



## 2014 POPULATION ASSESSMENT OF PACIFIC HARBOUR SEAL (*PHOCA VITULINA RICHARDSI*) IN THE STRAIT OF GEORGIA



Pacific Harbour Seal (Photo: B. Gisborne)

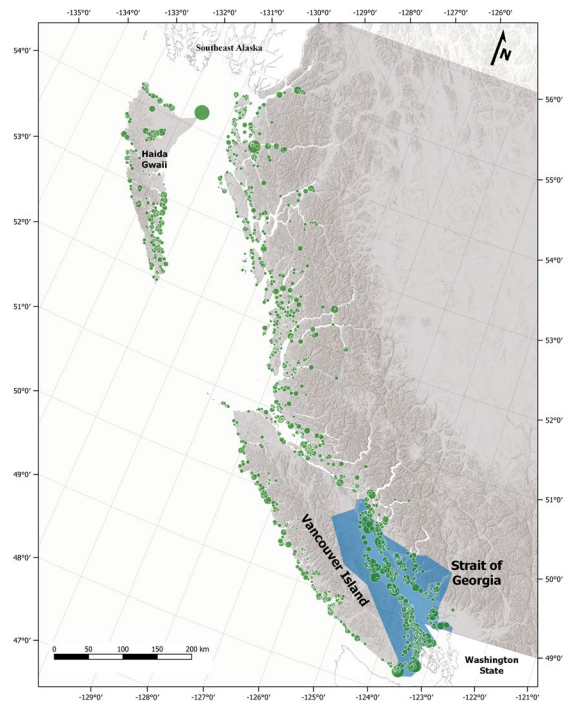


Figure 1. Distribution of Harbour Seal haulout sites in British Columbia (Strait of Georgia is indicated by the blue shading). Circles are scaled to relative number of animals counted at a site.

### Context:

The Strait of Georgia (SOG) supports the highest density of Harbour Seals on the British Columbia (BC) Coast and has been used as an index site for monitoring Harbour Seal abundance and distribution in BC since 1973. Harbour Seal populations in BC, including the SOG, were depleted due to commercial harvests for pelts and predator control programs. Aerial surveys indicate that the abundance of Harbour Seals increased dramatically after the species was protected in the early 1970s. While populations grew exponentially during the 1970s and 1980s, the population has been stable at ~39,000 seals in the SOG since the mid-1990s.

Harbour Seals have been identified as the primary prey species of threatened Transient Killer Whales in BC. Fisheries and Oceans Canada (DFO) Species at Risk Program has requested science advice on the current population status and distribution of Harbour Seals in the SOG to assist in further refining the features, functions and attributes of the habitat necessary for survival or recovery of the Transient Killer Whale. This information will be used to meet recovery strategy objectives involving prey availability, as identified in the Recovery Strategy for Transient Killer Whales.

*This Science Advisory Report is from the February 23–26, 2016 National Marine Mammal Peer Review Committee (NMMPRC): Part II. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.*

## SUMMARY

- Harbour Seals fulfil an important ecological role in the Strait of Georgia (SOG). They are a key prey species for Transient (also known as Bigg's) Killer Whales and current information on abundance and distribution of Harbour Seals has been identified as an important component of Transient Killer Whale habitat. They are also a major predator of several commercially important fish species in the SOG, including salmon, herring and Hake.
- Fisheries and Oceans Canada (DFO) has been conducting standardized aerial surveys during the pupping season since the early 1970s to determine Harbour Seal abundance and distribution in Canadian Pacific waters.
- Harbour Seal populations in the SOG increased exponentially at a rate of about 11.5% during the 1970s and 1980s, and then stabilized in the mid-1990s. Abundance increased from ~3,600 in 1973 to ~39,000 during 1994–2008.
- Based on surveys flown in 2014, Harbour Seal abundance in the SOG is estimated to have remained stable at ~39,000 (95% CI 35,000–42,100).
- Although overall numbers are stable in the SOG, there is evidence of continuing redistribution among haulout sites.
- In addition to ongoing population monitoring, further analysis of changes in Harbour Seal distribution and behaviour are required to support Transient Killer Whale recovery, assess fishery interactions, and identify potential impacts of proposed development in the SOG.

## BACKGROUND

The Pacific Harbour Seal (*Phoca vitulina richardsi*) is the most abundant pinniped species in the Northeast Pacific and is found throughout coastal and estuarine waters of British Columbia (BC), using haulout sites to rest, moult, and give birth. It is estimated that Harbour Seal populations were depleted to ~10,000 animals coast wide due to large-scale predator control programs and harvests in the late 1800s to mid 1900s. Abundance of Harbour Seals increased dramatically following their protection in the early 1970s then stabilized in the mid-1990s, with populations currently thought to be steady along much of the west coast of North America. Based on historic reconstructions it is estimated that a full recovery of Harbour Seal populations has taken place in BC waters.

