

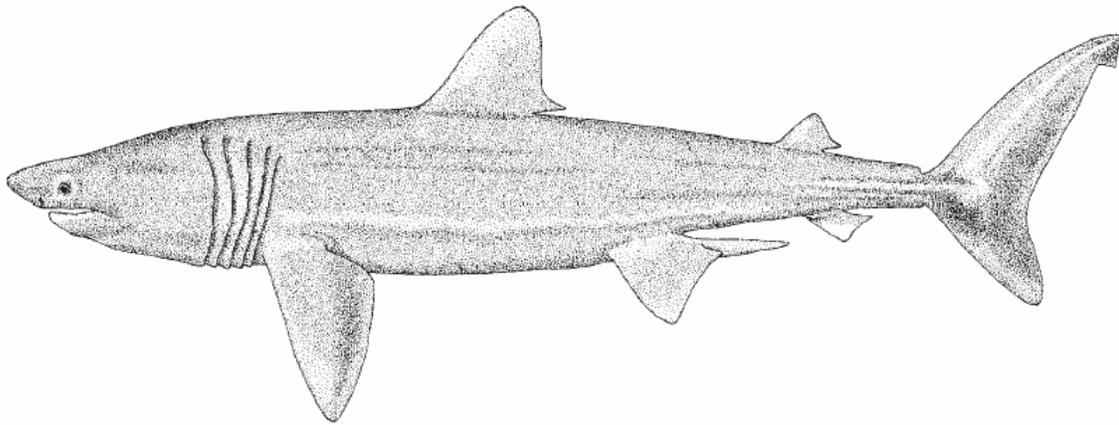
COSEWIC
Assessment and Status Report

on the

basking shark
Cetorhinus maximus

Pacific population

in Canada



ENDANGERED
2007

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:

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Basking shark — Source of figure: Compagno 2001.

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COSEWIC Assessment Summary

Assessment Summary – April 2007

Common name

Basking shark - Pacific population

Scientific name

Cetorhinus maximus

Status

Endangered

Reason for designation

This shark species is the only extant species in the family Cetorhinidae. It occurs circumglobally in temperate coastal shelf waters, and exists in Canada as two geographically isolated designatable units – Atlantic and Pacific. The species is vulnerable to incidental fishing mortality because of its low intrinsic productivity. Females do not mature until 16 to 20 years old, gestate between 2.6 and 3.5 years (the longest known gestation period for any vertebrate), and produce litters of only about 6 “pups”. These sharks are especially susceptible to entanglement in fishing gear and collision with boats because of their large size, surface behaviour and fearlessness around boats, and because their coastal distribution overlaps fishing and boating areas. Prior to 1970, large aggregations of these sharks were seasonally common in Pacific Canada, but only 6 sightings have been confirmed since 1996. This dramatic reduction in abundance is attributed to directed fisheries for liver oil (1941-1947) and an eradication program (until 1970) that killed hundreds, perhaps thousands of individuals between 1945 and 1970. The minimum historical population reconstructed from documented kills was at least 750 individuals, whereas the current population is virtually nil, implying a rate of decline exceeding 90% within < 2 generations. The species is believed to migrate seasonally between Canada and California, where regional aggregations were also severely depleted by historic fisheries. Rescue from outside Canada is unlikely.

Occurrence

Pacific Ocean

Status history

Designated Endangered in April 2007. Assessment based on a new status report.



COSEWIC
Executive Summary

basking shark
Cetorhinus maximus

Pacific population

Species information

Basking sharks are named after their conspicuous behaviour of ‘basking’ (more accurately feeding) at the surface. The basking shark is distinguished from other sharks by its large size (second largest fish in the world), elongated gill slits, pointed snout, a large mouth with minute teeth, and a crescent-shaped caudal fin. Colouration is typically blackish to grey-brown. Gill openings have prominent gill rakers.

Although there has been no research on the population genetics or population structure of basking sharks, due to its biogeographic separation from those in the Atlantic, the Pacific population of basking sharks is treated as a single COSEWIC Designatable Unit (DU). There is no evidence from either the North Pacific or North Atlantic of transoceanic movements.

Distribution

Basking sharks are found circumglobally in temperate coastal shelf waters but are characterized by localized occurrences. Canadian records from Pacific waters indicate they utilize virtually all coastal temperate waters. Conventional tagging studies have yielded no tag returns. Along the Pacific coast, basking sharks were observed historically in discrete locations off California in winter and spring and in particular areas off British Columbia in summer and fall suggesting a latitudinal migration. There are very limited observer data on bycatches of this species in Pacific waters because of the rarity with which basking sharks have been seen over the last thirty years. Historically, however, large aggregations were observed in nearshore waters along the west coast of Vancouver Island and in one location along the central mainland coast of British Columbia.

Habitat

Areas where oceanographic events concentrate zooplankton appear to be the favoured habitat of basking sharks, typically including fronts where water masses meet, headlands, and around islands and bays with strong tidal flow. There is recent evidence that basking sharks may also utilize deepwater habitats greater than 1000 m. The

quality of foraging habitat changes over short spatial and temporal scales based on oceanographic conditions.

Biology

Information on the early life history of this species is poorly known. Animals less than 3 m in length are rarely encountered. Size at birth probably ranges between 1.5 and 2.0 m. Litter size is known from only one animal with six young. Males are thought to reach maturity at between 12 and 16 years and females between 16 and 20 years. Pronounced sex segregation is evident in data from surface fisheries. Gestation has been estimated at 2.6 to 3.5 years, the longest known for any animal, with time between litters estimated at 2 to 4 years. Longevity is likely about 50 years, while maximum reported length is 12.2 m. The estimated annual productivity is the lowest of any shark known. Generation time is estimated between 22 and 33 years.

Adult basking sharks have no known predators but young individuals are most likely vulnerable to other large shark species. Basking sharks are primarily planktivores, seeking out areas of high zooplankton concentrations. A modelling study suggests that they should be able to obtain a net energy gain by feeding in areas of moderate zooplankton concentrations.

Population sizes and trends

No abundance estimates exist for basking shark populations in Canada's Pacific waters. Our understanding of population size and trends comes primarily from historical catch records.

Canada's Pacific population of basking sharks has virtually disappeared. Historical records indicate an abundant and widely spread population. Historical targeted killing (commercial and recreational), bycatch, and a directed eradication program by Canada's Department of Fisheries and Oceans, including the ramming of sharks with a blade-equipped boat, are believed to be responsible for their disappearance. There are only six confirmed records of basking sharks in the Canadian Pacific since 1996, four of which are from trawl fishery observer records. Overall, the population is but a small fraction of its relatively large historical abundance and distribution.

Limiting factors and threats

Ongoing mortality incurred from fishing operations and vessel collisions are thought to be the largest threats to basking shark populations. Of all shark species, the basking shark appears to be the most vulnerable to human impacts. Characteristics making them vulnerable include late age of maturity, low fecundity, long gestation period (apparently the longest of any vertebrate), long periods between gestations, low productivity, sex segregated populations, overlapping habitats with commercial fisheries, nearshore/coastal habitat, surface behaviour, no fear of vessels, and naturally small populations.

Special significance of the species

The basking shark is the only species in its family. The earliest fossil basking shark is 29 to 35 million years old. It qualifies for the category “charismatic megafauna” by virtue of its large size (second largest fish in the world) and conspicuous surface activity. On the Pacific coast basking sharks are the most plausible explanation for sea serpents, sea monsters, and the Cadborosaurus (Caddy). The high value of basking shark fins has promoted a lucrative trade to Asian countries. The recent inclusion of basking shark under Appendix II of CITES is intended to regulate this trade. The basking shark may be more vulnerable to human impacts than any other marine fish.

Existing protection

In Canada the species receives *de facto* protection by broad regulations that prohibit finning of any shark species. Given that there is no market for other parts of basking sharks in Canada, there is no directed exploitation. Directed kill of basking sharks is prohibited by European Community countries, United States, and New Zealand. They fall under a variety of status designations. Internationally, the IUCN Red List assessment has categorized basking sharks as Vulnerable globally and Endangered in the northeast Atlantic and north Pacific and even Critically Endangered in the case of “Barkley Sound”.



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.

COSEWIC Status Report

on the

basking shark *Cetorhinus maximus*

Pacific population

in Canada

2007

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SPECIES INFORMATION

Name and classification

The basking shark (*Cetorhinus maximus* Gunnerus, 1765) is the sole member of the family Cetorhinidae belonging to the order Lamniformes. Other common names include sun shark, bone shark, and elephant shark. In French this species is known as Pèlerin. In Pacific Canada, the basking shark was also commonly but incorrectly referred to as mud shark in early historical accounts.

Morphological description

This animal is most readily distinguished in the field from other sharks by its large size (maximum reported 12.2 m), elongated gill slits which extend almost to the mid-dorsal of the head, pointed snout, a large subterminal mouth with minute hooked teeth, caudal peduncle with strong lateral keels, and crescent shaped caudal fin (Compagno 2001, Figure 1). Colour is typically blackish to grey-brown, grey or blue-grey above and below on body and fins, undersurface sometimes lighter, often with irregular white blotches on the underside of the head and abdomen (Compagno 2001). Internal gill openings have prominent gill rakers formed from modified dermal denticles.

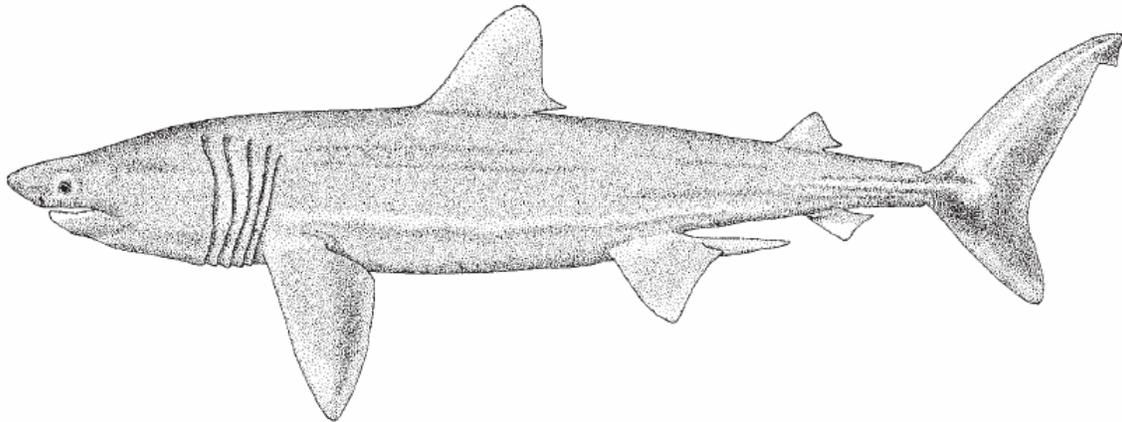


Figure 1. Basking shark (*Cetorhinus maximus*). Source of figure: Compagno 2001.

