PROPOSED

Species at Risk Act
Management Plan Series

Proposed Management Plan for the Pacific Harbour Porpoise (*Phocoena phocoena*) in Canada

Pacific Harbour Porpoise

August 2009

Fisheries and Oceans Canada
Pêches et Océans Canada
Canada

Management Plan for the Pacific Harbour Porpoise (*Phocoena phocoena*) in Canada [PROPOSED]

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About the *Species at Risk Act* Management Plan Series

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

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

What is a species of special concern?

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

What is a management plan?

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

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

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

What's next?

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

The series

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

To learn more

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

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Additional copies:

Additional copies can be downloaded from the SARA Public Registry (http://www.sararegistry.gc.ca/).

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PREFACE

The Pacific harbour porpoise is a marine mammal and is under the responsibility of the federal government. The *Species at Risk Act* (SARA, Section 65) requires the competent minister to prepare management plans for species listed as special concern. The Pacific harbour porpoise was listed as a species of special concern under SARA in 2003. The development of this management plan was led by Fisheries and Oceans Canada – Pacific Region, in cooperation and consultation with many individuals, organizations and government agencies, as indicated below. The plan meets SARA requirements in terms of content and process (SARA sections 65-68).

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

RESPONSIBLE AGENCIES AND JURISDICTIONS

Fisheries and Oceans Canada
Government of British Columbia
Environment Canada
Parks Canada
Transport Canada
Department of National Defence
Natural Resources Canada

AUTHOR

Fisheries and Oceans Canada (DFO).

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STRATEGIC ENVIRONMENTAL ASSESSMENT

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

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

Through the development of this plan numerous factors that jeopardize or have potential to jeopardize the management of these populations were evaluated and are presented. Harbour porpoise are particularly sensitive to disturbance or degradation of habitat resulting in a myriad of realized and potential threats to the species. The principal anthropogenic factors or threats affecting harbour porpoise in B.C. are; entanglement in fishing or other gear, habitat degradation, toxic spills, chemical contamination and acoustic disturbance. In some cases these factors threaten the population directly; in other cases they affect harbour porpoise habitat. It was concluded that some threats can be mitigated through the use of existing legislation, policies and programs and, in fact, there are numerous examples of mitigation measures that are currently employed. However, in other cases additional mitigation measure(s) in the form of enforcement of regulations, development of guidelines and protocols may be required to protect the population. In some cases, further research or evaluation may be necessary before recommendations on specific actions or activities can be formulated. The general type of research, evaluation and approaches for mitigation are presented in this management plan (see Section 2.3 ‘Actions’).

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

EXECUTIVE SUMMARY

Harbour porpoise (*Phocoena phocoena*) are a small marine mammal reaching a length of about 2.2 m and weight of about 75 kg when fully grown, making them the smallest cetacean in Canadian waters. The species exhibits sexual dimorphism, with females of this species generally being larger than males. Harbour porpoise are often difficult to observe in the wild, in part due to the grey-brown counter-colouration on the dorsal surface with lighter lateral undersides. A distinctive lateral grey-brown stripe(s) extending from the corner of the mouth, to the pectoral flipper on both sides of the animal can sometimes be observed. This is a shy species that seldom rides bow waves of vessels and rarely, if ever leaps out of water. Further complicating the observation of wild harbour porpoise is that the 15-20 cm high dorsal fin rarely makes an exit or entry splash.

In Canada, the species is found in the relatively shallow waters of the continental shelves and coastal waters on the east and west coasts of Canada. Pacific harbour porpoise are found throughout British Columbian waters, but certain areas appear to be seasonally favoured. More dense aggregations and increased seasonal densities have been reported from the southern Strait of Georgia and in Juan de Fuca Strait, near Victoria.

Little information is available on the abundance and population trends of the Pacific harbour porpoise in B.C. However, research on contaminant loading and genetic structure of the population suggests that harbour porpoise in B.C. may exist in stratified population sub-units, with little regional dispersal. There are reports that the harbour porpoise population of southern B.C. and northwestern Washington declined since the 1940's. This decline is inferred from qualitative observations and as such, assessment of trends in relative abundance over the last half century is difficult. The potential for further reduction or displacement exists, as both the human population and use of coastal waters increases.

Given that harbour porpoise inhabit coastal areas and appear to be particularly sensitive to environmental disturbance, there are several identified threats to this species. The most significant of threats are: entanglement in fishing gear, habitat degradation, toxic spills, acoustic disturbance, and contamination by persistent bioaccumulative toxic chemicals. Despite uncertainties on dietary needs, competition with fisheries is also of moderate concern for long-term impacts to population health. Further research will assist in clarifying this threat.

For populations, such as Pacific harbour porpoise, which may occur over small ranges or exist in restricted habitats, the cumulative effect of any combination of threats may result in more deleterious consequences than any single threat alone. Reducing the risk of entanglement and coastal habitat degradation is essential for effective management of this population. Uncertainties remain regarding harbour porpoise abundance and diet in B.C., and actions and objectives will address these and other issues. A multi-species approach to research efforts will allow for effective use of available resources.

TABLE OF CONTENTS

FIGURES & TABLES

1. SPECIES INFORMATION

1.1. Species Assessment Information from COSEWIC

Date of Assessment: November 2003

Common Name (population): Pacific Harbour Porpoise

Scientific Name: *Phocoena phocoena*

COSEWIC Status: Special Concern

Reason for Designation: Harbour porpoise appear to be particularly sensitive to human activities, and are prone to becoming entrapped and killed in fishing nets. They are a short lived, shy species that are now rarely seen at the highly developed areas of Victoria and Haro Strait. Continued development and use of its prime habitat by humans are some of the main threats. They are displaced by underwater noise, and could be affected by contaminants in their food chain.

Canadian Occurrence: Pacific Ocean

COSEWIC Status History: Species considered in April 1991 and placed in the Data Deficient category. Re-examined in November 2003, and designated Special Concern. The last assessment was based on an updated status report.

1.2. Description and Biology

Harbour porpoise are the smallest cetacean in Canadian waters and are typically less than 2.2 metres in length and 75 kg in weight, with females being larger than males. This species is often difficult to observe in the wild. This is in part due to the counter-colouration pigmentation pattern of grey-brown on the dorsal surface with lighter lateral undersides, and white to greyish-white on the most ventral surface. Grey stripes or flecks are often within the white pigmentation and distinctive lateral grey-brown stripe(s) extends from the corner of the mouth, to the anterior insertion of the pectoral flipper on both sides of the animal. The width and pigmentation of the stripe(s) varies among individuals, but is rarely visible on live, wild animals. Further complicating the observation of wild harbour porpoise is that the dorsal fin rarely makes an exit or entry splash, is approximately 15-20 cm in height and has no distinctive pigmentation, and the blow is rarely visible.

Average age estimates for harbour porpoise vary considerably across the global range for the species. In eastern Canadian waters, harbour porpoise lifespan is reported to be 13 years (Gaskin and Blair 1977), whereas in Japanese waters it is 11 years (Gaskin et al. 1991). In British Columbia, the oldest identified specimen was estimated to be 10 years of age (Baird 2003), however limited work has been done in this area.

The age of sexual and physical maturity differs by gender and varies geographically. In the western North Atlantic, maturity is attained between three and four years of age (Gaskin and Blair 1977); interestingly in the North Sea area, maturation is not attained until ages five to six

years (van Utrecht 1978).

In general mating occurs during the summer and early fall, and calving occurs in spring and summer months (Gaskin 1992, Read 1999, Evans and Stirling 2001) after a gestation period of about 330 days (Yasui and Gaskin 1986). Baird and Guenther (1995) reported calving from May to September for southern B.C. waters.

Females produce a single calf every one to two years (Boran et al. 2001,Read 1990, Read and Hohn 1995). Harbour porpoise are thought to have a polygynandrous mating system (*i.e.* both males and females mate with several members of the opposite sex (Grier and Burk 1992)). The physical characteristics of the male (its smaller body size, large testes and long penis), and apparent lack of social structure (Gaskin 1992) support this theory. Further support for this type of mating system is the lack of observed courtship behaviour. However, this may be due to the difficulties associated with observing harbour porpoise in the wild.

Weaning of calves may occur at approximately 4 to 5 months when the volume of milk produced by the mother is reduced by half (Gaskin et al. 1984, Yasui and Gaskin 1986). The total lactation period lasts approximately 8 to 12 months (Yasui and Gaskin 1986). Gaskin (1992) proposed that the mother-calf bond may exist for up to 18 months before the calf achieves complete independence. These data from studies in Atlantic Canada may be relevant for B.C. harbour porpoise, but no studies have confirmed this to date.

1.3. Populations and Distribution

Three subspecies of harbour porpoise are recognized throughout the species' global distribution; *Phocoena phocoena phocoena* in the North Atlantic, *Phocoena phocoena vomerina* in the North Pacific, and *Phocoena phocoena relicta* in the Black Sea (Rice 1998). Harbour porpoise are found along the coastal shelf, frequenting shallow bays, estuaries and tidal channels, on both sides of North America, in the North Atlantic (including Greenland and Iceland (CITES 2007)) Arctic, and North Pacific oceans. They also inhabit the Mediterranean, Baltic, North Barents and Bering Seas, as well as the northern and eastern parts of the Black Sea and Sea of Azov (Yasui and Gaskin 1986, Gaskin 1992). The Black Sea, North Atlantic and North Pacific populations are generally isolated from one another, and studies of the biology and natural life history and ecology of these animals have been conducted within these separate populations.

The harbour porpoise has a northern hemisphere, circumpolar distribution and inhabits the cold-temperate, sub-arctic waters of North America, the Russian Federation and Eurasia; as well as some mid North Atlantic landmasses, such as the Faeroe Islands, Greenland and Iceland (Gaskin et al. 1974, Gaskin 1992). Although a marine odontocete, they are known to ascend rivers as long as the water is brackish (Thwaites 1904-05, Scheffer and Slipp 1948, Gaskin 1991, Guenther et al. 1993). This species is seldom found in water warmer than 16°C (CWS 2007).

It is not known how much of the total available global habitat for harbour porpoise exists within Canada. Furthermore, it is not known what proportion of the total global abundance of harbour porpoise exists in Canadian waters.

In Canada, the species is found in the coastal waters of British Columbia, Quebec, Nova Scotia,

Newfoundland, New Brunswick and Prince Edward Island. In addition, there is one record of occurrence of harbour porpoise in the Beaufort Sea (van Bree et al. 1977).