The Strait of Georgia (SOG) provides the most extensive time-series for assessing population trends; it supports the highest density of Harbour Seals on the BC coast and has been used as an index site by DFO for monitoring Harbour Seal abundance and distribution in Canadian Pacific waters since 1973. The SOG is defined as all Canadian waters from Race Rocks in Juan de Fuca Strait in the south to the north end of Quadra Island in the north (Figure 1). Harbour Seal populations in the SOG increased exponentially at a rate of about 11.5% (95% CI 10.9–12.6%) during the 1970s and 1980s, and then stabilized in the mid-1990s. Abundance increased about 10-fold from ~3,600 (95% CI 2,480 to 4,650) in 1973 to 39,000 (95% CI 33,200 to 45,000) during 1994–2008, representing ~37% of the estimated 105,000 Harbour Seals inhabiting BC coastal waters.

There is ongoing interest in the role of Harbour Seals in the SOG ecosystem, both as key predators of fishery resources and as a prey species critical to supporting the recovery of Transient (also known as Bigg's) Killer Whales. Harbour Seals have been identified as the primary prey species for Transient Killer Whales in BC, estimated to account for more than half of their diet in this area. The increase in occurrence of Transient Killer Whales in the SOG over the past four decades has been attributed, in part, to the return of Harbour Seal abundance to historical levels in this area. The key habitat features identified as critical for the survival or recovery of the Transient Killer Whale population in BC are mostly linked to feeding and adequate abundance and distribution of prey, and ongoing assessment of abundance and distribution of key prey species has been identified as an important recovery objective.

In addition to supporting recovery of Transient Killer Whale populations, information on Harbour Seal abundance and distribution is routinely required for responding to management issues including environmental assessments, spill response, siting of aquaculture facilities, evaluating impacts of marine mammal populations on local fishery resources, evaluating potential impacts of changing ocean conditions, and supporting ecosystem based management in the SOG.

## ASSESSMENT

DFO has been conducting standardized aerial surveys during the pupping season since the early 1970s to determine Harbour Seal abundance and distribution in Canadian Pacific waters. Aerial surveys are conducted during low tides toward the end of the pupping season when peak numbers of animals are hauled out on land. Counts are standardized to account for slight differences in geographic coverage, missed sites, and the timing of surveys. The standardized counts provide a reliable index of relative abundance, but underestimate absolute abundance because some animals are in the water during surveys. An estimate of the total population size is obtained by applying correction factors derived from satellite telemetry data to account for animals that are at sea and missed during surveys.

An aerial Harbour Seal census was conducted in the SOG between August 11–22, 2014 to coincide with low tide cycles in the morning during the peak pupping season. Surveys were flown in a Cessna 180 flown at an altitude of 150–200 m at an airspeed of 125 km hr<sup>-1</sup> beginning about 2 hours prior to the lower daily low tide and ending up to 2 hours after low tide. Shorelines were followed and all islands circumnavigated at a height between 100–200 m; a detailed search of the entire survey area was undertaken checking all known haulout sites with three observers scanning for new haulout sites and swimming animals. Animals at each haulout were photographed and later counted from digital images.

In accordance with telemetry studies conducted in the early 1990s, it was estimated that on average 62% of animals were hauled out during surveys in 2014. A correction factor of 1.63 (CV=0.042) was therefore applied to Harbour Seal counts (not including swimmers) to account for animals in the water missed during surveys. The estimated abundance of ~39,000 (95% CI 35,000–45,100) based on 2014 counts represents no significant change from the estimate of ~39,100 (95% CI 33,200 to 45,000) based on the 2008 survey (Figure 2).