Genetic description

The population structure of basking sharks is poorly known. There has been no population genetic work done on this species. Inferences about population structure are based on records of seasonal occurrence and limited observations from tagging studies. In Canada, basking shark populations in the North Atlantic and North Pacific are geographically disjunct and are considered to be reproductively isolated from one another due to their preference for temperate waters that would preclude migration through the Arctic Ocean.

In the North Pacific, basking sharks were observed historically in discrete locations off California in winter to spring and regularly in particular areas off British Columbia in summer and fall (Squire 1967, 1990). This information, combined with recent satellite tracking information from the North Atlantic (Sims *et al.* 2003; Skomal *et al.* 2004; Skomal 2005), suggests the possibility of a single panmictic population along the west coast of North America. On the other hand, throughout their global range, basking shark aggregations have been reported to occur repeatedly in discrete areas where they are typically found in large numbers and for only part of the year (Compagno 2001). Thus, philopatry and more complicated genetic population structure may exist.

Designatable units

Given that basking sharks are found exclusively in temperate oceans and that there is no connection through the Arctic or from the south, the species in Canadian Pacific waters is considered to be separate from that in Canadian Atlantic waters and to comprise a separate designatable unit.

DISTRIBUTION

Global range

Basking sharks are found circumglobally in temperate coastal shelf waters but are characterized by localized occurrences (Figure 2), occurring off the coast of fifty countries (Froese and Pauly 2005). In the North Atlantic, basking sharks are observed in waters off countries as far south and east as Senegal, through to Europe (including the Mediterranean Sea), Norway, Sweden, Russia, westward to Iceland, Canada (Newfoundland, Nova Scotia, New Brunswick), along the eastern seaboard of the United States and into the Gulf of Mexico. In the North Pacific, they are observed as far south and west as Japan, through to China, along the Aleutian Islands, Alaska, British Columbia, along the western seaboard of the United States and Mexico (Baja California and northern Gulf of California) (Compagno 2001). Basking sharks have not been observed in equatorial waters.

Canadian range

The current distribution of basking shark in Canada's Pacific waters is largely unknown. There have only been six reliable sightings on the Pacific coast since 1994 (two confirmed live sightings and four reported as bycatch) (Figure 3). Historical records dating back to the late 1700s have been used to identify several discrete bays and inlets where basking sharks were once regularly found (Table 1; Wallace and Gisborne 2006). Large aggregations of basking sharks were found repeatedly in three areas: (1) Rivers Inlet/Queen Charlotte Sound; (2) Clayoquot Sound; and (3) Barkley Sound (Figure 3). Unconfirmed or smaller groups have been observed historically in numerous other locations in the Strait of Georgia (Cape Lazo, Texada Island and Saanich Inlet) and off the southern banks of Vancouver Island (Table 1).

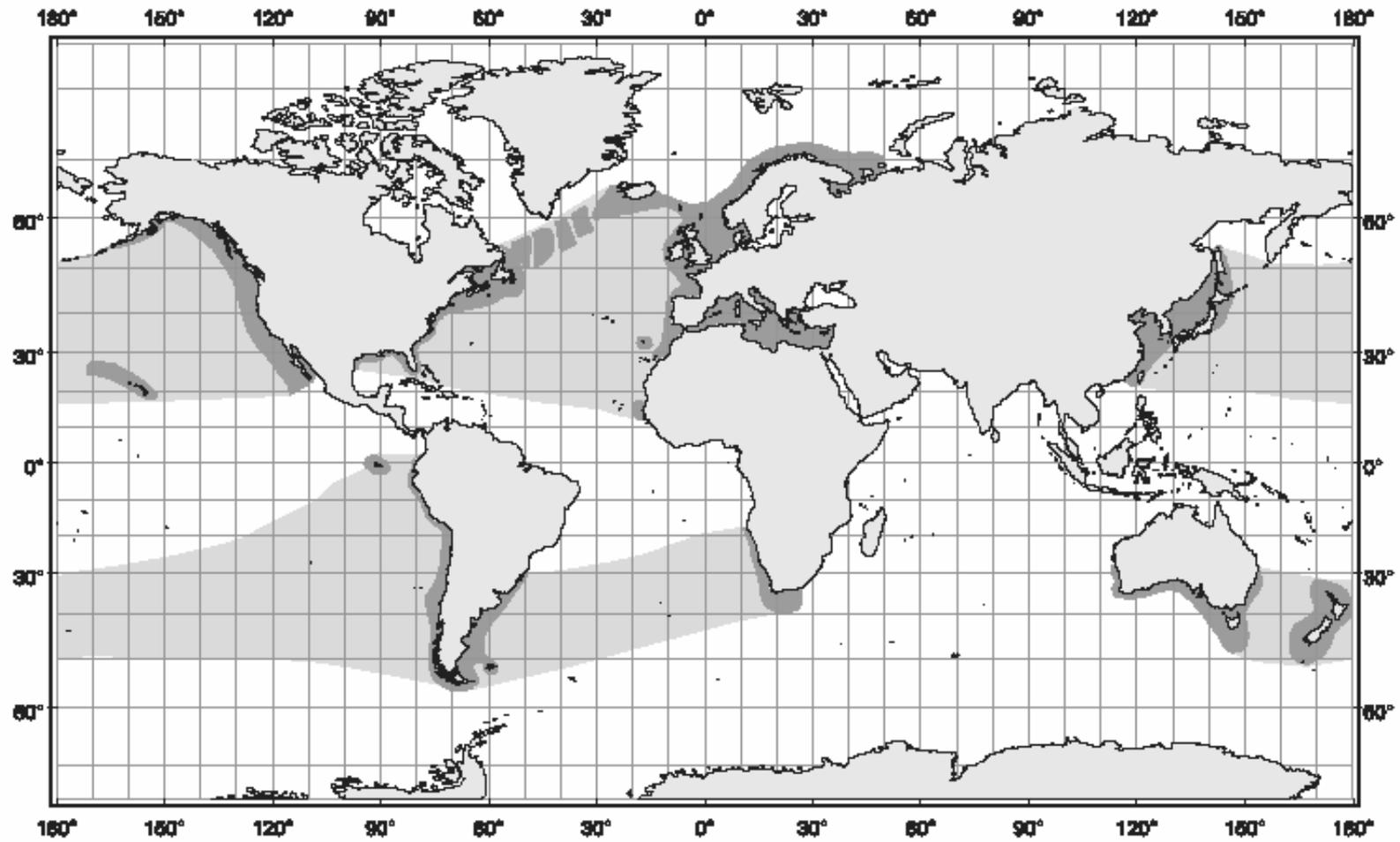


Figure 2. Global distribution of basking sharks. Dark grey areas represent known basking shark distribution and light grey areas represent possible distribution based on temperature preferences. Map source: Compagno 2001.

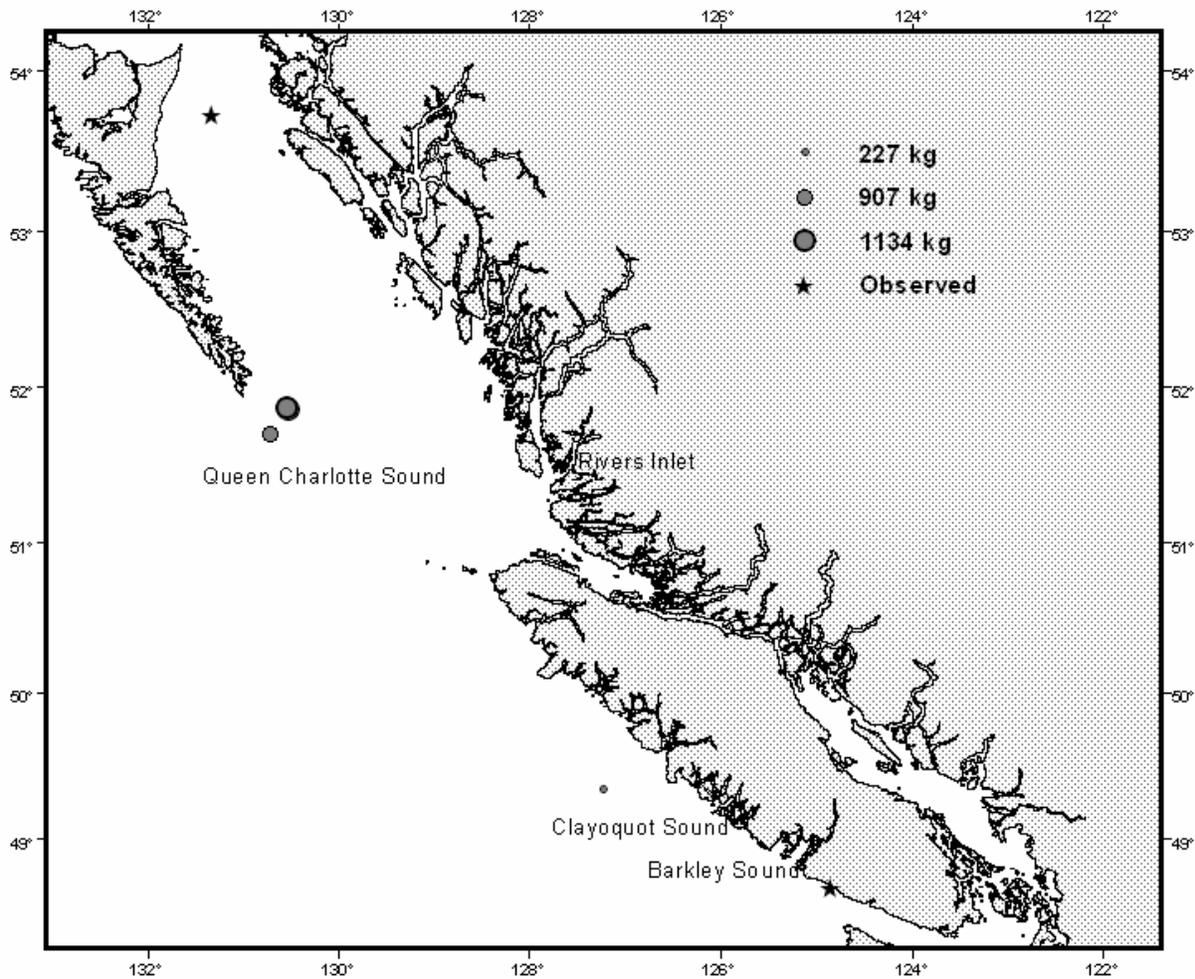


Figure 3. Known occurrences of basking sharks off British Columbia between 1996 and 2004 from trawl catches (the PacHarTrawl database, $n=4$, circles denote individual weights) and opportunistic visual surface sightings ($N = 2$; stars). Location names (Queen Charlotte Sound, Rivers Inlet, Clayoquot Sound, and Barkley Sound) refer to areas with large historical aggregations of basking sharks.

