



STOCK ASSESSMENT OF ATLANTIC HARBOUR SEALS (*PHOCA VITULINA VITULINA*) IN CANADA FOR 2019–2021



Aerial view of Atlantic Harbour Seals at haul-out site (Photo: DFO).

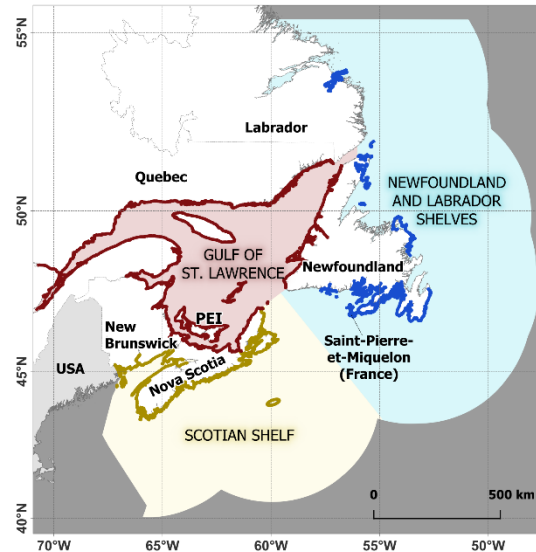


Figure 1. Map of Atlantic Canada showing the three survey regions and the aerial survey effort (darker coloured lines) within each region.

Context:

The designatable unit (DU) of *Phoca vitulina vitulina* consists of the harbour seals found on the Canadian Atlantic and Arctic coasts. This DU ranges into the waters of southern and western Greenland, the northeastern United States, and Saint-Pierre and Miquelon (France). The total population size has not been estimated for this DU. This subspecies was considered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in April 1999 and placed in the Data Deficient category. The status was then re-examined in November 2007 and assessed as Not at Risk.

Fisheries and Oceans Canada (DFO) undertook a coastal aerial survey of harbour seals in Atlantic Canada over a three-year period (2019–21). This review will generate the first abundance estimate for harbour seals in Atlantic Canadian waters.

Information generated from this review will also support the Department in meeting requirements for an updated harbour seal population assessment for Atlantic Canadian waters if required under the U.S. Marine Mammal Protection Act (MMPA) import provisions.

This Science Advisory Report is from the October 16–20, 2023 National Peer Review on the NW Atlantic Harbour Seal Population Assessment and Potential Biological Removal Levels. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

SUMMARY

- Aerial surveys to obtain counts of harbour seals were conducted in the Gulf of St. Lawrence (GSL, 2019), on the Scotian Shelf (SS, 2020), and on the Newfoundland and Labrador Shelves (NLS, 2021).
- A total of 10,327 seals were counted on haul-out sites, with 55%, 23%, and 22% of the seals counted in the GSL, SS, and NLS, respectively.
- To estimate abundance, counts were adjusted for the estimated proportion of seals which were at sea during the time of the surveys and were, therefore, unavailable to be counted.
- Correction factors were derived by combining recent data on haul-out behaviour of harbour seals in the St. Lawrence Estuary and haul-out correction factors reported in the literature.
- Haul-out correction factors of 2.55 (CV: 16.02%) and 1.64 (CV: 8.67%) for surveys flown during the pupping and moulting periods, respectively, were applied to the survey counts.
- The total estimated harbour seal abundance for Atlantic Canadian waters in 2019–21 was 25,200 individuals (95% CI 22,500–28,100; rounded to the nearest 100). The GSL, SS, and NLS accounted for 58%, 24%, and 19% of this total, respectively.
- Based on the estimated total abundance for 2019–21, the annual Potential Biological Removal (PBR) is 720 seals.
- The haul-out correction factors have a large impact on the abundance estimate but are informed by a limited amount of data on haul out behaviour in Atlantic Canada.

BACKGROUND

The harbour seal, *Phoca vitulina*, is globally the most widely distributed pinniped, occupying a wide variety of habitats and climatic zones in coastal waters across the Northern Hemisphere. Historical records indicate that the North Atlantic harbour seal (*Phoca v. vitulina*) was abundant in Atlantic Canada in the early 20th century. However, bounty programs implemented between 1927 and 1976 resulted in significant declines in abundance and notable disappearances from areas where they had typically been observed. Following the prohibition of hunting in 1979, efforts to estimate the abundance of harbour seals in Atlantic Canada were infrequent and restricted to limited geographical areas. There are no range-wide estimates of abundance or distribution for harbour seals in Atlantic Canadian waters and the overall population trend is unknown.