In western Canada, the species is found in British Columbia, with certain areas appearing to be seasonally favoured. More dense localized aggregations and increased seasonal densities have been reported from the southern Strait of Georgia (Calambokidis et al. 1997) and in Juan de Fuca Strait, near Victoria (Hall et al. 2002). According to the B.C. Ecosystems and Species Explorer database (http://srmapps.gov.B.C..ca/apps/eswp/), harbour porpoise are globally assigned a G4G5 status, which indicates that this species is globally apparently secure (G4), and demonstrably widespread and abundant (G5). However, in British Columbia the Pacific harbour porpoise is classified as S3 or 'blue listed'. The *Species at Risk Act* lists Pacific harbour porpoise as a species of special concern, which is defined as a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Little information is available on the abundance and population trends of the Pacific harbour porpoise. However, there are reports that the harbour porpoise population of southern British Columbia and northwestern Washington has declined since the 1940's (Scheffer and Slipp 1948, Flaherty and Stark 1982, Cowan 1988, Gaskin 1992, Calambokidis and Baird 1994). This suspected decline is inferred from qualitative observations and as such, assessment of trends in harbour porpoise relative abundance over the last half century is difficult. Therefore, it is likely impossible to determine whether this population has truly declined, or perhaps has experienced a distributional shift, thus appearing to have declined in certain geographical locations.

Range contraction may be another factor as historical records appear to indicate that harbour porpoise were commonly sighted from shore in the Juan de Fuca Strait, near Victoria region (Baird 2003). A shore sighting of harbour porpoise in this region would now be considered a rare occurrence (A. Hall, , Marine Mammal Research Unit, University of British Columbia, pers. obs.). The potential for further reduction or displacement exists, as both the human population and use of coastal waters increases in British Columbia.

Table 1. Surveys Estimating Harbour Porpoise Abundance in B.C. and Washington Inland Waters.

Abundance	CV	Season	Area	Reference
845	0.18, uncorrected	Summer	Southern B.C. inland waters	Calambokidis et al. 1997
1,025	0.15, uncorrected	Summer	Washington inland waters	Calambokidis et al 1997
'Low' abundance & density, no seasonal variation	n/a	Year-round presence	Strait of Georgia	Kemple 2002
860	0.197, uncorrected (95% CI 584-1266)	Summer	Juan de Fuca Strait	Hall 2004
252	0.373, uncorrected (95% CI 123 – 519)	Winter	Juan de Fuca Strait	Hall 2004
555	0.18, uncorrected	Average annual	Juan de Fuca Strait	Hall 2004
3,123*	0.10	Annual estimate averaged	Washington inland waters stock	NMFS 2006
9,120	95% CI: 4,210-19,760	Summer	B.C. inland waters	Williams & Thomas 2007
**Did not include B.C. waters*				

Harbour porpoise are an exceedingly difficult species to census, due to their naturally cryptic behaviour, colouration and small size. The difficulties associated with estimating the population size of harbour porpoise are evident in the variation between the few available estimates (Table 1).

Harbour porpoise have a nearly continuous distribution in the coastal waters off western North America. However, based on genetic (Gaskin 1992, Calambokidis and Baird 1994, Tiedemann et al. 1996, Andersen et al. 1997, Walton 1997, Wang and Berggren 1997, Rosel et al. 1999, Chivers et al. 2002) and contaminant research (Calambokidis and Barlow 1991), they appear to exist in stratified population sub-units. It appears that these subunits may exist over small geographical scales with little dispersal (Chivers et al. 2002). However, the exact boundaries of these sub-units are not yet known, and there appears to be limited genetic exchange between the Strait of Georgia, Juan de Fuca Strait and west coast Vancouver Island sub-units (Chivers et al. 2002). A photo-identification study in the San Juan Islands also provides evidence for local, discrete subpopulations (Flaherty and Stark 1982) with a high degree of site fidelity.

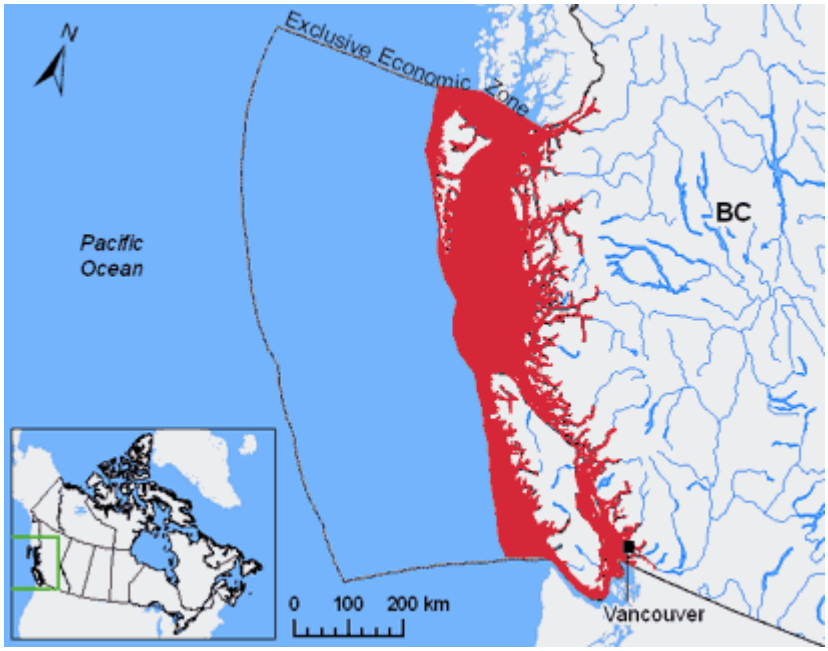

Figure 1. Harbour Porpoise Distribution in British Columbia. Map obtained from the Species at Risk Website[1].

1.4. Requirements of the Pacific Harbour Porpoise

1.4.1. Habitat and Biological Needs

The migration patterns and seasonal distribution of harbour porpoise along the west coast of North America are unclear, although they appear to be present year round in the inland waters of British Columbia and Washington (Keple 2002; Hall 2004). Harbour porpoise tend to occupy an ecological niche consisting of relatively shallow water, generally less than 200 m depth (ex. Hall 1996, Lockyer et al. 2001, Hall 2004). As shallow water predators they feed upon a variety of epipelagic and mesopelagic cephalopods and fish, such as market squid, herring, sand lance and hake (Walker et al. 1998, Hall 2004). Smith and Read (1992) determined that juveniles prey upon large zooplankton (*i.e*. euphausiids) while transitioning from a milk to solid diet. Seasonal importance of particular prey species has not been identified.

Radio telemetry tracking by Hanson et al. (1999) over a range demonstrated a relatively restricted range of habitat use by one animal over 215 days; this porpoise remained in the southern Strait of Georgia region. A photo-identification study in the 1980's also suggested limited movements in the U.S. San Juan Islands (Gaskin et al. 1974, Jefferson 1988). This is counter to the behaviour of harbour porpoise on the east coast of Canada, which are known to migrate following prey species south during winter months (E. Trippel, Fisheries and Oceans Canada-Maritimes Region, Science, pers. comm.).

[1] http://www.speciesatrisk.gc.ca/search/speciesDetails_e.cfm?SpeciesID=493#distribution

1.4.2. Ecological Role

Harbour porpoise are one of two phocoenid species occurring in British Columbia waters. This species occupies the same trophic level as adult salmon, both of which feed upon zooplanktivorous fish. In eastern Canada, juvenile harbour porpoise are secondary trophic level feeders.

As a mid-level trophic level species, porpoise are predators to forage fish and squid, but also serve as prey to higher trophic level species. Harbour porpoise comprise a significant component of the diet of transient killer whales in British Columbia (Ford et al. 1998, 2007). Additionally, several species of shark are known to consume harbour porpoise (DeMaddalena et al. 2007). See Section 1.4.3 'Limiting Factors' and Section 1.5.2.2 'Natural Threats' for further detail on predation. As with most marine mammals, harbour porpoise carcasses may sink to the sea floor, thus providing a rich source of nutrients for scavengers and benthic detrivores.

Historically, aboriginal peoples of British Columbia considered harbour porpoise to be a food source and are reported to have regularly killed them for food (Boas 1909, Drucker 1951, Suttles 1951). No hunts of harbour porpoise occur at the present time, though interest in resuming traditional hunting of cetaceans should not be ruled out in future Canadian treaty negotiations.

As a result of this species' apparent limited movement and moderately high position within the marine food web, harbour porpoise can also be used as indicators of ecosystem health. The ratios of bioaccumulative contaminants found within harbour porpoise tissues may prove useful in assessing the relative abundance of specific compounds in localized environments. Harbour porpoise distribution in combination with their relatively short life span makes them ideal candidates as sentinel species for the coastal environment.

1.4.3. Limiting Factors

Limiting factors are intrinsic to the biology of species, and as such can not be mitigated or managed. These bottom-up, top-down processes are generally mediated by the availability and quality of prey and by predators, respectively. However, human activities may contribute pressures which alter the balance of these limiting factors, and threaten the population. In such cases, actions are necessary to ensure that human activities do not place undue stress on limiting factors.

The population may be limited by low regional dispersal, and coupled with preferred use of shallow coastal habitat (e.g. Hall 1996, Lockyer et al. 2001, Hall 2004) may make sub-populations vulnerable to localized depletions. If physical dispersal is further reduced, genetic fitness among sub-populations may be compromised.

The most common known natural predators of Pacific harbour porpoise are transient killer whales (*Orcinus orca*) and white sharks (*Carcharodon carcharias)* (Gaskin et al. 1974). In British Columbia, increased use of Georgia Strait and adjacent waters by transient killer whales (*Orcinus orca*) over the past 30 years, has likely been driven by dramatic increases in harbour seal abundance (Ford et al. 1998) following targeted pinniped removals in the first half of the 20th century. This may have led to increase in predation on harbour porpoise, which now comprise approximately 15% of documented transient killer whale kills (Ford et al. 2007). The

extent to which killer whale predation limits this population has not been studied in detail.

Other potential predators may include the bluntnose sixgill shark (*Hexanchus griseus*), broadnose sevengill shark (*Notorynchus cepedianus*), Pacific sleeper shark (*Somniosus pacificus*), shortfin mako (*Isurus oxyrinchus*), and blue shark (*Prionace glauca*) (De Maddalena et al. 2007). In B.C., Baird and Guenther (1995) report finding one dead harbour porpoise with wounds consistent with that of a shark attack. White sharks are occasional visitors to B.C. waters, and as such risk of white shark predation is likely very low given current ocean conditions. Predation by other shark species more common in B.C. waters should not be discounted although the frequency and significance of shark predation on phocoenids in British Columbia is unknown.