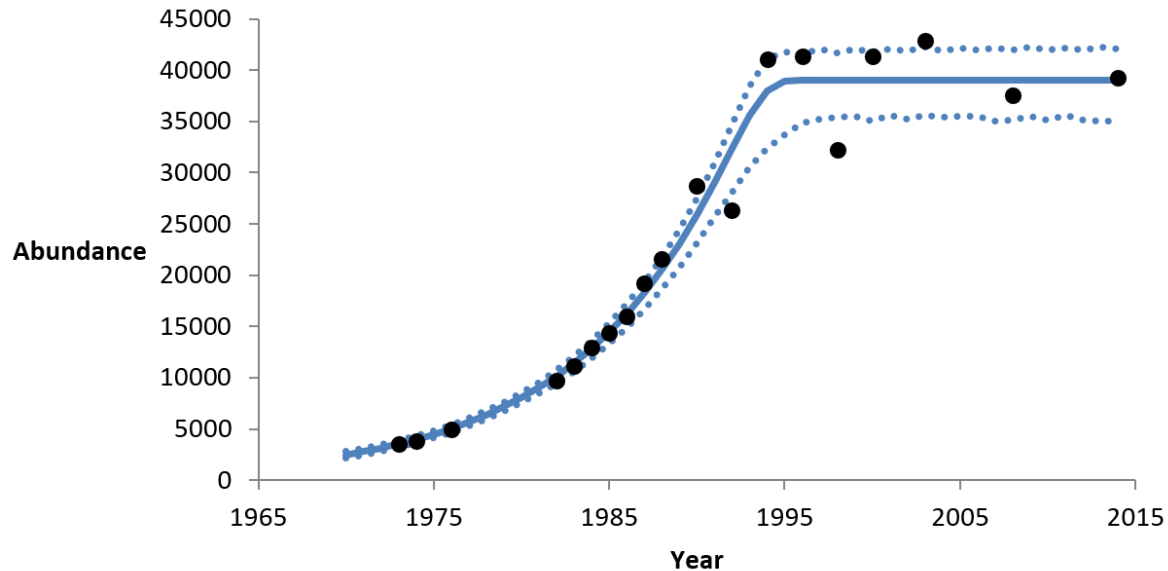


Figure 2. Trends in Harbour Seal abundance in the Strait of Georgia from standardized DFO aerial surveys. The solid trend line represents generalized logistic curves fitted using maximum likelihood methods and the dotted lines show 95% confidence intervals.

The importance of individual haulout sites varies widely, with sites used by a few to nearly 800 seals (Figure 3). There is also high variation in counts at individual haulouts from survey to survey. In 2014, seals were observed at a total of 408 haulout sites in the survey area; this includes 17 new locations not previously observed to be haulouts. Densities in the SOG remain at ~13.2 seals/kilometre of shoreline.

Although overall numbers are stable, there is continued evidence of changes in distribution among haulout sites within the SOG with a continued increase in the relative importance of southern Gulf haulouts observed in 2014. This shift appears to be from haulouts adjacent to deeper waters to those in shallow boulder beaches.

