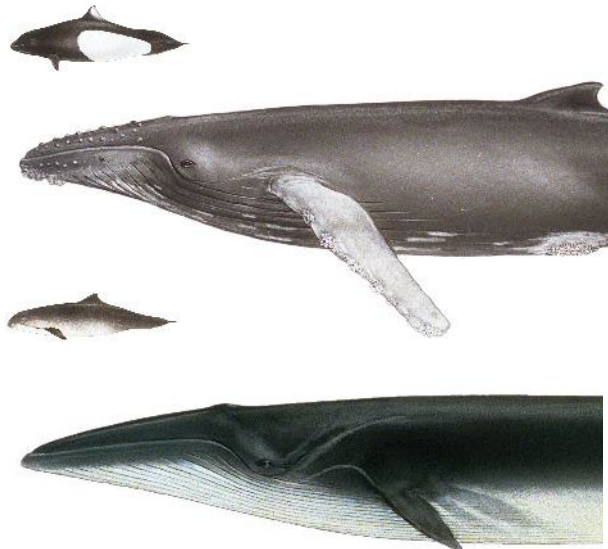




## ABUNDANCE AND DISTRIBUTION OF CETACEANS IN CANADIAN PACIFIC WATERS IN 2018



The four most commonly encountered species during the 2018 survey: from top to bottom, Dall's Porpoise, Humpback Whale, Harbour Porpoise and Fin Whale (*A. Denbigh*).

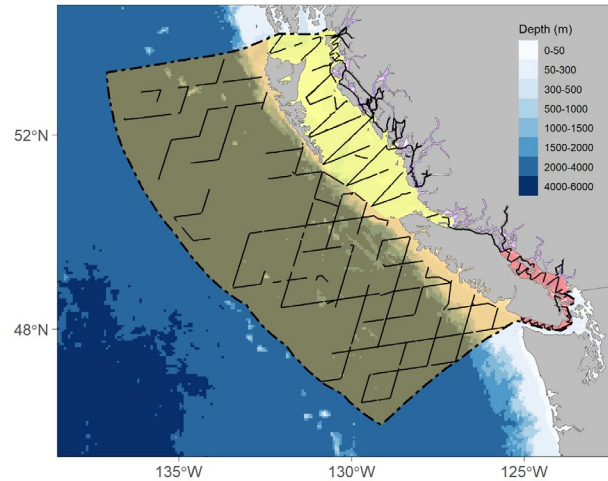


Figure 1. Realized visual effort (lines) and stratification of the survey area, showing the offshore block (orange) and the strata of the inshore block: 1: North Coast (yellow), 2: South Coast (red), 3: Johnstone Strait (green), 4: Mainland Inlets (purple).

### Context:

Several marine mammal species on the west coast of Canada are reported as bycatch in fisheries and aquaculture. A provision of the United States (US) Marine Mammal Protection Act (MMPA) will require Canada, as an exporter of fish products, to provide population estimates and rates of incidental mortality from fisheries operations by January 1, 2022. However, abundance estimates in Canadian Pacific waters are lacking for most cetacean species, especially for the offshore areas, or are too old to meet MMPA requirements. Species that are not covered by current census programs must be assessed using a dedicated systematic survey over the entire range of Canadian jurisdiction, such as those have been made in Atlantic Canada in 2007 and 2016 and in the Central Arctic in 2013. Its objectives were to document the distribution of marine mammals in Pacific Canada, as well as sea turtles and large fish species such as Basking Sharks and sunfish, and to estimate the abundance of cetacean species for which information is lacking or outdated (but not all species).

This Science Advisory Report is from the February 17–22, 2020 National Marine Mammal Peer Review Committee Meeting on the Pacific Region International Survey of Marine Megafauna (PRISMM). Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

## SUMMARY

- The Pacific Region International Survey of Marine Megafauna (PRISMM) was a multi-species, ship-based, systematic line transect survey conducted between July 4 and September 5, 2018 to estimate the abundance and distribution of cetacean species in Canadian Pacific waters.
- Over 2,000 sightings were made of 20 marine mammal species along 8,400 km of effort.
- Density and abundance were estimated for nine species using either standard line transect analyses or density surface modelling.
- Maps of predicted distribution were produced for the most commonly-encountered species (Humpback Whales, Fin Whales, Dall's and Harbour Porpoises).
- Once corrected for diving behaviour, abundance was estimated at 24,300 Dall's Porpoises (95%CI 19,500–30,300), 12,200 Humpback Whales (8,200–18,300), 7,400 Harbour Porpoises (3,600–15,200), 5,900 Pacific White-sided Dolphins (2,900–11,800), 3,000 Fin Whales (2,200–4,000), 2,200 Northern Right Whale Dolphins (730–6,700), 920 Risso's Dolphins (180–4,800), 200 Blue Whales (59–670), and 70 Sei Whales (24–210).
- These estimates represent the abundance of cetaceans in Canadian waters at the time of the survey but do not reflect the abundance of entire populations, which are distributed across wider areas of the Pacific.