Prey type and availability can limit predators, such as cetaceans. As harbour porpoise occupy a mid-trophic level niche and feed on a variety of known prey species (Walker et al. 1998, Hall 2004), limitations in one prey species will not likely limit population growth. However, overall prey availability and regional species composition may be altered by natural or anthropogenic factors. Given that specific details on seasonally, or regionally important prey of harbour porpoise in B.C. are not well understood, there is some uncertainty regarding prey as a potentially limiting factor.

Necropsies of stranded harbour porpoise demonstrate that internal parasites are common in this species (DFO-CRP unpublished data), though impacts on individual survival are unknown. Finally, ecosystem regime shifts may influence populations by periodically limiting population sizes in species with low population abundance, or limit population sub-units on a local scale, or may limit the population at-large.

1.5. Threats

Anthropogenic or human-caused threats generally fall into two categories, those with acute impacts, directly affecting individual animals and those having chronic impacts, which affect limiting factors, such as prey type and availability, habitat quality or immune function (Baird 2003).

For populations, such as Pacific harbour porpoise, which may occur over small ranges or exist in restricted habitats, the cumulative effect of any combination of the threats listed below (Section 1.5.1 ‘Threat Classification’) may result in more deleterious consequences than of any single threat acting upon the population in isolation. It should also be noted, that some harbour porpoise populations in British Columbia may be recovering from the effects of historic threats. If small, isolated populations exist, there is the possibility that regional extirpations have occurred in the coastal waters of British Columbia. This may exacerbate the impacts of identified threats.

Assessment of threats to the population (Table 2) allows for prioritization of recommended management and other actions to prevent this population from becoming threatened or endangered, and provides an indication of the feasibility for mitigation of a threat. Definitions of the terms used for rankings are available in Appendix I (Table 5).

1.5.1. Threat Classification

Threats were assessed based on their current likelihood of occurrence and severity of effect to the population. In addition, the certainty of a population-wide effect was incorporated to provide a measure of confidence in the rating of 'level of concern' and to identify threats where further monitoring or study may be useful in addressing uncertainties or knowledge gaps. Where certainty of effect is not demonstrated, weight of scientific evidence for other cetaceans may be deemed adequate to contribute to the assessment of the level of concern for a threat.

Mitigation potential refers to the likelihood that measures (future or existing) will adequately mitigate or prevent negative effects to the population. The level of concern rating reflects the current concern for impacts from a threat at this time, but future assessments could result in a change to the rating. Therefore the importance of long-term monitoring of the population can not be overstated.

Table 2. Summary of Threat Classification and Mitigation Potential for Identified Threats to Pacific Harbour Porpoise in B.C.
Mitigation potential refers to the likelihood that measures (future or existing) may mitigate or prevent negative effects to the population. This assessment is a current view of the state of threats to the population, and as such assessment ratings may change over time. (*) are naturally occurring threats to the population (i.e. limiting factors whose effects can be increased by human activities).

Threat Category	Sub-category	Stress to the Population	Severity of population-level impact	Uncertainty	Current Level of Concern	Mitigation Potential
Entanglement & Entrapment		Survival	High, based on weight of evidence	High	**Potentially HIGH**	potentially High if proactive measures are implemented
Habitat Degradation		Effects of pathogens Reproductive rate Prey availability Dispersal Predation risk Hybridization	Potentially, High	Medium	**HIGH**	Moderate
Toxic Spills		Effects of pathogens Reproductive rate Prey availability Survival	Moderate to High, dependent on spill location & timing	Medium Demonstrated in other cetaceans	**HIGH**	Moderate
Acoustic Disturbance		Prey availability Dispersal Predation risk Stranding	Low to High	Medium to High	**MEDIUM- HIGH**	Low, for chronic noise High, for acute noise
Contaminants	Regulated Persistent Bioaccumulative	Effects of disease & parasites Prey availability	Moderate to High	Medium	**MEDIUM-HIGH**	High

Threat Category	Sub-category	Stress to the Population	Severity of population-level impact	Uncertainty	Current Level of Concern	Mitigation Potential
	Toxic Chemicals (PBTs)	Reproductive rate Survival				
	Non-regulated PBTs	Effects of disease & parasites Prey availability Reproductive rate Survival	Moderate to High	Medium	**MEDIUM-HIGH**	Moderate
	Biological	Effects of pathogens Reproductive rate Stranding?	Low to Moderate	Medium	**LOW-MEDIUM**	Low to Moderate
Prey Reduction	Competition with Fisheries	Prey availability Effects of pathogens Predation risk	Potentially High	Medium to High	**MEDIUM**	High, if uncertainties regarding key prey needs are addressed
	Climate Change or Ecosystem Regime Shift*	Prey availability Effects of pathogens Predation risk	Unknown, likely variable	High	**UNKNOWN**	Unknown
Vessel Strikes		Survival	Unknown, variable depending on vessel size & speed	High	**UNKNOWN**	Low
Predation*		Predation risk may be	Unknown	High	**LOW**	None

Threat Category	Sub-category	Stress to the Population	Severity of population-level impact	Uncertainty	Current Level of Concern	Mitigation Potential
		altered by natural or anthropogenic threats Survival				
Diseases & Parasites*		May be increased by anthropogenic threats or regime shift Disease Reproductive rate	Typically Low	High	**UNKNOWN**	None Low, if due to anthropogenic means
Harmful Algal Blooms (HABs)*		Effects of disease Prey availability Dispersal Reproductive rate Stranding?	Unknown	High	**LOW**	None Low, if due to anthropogenic means (i.e. biological pollutants)
Stranding*		Survival Occurrence may be altered by natural or anthropogenic threats	Unknown	High	**UNKNOWN**	None If live stranded mitigation potential may range from low to high
Hybridization*		Reproductive rate Frequency may be increased by natural factors or anthropogenic habitat degradation	potentially High	High	**UNKNOWN**	None to Low (indirectly through mitigation of habitat degradation)

1.5.2. Description of Threats

1.5.2.1 Anthropogenic Threats

Entanglement & Entrapment

In a global review of porpoise gillnet mortality, Jefferson and Curry (1994) determined that all species of porpoise have substantial interactions with gillnet fisheries. According to the International Union for the Conservation of Nature (IUCN), the most important action for global protection is to reduce incidental mortality in gillnets and other fishing gear (Klinowska 1991).

In B.C., incidental mortality of harbour porpoise in fishing gear has been documented (Stacey et al. 1997, Hall et al. 2002), with entanglement and mortality reported for the dogfish drift gillnet fisheries, salmon troll and hake trawl fisheries (Pike and MacAskie 1969, Baird and Guenther 1991, 1995, Stacey et al. 1997). Quantitative assessment of small cetacean by-catch by Hall et al. (2004) determined that the highest levels of entanglement and mortality occur within the B.C. salmon gillnet fleet. Harbour porpoise may also be vulnerable to entanglement in aquaculture gear, and in tribal set net fisheries (in U.S. waters and Haro Strait), however data on entanglement rates are lacking.

For the vast majority of international locations where Jefferson and Curry (1994) confirmed incidental mortality in fisheries, estimates of total harbour porpoise mortality were absent; the necessary data for evaluation of present or historic impacts were lacking. These data gaps hold true for entanglement rates and sex or age specific vulnerability to entanglement in British Columbian waters.

In recent years, fisheries practices have been developed to reduce the potential for entanglements. Entanglement rates for harbour porpoise on both the east and west coasts of North America were demonstrably reduced by instituting use of barium sulphate coated nets, and acoustic alarms or deterrents net fishing gear used in test fisheries (Trippel et al. 1999; Gearin et al. 2000; Koschinski et al. 2006). However, these practices are not yet required for fishing gear on the west coast of Canada.

Despite unknown components of this threat to harbour porpoise in B.C., given the weight of evidence on entanglement risk elsewhere, and the IUCN conclusion regarding important mitigations, level of concern for entanglement or entrapment of harbour porpoise in B.C. is ‘potentially high’ (Table 2). Where modification of fishing gear has been successful in mitigating entanglement rates for harbour porpoise elsewhere (i.e. Atlantic Canada), recommendations to enact cost-effective modifications to gear can be considered.

Habitat Degradation

Harbour porpoise appear to be extremely sensitive to disturbance and consequently habitat degradation. Urbanization of coastal areas through the development of: marinas, docks, ferry terminals, tanker ports, wind farms, log dumps, aquaculture sites and other similar installations, may result in the physical exclusion of harbour porpoise from their preferred shallow water habitats. In addition, these activities, related ancillary works, and the related vessel traffic can create localized increases in ambient noise levels and contribute to acoustic disturbance of

porpoise (see also 'Acoustic Disturbance' threat). Physical or acoustic degradation of habitat may displace harbour porpoise, affect their potential to feed, affect reproductive success and social behaviour.

As a chronic threat involving many combined activities, this may lead to reduced individual and population fitness through compensatory behavioural changes. The synergistic effects of many forms of habitat degradation are difficult to ascertain. This threat is determined to be of a high level of concern for effects to the population in B.C. (Table 2). The ability to mitigate impacts of habitat degradation is determined to be moderate, as mitigation potential is dependent on the type of degradation.

Toxic Spills

Spills are recurrent events along the B.C. coast, and high densities of vessel traffic likely increase the risk of accidental spills. As harbour porpoise occupy coastal areas that are increasingly occupied by people (resulting in urbanization), and that are becoming heavily used by both industrial and recreational vessels, there is a strong likelihood of toxic spills affecting harbour porpoise and their habitat. A petrochemical spill in harbour porpoise habitat has the potential to both reduce habitat quality by contaminating or killing prey species, and to directly affect individual porpoise through inhalation of toxic vapours. The estimated small population size (Hall 2004, Williams and Thomas 2007) and potentially restricted habitat use (Hanson et al. 1999) exacerbates risks posed by regional threats, such as an oil spill.

Some uncertainty surrounding abundance estimates of this small population leaves high degree of concern for impacts from this threat (Table 2). Although measures to prevent and mitigate effects of spills are currently in place, once a spill occurs the effectiveness of clean up measures typically falls between 5 to 15% (Graham 2004), and is highly dependent on proximity to population centres with facilities and expertise for cleanup.

Acoustic Disturbance

Harbour porpoise demonstrate a change in behaviour in response to increased acoustic levels, and have been noted to be particularly susceptible to noise in their habitat. Anthropogenic noise alters the underwater acoustic environment and may interfere with foraging, navigating or social communication.