Over the time period of three generations (66-99 years), basking sharks have all but disappeared from all areas where they were historically abundant. This disappearance cannot be attributed to a reduction in search effort. The three areas identified as historically most important are still used intensively by mariners. Moreover, the coastline of BC is increasingly well-travelled by tourism operators and recreational users. Being large and conspicuous at the surface, basking shark would certainly have been reported in other areas if the distribution of basking shark had merely shifted. The historical extent of occurrence in Pacific Canada includes the area of the continental shelf at depths $<200\text{m}$, an area of $80,000\text{ km}^2$. The current extent of occurrence is unknown but much reduced.

Table 1. Historical sightings of basking sharks in British Columbia and adjacent waters listed alphabetically by location.

Location	Year	# Sharks/Comments	Source
Alberni Canal	1921	Stopped vessel	Port Alberni News, August 31, 1921
Astoria, Oregon	1943	1- 2000 lb liver	The Fisherman, August 24, 1943, p. 2
Ballenas Island (light station)	1956		Colonist, June 5, 1956 p.13
Barkley Sound (many locations)	1943-1969	Many sharks	Many sources (see Appendix 1)
Beaver Creek Wharf, North of Nanaimo	1893	“another lot of sharks”	Colonist, July 30, 1916
Bowen Island	1958	1	Sun, August 29, 1958, p. 29
Brentwood Bay	1952, 1956		Times Colonist, July 5, 1952, p.11; Colonist, June 5, 1956, p. 13
Cape Lazo	Late 1990s	1 (unconfirmed)	Mark Saunders, Pacific Biological Station
Clayoquot Sound	1973-1992		Summarized in Darling and Keogh (1994)
Cortes Island (Bliss Landing)	1942	1-1600 lb liver - dogfish net	The Fisherman, September 8, 1942, p. 3
Eagle Crest, Van. Island	1956		Colonist, June 5, 1956, p. 13
Esquimalt Harbour	1959	1 (23' long)	Times, July 17, 1959, p. 27
Fitzhugh and QC sounds	1955		Province, August 13, 1955, p. 20 (Mag. Sec.)
Gibsons (small island at the south end of Bowen Island)	1958	1 (27'10")	Sun, September 11, 1958, p. 21
La Perouse Banks	1935, 1944	numerous sharks	Department of Fisheries, File# 62-3-1, letter correspondence written April 15, 1935. Province, June 16, 1944, p. 5
Ladysmith	1952		Colonist, June 28, 1952, p.13
Mistaken Island	1956		Colonist, June 5, 1956, p.13
Namu (see Rivers Inlet)	1940-1948		Various
Neah Bay	1868		Swan, James G. 1868. The Indians of Cape Flattery. p. 29
North Saanich (Cole Bay)	1959	1 (not confirmed)	Colonist, June 19, 1959, p. 21
Oak Bay	1958	Not confirmed	Times, August 5, 1958, p. 15
Pachena Bay	1956	31 or 34 (single largest kill-April)	Vancouver Sun, May 16, 1956
Parksville (Rath Trevor Beach)	1948, 1956	1 (skeleton)	Vancouver Sun, December 18, 1948, p. 23 (confirmed by J.L. Hart at PBS). Colonist, June 5, 1956, p. 13
Parksville (Arbutus Point)	1943	1 (18' long)	Fisheries Research Board of Canada Progress Report 56, p. 15 (1943)
Port Alberni	1952	1 (15' 2000 lb)	Times Colonist, July 9, 1952, p. 9
Prince Rupert (Island Point)	1937 / 1938	1	The West Coast Fisherman, October 1990, p. 44-45
Qualicum	1892; 1946; 1955; 1956	~100 1, 1	Colonist, July 30, 1916 Colonist, Nov. 8, 1946, p. 16 Colonist, May 31, 1955, p. 24 Colonist, June 5, 1956, p. 13
Queen Charlotte Sound (most likely Rivers Inlet area)	1891, 1897	plentiful	Natural History Society of BC. 1891. The Economic Fishes of British Columbia. Vol. 1 No. 1 p. 20-33 Gosnell, R.E. 1897. Year book of BC
Rivers Inlet	1915; 1940-1948	100s of sharks reported	Province, July 15, 1915, p. 3 Numerous newspapers and fishing magazines (see Appendix 1)
Saanich Inlet	1956	1 hit, 4 observed	Times, April 20, 1956, p. 6
—Tod Inlet	1956 1957	(16.5', 2500 lbs)	Colonist, August 9, 1956, p.1 Times, November 28, 1957, p. 23
Texada Island	1947	12	Province, June 7, 1947, p. 5
Uchucklesit Harbour (Barkley Sound)	1948	8	Times, July 17, 1948, p. 6
Ucluelet	1946		West Coast Advocate, July 18 1946, p. 14
Ucluelet (4 miles offshore)	1955		Colonist, September 9, 1955, p. 13

HABITAT

Habitat requirements

The habitat requirements for basking sharks in Pacific Canadian waters have not been investigated. In other areas, basking sharks are known to be associated with oceanographic events that concentrate zooplankton, including fronts off headlands, around islands and in bays with strong fluctuation of water masses from tidal flow (Sims *et al.* 1997; Sims and Quayle 1998; Wilson 2004). Although they appear to prefer shallow coastal waters, basking sharks have been recorded in the epipelagic zone by aerial surveys, pelagic driftnet fisheries, and have been caught in bottom trawls off the St. Lawrence River, Scotian Shelf and Scotland (Compagno 2001; this study). Data from the Newfoundland Observer Program (NOP) indicate that basking sharks have been taken in trawl nets fishing in depths up to 1370 m with 15% of the records (n=414) from waters deeper than 1000 m.

Sub-surface diving behaviour is known from only seven animals which dived to depths well over 200 m and on one occasion to a depth of over 750 m (Sims *et al.* 2003; Skomal *et al.* 2004; Skomal 2005). Water column utilization varied considerably among individuals and is likely influenced by patterns of prey distribution varying by depth, location, and season. Skomal (2005) found that two basking sharks captured at the water surface, tagged and released in the same northwest Atlantic summer location (see Genetics section) moved to very different wintering habitats. One individual wintered off Florida and spent most of its time at the surface whereas the other individual wintered off of Jamaica and spent most of its time at depths below 480 m. With so few animals tagged it is difficult to characterize diving and water column utilization patterns except to note that all sharks showed considerable vertical movement.

Habitat trends

Habitat availability for this species is not likely to have changed. New evidence from basking sharks studied off England suggest that the sharks target areas of high zooplankton concentrations associated with both large and small scale oceanographic conditions that change quickly (lasting hours to days) (Sims and Quayle 1998). Longer-term trends in climate may influence prey availability but recent theoretical work suggests that basking sharks can achieve a net energy gain under moderate ($0.48-0.70\text{g m}^{-3}$) concentrations of prey (Sims 1999). For the purposes of this report, fisheries interactions (i.e., entanglement) and vessel collisions are considered as direct threats (in a later section) rather than as degradation of aquatic habitat.

Habitat protection/ownership

All habitat of basking sharks in Canada falls under federal jurisdiction managed primarily by Fisheries and Oceans Canada (DFO). At present, there is no intentional protection for basking shark habitat. In Pacific Canada, waters adjacent to Pacific Rim National Park (Broken Group and West Coast Trail components) are areas where

basking sharks were sighted historically. Present restrictions in these waters would not afford much protection against perceived threats (i.e., vessel collisions, entanglement in fishing gear and salmon farming net pens).

BIOLOGY

Biological information has been obtained primarily from the work by Compagno (2001) and from a United Kingdom proposal to list basking shark under Appendix II of CITES (United Kingdom 2002). Both reports provide a comprehensive review of basking shark biology.

Life cycle and reproduction

The life cycle and reproduction of basking sharks are poorly understood but likely similar to other lamnoid sharks. Pairing is thought to occur in early summer based on observed courtship behaviour (nose to tail circling) and scarring (Matthews 1950; Sims *et al.* 2000). Gestation period has been estimated at 3.5 years by Parker and Stott (1965) and, more recently, at 2.6 years by Pauly (2002) who assumed a length at birth of 1.5 m and a von Bertalanffy growth coefficient (K) of 0.062/yr. Information about pregnancy is based on a single basking shark with a litter of six young estimated to be between 1.5 and 2 m in length (Compagno 2001). Like other lamnoid sharks, the basking shark may exhibit embryonic ovophagy, which supplies nutrients to the developing embryos (Compagno 2001). Time between successive litters may be two to three years (Compagno 2001).

Longevity is presumed to be approximately 50 years and age at maturity is estimated at 12 to 16 years in males and 16 to 20 years in females (UK 2002). Length at maturity is estimated at 4.6 to 6.1 m for males based on clasper development (Bigelow and Schroeder 1948); females are presumed to mature at a larger size than males as in many other shark species. Estimates of annual productivity (r_{msy}) range from 0.013 to 0.023 based on the methodology of Smith *et al.* (1998) using age at maturity, maximum age and average fecundity (UK CITES proposal 2002). This suggests that the potential for recovery (rebound rate) is lower for basking shark than for any of the 26 species of Pacific shark examined by the Smith *et al.* (1998). Pauly (2002) calculated the natural mortality (M) to be 0.068. Based on an age of maturity of 18 years for females (midrange of 16-20 years), the generation time can be estimated as $18 + 1/0.068 = 33$ years. In contrast, the UK CITES proposal (2002) reports the generation time as 22 years.

Herbivory/predation

At birth, basking sharks are between 1.5-1.7 m in length, large enough to escape predation by most marine species. Very large predators, such as the white shark and killer whale may kill basking sharks but no such kills have ever been documented.

Physiology

Basking sharks have been recorded in surface waters ranging from 8 to 24°C, with most observations from 8 to 14°C (Compagno 2001). Four sharks tagged with temperature data loggers in the northeast Atlantic were typically found in waters between 9 and 16°C (Sims *et al.* 2003).

Basking sharks periodically shed their gill rakers and are presently thought to cease feeding while they regenerate new ones (4-5 months) (Compagno 2001). Their massive livers may act as a metabolic store that maintains energetic requirements while not feeding (Compagno 2001). Recent tagging has largely disproved the longstanding theory that basking sharks 'hibernate' in deep water over the winter (Sims *et al.* 2003).