In contrast to Atlantic Canada, the harbour seal population in US Atlantic waters has been periodically assessed since 1981 based on aerial surveys conducted along the coast of Maine during the pupping period. Harbour seal abundance in Maine increased until the early 2000s and then declined through to 2012, but appears to have since stabilized.

ASSESSMENT

Survey Coverage and Methods

Aerial surveys to count harbour seals were conducted in the Gulf of St. Lawrence (GSL, 2019), on the Scotian Shelf (SS, 2020), and on the Newfoundland-Labrador Shelves (NLS, 2021). The survey of the NLS included coverage of the French archipelago of Saint Pierre et Miquelon (SPM, Figure 2).

The timing and duration of the survey windows varied by region (Table 1). The GSL and SS survey windows coincided with the pupping season for harbour seals during which they are known to spend more time hauled out and are, therefore, more likely to be detected and counted. The NLS survey coincided with the end of the pupping period and the subsequent moulting period, during which harbour seals also spend a greater proportion of the time hauled out, and conditions are generally more suitable for flying aerial surveys on the NLS.

In all regions, particular attention was paid to areas where high numbers had been reported or observed in earlier studies. On the NLS, coastal surveys were completed only in areas that harbour seals were known to be present, based on interviews with science staff, fishermen, and DFO Conservation and Protection officers conducted in the spring of 2021.

Full details on survey coverage, methods, and detailed information on the locations of haul-outs for the GSL, SS, and NLS can be found in Mosnier et al. (2023), Lidgard et al. (2023), and Hamilton et al. (2023), respectively.

Photographs of haul-out sites were taken for confirmation of counts and species (grey seals, *Halichoerus grypus*, may be hauled out in the same locations as harbour seals). In each survey region, a subset of photographs was selected and counted by two readers. The counts obtained were compared against a consensus count to check for perception bias. Based on the analyses of the comparison counts, perception bias was deemed negligible, and the survey counts obtained from photographs were not corrected for perception bias.

For a small number of areas where low altitude flights were prohibited, counts were obtained from either vessel-based observations or drone imagery following protocols consistent with those used in the aerial surveys. The survey of Sable Island (SS) was conducted from shore using an All-Terrain vehicle which circumnavigated the island at low tide.

Correction Factors

To estimate abundance, survey counts must be adjusted for the proportion of animals that were at sea during the time of the survey and were, therefore, unavailable to be counted. Haul-out correction factors (CF) were calculated using: (1) data collected during the pupping period from satellite telemetry deployments on harbour seals in the St. Lawrence Estuary (SLE) in 2021–22; and (2) published literature values for the pupping and moulting periods. The average proportion of harbour seals hauled out during survey-like conditions estimated from the 2021–22 SLE satellite telemetry deployments was 0.33 (CV: 0.417, N=12), for a mean CF of 3.0 for the pupping period. Due to concerns about the low sample size, biased representation of different age-sex classes in the sample, and limited geographic coverage, the CF calculated from the SLE satellite telemetry data was combined with three estimates from the literature for the northwest Atlantic pupping period. The pooled mean proportion of the population hauled out during the pupping period was 0.39 (CV: 0.160), resulting in a CF of 2.55. For areas of the NLS surveyed during the moulting period, four published estimates, from the northeast Atlantic and northwest Atlantic were combined to obtain a mean proportion of the population hauled out of 0.61 (CV: 0.087), resulting in a CF of 1.64.

The total population abundance was estimated by multiplying the counts from the pupping and moulting periods by their corresponding CF and summing across regions (Table 1).