Observed responses range from acute to chronic behavioural changes, such as temporary habitat avoidance to exclusion from regions with chronic increases in noise levels (Culik et al. 2001, Johnston 2002, Olesiuk et al. 2002, Koschinski et al. 2003, Carstensen et al. 2006). Sources of acoustic disturbance that may impact the population in B.C. include both chronic and acute noise. Examples include:

<u>Chronic Noise</u>

- Vessel traffic (recreational & commercial)
- Aquaculture installations
- Alternative energy operations (e.g. wind farms, turbines)

- Fossil fuel exploration and extraction[2]
- Marine construction (e.g. cable laying, dock construction)

Acute Noise

- Exploratory acoustic surveys (e.g. seismic surveying)
- Military naval activities (e.g. live fire exercises, tactical sonar use)
- Marine construction (e.g. explosions, pile driving)
- Acoustic Deterrent Devices[3]

Carstensen et al. (2006) noted a significant increase in intervals between re-sights of harbour porpoise at wind farm sites during construction. Of particular note, installation of steel piles (which cause vibration) resulted in increased intervals between re-sights in both construction and reference areas, indicating that even attenuated noise levels in reference areas well outside the construction zone were sufficient to cause changes in porpoise behaviour. Harbour porpoise may demonstrate strong behavioural reactions to acute noise disturbance due to their reliance on high frequency sound for communication and foraging. This threat has a broad spectrum of possible outcomes ranging from temporary displacement from key habitats (*e.g.* foraging, mating) to physical injury or death.

At present, several management measures are in place to mitigate noise stress, though the urban coastal habitat of harbour porpoise makes them vulnerable to acoustic stress. Therefore, level of concern is medium-high (Table 2) for this threat to the population. Mitigation potential for chronic noise is likely to be low, though management of acute noise can be achieved through review and revision of protocols for activities involving acute noise stress to marine environments.

Contaminants – Regulated & Unregulated Persistent Bioaccumulative Toxic Chemicals, & Biological Contaminants

Contamination can occur in the form of marine debris, anthropogenic biological pollutants (e.g. sewage outflow) or via chemical contamination of habitat or prey. Harbour porpoise have been known to ingest plastic debris, and in some cases this has resulted in death (Baird and Hooker 2000). While this threat has the potential to harm or kill a harbour porpoise, it is unknown what the population-level effects of marine debris may be.

Though the diet of harbour porpoise in B.C. is somewhat uncertain, harbour porpoise in general, are known to feed on a variety of cephalopods and forage fish (e.g. market squid, herring, sand lance and hake) (Walker et al. 1998, Hall 2004). While harbour porpoise occupy the same trophic level as adult salmon, the degree to which regulated or unregulated persistent bioaccumulative toxic chemicals[4] (PBTs) concentrate in harbour porpoise or their prey is unknown. The production of many legacy, or regulated PBTs (e.g. PCBs, DDTs) has been discontinued in North America, though their concentrations in the environment and in organisms

[2] Oil and gas exploration does not occur at this time due to a moratorium on offshore fossil fuel exploration/extraction in British Columbia.

[3] The use of acoustic deterrent devices at aquaculture sites is no longer permitted in B.C.

[4] Persistent bioaccumulative chemicals that may affect harbour porpoise are listed in Appendix I.

often remains high, and reversal of contamination is likely to occur on a scale of several decades (Hickie et al. 2007). Two studies from the United Kingdom indicate positive correlation of PCB contaminant burdens with nematode infestation, and a causal relationship to infectious disease mortality in Atlantic harbour porpoise (Bull et al. 2006, Jepson et al. 2005). Calambokidis et al. (1986) documented some regional differences in toxic contamination of harbour porpoise on the west coast of North America, suggesting not only allopatric occurrence of harbour porpoise, but also localized hotspots of contamination. The demonstrated relationship between contaminant burden and immunological effects, suggests further study and monitoring of contaminant levels in Pacific harbour porpoise may be necessary.

New generations of unregulated PBTs are currently produced locally, nationally and on a global scale. These emerging chemicals have similar properties to legacy pollutants (Ross 2006) and typically their use and production is increasing, while regulations for their use and disposal continue to lag (DFO 2008). The main current concern for emerging pollutants stems from polybrominated biphenyl ethers (PBDEs), as the presence of these chemicals in British Columbian ecosystems is rapidly increasing (Rayne *et al.* 2004; Elliott *et al.* 2005). The toxic effects of PBDEs are still unclear, but there is growing scientific evidence to suggest that these chemicals may have similar toxic properties to PCBs (Ross 2006).

Small cetaceans lack the metabolic capacity to degrade or excrete pollutants and thus retain high quantities in their systems (Tanabe et al. 1988). These pollutants may increase the risk of immune-suppression (Hall et al. 2005), and potentially reduce reproductive capabilities and neonate survival. The historical and emerging effects of marine contamination from polluting activities on harbour porpoise populations are uncertain, though given the likelihood of localized hotspots of contamination in harbour porpoise habitat, this threat is rated at medium to high level of concern (Table 2). Regulations and monitoring of point sources of contamination can alleviate some concern for this threat; however, long-term chronic exposure to pollutants (both regulated and unregulated) creates uncertainty regarding effects to long-term reproductive health of this population.

Biological pollution may occur in the form of nutrient-loading, hormones and antibiotic contamination entering the marine environment via sewage outflow, agricultural and other sources. Bacterial isolates recovered from harbour seals (*Phoca vitulina*) in the greater Victoria area and Puget Sound have revealed multiple antibiotic resistance (S. Raverty pers. comm.), suggesting some degree of selective pressure or possible antimicrobial pressures within the habitat. Additionally, *Cryptococcosis,* a respiratory fungal infection, historically associated with terrestrial environments, has sporadically been associated with marine mammal losses (particularly in captive dolphins and wild animals in Australia). Within the northeastern Pacific Ocean (including coastal B.C.), there has been an outbreak of this condition in stranded harbour porpoise and has been associated with a multi-species outbreak (Raverty et al. 2007).

Introduction of foreign diseases into a population of highly social cetaceans may result in disease outbreaks leading to population decline (Guimarés et al. 2007). As there is some suggestion that harbour porpoise may have a polygynandrous mating system (Grier and Burk 1992), they may be vulnerable to outbreaks of highly contagious diseases. As occurrence of disease may be the result of natural pathogens in the environment, or from anthropogenic nutrient-loading or introduction of foreign pathogens, sources of biological pollutants should be assessed and

monitored to effect adequate mitigation of those anthropogenic threats. Exposures to contagions or other biological pollution may lead to negative synergistic effects with other stresses.

Reduction in Prey

Annually, harbour porpoise carcasses are recovered from coastal beaches and waterways in southern British Columbia, a portion of which appear emaciated (DFO-CRP, unpublished data). Although sometimes attributable to an underlying disease, physical injury, or physical obstruction, the cause of emaciation cannot always able to be determined. There may be variability in the availability of high quality prey due to natural population dynamics, or targeted harvest of prey species.

Harbour porpoise are known to feed on a variety of cephalopods and forage fish of commercial significance, such as market squid, herring, sand lance and hake (Walker et al. 1998, Hall 2004), however the complete prey spectrum of Pacific harbour porpoise is poorly understood. As harbour porpoise occupy a mid-trophic level niche and are known to feed on a variety of prey species (Walker et al. 1998, Hall 2004), limitations in one prey species alone will not likely limit population growth. However, overall prey availability and regional species composition may be altered by natural or anthropogenic factors. Harvest of prey species may alter the local prey abundance, influencing the population dynamics of harbour porpoise if they are required to shift to a less energetically rewarding prey species. Direct competition for resources may occur for several prey species, particularly herring, hake and squid, in Pacific coastal regions and further research will assist in clarifying this threat.

Given that harbour porpoise and their prey are trans-boundary species, adequate mitigation may require additional collaboration and cooperation with U.S. fisheries management. If changing ocean conditions or other factors reduce or shift the abundance or availability of prey, competition with commercial fisheries could become an increasing threat of significant concern.

Natural shifts in ecosystem processes (also termed ‘regime shifts’) as a result of large scale events, such as El Niño or the Pacific decadal oscillation, occur on a recurrent basis and may affect species composition, or other intrinsic processes within coastal habitat for Pacific harbour porpoise (Francis *et al.* 1998; Hare & Mantua 2000). While significant effects to marine mammals resulting from regime shifts have not been observed in B.C., such large scale environmental changes may affect prey supply and quality. Changes in climate may affect distribution of harbour porpoise and their prey, within and outside Canadian political boundaries, or acute effects such as impacts to population viability or individual survivorship may become evident.

In times of other physical stress, this could lead to increased susceptibility to disease and may directly affect survival (e.g. starvation). Despite the limited information regarding the diet of harbour porpoise, the recognition that several commercially important fish species are prey of harbour porpoise, warrants a moderate concern for potential stress to the population (Table 2). At present, the diet of harbour porpoise on the west coast of North America is poorly understood, and seasonal or geographic variability of prey species is unknown. Research will assist in addressing knowledge gaps related to diet and better identification of important prey species, which can assist in development and application of appropriate management measures.

Vessel Strikes

Like many other cetaceans, harbour porpoise rest at the surface. As harbour porpoise habitat overlaps with that of urbanized marine environments, this increases their vulnerability to vessel strikes. The *Fisheries Act* Marine Mammal Regulation protects harbour porpoise and other marine mammals from disturbance, and the Canadian-U.S. '*Be Whale Wise*: Marine Wildlife Guidelines for Boaters, Paddlers and Viewers' require that a minimum of 100 m distance from any marine mammal be maintained by all vessels.

There have been 2 reported cases of vessels striking harbour porpoise in Canadian waters over two years (DFO-CRP unpublished data). Due to the difficulty in detecting harbour porpoise on the water (see 'Species Description') and poor knowledge of this species by the general public, vessel strikes involving harbour porpoise are likely under-reported, causing an underestimate of the total annual occurrence of vessel strikes in British Columbia. Further information is required to assess potential impacts to local or coast-wide abundance.

1.5.2.2 Natural Threats

Natural threats to this population are those which may be exacerbated by synergistic effects between limiting factors, or by threats. For example, prey may be limited by a natural regime shift, and/or by anthropogenic threats (e.g., toxic contamination, harvest). While natural threats are unlikely to be managed or mitigated, in and of themselves, these factors have the potential to impact the Pacific harbour porpoise and force population decline, and thus additional research needs should be identified, and the population monitored to detect trends in abundance and distribution to determine potential effects of natural threats.

Predation

Since harbour porpoise comprise about 15% of the diet of transient killer whales (Ford et al. 2007), factors increasing this predation rate could result in greater impact to harbour porpoise abundance. As predation by sharks in B.C. waters is unknown, potential population-level impacts are unclear. See 'Limiting Factors' for further detail on predation.