## BACKGROUND

In Canadian Pacific waters, recent abundance estimates are available for several marine mammal species that are surveyed at scheduled intervals (e.g., Resident Killer Whales, Sea Otters, Steller Sea Lions). For most cetaceans, however, abundance estimates are not current (>10 yr old) or are lacking altogether, especially in offshore areas, and had to be assessed using a dedicated survey. To document the distribution of marine mammals and to meet the requirements of the United States (US) *Marine Mammal Protection Act*, the Pacific Region International Survey of Marine Megafauna (PRISMM) was conducted in inshore and offshore Pacific Canadian waters from July 4 to September 5, 2018.

## ASSESSMENT

### Survey

PRISMM was a ship-based survey using distance sampling methods to estimate abundance. Vessels covered an area from the Alaskan border to the Washington State border, and from the coast to the 200 nm limits of the Canadian Exclusive Economic Zone. The study area was divided into an inshore block and an offshore block (Fig. 1).

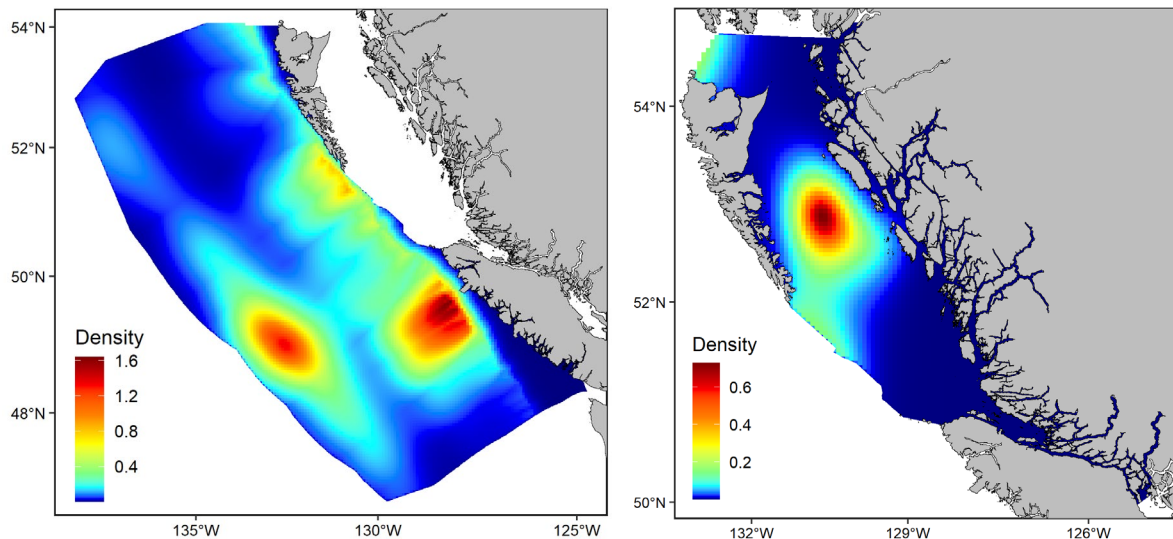
The survey resulted in over 2,000 sightings of 20 marine mammal species. Humpback Whales were the most commonly encountered cetacean in Pacific Canadian waters and were found in all survey blocks, including mainland inlets, with Fin Whales the second most common baleen whale. Blue and Sei Whales were seen on 6 and 4 occasions, respectively (all in the offshore stratum). Dall's Porpoises were commonly encountered throughout the offshore stratum and along the North Coast, while Harbour Porpoises were seen in large numbers along the South Coast. Only 25 sightings of Pacific White-sided Dolphins were made during the entire survey.

## Analysis

The probability of detecting an animal given its distance from the transect line was estimated as a function of the perpendicular distances of the sightings. Based on these detection functions, the density of individuals seen on the transect lines was then extrapolated to the entire survey area to estimate abundance.

In addition, spatial models were used to produce density and distribution maps for the most commonly-encountered species (e.g., Fig. 2). For Fin Whales and Dall's Porpoises, these models provided more precise abundance estimates because they take into account the spatial structure of the sightings data.