Dispersal/migration

Very little is known regarding the dispersal and migratory patterns of individual basking sharks. There has been only one conventional tagging study in the North Atlantic and none of the 156 individuals tagged was recaptured (Kohler *et al.* 1998). Seasonal migrations are suspected to occur from deep to shallow water or from lower to higher latitudes based on seasonal changes in abundance on both the Atlantic and Pacific coasts of North America.

In the northeast Pacific, basking sharks were visibly most abundant in spring and summer off British Columbia and Washington, and off California in autumn and winter. It has been inferred from these observations that there is a single northeast Pacific population that migrates seasonally (Compagno 2001).

Similarly, off the U.S. Atlantic seaboard, seasonal appearances of basking sharks moving from south to north between spring and summer suggest an annual latitudinal migration. Recent tracking studies of three basking sharks in the northwest Atlantic provide evidence for strong latitudinal movements southward associated with a change in seasons from late summer to winter (Skomal *et al.* 2004; Skomal 2005). However, three satellite-tagged sharks in the northeast Atlantic (U.K.) tracked for 162, 197, and 198 days did not exhibit any strong latitudinal migration between seasons but rather horizontal movements associated with the continental shelf (Sims *et al.* 2003).

There is evidence that basking shark populations may segregate spatially and seasonally by sex and/or maturity. Watkins (1958) found that most basking sharks caught in Scottish (95%) and Japanese (65-70%) surface fisheries were female. Compagno (2001) reported that in fisheries off the United Kingdom, basking sharks were mostly females (97.5%) when encountered frequently in summer but mostly males (unknown %) and uncommon in winter. Lien and Fawcett (1986) reported that more males than females were caught incidentally in the inshore waters of Newfoundland. Globally, there is an absence of pregnant specimens reported, which might indicate a spatial or bathymetric segregation of breeding and non-breeding members of the population. Alternatively, the absence of records of pregnant females may simply reflect

the low reproductive capacity of the species. In Clayoquot Sound, Darling and Keogh (1994) identified two males by the presence of large white claspers hanging from the pelvic region. Basking sharks are rarely encountered until they have reached 3 m in length. There is only one confirmed account of a juvenile basking shark (1.7 m) and it was observed off the British Isles (Compagno 2001).

Interspecific interactions

The presence of basking sharks on the ocean surface in areas of high zooplankton concentrations, combined with the anatomical adaptation of specialized gill rakers, suggests that they are primarily planktivores. Stomach content analyses confirm that zooplankton is the preferred prey, but these analyses are based primarily on basking sharks that were active at the surface when they were captured in commercial fisheries. Deepwater pelagic shrimps have been found in the stomach of one basking shark from Japan suggesting that mesopelagic food sources may be important too. Compagno (2001) mentions an anecdotal report of basking sharks preying upon small schooling fishes such as herring. Similarly, a gillnet fisherman from British Columbia reported catching a 7.8 m (26 ft) basking shark which when hoisted by the tail with a crane, was found to be full of 20 cm (8 inch) herring (Gisborne pers. comm. 2004a). Thus, a wider range of prey sources, aside from zooplankton, may be utilized.

Basking sharks have been found to actively seek out areas of high zooplankton concentrations (Sims *et al.* 1997; Sims and Quayle 1998). Sims (1999) calculated that a minimum prey density of between 0.55 and 0.74 g·m⁻³ would be required for net energy gain and corroborated his estimate with field observations. This implies that basking sharks can survive and grow in conditions where prey concentrations are lower than previously thought necessary (Parker and Boeseman 1954).

Behaviour

Basking sharks are known for their tendency to appear seasonally in large aggregations in particular localities where they are observed intermittently over several months before disappearing again (Darling and Keogh 1994; Compagno 2001). In British Columbia, anecdotal and newspaper accounts also indicate that several bays and small inlets were noteworthy for the regular occurrence of high densities of basking sharks. These aggregations may reflect some unknown breeding or foraging behaviour (Harvey-Clark *et al.* 1999; Sims *et al.* 2000).

An aggregation of basking sharks in Pachena Bay (west coast of Vancouver Island) was described firsthand by a journalist on board a fisheries patrol vessel as “*literally crawling with sharks. There were dorsal fins [basking shark] everywhere we looked*” (Vancouver Sun, May 16 1956). Densities of basking sharks in the Alberni Canal (1921) (Barkley Sound, west coast of Vancouver Island) were described as being in the thousands by the owner of a whaling company (Port Alberni News, August 31, 1921). Similarly Gisborne (2004b pers. comm.) describes how “*one day, somewhere between 1960 and 1962, I was boating up Effingham Inlet (Barkley Sound, west coast*

of Vancouver Island) in my 16' boat; when I got near the head of the inlet, all I could see were dorsal fins [basking shark].” Anecdotal reports of aggregations in Clayoquot Sound are also reported in Darling and Keogh (1994).

Adaptability

All known or inferred life history parameters imply that basking shark populations cannot recover quickly following a reduction in abundance. They may respond to changes in the environment by shifting their distribution to more favourable areas. Aquaculture or artificial captive breeding is not a feasible option to promote recovery.

POPULATION SIZES AND TRENDS

It is important to note that basking sharks have only been enumerated while visible at the surface but the percentage of time spent at the surface is unknown. Surface activity is likely influenced by prey distribution (see Habitat section), weather conditions, and reproductive behaviours (e.g., nose to tail circling). There is no basis to speculate about inter-annual trends in the amount of time a basking shark population spends at the surface.

Search effort

Current

Although no comprehensive survey data exist for basking sharks in Canada's Pacific region, extensive boat-based surveys of marine mammals have been conducted in coastal habitat suitable for basking sharks for more than 20 years. Since 2002, the coastal surveys were augmented by offshore surveys along the west coast of Vancouver Island, west and east coasts of the Queen Charlotte Islands, and central coast of the mainland (Ford pers. comm. 2004). In addition, surveillance flights (8 with a marine mammal observer) were conducted mostly in 2002 and 2003, covering all parts of the coast out to 200 nautical miles offshore (Ford pers. comm. 2005). No basking sharks have been observed in any of these surveys.

The Juan de Fuca Express operates along the southwest coast of Vancouver Island between Port Renfrew and Bamfield. Since 1996, at least 1900 passes have been made through these waters during summer months with no records of basking sharks (Gisborne pers. comm. 2006). The water taxi service is operated by a trained marine mammal observer.

In British Columbia there is an extensive marine tourism industry that overlaps with historic areas of basking shark occupancy. An informal telephone and email survey of marine operators (including ferry, transport, and tourism operators), researchers, and educators was undertaken by one of the authors. From these correspondences there were only six recorded sightings since 1973 (not including Clayoquot Sound) (Table 2).

The B.C. Cetacean Sightings Network has no records of basking sharks (Pinnell pers. comm. 2004). The main historical areas of large aggregations of basking sharks are Rivers Inlet, Barkley Sound and Clayoquot Sound. If surface-active basking sharks were using these areas they would certainly be noticed and reported due the presence of tourism operators, a biological station, fishing operations, and extensive marine transport networks. Darling and Keogh's (1994) paper provides a comprehensive list of reliable sightings in Clayoquot Sound and includes 54 basking shark observations from a commercial pilot's flight log (1973-1992, observations in all but 5 years), and six other observations (1988-1991). All observations were from channels and inlets.

Table 2. Recent sightings of basking sharks in Canada's Pacific waters based on a survey of marine vessel operators, researchers, and educators.

Date	Name/Affiliation	Location	Comments
1973	Gisborne, B. (Juan de Fuca Express water taxi)	Head of Bamfield Inlet, Barkley Sound	
1979	Stewart, Anne (BMSC, Public Education)	Trevor Channel, Barkley Sound	
1982	Stewart, Anne (BMSC, Public Education)	Trevor Channel, Barkley Sound	35' long
1984	Watson, Jane (Malaspina University College)	Trevor Channel, Barkley Sound	Present for a week
1999	Mitchell, Jim (DFO, South Coast Division)	48 39 50N, 124 50.8W; southwest coast Vancouver Island (off Nitnat)	12', in 8 m of water
2002	Kattler, D. (BC Ferries 2nd Officer)	30 miles SW of Rose Spit (53 43.1 131 18.95)	July
2005	Lloyd, Kitty (Naturalist, Bluewater Adventures)	Queen Charlotte Islands	

Since 1996, the groundfish bottom trawl fishery (outside waters-'Option A') has been monitored intensively (100% observer coverage on all trips). The number of separate bottom trawl tows has averaged about 18,000 per year yet the database includes only four reliable records of encounters with basking sharks (PacHarvTrawl) (Table 3). There are no known basking shark records in other fisheries surveys, surveillance flights, or catch databases. If basking sharks were present, they would be caught as bycatch in the commercial Pacific hake fishery because both species typically prefer zooplankton-rich waters, yet again no encounters have been recorded from this fishery despite comprehensive observer coverage.

Table 3. Occurrence of basking sharks in groundfish trawl surveys off British Columbia between 1996-2004. Source: Pactrawl database.

Fishing Year	Latitude	Longitude	Estimated Weight (kg)	Month	Fishing Depth (m)
1996	51.86	130.52	1100	May	288
2000	51.88	130.54	1100	February	353
2000	51.70	130.72	900	March	381
2004*	Rennell Sound		1350	August	Unknown

*Record confirmed from photograph taken onboard, not yet available in database.

Historical

Considerable effort was made to comprehensively examine historical records to develop an understanding of past abundance (this study; Wallace and Gisborne 2006). Records examined were from scientific sources, newspapers, government records pertaining to the eradication program, commercial harvest, and sport fishing of basking sharks. These records are listed in Appendix 1. The conclusions of this report do not depend on the specifics of the anecdotal and newspaper reports, but these accounts are expected to provide a reliable indication of general abundance and distribution.

Historic and scientific record

The early historic and scientific record for the Pacific population is limited but consistently describes basking sharks as an abundant species. In a newspaper article in 1862 J.G. Swan describes basking sharks as “plentiful” and describes the waters along the shores of Juan de Fuca Strait (near Port Renfrew) as “alive” with basking sharks (Appendix 1). Swan (1868) describes basking sharks as “very abundant during the summer and fall” in a journal entry referring to Neeah Bay, Washington. Dawson (1880) published a report on the Queen Charlotte Islands and states that “large sharks abound on the northern and western coast”. Although he does not mention the species of shark, he wrote that the livers produce “a large quantity of oil”, and therefore, it is likely that he is referring to basking sharks. In 1905 there is a brief mention of basking sharks in the *British Columbia Fisheries Commission* report stating that they are common in Queen Charlotte Sound during the summer months and that they are harmless and can be touched by hand. The first scientific account was by Clemens and Wilby (1935) who describe the basking shark as “common along the British Columbia coast.” There is also one correspondence between Dr. W.A. Clemens with the Chief Supervisor of Fisheries, J.A. Motherwell in April 1935 who noted, while on a fur seal survey, that there were “numerous humpback whales and basking sharks” approximately 25 miles south of Pachena (southwest Vancouver Island coast). Darling and Keogh’s (1994) paper is the only scientific study on basking sharks on Canada’s Pacific coast.