While predation no doubt limits the population of harbour porpoise, it is not considered a major threat causing population decline (Table 2). As predation is a natural event, direct mitigation is not feasible. However, anthropogenic threats increasing predation risk, such as habitat degradation, can be mitigated or managed.

Diseases & Parasites

Study of pathological causes of mortality of harbour porpoise in B.C. is an emerging research topic. Examination of stranded small cetaceans in B.C. has recorded incidence of pathogens or parasites, including *Brucella* spp., in 47% cases (Raverty et al. 2007). Since stranded harbour porpoise often exhibit high parasite loads, this appears to be normal for the species.

Of specific importance, is the incidence of *Cryptococcus gatti* as cause of death in harbour porpoise (Raverty et al. 2005, Raverty et al. 2007). This yeast infection is an invasive, terrestrially based pathogen that has become an emerging threat to both terrestrial and marine

mammals in recent years in B.C.

Population-wide effects of naturally-occurring pathogens are unknown at present, and likely vary depending on type of infection (e.g. virulent, acute, and chronic). The high metabolic rate of small cetaceans, such as harbour porpoise (A. Hall pers. comm.), may lead to more rapid presentation of disease symptoms, thus highlighting the importance of consideration for synergistic effects of stressors. Combined effects of stressors can exacerbate the consequences of diseases or parasites (e.g. Bull et al. 2006, Jepson et al. 2005).

Harmful Algal Blooms (HABs)

Algal blooms are a natural, seasonal occurrence on the B.C. coast, though increased nutrient-loading (e.g. sewage outflows and agriculture runoff) may alter the frequency or intensity of blooms in certain areas. HABs have been implicated in marine mammal illness and mortality (Gulland and Hall 2007), plankton-sourced neurotoxins, such as saxitoxin (from red tide), have been found to bind to the brain tissue of some pinnipeds and cetaceans (Trainer and Baden 1999). Though not specifically recognized as a source of small cetacean mortality on the B.C. coast (Table 2), HABs are considered a potential limiting factor to survival via impacts to prey availability, as HABs have been implicated in fish kills in B.C. (Taylor et al. 1994). Therefore, anthropogenic sources of biological pollutants potentially contributing to algal blooms should be monitored and managed to mitigate for this threat.

Stranding

Harbour porpoise are the most commonly reported stranded small cetacean in British Columbia (Baird and Guenther 1995), though there are no records of live stranded harbour porpoise in B.C. (e.g. only dead animals wash ashore). Fisheries & Oceans Canada's marine mammal incident database recorded 67 stranding events for Pacific harbour porpoise from 2003 to present (DFO-CRP unpublished data). Stranding incidents have typically involved one animal, with no live or mass stranding of harbour porpoise documented in B.C. Disease as a proximate cause of death was noted in 47% of necropsies conducted on small cetaceans in B.C. (Dall's and harbour porpoise), (Raverty et al. 2007). However determination of exact cause of death was not always possible and the significance of stranding events at a population level is currently unknown. Threats likely to increase the occurrence of stranding events may increase the effect that this natural factor currently has on a population, or population sub-unit level. For example, tactical sonar use has been implicated in mass stranding of beaked whales in the Caribbean (Jepson et al. 2003). Where live stranded harbour porpoise are reported, efforts may be made to rescue the animal(s), where and when possible.

Hybridization

As cited in the 2003 COSEWIC assessment and updated status report (Baird 2003), hybridization in mammalian species typically occurs in situations where one population is in decline, and habitat has been disturbed. While harbour and Dall's porpoise hybrids have been observed in southern B.C. waters (Baird et al. 1998, Willis et al. 2004), the significance of this hybridization as a potential threat causing population decline is unclear. Theoretically, if incidence of hybridization were to increase, there may be concern for genetic fitness of harbour porpoise in

B.C. Given that current data suggests the B.C. population is comprised of stratified subunits, having little dispersal or genetic exchange over small geographic scale (Chivers et al. 2002), this may increase likelihood that habitat degradation may force or increase the risk for localized hybridization between these species.

Therefore, though mitigation potential has been rated low (Table 2), data collection on observations of harbour porpoise hybrids, as well as mitigation of coastal habitat degradation will assist in monitoring and reducing the risk of this potentially limiting factor.

1.5.2.3 Cumulative or Synergistic Effects of Threats &/or Limiting Factors

For populations, such as Pacific harbour porpoise, which may occur over small ranges or exist in restricted habitats, the cumulative effect of any combination of listed anthropogenic or natural threats may result in more deleterious consequences than any single threat acting upon the population in isolation. The effects of threats and limiting factors can be difficult to distinguish from one another, making conclusions regarding causes of population decline often difficult to ascertain. Several studies have illustrated the potential for synergistic negative effects of stressors to harbour porpoise health. Positive correlations between toxic contamination, disease and heavy parasite loads have been documented for harbour porpoise (Jepson et al. 2005, Bull et al. 2006). This evidence of combined effects of stress on harbour porpoise, coupled with uncertainties about population abundance, and potential sub-populations demonstrates the need for research in order to adequately mitigate stress on this population in B.C. Therefore the importance of targeted research programs and long-term monitoring will be important in forecasting population level effects.

1.6. Actions Already Completed or Underway

The federal *Species at Risk Act* (SARA) requires that management plans be developed for species listed as special concern, triggering the development of this management plan for Pacific harbour porpoise. While no management actions have been initiated to specifically address conservation of Pacific harbour porpoise, several actions to protect and preserve other marine species and ecosystems may prove useful for management. The actions and initiatives listed below may mitigate stresses, or provide valuable opportunities to gain knowledge or promote awareness of the population. Actions currently underway may also be listed in Section 2.3 (‘Actions’) and Section 4 (‘Associated Plans’) in order to promote their completion, or to increase their effectiveness for protection.

Pacific harbour porpoise are currently protected under the following legislation, protocols and policies:

- Internationally, the harbour porpoise is listed on the IUCN Red List of Threatened Species, and is listed on Appendix 2 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (CITES 2007) which prohibits trade of harbour porpoise;

- Canada's federal *Fisheries Act* contains provisions for protection of fish and marine mammal habitat (S. 35, 36), and the Marine Mammal Regulation, protects all marine mammals from disturbance and injury;

- Fisheries & Oceans Canada *Statement of Canadian Practice with respect to the Mitigation of Seismic Sound in the Marine Environment* (DFO 2007);

- Department of National Defence [DND] 'Maritime command order: marine mammal mitigation procedures' (DND 2007) mitigates disturbance from tactical sonar use;

- Environmental Quality Guidelines for water, air, sediment and tissues are published by the Canadian Council of Ministers for the Environment [CCME] and the B.C. Ministry of Environment [MoE];

- By-laws, Codes of practice and Action groups are developed and implemented regionally and municipally for mitigation of environmental stresses;

- Regional Environmental Emergency Teams [REET], regional, national and international spill response programs manage toxic spills and monitoring of contaminated sites (e.g. Can-US Dix Plan, B.C. Marine Oil Spill Contingency Plan).

I. Regulatory Development and Review Currently Underway

- *Fisheries Act* 'Marine Mammal Regulation' [MMR] is being amended to increase prevention and mitigation of disturbance to marine mammals

- Development of proposed Risk Management Strategy for Polybrominated Diphenyl Ethers (PBDEs) by Environment Canada, under the *Canadian Environment Protection Act*

II. Stewardship Measures Currently in Place

- '*Be Whale Wise*: Marine Wildlife Guidelines for Boaters, Paddlers & Viewers' provides guidelines for human behaviour and minimum vessel distances around wild marine mammals

- Information on sightings of marine mammals are collected by the B.C. Cetacean Sightings Network (1-866-I-SAW-ONE; www.wildwhales.org), a partnership between the Vancouver Aquarium and DFO

- Information on incidents (e.g. strandings, entanglements) and marine mammal sightings are collected by the B.C. Marine Mammal Response Network [MMRN] (1-800-465-4336) program and other organizations

- Straitwatch and the B.C. Cetacean Sightings Network educate boaters on marine mammal viewing guidelines and threats to marine mammals

- Public and industry initiatives such as, 'Toxic Smart' or 'Clean Print B.C.', increase awareness of chemical stress to marine habitats

- Remediation programs can be carried out on a case-by-case basis for disturbed habitat

- Whale Watch Operators Association Northwest has implemented Best Management Practices (www.nwwhalewatchers.org) for all its members to ensure that operators behave in a manner which respects the spirit of the '*Be Whale Wise*: Marine Wildlife Guidelines for Boaters, Paddlers and Viewers'

III. Conservation Strategies Currently Under Development

Following the coming into force of SARA in 2003, marine conservation strategies for 'at-risk' marine mammals have been drafted. These documents include recommended actions for protection of marine mammal species. In a larger context, these management actions may also benefit Pacific harbour porpoise. Please refer to Section 4.0 'Associated Plans' for specific recovery plans with actions relevant to the protection and management of harbour porpoise in British Columbia.

1.7. Knowledge Gaps

Additional research efforts to address data deficiencies will assist in developing management actions for the protection of harbour porpoise in British Columbia. Dizon et al. (1992) suggest that closing knowledge gaps regarding species population structure are particularly important in development of conservation strategies.

Life history parameters of harbour porpoise appear to vary from region to region (Gaskin and Blair 1977, van Utrecht 1978, Gaskin et al. 1991, Baird 2003), and thus clarifying reproductive rates, longevity and age of sexual maturity for harbour porpoise in B.C. will assist in determining potential population growth rates. Additionally, investigating the age and sex structure of the population will complement these efforts and may provide a preliminary indication of population health. Ongoing investigation of genetic makeup for harbour porpoise on the west coast of North America will continue to address questions regarding potential stratification of the population, as well as local and regional dispersal.

Although harbour porpoise are known to inhabit coastal areas around the globe, habitat use for B.C. harbour porpoise, outside of the southern Juan de Fuca and Haro Straits is poorly understood. Like all cetaceans, habitat use is likely primarily governed by the availability of prey species. While harbour porpoise are known to feed on forage fish and squid (Walker et al. 1998, Hall 2004), it is unknown which species are seasonally, or regionally important prey items. Additionally, it is unknown whether specific areas of core habitat may be important to harbour porpoise for mating, birthing, foraging or other life history requirements.

