western Alaska, an area that previously accounted for the majority of the global sea otter population, poor recovery in California, and insufficient information about the population in Russia, which is believed to be threatened by poaching (IUCN 2004.).

The sea otter is listed in CITES Appendix II, but the southern subspecies (*Enhydra lutris nereis*) is listed in Appendix I. Species in Appendix I are considered to be threatened with extinction and CITES prohibits commercial international trade in specimens of these species. Species in Appendix II are not necessarily threatened with immediate extinction, but may become so unless trade is closely controlled (CITES n.d.).

TECHNICAL SUMMARY

Enhydra lutris

Sea otter

Loutre de mer

Range of Occurrence in Canada: Pacific Ocean

Extent and Area Information	
<ul style="list-style-type: none"> <i>Extent of occurrence (EO)(km²)</i> Coastal waters of west coast Vancouver Island and central British Columbia coast where sea otter occupation has been confirmed from dedicated surveys and from ATK. It does not include sightings of single animals outside this continuously occupied range. Area is calculated from shore to the 50 m depth contour; deep inlets are cut off. 	10,000 km ²
<ul style="list-style-type: none"> <i>Specify trend in EO</i> 	increasing
<ul style="list-style-type: none"> <i>Are there extreme fluctuations in EO?</i> 	No
<ul style="list-style-type: none"> <i>Area of occupancy (AO) (km²)</i> same as EO 	10,000 km ²
<ul style="list-style-type: none"> <i>Specify trend in AO</i> 	increasing
<ul style="list-style-type: none"> <i>Are there extreme fluctuations in AO?</i> 	No
<ul style="list-style-type: none"> <i>Number of known or inferred current locations</i> 	2
<ul style="list-style-type: none"> <i>Specify trend in #</i> 	none
<ul style="list-style-type: none"> <i>Are there extreme fluctuations in number of locations?</i> 	No
<ul style="list-style-type: none"> <i>Specify trend in area, extent or quality of habitat</i> 	Increasing
Population Information	
<ul style="list-style-type: none"> <i>Generation time (average age of parents in the population)</i> age at first birth = 3, longevity = 15 to 20, gen.time = 3 + .33(15-3) to 3 + .33(20-3) 	7 to 9 years
<ul style="list-style-type: none"> <i>Number of mature individuals.</i> Data to produce a life table do not exist for British Columbia. The proportion of adults is assumed to be 50% of the total population based on estimates of age at first reproduction of other sea otter populations. 	~ 1,600 adults
<ul style="list-style-type: none"> <i>Total population trend:</i> Population data from Watson <i>et al.</i> 1997 and Nichol <i>et al.</i> 2005 indicate that the population has been increasing. 	<u>Vancouver Island</u> 18.6% yr ⁻¹ (1977-1995) 15.6% yr ⁻¹ (1977-2004) 19.1% yr ⁻¹ (1977-1995) 8.0% yr ⁻¹ (1995-2004) <u>Central B.C. coast</u> 12.4% yr ⁻¹ (1990-2004)
<ul style="list-style-type: none"> <i>% decline over the last/next 10 years or 3 generations.</i> 	None over last 10 years
<ul style="list-style-type: none"> <i>Are there extreme fluctuations in number of mature individuals?</i> 	No
<ul style="list-style-type: none"> <i>Is the total population severely fragmented?</i> 	No
<ul style="list-style-type: none"> <i>Specify trend in number of populations</i> 	N/A
<ul style="list-style-type: none"> <i>Are there extreme fluctuations in number of populations?</i> 	Not in Canada
<ul style="list-style-type: none"> Populations with number of mature individuals in each: a crude estimate based on 50% of the population being reproductive might be 1,350 on Vancouver Island and 250 on the central coast 	
Threats (actual or imminent threats to populations or habitats)	
Environmental contamination, especially oil spills, entanglement in fishing gear and collision with vessels, illegal killing.	

Rescue Effect (immigration from an outside source)	
<ul style="list-style-type: none"> • <i>Status of outside population(s)</i> U.S. federal <i>Endangered Species Act</i>: California – Threatened, Southwestern Alaska Stock – Threatened, State Special Species Policy – Washington – Endangered 	
<ul style="list-style-type: none"> • <i>Is immigration known or possible?</i> 	Yes, wandering males
<ul style="list-style-type: none"> • <i>Would immigrants be adapted to survive in Canada?</i> 	Yes
<ul style="list-style-type: none"> • <i>Is there sufficient habitat for immigrants in Canada?</i> 	Yes
<ul style="list-style-type: none"> • <i>Is rescue from outside populations likely?</i> 	Rescue is unlikely because sea otters are non-migratory, exhibit high site fidelity and occupy relatively small overlapping home ranges
Quantitative Analysis [provide details on calculation, source(s) of data, models, etc]	None available
Current Status COSEWIC: Threatened (2000) Special Concern (2007)	

Status and Reasons for Designation

Status: Special Concern	Alpha-numeric code: Not applicable
Reasons for Designation: The species had been extirpated in British Columbia by the fur trade by the early 1900s, and was re-introduced from 1969-72. It has since repopulated 25-33% of its historic range in British Columbia, but is not yet clearly secure. Numbers are small (<3,500) and require careful monitoring. Their susceptibility to oil and the proximity to major oil tanker routes make them particularly vulnerable to oil spills.	
Applicability of Criteria	
Criterion A: (Declining Total Population): The population has increased at rates of 8 – 19% per year since censuses were initiated in 1977. The rate of increase has slowed in recent years.	
Criterion B: (Small Distribution, and Decline or Fluctuation): Extent of occurrence is <20,000 km ² , but the population is not declining or fluctuating.	
Criterion C: (Small Total Population Size and Decline): Total population is ~3,200 animals of which half are assumed to be mature individuals (~1,600). The population is small, but there is no decline or fluctuation in numbers.	
Criterion D: (Very Small Population or Restricted Distribution): There are >1,000 mature individuals.	
Criterion E: (Quantitative Analysis): None have been undertaken.	

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