Abundance and mortality

The current abundance of basking sharks in Canada’s Pacific waters is unknown but all evidence indicates it is much reduced. Evidence from historical records shows a wide distribution with several areas supporting localized aggregations numbering in the hundreds or possibly thousands (Wallace and Gisborne 2006). At present, basking sharks appear infrequently in Pacific waters with only six confirmed sightings since 1996 and only ten since 1973 (not including Clayoquot Sound), of which four are from trawl observer records and were likely killed (Tables 2 and 3). Thus, there is no reliable way to estimate the current population size.

Fluctuations and trends

To assess basking sharks over three generations requires going back at least 66 years. From 1900 to 1970, basking sharks were regularly found in numerous locations along British Columbia's coast (see Table 1). Throughout this period they were subject to a commercial harvest, a directed eradication program, incidental catch, and sport harpooning. This study has summarized all known historical records of basking sharks in Canada's Pacific waters and conservatively concludes that over 1000 sharks were killed between 1945 and 1970 (Appendix 1).

Commercial fishery

Most information on the commercial fishery for basking shark livers is qualitative from newspaper reports. A newspaper article from 1921 quotes the head of Consolidated Whaling Company who describes how "schools of thousands [basking sharks]" in Alberni Canal were so dense that in July "one of the coastal steamers ran into such a solid school of these big fellows that, packed tightly against the sides of the boat and around her bow, they stopped her completely" (Port Alberni News, August 31, 1921). Fisheries statistics from this era make no reference to basking shark landings as the products of the basking sharks were likely sold and categorized as reduction products such as fish oils, fish meal or fish fertilizer.

Based on economic data and newspaper sources, it appears that the war-era commercial fishery for basking shark liver was likely limited to the years between 1941 and 1947. Newspaper articles from 1946 reported that "several fishboats [sic] in the Bamfield area" were utilizing harpooning techniques in the pursuit for basking sharks (Vancouver Sun 1946). Unfortunately all basking shark landings were lumped together and reported as "Mixed Shark" which comprised brown cat, blue, sleeper, and salmon sharks. Between 1941 and 1945 there was 379 t (841,600 pounds) of mixed shark liver reported in the annual catch summaries. According to newspaper records, each basking shark yielded approximately 450 kg (1000 pounds) of liver. If, for example, 10% of the liver landings were from basking sharks, then approximately 80 sharks may have been processed. There is no reasonable basis to speculate about the numbers of sharks killed.

Fisheries interactions and eradication

For much of the last century, basking sharks were considered a nuisance to commercial salmon fishing operations, both gillnetting and trolling. Basking sharks appeared to favour habitats similar to those of salmon (e.g., areas of dense aggregations of zooplankton) and consequently interacted with salmon fishing fleets. Mortality was incurred from both entanglement and directed eradication aimed to reduce the nuisance factor. Reports of four basking sharks in commercial groundfish trawl fisheries since 1996 suggests that bycatch of basking sharks has likely occurred at some level throughout the 70-year history of the trawl fleet.

Following are some brief descriptions taken from newspapers and other reports to assist in describing the interactions and for estimating mortality.

Rivers Inlet

A photograph taken in 1901 in Rivers Inlet is the first verified interaction between a basking shark and the salmon gillnet fleet (BC Archives 2004). In 1942, “hundreds of huge basking sharks” were reported to have caused “thousands of dollars” worth of damage to gillnets in the Rivers Inlet district (Province 1942). In 1943, B.C. Packers responded to this loss by designing the “razor-billed shark slasher”, a specially fitted boat “with a sharp steel ram [that] cuts the sleeping monsters down as they lay on the surface” (Province 1943). Only six sharks were reported in the media to have been killed by this device. In June of 1944 it was reported that “giant sharks [basking] are again annoying sockeye salmon fishermen at Namu” and that the sharks are “much bigger than in other years” (Colonist 1944). In 1947, it was reported that “numbers of huge sharks” were inflicting “heavy damage” on the 100 boats fishing in Rivers Inlet (Province 1947). In July 1947, it was reported that “along the mainland coast...thousands of basking sharks have invaded the waters in the past week” (Colonist 1947). It is unknown if the slashing device was utilized subsequent to 1943. Since 1948 there have been no further records of basking sharks in the Rivers Inlet area. It should be noted that in some years, up to 1200 boats fished the Rivers Inlet fishing grounds. There are several other newspaper references to this area listed in Appendix 1.

Barkley Sound

Anecdotal and newspaper reports describe locations in the Barkley Sound region with hundreds if not thousands of basking sharks (Appendix 1). Between 1945 and 1969, and possibly earlier, basking sharks were a well known nuisance to Barkley Sound gillnetters (Appendix 1; Table 4). Despite annual calls by fishermen for an eradication program between the years of 1948-1954, it was not until 1955 that the Federal Fisheries Department of Canada actively engaged in an eradication program. From 1955-1969, 413 sharks were killed by a large blade mounted on the bow of a fisheries patrol vessel (Table 4). Prior to the blade method of eradication, shooting and harpooning by patrol vessels was also tried. Concurrent to the blade method, other patrol vessels along the coast were under directive to opportunistically ram basking sharks which may account for an additional 200-300 kills (Fletcher, pers. comm. 2004).

Entanglement was likely the largest source of historical mortality, but the number of kills cannot be accurately quantified. Once a basking shark became entangled in a gillnet, sharks either died or were killed by fishermen in an attempt to salvage their nets (Peterson 1999). In November 1952, *Western Fisheries* reported that a single gillnetter caught seven basking sharks in that one season alone. One Barkley Sound fishermen recounted “destroying” seven or eight basking sharks over several years (circ. 1950s) that were caught in his net. The same fisherman estimated that there were approximately 150 gillnetters operating in Barkley Sound during this period and therefore many mortalities would have gone unrecorded (Peterson 1999). There have also been reports of entanglement in trolling gear (Table 4). In any given year between 1942-1969) several hundred gillnetters fished in these core areas. Based on historical interpretation by the authors, it is suspected that several hundred sharks (400-1500) may have been killed from entanglement in Rivers Inlet and Barkley Sound from 1942-1969.

Table 4. Occurrence of basking sharks in Barkley Sound as reported in the *Barkley Sound Area Annual Fisheries Reports (1949-1969)*.

Year	Comments Transcribed from Reports	# killed
1949	Basking sharks appeared in Barkley Sound at the start of the sockeye season and did some damage to fishermen's nets. This year however they did not remain in the area as long as usual and damage was much lighter than it has been for the past few years.	
1950	Basking sharks appeared in large numbers during the sockeye season and did a great deal of damage to fishermen's nets.	
1952	Basking sharks did not appear so numerous in Barkley Sound this year and consequently damage to Sockeye gill-nets was not too serious.	
1955	Predators as usual inflicted their toll on fish and fishermen, with the basking shark again in the limelight. These sharks appeared in Barkley Sound in late February and remained a menace to gill-nets until June, at which time the bulk of them moved offshore where they hampered trolling operations. After rather futilely attempting to reduce their numbers by harpooning, permission was granted by the Department to have a knife-like weapon installed on the bow of the patrol vessel. This device, after a few strengthening modifications, proved very effective and a total of 65 sharks were killed during the year, evoking many favorable comments from fishermen. Basking sharks were again present in large numbers in and off Barkley Sound, causing considerable damage to trolling gear and nets. The knife installed on the FPC "Comox Post" to help combat this menace proved successful, with 65 being destroyed.	65
1956	Basking sharks were again present in large numbers in and off Barkley Sound. By use of the shark knife mounted on the FPC "Comox Post", 105 were destroyed, following which very few reports of net damage were received by fishermen.	105
1957	Basking Sharks: Were again present in and off Barkley Sound in quite large numbers, although evidently decreased from the previous year judging by the lighter net damage. Only 7 were destroyed by the use of the knife on the bow of the F.P.C. "Comox Post" due to the fact that the boat was in refit during the time the sharks were most prevalent.	7
1958	Basking Sharks: Were again present in quite large numbers but did not show on the surface very often during the hot summer. During October when the sharks were showing the "Comox Post" was in refit. However, during the season the "Comox Post" destroyed a total of 52 with the knife mounted on the bow. Considerable net damage was caused by the sharks during October, and during the sockeye fishing in summer.	52
1959	Basking Sharks: Were as usual present in quite large numbers in Barkley Sound during the Spring, Summer, and Fall, and they were destroyed by means of the knife mounted on the FPC "Comox Post" whenever seen. During 1959 a total of 47 were destroyed in this manner. Considerable damage to salmon gillnets were reported throughout the season, mainly during the summer Sockeye fishery in Alberni Inlet.	47
1960	Basking Sharks: Were again very numerous in Alberni Inlet and Barkley Sound, causing considerable damage to gillnets. However, as they did not often show on the surface, only eleven were destroyed by the knife mounted on the bow of the FPC "Comox Post".	11
1961	Basking Sharks: Were as usual very numerous in Barkley Sound but, except for May and part of June, they did not often show, while still doing considerable damage to salmon gillnets. From May 9 th to August 10 th 32 were destroyed by means of the knife mounted on the FPC "Comox Post". This was the total for the year.	32
1962	Basking Sharks: Were numerous in Barkley Sound, and 20 were destroyed by the knife on the FPC "Comox Post".	20
1963	Basking sharks were destroyed by the knife on the FPC "Comox Post", and in this manner 37 were destroyed during the year, compared to 21 last year, 32 in 1961, 11 in 1960, 47 in 1959, and 52 in 1958.	37
1964	Basking Sharks: Were quite numerous in Barkley Sound during the summer, but none were destroyed due to the absence of the refit of the FPC "Comox Post", which is the only vessel adapted to carry the shark knife.	0
1965	The destruction of basking sharks by the knife-equipped F.P.C. "Comox Post" was only 8, compared to none in 1964, 37 in 1963, 20 in 1962 and 32 in 1961.	8
1966	The destruction of basking sharks in the Barkley Sound subdistrict this year was nil. Although the FPC "Comox Post" has the knife located at Ecoole for quick attachment there were no basking sharks reported. For some reason this past year they were not showing at the surface.	0
1967	21 basking sharks were destroyed in Barkley Sound by the Departmental personnel using the Comox Post Shark Knife attachment. Three nets were destroyed by these fish in 1967. One was a total loss, and the other two were 60% losses. Several gillnets were damaged by basking sharks in the early part of the season. 21 sharks were destroyed in two days by the FPC "Comox Post". No damage to nets was reported after that date, and sightings of the animals decreased considerably.	21
1968	Trollers and one gillnetter reported basking sharks tangling up and destroying their gear on May 17 th . The shark knife was installed and eight basking sharks were destroyed on May 22 nd . The sharks then moved out of the area.	8
1969	No control program was carried out on the basking shark population. Six reports were received of nets being damaged and two nets were completely destroyed. One shark was strangled in a gillnet. The shark knife was installed on the FPC "Comox Post" with "nil" results.	0