Uncertainties regarding magnitude of threats or limiting factors include, but are not limited to:

- Population-level significance of fishing- and aquaculture-related mortality in B.C.
- The temporal and geographic significance of boat collisions on overall population health

- The effect of killer whale predation on juvenile and adult mortality rates
- Potential differences in survival between U.S. or Canadian waters, and related causes of mortality
- The effects of vessel disturbance (acoustic and physical disturbance) and seasonal changes in acoustic disturbance on habitat use, population health and foraging success
- The causal factors of stranding and potential cumulative effects are unknown
- The degree of contaminant loading (for both regulated and un-regulated persistent pollutants) in harbour porpoise, their prey and habitat

2. MANAGEMENT

Despite uncertainty regarding species biology or conservation needs, management actions that may reduce the risk of population level effects of threats, should be undertaken.

2.1. Goal

The goal of the management plan for Pacific harbour porpoise is to maintain a self-sustaining population within its known range in Pacific waters of Canada.

As there remains high uncertainty regarding the numbers of harbour porpoise which utilize habitat in British Columbia, a numeric abundance-related goal is not prudent. Instead, supporting the population of Pacific harbour porpoise in order that it maintains self-sustaining abundance is the priority. As knowledge gaps remain regarding stock structure, maintenance of potential genetic, and behavioural diversity (i.e. population subunits) it may be important to preserve any unique features of this population, to prevent it from becoming 'threatened' or 'endangered'. As harbour porpoise move between U.S. and Canadian waters, the role of Canadian management will be to protect the population within Canada, and contribute to research and conservation initiatives in the U.S., where feasible. It will be necessary to address knowledge gaps regarding harbour porpoise biology (see Section 1.7), threats in order to achieve the stated goal.

2.2. Objectives

Population Objectives:

P1 *To maintain the summertime, inland-waters abundance of Pacific harbour porpoise (averaged over 5 years) at, or above the most recent estimate of average population abundance (in Williams and Thomas 2007).*

P2 *To maintain the summertime abundance of Pacific harbour porpoise in the Juan de Fuca Strait (averaged over 5 years) at, or above the most recent estimate of average summertime abundance (in Hall 2004).*

Distribution Objective:

D1 *Maintain the population's current range of occupancy and distribution on the*

coast of B.C.

There are few estimates of harbour porpoise abundance in B.C. and Washington State (Calambokidis et al. 1997, Hall 2004, NMFS 2006, Williams and Thomas 2007). Despite some uncertainties surrounding abundance estimates, maintenance of population abundance at, or above the current estimated average summertime, abundance for inland waters of B.C. (9120 individuals), and local summertime abundance in Juan de Fuca Strait of 860 individuals, averaged over a five year span, provides a preliminary baseline to assist in measurable, conservation targets for this population. Monitoring indices of abundance in key locations will assist in achieving these objectives (P1, P2). A research objective to estimate levels of human-caused mortality (R4) that will not jeopardize potential to reach P1 and P2 should be developed to assist in determining whether P1 and P2 objectives have been, or can be achieved under current conditions.

As new information becomes available, population and distribution objectives will likely require revision to reflect advances in scientific knowledge and prudent conservation of the population. From a Canadian management perspective, research to further define distribution and population levels of harbour porpoise in B.C. waters is a priority.

Research & Monitoring Objectives:

Over the next ten years, research objectives are to:

R1 *Determine seasonal distribution and abundance for the Pacific harbour porpoise in B.C.*

R2 *Contribute to, or foster the understanding of general aspects of the biology and ecological role of Pacific harbour porpoise in B.C. on an ongoing basis. Of particular importance, are studies on foraging ecology, habitat use in urbanized, coastal areas, and life history.*

R3 *Support, foster and contribute to research addressing knowledge gaps regarding effects of entanglement, coastal habitat degradation, catastrophic spills, and acoustic disturbance, as well as effects of other identified (Table 2) and non-identified threats to this population, on an ongoing basis.*

R4 *Assess available methods and estimate levels of annual human-caused mortality that the population can sustain, while achieving objectives P1 and P2.*

There are significant knowledge gaps on the general biology and ecological role of Pacific harbour porpoise, and addressing these knowledge gaps for harbour porpoise in British Columbian waters over the next ten years will aid in directing management efforts. While research efforts to address uncertainties on threats to the population are necessary, addressing questions on general biology (Obj: R3) is considered a higher priority at this time. Efforts to address research objectives R1 through R3 will provide data to assist an assessment of sustainable human-caused mortality (R4). The potential biological removal model is one model that was developed and is used widely in the U.S. (Wade 1998). Recent work by Williams et al.

(2008), though limited by sample size and uncertainties in population estimates, provides some interesting preliminary analyses of relevance to the harbour porpoise population in B.C. Collaboration with U.S. researchers will contribute to a growing body of knowledge on harbour porpoise on the west coast of North America.

Management Objectives:

Over the next ten years management objectives are to:

M1 *Reduce the risk of entanglement or entrapment of Pacific harbour porpoise in fishing or other gear in B.C.*

M2 *Reduce degradation of coastal habitat such that it does not displace Pacific harbour porpoise from known habitats in B.C.*

M3 *Reduce the risk of catastrophic spills impacting the Pacific harbour porpoise population in B.C.*

M4 *Minimize the exposure of Pacific harbour porpoise to acute or chronic sound levels in excess of those considered to cause behavioural or physical harm in cetaceans*

M5 *Reduce the exposure of Pacific harbour porpoise to regulated and currently unregulated persistent bioaccumulative chemicals*

M6 *Promote international collaboration, independent research, education and outreach on management and conservation initiatives*

Entanglement and entrapment, habitat degradation, catastrophic spills, acoustic disturbance, and contaminants were assessed to be the top threats to Pacific harbour porpoise (Table 2). Despite data deficiencies regarding these threats, the purpose of the above listed management objectives is to increase management of activities causing stress to the population, to proactively protect harbour porpoise in British Columbia. This, complemented by research efforts to determine potential biological removal and to address knowledge gaps, will aid in achieving the stated goal and contribute to effective management of anthropogenic-related mortalities. All threats also occur outside of Canadian jurisdiction, and support for international collaboration will aid in trans-boundary conservation efforts.

Threats assessed at low or unknown level of concern do not have specific objectives or new recommendations for mitigation; instead knowledge gaps will be filled by opportunistic or cost-effective means, where feasible. Effects of some threats impact individuals, but do not constitute a population level effect. Where mitigation feasibility is high (Table 2) and resources are available, it is prudent to manage and mitigate these threats.

2.3. Actions

The following actions (not listed in order of priority) are in support of management goals and objectives outlined in Sections 2.1 and 2.2 in order to prevent Pacific harbour porpoise from becoming listed as 'threatened' or 'endangered'. Many of the actions listed below are currently underway (see Section 1.6 'Actions already completed, or underway'), and may have been identified in other recovery planning documents to date (See Section 4 'Associated Plans'). The synchronization of these listed activities for protection, management and research will facilitate a multi-species approach to marine mammal conservation in British Columbia, and allow for effective use of available resources. Actions have been recommended where implementation is deemed to be practical and feasible, and most likely to result in successful protection of the population in B.C.

Where responsibility for actions is determined to fall under Fisheries & Oceans Canada jurisdiction, actions will be implemented directly as availability of funding and other resources permits. However, collaboration with other responsible agencies and organizations will be necessary in some cases to complete actions. If responsibility for actions falls outside of the mandate of Fisheries & Oceans Canada, or outside of its jurisdiction, support for implementation of the action(s) and contribution to effort(s) will be a priority where feasible. Participating agencies and organizations and implementation timelines for each of the listed actions are presented in Table 4. Organizations currently involved in data collection on Pacific harbour porpoise are listed in Appendix II.

2.3.1. Protection

As with all cetaceans, the Pacific harbour porpoise population is federally protected under the *Fisheries Act*, Marine Mammal Regulation. However, additional protection may be required, as the *Fisheries Act* does not have specific guidance on reduction, prevention or management of incidental mortality.

1. To protect Pacific harbour porpoise from acute acoustic disturbance and effectively mitigate negative population level effects, review, and if necessary revise, the Canadian Department of National Defence 'Maritime command order: marine mammal mitigation procedures' (DND 2007) to minimize impacts of tactical sonar noise on harbour porpoise in coastal waters of B.C.

2. To protect the population from physical disturbance, vessel interactions and chronic noise stress;

    a. Complete Marine Mammal Regulation [MMR] amendments under the *Fisheries Act* to reduce the risk of displacement from habitat, collisions with vessels, and the effects of acoustic and physical disturbance.[5]

[5] To view the proposed amendments to the Marine Mammal Regulation, visit http://www-comm.pac.dfo-mpo.gc.ca/pages/consultations/marinemammals/mmr-update_e.htm

b. Continue enforcement of MMR and regional guidelines for marine mammal viewing, as well as relevant regulations for coastal marine industrial development.

2.3.2. Management

Management actions to address key threats are listed below. Though contaminants are listed as a key threat to harbour porpoise, the management of biological and chemical contamination falls under the jurisdiction of Environment Canada.

3. Develop cooperative research programs to address data deficiencies regarding threats and species biology.

4. Strengthen measures to reduce the risk of entanglement for Pacific harbour porpoise in fishing and aquaculture gear.

    a. Gather data to provide advice for mitigation of entanglement risk.

        i. Continue to provide data, when possible, to support comprehensive understanding of rates of incidental by-catch, entanglement in fishing and aquaculture gear.

        ii. Strengthen, support and foster, where feasible, the continued development of fisheries observer reporting standards and guidelines for marine mammal species identification and data collection to clarify the extent of entanglement rates, by-catch, and gathering of samples, where possible, and when required.

    b. Develop methods to reduce the risk of entanglement in salmon gillnets.

        i. Review the feasibility of implementing the use of acoustic deterrent devices (‘pingers’) on salmon gillnets throughout the industry for emergency, temporary mitigation of entanglement risk at ‘hotspots’ having significant entanglement rates. Input from marine mammal experts during development of fisheries management standards and protocols will be essential for effective mitigation.

        ii. Review the feasibility of implementing the use of barium sulphate-coated gillnets in the salmon gillnet fishery (in specific fishing areas) for long-term reduction in entanglement risk. Input from marine mammal experts during development of fisheries management standards and protocols will be essential in carrying out this action.

        iii. As information becomes available, other alternative gear types may assist in minimizing the likelihood of marine mammal entanglements in fishing and aquaculture gear, and their use should be considered in terms of reducing impacts to the harbour porpoise population. This action will assist in the continued evolution of guidelines, regulations and standards.

c. To proactively reduce potential risks of entanglement, develop, review and implement aquaculture best management practices for mitigation of marine mammal entanglement or entrapment in aquaculture gear.

i. Complete development of reporting requirements for marine mammal incidents at aquaculture sites. Of particular importance are accurate species identification, data collection, and temporal requirements for reporting of incidents.

ii. Develop operational standards for the aquaculture industry outlining potential mitigation measures to reduce the risk of harbour porpoise entanglements or entrapment in gear at fallowed sites.