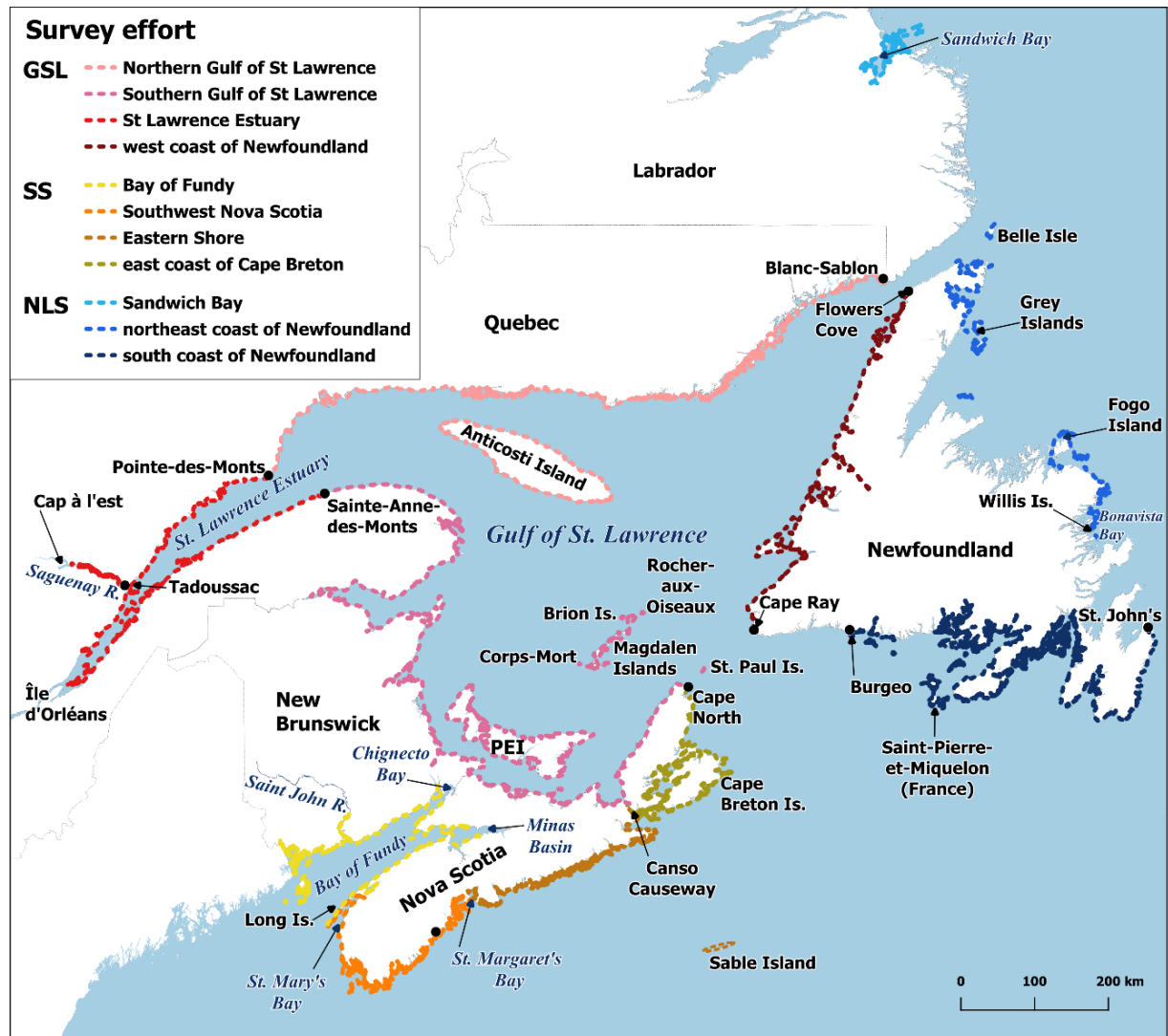


Figure 2. Map of the realized survey coverage for the 2019–21 Atlantic Canada wide harbour seal survey.

Estimates of Abundance

Counts by survey area for each region are shown in Table 1. No correction for perception bias was applied to the counts in any of the surveyed regions (see Methods).

The total count for Atlantic Canadian waters was 10,327 individuals (Table 1). The GSL, SS, and NLS accounted for 55%, 23%, and 22% of the total count respectively (Table 1). A total of 674 seals were counted in SPM. These seals are not included in the counts for the NLS region.

Total estimated harbour seal abundance for 2019–21 was 25,183 (95% CI 22,548–28,126) individuals. The GSL, SS, and NLS accounted for 58%, 24%, and 19% of the total estimated abundance, respectively (Table 1). Within the GSL, the SLE accounted for 16% of the regional survey effort but 37% of the total estimated abundance for the region (Table 1). Harbour seals were found hauled out in all parts of the SLE (Figure 3) and the estimated density (number of individuals sighted per km of coastline surveyed) for this area (1.4 km^{-1}) was between 2.8 and 7.0 times higher than for any of the other survey areas in Atlantic Canada (range $0.2\text{--}0.6 \text{ km}^{-1}$).

Compared to the SLE, harbour seals were sighted less frequently in the southern Gulf, northern Gulf, and along the west coast of Newfoundland, with larger aggregations of hauled-out seals concentrated in a few areas (Table 1, Figure 3). On the SS, densities were highest for the Bay of Fundy and southwest Nova Scotia (Figure 3) which, combined, accounted for 71% of the regional abundance (Table 1). Densities in the NLS surveys were highest along the south coast (Figure 2) which accounted for 82% of total estimated abundance for the region (Table 1).