Clayoquot Sound

Darling and Keogh (1994) provide a thorough report of basking shark behaviour, abundance and distribution in Clayoquot Sound using observations from 1973-1992. Aerial sightings and other anecdotal reports indicate that basking sharks were in the Sound throughout most of the 20-year period investigated. A single summer of photographic identification work undertaken in 1992 resulted in 27 individuals being photo-identified. Many of the sharks had wounds from propellers which was supported by observations of the sharks seemingly being attracted to boat propellers. The following summer resulted in a few sporadic sightings (not reported) and since 1994 there have been no confirmed sightings from Clayoquot Sound (Darling pers. comm. 2003). Their disappearance coincides with the rapid development of salmon aquaculture in the region but there is no formal evidence to link these two events (Darling pers. comm. 2003). In Clayoquot Sound the salmon farms make large netted pens perpendicular to the coastline within the areas where basking sharks were common for centuries. According to Darling (pers. comm. 2003) basking sharks are easily entangled in anything, even a single line going to a prawn trap, and therefore would be vulnerable to entanglement in the net pens of a salmon farm. Official replies from salmon farm companies state that entanglements have not occurred but unofficial communications from employees suggest otherwise (Darling pers. comm. 2005).

It is possible that their sudden disappearance from Clayoquot Sound was caused by a shift in distribution but there are no records of their reappearance in other locations. Jordan (1887), who wrote extensively on whaling, noted that in Monterey Bay the basking shark was sometimes not seen for 20 years.

Sport Kills

It is not possible to estimate the number of basking sharks killed for sport in the 1940s through to the mid-1960s as the only written records are from newspaper stories (Table 5). In the 1940s, the sport of harpooning basking sharks had acquired enough interest that the Canadian Pacific Railway promoted fishing for BC basking sharks in publicity releases (Colonist, September 27, 1953). One newspaper article describes a person harpooning ten and landing five in a single day around the waters off Texada Island in June (Province, June 7, 1947). Sport kills for basking sharks, which includes all forms of 'recreational' killing and harassment leading to death was likely in the multiple hundreds (50-400).

Estimated total mortality and decline

There is great uncertainty associated with trying to interpret and quantify historical information. In this report it has been estimated that the total number of sharks killed (1945-1970) by eradication is 413, other patrol/eradication methods (200-300), entanglement (400-1500), and sport kills (50-400). This results in a range of kills between 1000-2600. Note that this estimate does not include commercial kills for liver oil.

Table 5. Occurrence of basking sharks in sport fishery as reported in British Columbia newspapers.

Year	Location	Number reported	Month	Source
1947	Texada Island	5 killed, 5 misses, 2 unknown	June	Province, June 7 1947 p. 5 Times Colonist, July 5 1952 p. 11.
1952	Brentwood Bay	School of basking sharks	July	Times Colonist, July 5 1952 p.11
1952	West Coast VI	3 killed	July	Colonist, April 20 1956 p. 1
1956	Saanich Inlet	1 killed	April	Colonist, June 5 1956 p. 13
1957	Qualicum Beach	“Considerable numbers”	June	

A minimum historical population of 750 individuals can be reconstructed from the estimated annual removals from 1945 to 1970 ($N_m = 40$ individuals, i.e., 1000/25 years) coupled with the estimate of annual productivity ($r = 0.023$, see Lifecycle and Reproduction section). In other words, at a mortality rate of 40 animals per year, it would take 25 years for an initial population of 750 to be diminished to zero assuming $r = 0.023$. Note that there is no reliable information on trends in abundance to corroborate this inference.

Summary

There is little doubt that basking sharks once frequented British Columbia’s coast in numbers and distribution much larger than found today (Wallace and Gisborne 2006). For most of the historical record, basking sharks were regularly encountered by mariners. They were described as being *plentiful* and *common* in several early descriptions. The disappearance of local aggregations coincides with known sources of human-caused mortality, which is consistent with experiences from other regions in the world. Where basking shark populations have been observed, annual number of records is at most in the low thousands (Squire 1967; Compagno 2001). The small local occurrence of basking sharks in Clayoquot Sound was the last known aggregation in British Columbia.

There are very few recent surface (i.e., visual observations) or subsurface (trawl observer data) records, suggesting that basking sharks are presently rare in British Columbia waters. Overall, it appears that the population coastwide has declined from a minimum of 750 individuals to virtually none within a span of 60 years (2-3 generations).

Rescue effect

The only other area known for basking shark aggregations in the eastern north Pacific is central and southern California. Basking sharks in British Columbia and California sharks may belong to one population based on convincing data for the seasonal disappearance of basking sharks from California waters between May and July, just as they reappear in relative abundance in waters off BC (Squire 1967, 1990).

Within California waters, two areas in particular were known to have high concentrations, Monterey Bay and Pismo Beach (Squire 1967). Squire (1990) notes that there was a greater abundance of basking sharks observed prior to 1970 based on extensive aerial survey data. Humans, both in Canada and California, have inflicted significant mortality upon the Pacific populations. In California, the basking shark fishery developed in earnest in 1924 as a sport. Between 1924 and 1938 an average of 25 sharks per year were killed with close to a 100 being landed in one year. Starting in 1946 the fishery targeted basking sharks for their livers, 300 sharks were taken in the first season. Efficiency in capturing sharks was improved by using aerial surveillance to spot the animals (Phillips 1948). The number of California kills from the late 1940s is estimated at 200/year (Roedel and Ripley 1950). It is generally accepted that the fisheries of the 1940s and 1950s reduced the populations substantially, and that the species has never recovered (UK CITES proposal 2002, Van Sommeran pers. comm. 2004). The concurrent disappearance in waters off both California and British Columbia is further evidence of a single population.

Overall, the likelihood of a rescue effect from U.S. waters is considered low. First, abundance in US waters is also depleted. Second, no rescue effect has been evident to date, 30 years after directed killing ceased. The population structure of basking sharks may be more complicated than is presently inferred from seasonal migration. For example, a similar inference about population structure in Pacific salmon based only on the seasonality of individual movements would be seriously in error.

LIMITING FACTORS AND THREATS

Basking sharks are particularly vulnerable to any human-induced mortality because of their late age of maturity, low fecundity, long gestation period, long periods between gestations, low productivity, sex segregated populations, use of habitat that supports commercial fisheries, lack of fear of vessels, and current small population size.

Human-induced mortality in Pacific Canadian waters is primarily from continued interactions with fishing gears as well as collisions with vessels (although there are only anecdotal records to verify this). Records indicate that basking sharks are readily caught by trawl (bottom, midwater, and shrimp), and easily become entangled in longlines, gillnets, prawn traps, cod traps, and even herring seines.

Historical fisheries and the directed eradication program appear to be the most likely causes for the low abundance of basking sharks observed today in Canada's Pacific waters. There have been few confirmed sightings or catches in recent times. Only four basking sharks have been captured (and presumably killed) since 100% observer coverage of the groundfish trawl fishery began in 1996 (Table 2). Basking sharks are susceptible to entanglement or capture by other gear types as well. In Clayoquot Sound there have been three reports of entanglement, one with prawn gear (1988), one in a herring seine (1992), and one in a salmon gillnet (1992) (Darling and Keogh 1994). Despite the few recent instances of mortality, fisheries interactions remain

a concern because of the decline in the number of basking sharks. In fact, most basking sharks sightings are now associated with incidental capture.

SPECIAL SIGNIFICANCE OF THE SPECIES

The basking shark is monotypic within the family Cetorhinidae and is one of only three genera of filter feeding sharks. The earliest fossil records for basking sharks are thought to have originated between 35 and 29 million years ago (Leriche 1905; Martin pers. comm. 2005). Other noteworthy life history characteristics include the longest gestation of any vertebrate (estimated at 2.6 to 3.5 years), very late maturity, slow growth, probable low fecundity, all contributing to an extremely low intrinsic population growth rate. These traits make the basking shark extremely vulnerable to exploitation (Pauly 2002).

The trade of basking shark fins to Asian countries continues to be of international concern. The fins from basking sharks have fetched USD 30,000/t in international trade (Fairfax 1998). In 2000, the fins from basking sharks caught in Norway were valued at \$2000 per shark. The recent inclusion of basking sharks under Appendix II of CITES is intended to regulate this trade. At present, there is a zero quota from European waters and the World Conservation Monitoring Centre has no recent records (Fowler pers. comm. 2004).

Basking sharks are a plausible explanation for some reports of sea serpents, sea monsters, and the Cadborosaurus (Caddy). There have been 181 'Caddy' sightings in British Columbia since 1881 (Leblond and Bousfield 1995). Many of the stranded sea monsters between 1930 and 1960 were proven to be basking sharks; all known strandings of basking sharks (n=3) occurred in late fall, perhaps reflecting some unknown aspect of their life history.

Basking sharks fit the description of large charismatic mega-fauna and as such have proven to provide socio-economic benefits in places where their populations are accessible to eco-tourists.

ABORIGINAL KNOWLEDGE

There are few known records referring to Aboriginal use of basking sharks. George (2003) mentions that there is a stream in Clayoquot Sound called 'Shark Creek' which is named after the Nuu-Chah-Nulth place name, *mamach-aqtlnit*, which is the translation for basking shark. Drucker (1951) explains how Nootkan tribes in the 1850s harpooned big "mud sharks" using sealing harpoons and how hunting them was not dangerous or difficult as the shark was not "wary".

Dawson (1880) reported that, "*large sharks are much feared by the Haidas, who allege that they frequently break their canoes and eat the unfortunate occupants. No*

instance of this kind is known to me, but they fear to attack these creatures. When, however, one of them is stranded, or found from any cause in a moribund state, they are not slow to take advantage of its condition, and from the liver extract a large quantity of oil.”

The Province newspaper in 1944 published an article about the Huu-ay-aht Whaling Chief John Moses (Barkley Sound) who “on any sunny day when the water is reasonably calm” would paddle his dugout canoe, sometimes 10 miles offshore to kill basking sharks by means of “heavy spear attached to 600 feet of half-inch rope”. Once speared, a struggle would sometimes extend over a period of six hours, after which time he would tie the dead basking shark astern and set out to tow it back to shore—10 miles away. The incentive for the trip was \$80 for selling the liver.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

There is no explicit protection of basking sharks in Canada. This species receives *de facto* protection by broad regulations that prohibit finning of any shark species. Given that there is no market for other parts of basking sharks in Canada, there is no directed exploitation. Elsewhere in their global range, they fall under a variety of protective measures or status designations. Internationally, the IUCN Red List assessment has categorized basking sharks as Vulnerable globally and Endangered in the northeast Atlantic and north Pacific and even Critically Endangered in the case of “Barkley Sound” (Canada) (Fowler 2000). In 2002, a CITES Appendix II proposal put forth by the government of the United Kingdom was accepted and came into effect at the end of February 2003.