5. Manage and reduce input of chemicals into known harbour porpoise habitat to reduce toxic loading of individuals, habitat and prey species.

a. Develop marine mammal-specific measures for inclusion into catastrophic spill response programs,

i. Develop an emergency response plan to identify marine mammal expertise required in spill response initiatives, when triggered.

ii. Develop a marine mammal-specific operational manual to be included into existing catastrophic spill response plan(s)[6] to identify response protocols and data collection required for mitigation and monitoring of short and long-term effects to marine mammals and important habitat.

b. Review and routinely monitor point-source contamination in known harbour porpoise coastal habitat in B.C.

i. Review management of point-sources of toxic pollution to assess relevancy of current federal, provincial, and regional guidelines for thresholds for environmental contamination for specific chemicals listed in Appendix I, in terms of potential effects to harbour porpoise.

ii. Routinely monitor these point-sources to assess compliance with federal, provincial, and regional guidelines regarding thresholds for environmental contamination for the specific chemicals listed in Appendix I.

iii. Develop regulations for management of new and emerging persistent bioaccumulative toxic chemicals (PBTs), specifically polybrominated diphenyl ethers (PBDEs), to mitigate contamination of coastal habitat

[6] Include in the operational manual, measures outlined in the Fisheries & Oceans Canada ‘Marine mammal incident response’ manual (draft) and ‘Sea otter oil spill response plan for Canada’s Pacific coast’ (working document).

6. Continue the permitting of research, monitoring and assessment (Sections 2.3.3 & 2.3.4) to address key knowledge gaps, clarify identified threats and prevent duplication of research activities for harbour porpoise in B.C.

7. Support the Marine Mammal Response Network, to facilitate standardized collection of information on incidents, and for coordination of necropsies of carcasses, to support comprehensive understanding of catastrophic spills, noise and physical disturbance, vessel collisions, entanglement.

2.3.3. Research

The following areas are those that have been identified as a priority for research actions to address key knowledge gaps surrounding species biology. Where feasible, Fisheries & Oceans Canada will encourage the following research efforts. Other potential areas for research efforts have been listed in previous sections of this management plan (See Section 1.7 Knowledge Gaps) and should also be considered in the context of supporting those topics listed below.

8. Contribute, where feasible, to coordination of reconnaissance vessel survey(s) to assist in efforts to provide coast-wide population abundance estimates for Pacific harbour porpoise in B.C. Conduct aerial surveys, if feasible.

9. Contribute, where feasible, to development of methodology for studies investigating the habitat and dietary requirements of Pacific harbour porpoise in B.C.

    a. Contribute, where feasible, to determination of seasonally important prey species and nutritional needs for harbour porpoise in B.C.

    b. Support, when feasible, telemetry surveys to determine seasonal habitat use, and potentially important core areas for Pacific harbour porpoise.

10. Determine the range and seasonal occurrence of Pacific harbour porpoise in B.C.

    a. Share data on harbour porpoise collected during seasonal, multi-species reconnaissance vessel surveys in B.C., and aerial survey data, when appropriate.

    b. Share data on harbour porpoise gathered from remote acoustic monitoring packages to contribute to determination of seasonal occurrence.

11. Continue to contribute tissue samples, when feasible, for genetic analysis to determine the stock structure and genetic variability of harbour porpoise in B.C. and the western United States.

12. When feasible, assess age of stranded animals via necropsy, using currently accepted aging techniques (e.g. Hohn and Lockyer 1995) to contribute to the studies determining the age structure of the B.C. population.

2.3.4. Monitoring and Assessment

13. Monitor regional and seasonal abundance.

    a. Contribute to determination of survey frequency and methodology required to monitor regional and seasonal abundance of harbour porpoise.

    b. Contribute to determination of appropriate index sites for use in long-term monitoring of regional or local abundances to support 13a.

    c. Support, where feasible, land-based and/or vessel-based surveys to routinely monitor index sites (e.g. areas of known harbour porpoise occurrence), based on findings from 13a, b.

    d. Support, where feasible, photographic analyses of individuals to complement surveys determining regional and seasonal abundance to support 13 a to c.

14. Continue to support the collection of sightings information to contribute information on distribution, occurrence and threats to harbour porpoise in B.C.

15. Conduct ongoing assessments of the vulnerability of harbour porpoise to identified threats, as this population's distribution is further identified.

    a. Coordination of collection of dead stranded animals for necropsy, and tissue sample collection to determine causes of death, as well as contaminant loading, when possible.

    b. Continue to maintain a database for reported incidents involving marine mammals, including harbour porpoise. Incidents of specific importance for recording are those involving entanglement or incidental by-catch in fishing or aquaculture gear, catastrophic spills, acute acoustic disturbance.

16. Assess the potential for fisheries interactions.

    a. Use seasonal occurrence data on harbour porpoise and documented salmon gillnet fishing sites, to determine potential for incidental by-catch in salmon gillnets. This action will be contingent upon results from research efforts on seasonal occurrence of harbour porpoise (Action 10).

    b. Using information on significance of herring and hake in harbour porpoise diet and current harvest levels of these species, assess the potential for resource competition, and likelihood of negative impacts to the harbour porpoise population in B.C. This action will be contingent upon results from research efforts investigating harbour porpoise diet (Action 9a).

2.3.5. Outreach and Communication

17. Foster improved communication networks to increase awareness of management planning initiatives.

    a. Build intra- and interagency networks, when appropriate, for effective communication regarding catastrophic spill response and mitigation of entanglement, to allow timely, effective and coordinated actions by responsible agencies and parties.

    b. Continue ongoing media communications and promotion of the Marine Mammal Regulation and '*Be Whale Wise*: marine wildlife guidelines for boaters, paddlers and viewers' to reduce physical and acoustic disturbance for harbour porpoise in coastal areas.

    c. Support, where feasible, independent education programs and outreach efforts on chronic acoustic disturbance, coastal habitat degradation, and entanglement risks with respect to potential mitigation of impacts to harbour porpoise.

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

3. PROPOSED IMPLEMENTATION SCHEDULE

Fisheries & Oceans Canada encourages other agencies and organizations to participate in the conservation of the Pacific harbour porpoise through the implementation of this management plan. The agencies in Table 3 have been identified as partners for implementing the recommended actions.

Table 4 summarizes those actions that are recommended to support the management goals and objectives. The activities implemented by Fisheries & Oceans Canada will be subject to the availability of funding and other required resources. Where appropriate, partnerships with specific organizations and sectors will provide the necessary expertise and capacity to carry out the listed action. However, this identification is intended to be advice to other agencies, and carrying out these actions will be subject to each agency's priorities and budgetary constraints. Organizations currently collecting data on Pacific harbour porpoise are listed in Appendix II.

Table 3. The management actions outlined in this plan are to be carried out, where and when appropriate, in partnership with the following organizations.

Organization	**Acronym**
Fisheries & Oceans Canada	DFO
Marine Mammal Response Network	MMRN
Department of National Defence	DND

Organization	**Acronym**
Environment Canada	EC
Transport Canada	TC
Natural Resources Canada	NRCan
Canadian Coast Guard Services	CCGS
National Energy Board	NEB
First Nations	FN
B.C. Province	B.C. Prov
Ministry of Agriculture, Food & Fisheries	MAFF
Vancouver Aquarium Marine Science Centre	VAMSC
B.C. Cetacean Sightings Network	B.C.CSN
Straitwatch	Straitwatch
Universities having relevant research programs	Universities
U.S. National Marine Fisheries Service, National Oceanic & Atmospheric Administration, National Marine Mammal Lab	NOAA
Whale Watch Operators Association Northwest	WWOANW
Environmental non-Governmental Organizations	ENGOs
To be determined	TBD

Table 4. Proposed Implementation Schedule

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies*	Timeline
Protection					
1. Review of DND protocol for tactical sonar use, revise if necessary	P2; D1; M4	M	Injury to animals due to tactical sonar use; long-term displacement from habitat	DFO, DND	3 years
2. Protect the population from physical disturbance, vessel interaction, chronic noise stress					
a) Complete MMR amendments	D1; M2	M	Increase protection from physical & acoustic disturbance; vessel strikes	DFO	Ongoing, projected completion 1 year
b) Continue enforcement of MMR, regional guidelines for marine mammal viewing, & coastal development	D1; M2	M	Continued protection from physical & acoustic disturbance; vessel strikes	DFO, CCG	Ongoing
Management					
3. Develop cooperative research programs	R1 through R5; M1 through M6	H	Address data deficiencies; threats; species biology; foster independent research; prevent duplication of effort	DFO, Universities, FN, WWOANW, TBD	Immediate
4. Strengthen measures to reduce entanglement risk in aquaculture & fishing gear					
a) Gather data to provide advice on mitigation of entanglements					

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

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies*	Timeline
i) Continue to provide data on by-catch, entanglement	R4; R5; P1; P2	H	Maintain database on incidents; network; gather data	DFO, TBD	Ongoing
ii) Continue development of fisheries observer reporting standards & guidelines; species identification, data collection	P1; P2; D1; R4; R5; M1	H	Clarify extent of fisheries interactions	DFO, Fishing industry, TBD	1 year
b) Develop methods to reduce entanglement in salmon gillnets					
i) Review the feasibility of implementing the use of acoustic deterrent devices on salmon gillnets as an emergency, temporary mitigation measure for entanglement hotspots	P1; P2; D1; M1	M	Emergency mitigation of entanglement risk	DFO, Fishing industry	3 years
ii) Review the feasibility of implementing the use of barium sulphate netting for long-term mitigation of entanglement	P1; P2; D1; M1	H	Long-term reduction in entanglement risk	DFO, Fishing industry	1 year
iii) Consider the use of alternative fishing gear (as information becomes available) to reduce entanglement risk	P1; P2; D1; M1	H	Reduce entanglement risk	DFO, Fishing industry	As information on alternative gear- types becomes available
c) Develop, review, implement aquaculture protocols for mitigation of entanglement.					
i) Complete reporting requirements for entanglement at aquaculture sites; species identification, data collection, time requirements for reporting	P1; P2; D1;R5; M1	LM	Reduce entanglement risk	DFO, Fishing industry	4 years
ii) Develop operational standards for mitigating entanglement at fallowed aquaculture sites	P1; P2; D1; M1	LM	Reduce entanglement risk	DFO, Fishing industry	4 years
5. Manage, reduce input of chemicals into harbour porpoise habitat					
a) Develop marine mammal-specific measures for inclusion into catastrophic spill response programs					