Potential Biological Removal (PBR)

Based on results of broadscale genetic analyses, observations of long-distance movements in adults and juveniles, the broad distribution and proximity of harbour seal haul-out sites across the Atlantic Canadian range (Figure 3), and the absence of geographic barriers to dispersal, we have assumed that harbour seals from the northwest Atlantic represent a single population. Based on this assumption we calculated a single PBR value for Atlantic Canadian waters.

The annual PBR estimate for the Atlantic harbour seal in Canadian waters was 720 seals using an estimated minimum population size (N_{\min}) of 24,016 seals, a recovery factor (F_R) of 0.5 and the default maximum rate of population increase (R_{\max}) of 12% for pinnipeds. An F_R of 0.5 was selected based on the overall abundance of the population, a lack of trend data for most of the Atlantic Canadian range and the fact that there has been only a single range-wide survey of harbour seal abundance and distribution in Atlantic Canadian waters.

Sources of Uncertainty

The counts of hauled out seals obtained during the aerial surveys should be considered minimum values as a result of the imperfect detection of hauled out seals and the imperfect detection of seals that entered the water prior to the count due to disturbance.

Survey counts were not adjusted for animals available to be counted but not seen, variation among regions in the timing of pupping, or issues with species identification. As a result, the uncertainty in the abundance estimate is likely underestimated which can impact the PBR estimate.

Ideally, instrument deployments to obtain haul-out correction factors should occur in the same regions and within the same time period as the associated aerial surveys, and include a representative cross section of the population by sex and age class. The correction factors used here rely on data mostly collected from outside of the survey area, in different years and even different decades. The impact of applying haul-out correction factors obtained from outside the survey region to calculate abundance is unknown.

Three years were required to complete a full survey of Atlantic Canadian waters. In addition, the survey of the NLS took longer than planned, resulting in it extending into the moulting period. Movements of individuals between survey regions or within survey areas can result in seals being double counted or missed. The abundance estimates assume seal movements were random.