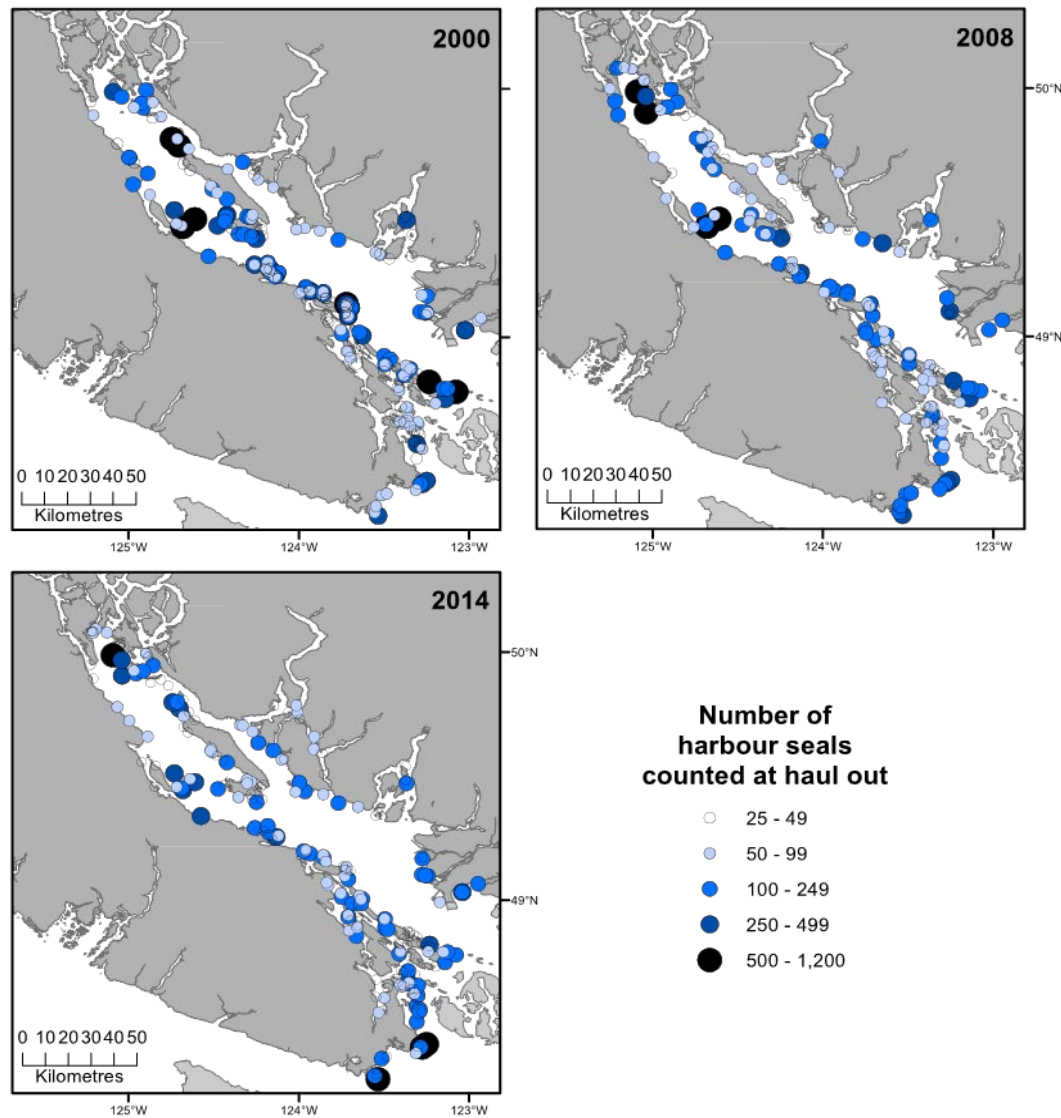


Figure 3. Harbour Seal distribution at haulouts throughout the Strait of Georgia from surveys flown in 2000, 2008, and 2014.

### Sources of Uncertainty

Counts are corrected for the unknown proportion of animals foraging at sea during surveys (and therefore not included in counts from survey photos). There is uncertainty around the correction factor (CF) and associated variance applied to survey counts to provide estimates of abundance. The CF is based on an analysis of haulout patterns from time-depth recorders (TDRs) deployed 1990–94 and haulout behavior may have changed since then in response to changes in population demographics, predator abundance, patterns of human disturbance, dynamic ocean conditions and prey availability.

There is uncertainty associated with the counts themselves, related to timing of surveys relative to the pupping season. It is possible that timing of peak pupping season has changed and the correction factor needs to be updated to reflect current conditions in the SOG.

There is uncertainty related to movement, either directed or seasonal, of Harbour Seals between the SOG and Puget Sound and whether they are part of the same population.

Although abundance of Harbour Seals appear to be stable in the SOG, there is evidence of continuing redistribution among haulout sites. There is uncertainty as to whether changes in haulout numbers actually represent changes in distribution or in fact reduced pupping or survival/mortality in some areas relative to others. There is therefore uncertainty as to whether accessibility of Harbour Seals to predation by Transient Killer Whales has changed with shifts in haulout use and haulout behaviour.

## **CONCLUSIONS AND ADVICE**

This survey provided a current abundance estimate for Harbour Seals in SOG in the breeding season of ~39,000 (95% CI 35,000–42,100) and represents no change from the previous assessment in 2008. The Harbour Seal population remains stable, with evidence of ongoing redistribution throughout the SOG. Changes in Harbour Seal distribution could be significant to Transient Killer Whales and analysis of potential impacts in terms of their availability and vulnerability to predation is warranted. Not only would these changes impact their role as prey, but their ecological role as predators in turn.

Updated surveys in areas outside of the SOG are required to determine population trends in other important Harbour Seal areas.

## **OTHER CONSIDERATIONS**

In addition to questions related to prey availability for Transient Killer Whales there is ongoing concern over Harbour Seal interactions with fishing activities and impact on fishery resources. To put diet studies into context and update bioenergetics models, updated correction factors, pupping curves and life tables are recommended. There is continued interest in ecosystem-based management, examining the role of seals as both predators and prey, and how they may be impacted by or respond to changes in ocean conditions. Abundance and distribution data for harbour seals can be used to update ecosystem models being developed for the SOG.

There is ongoing interest in using Harbour Seal as a general indicator of the status of food webs and ecosystem health and the species continues to be used as a sentinel for chemical contaminants in high-level predators in marine food webs.

The SOG is contiguous with Puget Sound, and an assessment of the Salish Sea population would benefit from coordinated surveys in neighboring United States waters.

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## SOURCES OF INFORMATION

This Science Advisory Report is from the February 23–26, 2016 National Marine Mammal Peer Review Committee (NMMPRC): Part II. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

DFO. 2007. [Recovery Strategy for the Transient Killer Whale \(\*Orcinus orca\*\) in Canada](#), *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Vancouver, vi + 46 pp.

DFO. 2017. [Proceedings of the 2016 National Marine Mammal Peer Review Committee \(NMMPRC\): Part II; February 23-26, 2016](#). DFO Can. Sci. Advis. Sec. Proceed. Ser. 2017/025.

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