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies*	Timeline
i) Develop an emergency response plan to include marine mammal expertise into spill response initiatives	P2; M2; M3; M5; M6	H	Effective, coordinated response for toxic spills affecting marine mammals	DFO,EC, CCG, B.C. Prov, TC NOAA	1 year
ii) Develop a marine mammal-specific operational manual	P2; M2; M3; M5; M6	H	Effective, coordinated step-wise response to toxic spills; standardized data collection; monitoring	DFO, EC, CCG, B.C. Prov, TC, NOAA	1 year
b) Review and routinely monitor point-source contamination in known harbour porpoise habitat in B.C.					
i) Review management of point-sources of chemicals to assess relevancy of federal, provincial, regional thresholds for contamination (chemicals listed in Appendix I)	P1; P2; M2; M3; M5; M6	MH	Relevance of guidelines & thresholds in terms of physiological effects to marine mammals through contaminant loading, habitat & prey	EC, B.C. Prov, Municipalities	3 years
ii) Routinely monitor these point-sources to assess compliance with federal, provincial, regional guidelines for thresholds	P1; P2; M2; M3; M5; M6	MH	Compliance w/ guidelines & thresholds for environmental contamination; contaminant loading, habitat & prey	EC, B.C. Prov, Municipalities	3 years
iii) Develop regulations for new, emerging PBTs, specifically. PBDEs	P1; P2; M2; M3; M5; M6	MH	Development of measurable guidelines and regulations for management of PBTs	EC, B.C. Prov, Municipalities	3 years
6. Continue issuing permits for non-DFO research, monitoring and assessments	R1 through R5; M6	H	Clarify threats; species biology; foster independent research; prevent duplication of effort	DFO, TBD	Ongoing

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies*	Timeline
7. Support MMRN program	R4; R5	LM	Standardized incident data collection; necropsies	DFO, WWOANW, TBD	Ongoing
Research					
8. Reconnaissance vessel surveys to provide coast-wide abundance estimates. Aerial surveys, if feasible	R1;R2; R3; R5; M6	H	Abundance estimates; seasonal distribution	TBD, DFO, ENGOs, NOAA, Universities	1 year
9. Develop methodology for studies on habitat and dietary requirements					
a) Determine seasonally important prey species and nutritional needs of harbour porpoise in B.C.	P1; P2; R1; R3	MH	Dietary needs	DFO, ENGOs, Universities, NOAA	2 years
b) Support, when feasible, telemetry surveys	D1; R1; R3	LM	Seasonal habitat use, important core areas	TBD, DFO, ENGOs, NOAA, Universities	4 years
10. Determine range and seasonal occurrence in B.C.					
a) Share harbour porpoise data from reconnaissance surveys	D1; R1; R3; R5	H	Data sharing; seasonal distribution	DFO, ENGOs, Universities, NOAA, TBD	1 year
b) Share harbour porpoise data from remote acoustic packages	D1; R1; R3	H	Data sharing; seasonal distribution	DFO, ENGOs, Universities, NOAA, TBD	1 year
11. Contribute to genetic analyses by collecting tissue samples, when possible	R3	L	Determination of stock structure; genetic variability in population	DFO, NOAA, TBD, ENGOs, Universities	Opportunistic
12. Assess age of stranded animals via necropsy & use of accepted aging techniques, where feasible	R3	LM	Stranding response, sample collection, determination of age structure	DFO, MAFF, NOAA, TBD	Ongoing
Monitoring & Assessment					
13. Monitor regional & seasonal abundance					

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies*	Timeline
a) Contribute to determination of survey frequency necessary to monitor regional & seasonal abundance	P2; D1; R1; R2 R3; M6	MH	Development of survey methodology	TBD, DFO, NOAA, ENGOs, Universities	3 years
b) Contribute to determination of appropriate index sites for use in long-term monitoring of 13a	P2; D1; R1; R2 R3; M6	MH	Appropriate siting of surveys	TBD, DFO, NOAA, ENGOs, Universities	3 years
c) Support, where feasible, land-based &/or vessel-based surveys to carry out 13a & 13b	P2; D1; R1; R2 R3; R5 M6	MH	Determination of local abundance	TBD, DFO, NOAA, ENGOs, Universities	3 years
d) Support, where feasible, photographic analyses of individuals to support 13a through 13c	P2; D1; R1; R2 R3; M6	LM	Determination of seasonal occurrence; site fidelity; movements	TBD, DFO, NOAA, ENGOs, Universities	4 years
14. Continue to support the collection of sightings information	R1	M	Distribution and occurrence; threats; data collection	DFO, B.C.CSN, WWOANW	Ongoing
15. Conduct assessments of vulnerability to identified threats					
a) Coordination of collection of dead stranded animals for necropsy & tissue sampling	R3; R4	MH	Determination of cause of death; contaminant & pathogen loading, aging, stranding response	DFO, MAFF, NOAA, TBD	Ongoing
b) Maintain database on reported incidents involving harbour porpoise	R4: R5	MH	Clarification of extent of threats; entanglement; by-catch; toxic spills; acoustic disturbance	DFO, TBD	Ongoing
16. Assess potential for fisheries interactions					

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies*	Timeline
a) Utilize data on seasonal occurrence, fishing sites to determine risk for incidental by-catch	P1; P2; D1; R3; R4; M1	MH	Clarification of extent of threats; entanglement; by-catch	TBD, DFO, NOAA	2 years, contingent upon #10 results
b) Assess potential for resource competition using research results on harbour porpoise diet and harvest levels of herring and hake	P1; P2; D1; R3; R4	M	Determine potential risk of prey limitation	DFO, NOAA, TBD, Universities	3 years, contingent upon #9a results
Outreach & Communication					
17. Foster communication networks					
a) Develop intra- & inter-agency communication networks	P2; D1; M2; M3; M5; M6	H	Effective communication for catastrophic spill response; reduction of entanglement risk	DFO, EC, CCG, B.C. Prov, TC, Municipalities, ENGOs, Industries, NOAA, TBD	1 year
b) Promotion of MMR, & BWW guidelines	P2; D1; M6	M	Mitigate physical & chronic acoustic disturbance; outreach; communication	DFO, WWOANW, ENGOs, Straitwatch	Ongoing
c) Foster education programs on chronic acoustic disturbance, habitat degradation, entanglement	P2; D1; M1; M2; M4; M6	LM	Foster independent programs; outreach; communication; acoustic disturbance; habitat degradation; entanglement	DFO, B.C.CSN, Straitwatch, ENGOs, WWOANW, TBD	5 years
d) Trans-boundary, inter-jurisdictional collaboration	All objectives	H	Data sharing; foster collaborative programs	DFO, NOAA, FN, WWOANW, ENGOs, TBD	Immediate

4. ASSOCIATED PLANS

The following are recovery plans which identify similar threats to other marine mammals at-risk, and contain similar recommendations for mitigation of threats identified in this Management Plan for Pacific harbour porpoise in Canada. Implementation of actions listed (in Section 2.3) in this, and the recovery plans listed below will provide a multi-species and multi-jurisdictional approach to conservation of marine mammals on the west coast of North America.

- Management plan for the offshore killer whale (*Orcinus orca*) in Canada [Proposed]. (DFO 2008a)
- Management plan for the Steller sea lion (*Eumetopias jubatus*) in Canada [Draft]. (DFO 2008b)
- Management plan for the northeastern Pacific grey whale (*Eschrichtius robustus*) in Canada. [Draft]. (DFO 2008c)
- Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada [Final] (DFO 2007)
- Recovery Strategy for the Northern and Southern Resident Killer Whale (*Orcinus orca*) in Canada. [Final] (DFO 2008)
- Recovery Strategy for the Sea Otter (*Enhydra lutris*) in Canada [Final] (DFO 2007a)
- Action Plan for Blue, Fin and Sei Whales (*Balaenoptera musculus, B. physalus* and *B. borealis*) in Pacific Canadian Waters [Draft] (DFO 2006)

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APPENDIX I: Terminology
Threat Assessment & PBT Chemicals

Table 5. Details on Terms Used for Assessment of Threats to the Pacific Harbour Porpoise Population.

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

Table 6. Persistent Bioaccumulative Chemicals that May Pose a Risk to Pacific Harbour Porpoise.
The table was obtained from the final Recovery Strategy for northern and southern resident killer whales (DFO 2008).

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

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

APPENDIX II: Organizations Currently Involved In Research on Harbour Porpoise

Organizations currently involved in research on Pacific harbour porpoise in British Columbia.

- University of British Columbia, Marine Mammal Research Unit, Vancouver, B.C.
- Fisheries & Oceans Canada, Nanaimo, B.C.
  - Science Branch
  - DFO Marine Mammal Incident Response Program
- B.C. Cetacean Sightings Network, Vancouver Aquarium Marine Sciences Centre, Vancouver, B.C.
- Raincoast Conservation Society
- B.C. Ministry of Agriculture, Food & Fisheries, Abbotsford, B.C.
- Juan de Fuca Express, Victoria, B.C.
- U.S. National Oceanic & Atmospheric Administration, Seattle, WA
- Cascadia Research Collective, Friday Harbor, WA
- Cornell University, Bioacoustics Research Program

APPENDIX III: Record Of Cooperation & Consultation

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

There are few people in Canada, or elsewhere, with scientific, technical, traditional or local knowledge of Pacific harbour porpoise. As a result, DFO brought together a small internal working group of technical experts in science, and management to develop an initial draft of this management plan.

A Cetacean Management Planning Technical Workshop was hosted in November of 2007 to provide a forum for the sharing of knowledge and expertise on a number of 'special concern' cetaceans for which management plans were developed. A group of scientific and technical experts including; independent researchers, environmental non-governmental organizations, and other governmental (federal and provincial) staff from both Canada and the United States were contacted to attend this workshop. An invitation letter was sent to all coastal First Nations soliciting their participation in the workshop. This workshop was invaluable in assisting the DFO internal working group in drafting the Management Plan for Pacific Harbour Porpoise in Canada. Given that the population considered in this management plan frequents both Canadian and United States (US) waters, bilateral government and non-government input and collaboration was sought.

A draft version of the management plan was posted to the DFO Pacific Region website for public comment period from April 7 to May 12, 2008. These consultations were web-based, and also included mail-outs to all coastal First Nations. An initial draft of the management plan, discussion guide and feedback form were made available. In addition, a message announcing the

development of the management plan, was sent to a marine mammal list serve (MARMAM) with a broad local and international distribution to marine mammal researchers and interested parties, and to a distribution list of whale-related contacts provided to DFO in recent years from environmental groups, non-governmental organizations, government agencies, and the eco-tourism sector.

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

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

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