Once corrected for diving behaviour, abundance was estimated at 24,300 Dall's Porpoises (95%CI 19,500–30,300), 12,200 Humpback Whales (8,200–18,300), 7,400 Harbour Porpoises (3,600–15,200), 5,900 Pacific White-sided Dolphins (2,900–11,800), 3,000 Fin Whales (2,200–4,000), 2,200 Northern Right Whale Dolphins (730–6,700), 920 Risso's Dolphins (180–4,800), 200 Blue Whales (59–670), and 70 Sei Whales (24–210). Table 1 provides estimates for each stratum.



*Figure 2. Estimated densities (fill colour indicates the number of individuals per 25 km<sup>2</sup> grid cell) of Fin Whales in the offshore (left) and inshore (right) blocks.*

## Sources of Uncertainty

There is higher uncertainty around the abundance estimates for species with few sightings (i.e., Blue Whales, Sei Whales, and dolphins). Moreover, low search effort in shallow waters or close to the coast (due to the size of the research vessels) could have resulted in underestimating the abundance of some cetacean species (especially small odontocetes, Grey Whales and Minke Whales), but the magnitude of that potential bias is unknown.

Observers can miss animals that are underwater (availability bias) and miss animals at the surface on the trackline (perception bias). Perception bias could not be estimated from the data collected in this survey and thus abundance estimates likely underestimate true population sizes. Abundance estimates were adjusted for availability bias based on published values. However, dive behaviour of cetaceans is known to vary considerably. Therefore, it is likely that the correction factors underestimate the real uncertainty and could bias the abundance estimates.

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These estimates represent the abundance and distribution of cetaceans in Canadian waters at the time of the survey but do not reflect the abundance of entire populations, which are distributed across wider areas of the Pacific. The resulting maps represent the distribution of animals for this single survey.

PRISMM was limited to a single season (summer) and a single year (2018). The survey timing corresponded to the anticipated peak abundance of several migratory species, but the results do not convey possible seasonal or annual fluctuations in abundance and distribution of cetaceans in Canadian Pacific waters.

**CONCLUSIONS**

PRISMM achieved its main objective of providing new or updated abundance estimates for nine cetacean species (Table 1). Combined with the available distribution models, these results can be compared with previous surveys as well as historic whaling data to document population trends and the extent of recovery of previously harvested populations.

*Table 1. Abundance estimates of cetaceans in Pacific Canadian waters in 2018 for each stratum (with coefficient of variation). Estimates for Fin Whales and Dall's Porpoises were produced by spatial models (with the inshore block divided into the North Coast and the Salish Sea, each with connecting inlets). All abundance estimates have been corrected for diving behaviour.*

Stratum	Dall's Porpoise	Humpback Whale	Harbour Porpoise	Pacific White-sided Dolphin	Fin Whale	Northern Right Whale Dolphin	Risso's Dolphin	Blue Whale	Sei Whale
North Coast	5,309 (0.16)	1,961 (0.31)	1,980 (0.74)	366 (0.74)	165 (0.50)	0	0	0	0
Johnstone Strait		0	4 (0.60)	80 (0.30)		0	0	0	0
Inlets		1,361 (0.45)	737 (0.57)	47 (1.01)		0	0	0	0
South Coast	595 (0.32)	366 (0.40)	3,589 (0.44)	0	0	0	0	0	0
Offshore	18,387 (0.13)	8,556 (0.27)	1,042 (0.61)	5,390 (0.39)	2,800 (0.15)	2,207 (0.62)	920 (1.00)	199 (0.68)	70 (0.60)
<b>Total</b>	<b>24,290 (0.11)</b>	<b>12,244 (0.21)</b>	<b>7,352 (0.39)</b>	<b>5,882 (0.37)</b>	<b>2,965 (0.15)</b>	<b>2,207 (0.62)</b>	<b>920 (1.00)</b>	<b>199 (0.68)</b>	<b>70 (0.60)</b>

**OTHER CONSIDERATIONS**

These coast-wide, updated abundance estimates can also inform Potential Biological Removal limits for fisheries bycatch, and the spatial models could be used to inform assessments of the risk of entanglements, vessel strikes, acoustic disturbance, and other anthropogenic threats.

Because many cetacean populations range over wide areas of the north Pacific, the timing of the Canadian PRISMM survey was also aligned with that of the National Oceanic and Atmospheric Administration (NOAA)'s major cetacean survey of US eastern Pacific waters

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(which takes place every five years). When combined, these data will provide a more synoptic view of cetacean distribution.

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## **SOURCES OF INFORMATION**

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Wright, B.M., Nichol, L.M., Doniol-Valcroze, T. 2021. [Spatial density models of cetaceans in the Canadian Pacific estimated from 2018 ship-based surveys](#). DFO Can. Sci. Advis. Sec. Res. Doc. 2021/049. viii + 46 p. (Erratum: March 2022)

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