In US federal Atlantic waters basking sharks are protected by a National Marine Fisheries Service regulation for Atlantic shark fisheries which prohibits directed commercial fishing, landing and sale. The United Kingdom is the only country with strict protection for basking sharks, which in addition to any form of killing also has laws against disturbance and harassment. New Zealand’s *Fisheries Act* prohibits the targeting of basking sharks but allows the bycatch to be utilised. In the Mediterranean Sea basking sharks are listed on Annex II of the *Barcelona Convention for the Protection of the Mediterranean Sea Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean*. To date only Malta has legally protected basking sharks. The Mediterranean population is also listed on Appendix I of the *Bern Convention for the Conservation of European Wildlife and Habitats*.

Basking sharks in Pacific waters have not been assessed by the British Columbia Conservation Data Centre.

TECHNICAL SUMMARY

Cetorhinus maximus

Basking Shark

Pacific population

Range of Occurrence in Canada: Pacific Ocean

Pèlerin

Extent and Area Information	
<ul style="list-style-type: none"> Extent of occurrence (EO)(km²) <p>Pacific: no basis to estimate current area</p>	Unknown
<ul style="list-style-type: none"> Specify trend in EO 	Reduction
<ul style="list-style-type: none"> Are there extreme fluctuations in EO? 	Unlikely
<ul style="list-style-type: none"> Area of occupancy (AO) (km²) <p>Pacific: no basis to estimate current area</p>	Unknown
<ul style="list-style-type: none"> Specify trend in AO 	Large reduction
<ul style="list-style-type: none"> Are there extreme fluctuations in AO? 	Unlikely
<ul style="list-style-type: none"> Number of known or inferred current locations 	Continuous distribution
<ul style="list-style-type: none"> Specify trend in # 	Not applicable
<ul style="list-style-type: none"> Are there extreme fluctuations in number of locations? Some indication of interannual variability. 	Not applicable
<ul style="list-style-type: none"> Specify trend in area, extent or quality of habitat <p>Pacific population no longer present in areas of historical importance</p>	Unknown
Population Information	
<ul style="list-style-type: none"> Generation time (average age of parents in the population) 	Probably 22-33 years
<ul style="list-style-type: none"> Number of mature individuals 	Rare
<ul style="list-style-type: none"> Total population trend: 	Decline
<ul style="list-style-type: none"> % decline over the last/next 10 years or 3 generations. 	>90% (inferred)
<ul style="list-style-type: none"> Are there extreme fluctuations in number of mature individuals? 	Unlikely
<ul style="list-style-type: none"> Is the total population severely fragmented? 	Continuous distribution
<ul style="list-style-type: none"> Specify trend in number of populations 	Not applicable
<ul style="list-style-type: none"> Are there extreme fluctuations in number of populations? Possible extremes in locations but not actual populations. 	Not applicable
<ul style="list-style-type: none"> List populations with number of mature individuals in each: 	
Threats (actual or imminent threats to populations or habitats)	
<p>Historical fisheries and directed eradication program are the most likely cause for the low abundance of basking sharks observed today. Interaction with fishing gears is currently the single greatest known threat to this species in Canada. Basking sharks are vulnerable to being caught/entangled in nearly all forms of fishing gear (seines, gillnets, troll, traps, longlines, salmon net pens and trawls). Occasional bycatch is reported on Pacific coast. Collisions with vessels are not often reported but may also cause mortality. The biology and population history of this species suggests that they are especially vulnerable to long term human-induced mortality.</p>	
Rescue Effect (immigration from an outside source)	
<ul style="list-style-type: none"> Status of outside population(s)? <p>USA: probably same population as in Canada. Numbers severely depleted in primary US site, California.</p>	
<ul style="list-style-type: none"> Is immigration known or possible? 	Yes
<ul style="list-style-type: none"> Would immigrants be adapted to survive in Canada? 	Likely
<ul style="list-style-type: none"> Is there sufficient habitat for immigrants in Canada? 	Yes
<ul style="list-style-type: none"> Is rescue from outside populations likely? <p>Abundance in US waters is similarly depleted.</p>	No

Quantitative Analysis [provide details on calculation, source(s) of data, models, etc]	Not undertaken
Current Status COSEWIC: Endangered (2007) IUCN (2000): Globally-vulnerable, NE Atlantic-Endangered, North Pacific endangered CITES: Appendix II	

Status and Reasons for Designation

Status: Endangered	Alpha-numeric code: A2a; C1
<p>Reasons for Designation:</p> <p>This shark species is the only extant species in the family Cetorhinidae. It occurs circumglobally in temperate coastal shelf waters, and exists in Canada as two geographically isolated designatable units – Atlantic and Pacific. The species is vulnerable to incidental fishing mortality because of its low intrinsic productivity. Females do not mature until 16 to 20 years old, gestate between 2.6 and 3.5 years (the longest known gestation period for any vertebrate), and produce litters of only about 6 “pups”. These sharks are especially susceptible to entanglement in fishing gear and collision with boats because of their large size, surface behaviour and fearlessness around boats, and because their coastal distribution overlaps fishing and boating areas. Prior to 1970, large aggregations of these sharks were seasonally common in Pacific Canada, but only 6 sightings have been confirmed since 1996. This dramatic reduction in abundance is attributed to directed fisheries for liver oil (1941-1947) and an eradication program (until 1970) that killed hundreds, perhaps thousands of individuals between 1945 and 1970. The minimum historical population reconstructed from documented kills was at least 750 individuals, whereas the current population is virtually nil, implying a rate of decline exceeding 90% within < 2 generations. The species is believed to migrate seasonally between Canada and California, where regional aggregations were also severely depleted by historic fisheries. Rescue from outside Canada is unlikely.</p>	
<p>Applicability of Criteria</p> <p>Criterion A: (Declining Total Population): Meets Endangered A2a (Population decline >50% over the past 3 generations, based on direct observation, where the reduction or its causes may not have ceased, may not be understood, or may not be reversible).</p> <p>Criterion B: (Small Distribution, and Decline or Fluctuation): Not applicable.</p> <p>Criterion C: (Small Total Population Size and Decline): Meets Endangered C1 (Number of mature individuals <2,500 and an estimated continuing decline rate of at least 20% in 2 generations (44-66 years); only 6 confirmed sightings since 1996 of which 4 were encountered as bycatch and likely died.</p> <p>Criterion D: (Very Small Population or Restricted Distribution): May apply since remaining population is suspected to be less than 250 individuals, but current estimates are not sufficiently precise to defend this conclusion.</p> <p>Criterion E: (Quantitative Analysis): Not applicable.</p>	

ACKNOWLEDGEMENTS

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This report was handled for COSEWIC by Mart Gross and Howard Powles (Co-chairs, Marine Fishes Specialist Subcommittee) and by Jeff Hutchings and Chris Wood (Marine Fishes Specialist Subcommittee Members).

AUTHORITIES CONSULTED

Federal government (DFO) authorities on this species are co-authors of this report. The British Columbia Conservation Data Centre has not assessed the basking shark. Findings from international conservation organizations are included in the report (i.e., IUCN and CITES).

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Dr. Scott Wallace is an independent fisheries scientist (PhD UBC Fisheries Centre) and operates a consulting firm, Blue Planet Research and Education, on Vancouver Island, BC. His interests are best management practices and the sustainability of Pacific fisheries. Dr. Steven Campana is a DFO Senior Scientist at the Bedford Institute of Oceanography, Nova Scotia where he studies Canada's Atlantic sharks. Dr. Gordon (Sandy) McFarlane is a DFO scientist at the Pacific Biological Station, BC where he studies the biology and distribution of sharks and skates. Dr. Jacquelynne King is a DFO scientist at the Pacific Biological Station, BC where she studies age and growth parameters for big and longnose skates, ageing methodology for sixgill sharks, and distribution and migration of spiny dogfish.

Appendix 1. Headlines and titles of articles pertaining to basking sharks from non-scientific sources from 1858 to present day with an emphasis on British Columbia and adjacent waters.

Title of Article or Headline	Source
Clayoquot Sound—The Tonquin Massacre	Victoria Gazette, September 9, 1858, Number VII
The Fishes of Puget Sound	Washington Standard, June 20, 1862
Battle with Shark	Colonist, September 9, 1905
Shark Killed by Millmen at Cedar Cove	Province, December 5, 1905, p. 1
Fisherman's Desperate Fight With Shark	Province, September 17, 1906, p. 16
Captured a Shark	Colonist, October 6, 1906, p. 8
Will Engage in Shark Fisheries	Unknown, December 27, 1910
Caught Shark in Salmon Net: Excitement at Rivers Inlet When Sea Tiger was Captured	Province, July 15, 1915, p. 3
Sees Several Sharks Among Salmon School off Mouth of Fraser	Sun, August 2, 1915, p. 9.
Sharks in Local Waters	Colonist, July 30, 1916
Says Shark Meat is Very Superior Food	Colonist, July 25, 1920, p. 21
Shark Industry to be Developed on Large Scale	Times, August 25, 1921, p. 12
Shark Fishing Industry to be Located on Alberni Canal	Port Alberni News, August 31, 1921
Halibut Fishermen Say "Sea Serpent" Is a Gigantic Shark	Province, September 27, 1925, p. 16
Mystery Beast Believed to be Ancient Seacow	Province, November 24, 1934, p. 1
'Sea Monster' Basking Shark Declares Fisheries Expert	Sun, November 26, 1934, p. 1.
A Canadian "Monster": Sea-cow, Basking Shark, or "Cadborosaurus"?	The Illustrated London News, Dec.14, 1934
Byline: A battle was seen between a twenty foot shark and six sea lions.	Western Fisheries, March 1935, p. 20
Unidentified Sea Monster Found Dead	Colonist, October 8, 1936, p. 1
Gill Net Fishing Gear in Rivers Inlet	Western Fisheries, July 1937, p. 20
Dogfish and Sharks	Western Fisheries, August 1937, p. 13
Fish Meal and Oil Production and Markets	Western Fisheries, November 1937, p. 27
Sharks of the Seven Seas	Western Fisheries, February, 1938 p. 10
Sea Monster is Observed Off Oak Bay	Colonist, November 16, 1938, p. 5.
Fishing Fleet News: Seattle Seiner Lands 10-ton Shark	Western Fisheries, December 1938, p. 14
Narrow Escape	The Zeballos Miner, January 23, 1939
Report of Gillnet Fishing in Sooke Area During 1938	The Fisherman, May 9, 1939, p. 1
Sharks in B.C. Waters But Harmless	Pacific Coast News, July 27, 1939, p. 1
Tittle Tattle	The Fisherman, September 12, 1939, p. 8
Reports from Fishing Grounds	The Fisherman, July 30, 1940, p. 1
Here and There (Smiths Inlet)	The Fisherman, July 22, 1941, p. 4
Here and There (Smiths Inlet)	The Fisherman, July 29, 1941, p. 4
Fishing Ground Reports	The Fisherman, July 14, 1942, p. 2
Sharks Take Profit: Fishermen Report Their Nets Ruined	Province, August 14, 1942, p. 28
Here and There (Bliss Landing)	The Fisherman, September 8, 1942, p. 3
War Declared on B.C. Sharks	Province, February 3, 1943, p. 5
War Against Sharks is Declared	The Fisherman, February 9, 1943, p. 4

Title of Article or Headline	Source
Riflemen to Hunt Sharks	Sun, March 20, 1943, p. 23
Coast Shark Livers Help Bombing Raids on Berlin	Sun, March 30, 1943, p. 13
Fishermen Plan Mutual Aid Against Sharks	Sun, July 8, 1943, p. 19
Six Sharks Killed by Packers Boat	Province, July 12, 1943, p. 25
Fishing Ground Reports (Good Hope Cannery, Rivers Inlet)	The Fisherman, July 20, 1943, p. 3
How Insurance for Nets Works	The Fisherman, July 20, 1943, p. 2
Net Insurance Popular at Margaret Bay	The Fisherman, August 17, 1943, p. 3
Shark Liver Weighs 2,000 Lbs. (Astoria, Oregon)	The Fisherman, August 24, 1943, p. 2
Three-ton Shark Yielded 1,155 Lbs. of Liver	Commercial Fishermen's Weekly August 27, 1943, p. 318
Paddles Out To Sea To Fight Sharks	Province, June 10, 1944, p. 5
Sharks Tear Salmon Nets Near Namu	Province, June 27, 1944, p. 23
Giant Sharks Spoil Catch.	Colonist, June 29, 1944
Fishmen Say Giant Sharks Tearing Nets	New Herald, June 29, 1944, p. 1
Damage By Sharks.	Colonist, July 1, 1944, p. 21
Net Insurance at Margaret Bay	The Fisherman, July 18, 1944, p. 3
Giant Shark Loses Liver In Fight With Fisherman	Sun, May 25, 1945, p. 17
Catch 29-Ft. Shark; Liver Weighs 1747 Lbs.	Province, June 4, 1945, p. 22
Fish Shorts (Alberni Canal)	The Fisherman, June 5, 1945, p. 5
Sharks Destroy Nets	West Coast Advocate, June 28, 1945, p. 1
Sharks	West Coast Advocate, July 5, 1945, p. 11
Results Follow Shark Editorial	West Coast Advocate, July 12, 1945, p. 1
Basking Sharks Menace Fishing on West Coast	Province, July 16, 1945, p. 21
Removal of Shark Menace to Salmon Fishing is Urged	West Coast Advocate, August 2, 1945, p. 11
B.C. Fishermen Battle Shark Peril	Province, Nov. 17, 1945, p. 8 (mag. Sec.)
Bamfield News	West Coast Advocate, July 11, 1946, p. 5
Shark Harpooned, Caught Off Nanaimo	Sun, July 11, 1946, p. 5.
Shark's Liver Brings \$66	West Coast Advocate, July 11, 1946, p.10
Coast Fishermen Report Large Shark Catches	West Coast Advocate, July 18, 1946, p. 14
Harpoon, Rifle "Catch" Sharks off B.C as Livers Sought for Vitamin Oil	Fisheries News Bulletin, Vol.XVII #203-4
Sleeping Fisherman Nets Big Mud Shark	Colonist, Nov. 8, 1946, p. 16
Harpoon Favored In Shark Fishing	Sun, December 3, 1946, p. 21
Sharking	British Columbia Digest, Mar.1947, p. 73-74
Sharkhunting Latest Sport Around Texada Island	Province, June 7, 1947, p. 5
Sharks Damage Salmon Nets As Rivers Inlet Run Opens	Province, July 2, 1947, p. 33
Numerous Basking Sharks Menace to Nets Of Salmon Fishermen Along Coast of B.C.	Colonist, July 16, 1947, p. 17
Seiners Get Big Haul	The Fisherman, Aug. 8, 1947, p. 2
Seven-Ton Shark Landed After Epic West Coast Fight	Province, September 30, 1947, p. 30
Sharks Long as Street Cars Romp Off B.C. Coast	Sun, October 11, 1947, p. 5
Scientists Say Monster Not Caddy	Times, December 8, 1947 p. 3
'Caddy' Remains May Be Only Basking Shark	Sun, December 8, 1947 p. 1
Identifies Skeleton of Enormous Basking Shark	Colonist, December 13, 1947, p. 22

Title of Article or Headline	Source
Island Sea Monster Just 'Basking Shark'	News Herald, December 13, 1947 p. 4
Skeleton is of Record Size Basking Shark	West Coast Advocate, Dec.18, 1947, p. 1
British Columbia's Basking Shark	Province, December 29, 1947, p. 4
Log of the Mistral	The Fisherman, July 9, 1948, p. 6
Bounty on Basking Sharks Wanted by Coast Fishermen.	Times, July 17, 1948, p. 6
Log of the Mistral	The Fisherman, July 23, 1948, p. 6
Basking Sharks in Puget Sound and Washington Coastal Waters	Tacoma Natural History Bulletin Vol. 1 #6
Hunting Sharks Done With Harpoons, Rifles	Colonist, December 12, 1948, p. 17
Maybe 'Caddy' Mystery Now Solved	Sun, December 18, 1948, p. 23
War's Shark Liver 'Bonanza' Over As Industry Almost Dead	Times, May 9, 1950, p. 2
There Were Ten (Poem)	Western Fisheries, December, 1950, p. 25
Basking Mud Sharks Mistaken for 'Caddy'	Sun, May 31, 1951, p. 11
Special Gear Tried Against Sharks in Barkley Sound	The Fisherman, June 19, 1951, p. 2
Shark's Fin Bill's Soup Not Serpent	Times, September 10, 1951, p. 13
Big Shark Observed in Ladysmith Harbor	Colonist, June 28, 1952, p. 13
Sharks Numerous: Harpoons New Tackle in Brentwood Waters	Colonist, July 5, 1952, p. 11
Shark Big, But Basker, Not Biter	Colonist, July 9, 1952, p. 9
Gill-Netting and Basking Sharks	Western Fisheries, November 1952, p. 12
Sharks, Seals Bring Misery to Fishermen	Colonist, June 13, 1953, p. 13
Sharks, Hair Seals Harry BC Fishermen	Province, June 14, 1953, p. 5
Basking Sharks, Hair Seals Still Lead West Coast Fish Fleet's Nuisance List	Colonist, June 23, 1953, p. 2
Seals, Sharks Raid B.C. Fishers' Nets	Sun, June 24, 1953, p. 8
Shark in Gillnet Proves Costly to Q.C. Fisherman	Western Fisheries, September 1953, p. 22
Doubt Raised That Monster Really Shark	Colonist, September 20, 1953, p. 17
Sharks Return May Revive Thrilling Sport	Colonist, September 27, 1953, p. 5
Clever Marksman	West Coast Advocate, May 26, 1955, p. 1
Cruising Shark Sighted Off Qualicum Beach	Colonist, May 31, 1955, p. 24
B.C. Sharks 'Cut Up' By Unique Bow Ram	Colonist, June 22, 1955, p. 1
New Weapon Destroys Basking Sharks	Province, June 23, 1955, p. 7
Ship Fights Sharks Off B.C. Coast	Sun, June 23, 1955
Find New Method of Despatching the Basking Shark	West Coast Advocate, June 23, 1955, p. 1.
Troublesome Basking Sharks "Speared" by Patrol Vessel	Western Fisheries, July 1955, p. 19
Sliced Basking Shark Newest Fishery Dish	The Fisherman, July 5, 1955
Knife-like Ram On Vessel's Prow Kills Sharks	Trade News, August 1955, Vol. 8, No. 2. p. 5
B.C.'s big basking sharks are giants with no bite	Province, August 13, 1955, p. 20. (Mag. Sec.)
Giant too strong...Rampaging Sharks Best Sport For Thrill-Seeking City Dentist	Colonist, September 9, 1955, p. 13
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2-Hour Fight Lands 2,500-Pound Shark	Times, April 20, 1956, p. 6
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Boat Kills 31 Sharks in One Day	Times, May 3, 1956, p. 1
Fishermen Ready Boats and Gear for Season Catch	West Coast Advocate, May 3, 1956, p. 1
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Shark hunters clean up on west coast pests	Province, May 4, 1956
Basking-Shark Killer Rids Coast of Menace	Colonist, May 4, 1956, p. 20
Steel Prow Halts Invasions of Sharks	Sun, May 7, 1956, p. 11
Basking Shark School Won't Get to College	The Fisherman, May 8, 1956, p. 3
Shark Killer Ship Stabs 34 in a Day	Sun, May 16, 1956
Week-End Holiday—For Some.	Colonist, May 27, 1956, p. 2
Fewer Basking Sharks	West Coast Advocate, May 31, 1956, p. 5.
Island Shark Fishing to Be Revived	Colonist, June 5, 1956, p. 13
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Fishermen Tell Whale of a Tale But Who Likes Shark Shenanigans?	Times, November 28, 1957, p. 23
Frisky Fish Blamed As Boat Overturned	Times, August 5, 1958, p. 15
18-Foot Shark Caught In Net Off Bowen	Sun, August 29, 1958, p. 29
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Fisherman lands 27-foot shark near Gibsons	Province, September 11, 1958
Shark Panics Swimmers Children Dash to Shore	Colonist, June 19, 1959, p. 21
Relax: Those sharks aren't man-eaters!	Province, June 20, 1959, p. 1
Sharks Abound, But No Man-Eaters Here	Times, July 8, 1959, p. 4
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Forty-foot Sharks Cruise Around Vancouver Island	Islander, November 1975
++From the Goodlad Album (Photograph and caption)	West Coast Fisherman, April 1990, p. 61
1. Sleeping Giants 2. Ship Spears Sharks	West Coast Fisherman, Oct. 1990, p. 44-49
Huge knife sliced basking shark	Islander, September 1992

Sun=Vancouver Sun, Colonist=Daily Colonist (Victoria), Times=Victoria Daily Times