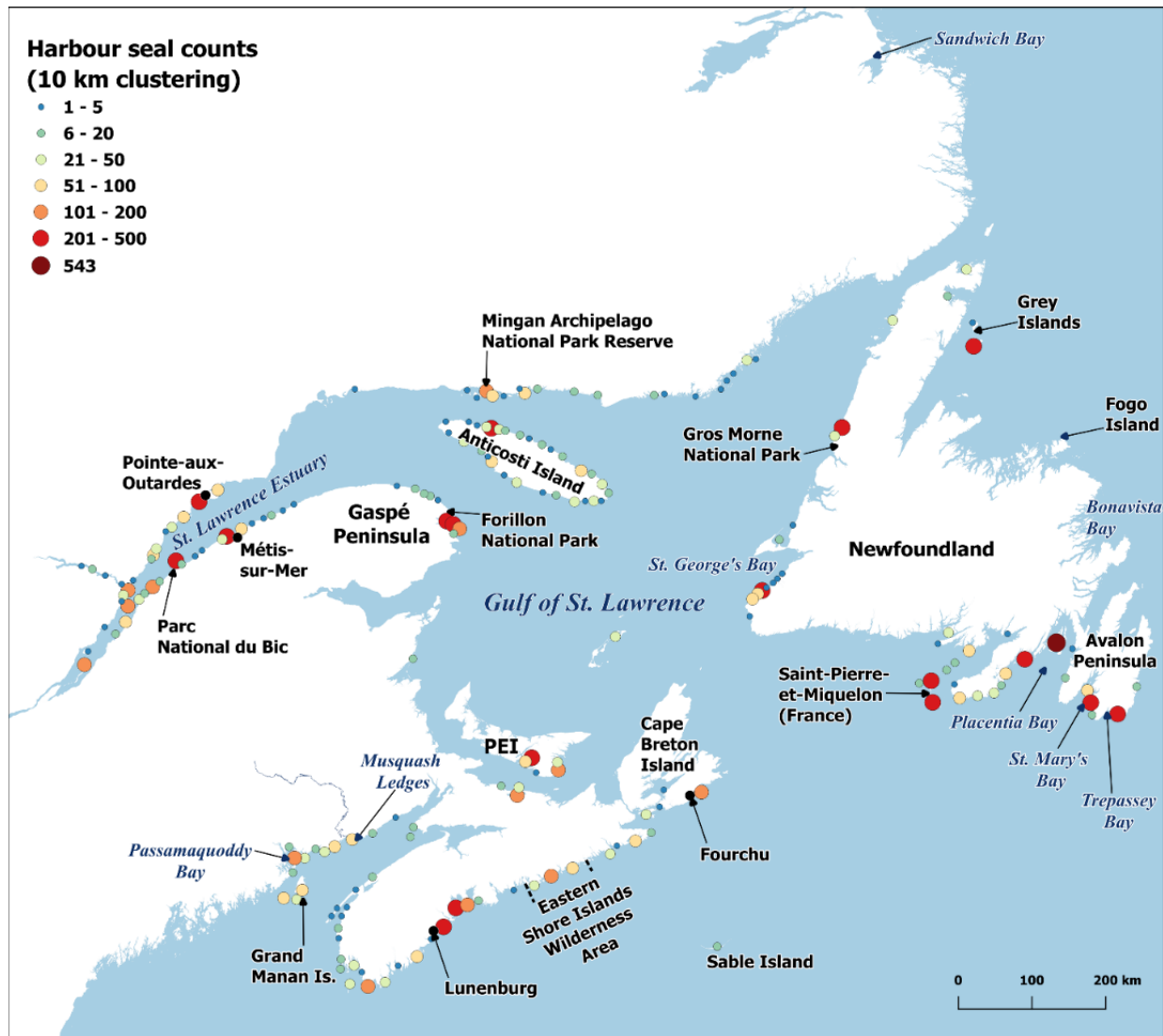


Figure 3. Location and counts of harbour seals detected during the 2019–21 Atlantic Canada wide harbour seal survey presented as spatially clustered points based on a threshold of 10 km.

CONCLUSIONS

This is the first range-wide survey in Atlantic Canada to examine harbour seal abundance and distribution. The abundance estimate of harbour seals in Atlantic Canada is 25,200 seals (rounded to the nearest 100). With a single abundance estimate, it is not possible to provide information on population trends. The estimated annual PBR is 720 seals.

OTHER CONSIDERATIONS

Regular surveys are needed to monitor the abundance and trends of harbour seals in Atlantic Canada. Increased competition with grey seals, increases in the presence of marine predators such as white sharks (*Carcharodon carcharias*), and other impacts related to climate change are likely to affect the dynamics of this small coastal seal. Additional research efforts would be needed throughout Atlantic Canada to better understand the seasonal movements and

dispersal of harbour seals, and to obtain haul-out correction factors for a representative cross-section of the population by age and sex.

The 2018 estimated abundance of harbour seals in adjacent US waters is 61,340 seals. This abundance estimate, and its associated PBR (1,729 seals), does not include individuals which breed in Canadian waters. The survey of the NLS region included coverage of harbour seal haul-out sites in the archipelago of SPM, France, with a total count of 674 seals. Seasonal, transboundary movements of seals which breed in US or French waters are not accounted for in the population estimate or PBR for Atlantic Canadian waters.

**Stock assessment of Atlantic harbour seals
(*Phoca vitulina vitulina*) in Canada for 2019–2021**

National Capital Region

Table 1. Counts and estimated abundances by survey regions and areas for the 2019–21 Atlantic Canada wide harbour seal survey. CF, haul-out correction factor.

Region	Survey Year	Survey Area	Survey Window	CF	Counts	Abundance (95% CI)
Gulf of St. Lawrence¹ (GSL)	2019	St. Lawrence Estuary (SLE)	June 13–21	2.55 (CV 16.02%)	2,140	5,452 (3,984–7,461)
		Southern Gulf	June 4–11	"	1,799	4,583 (3,348–6,274)
		Northern Gulf	June 22–28	"	979	2,494 (1,819–3,420)
		West Coast NL	June 29–30	"	796	2,028 (1,478–2,783)
	Total	-	-	5,714	14,557	(12,288–17,245)
Scotian Shelf² (SS)	2020	Bay of Fundy	June 14–18	2.55 (CV 16.02%)	638	1,625 (1,183–2,233)
		SWNS	June 18–25; July 5-7	"	1,043	2,657 (1,938–3,643)
		Eastern Shore	June 19; July 2–17	"	308	785 (568–1,085)
		Cape Breton	June 26; July 4–16	"	331	843 (611–1,165)
	2021	Sable Island	June 2	"	6	15 (8–30)
	Total	-	-	2,326	5,926	(4,957–7,083)
Newfoundland and Labrador Shelves^{3, a} (NLS)	2021	South Coast ^b	July 6–8	2.55 (CV 16.02%)	706	1,799 (1,310–2,470)
		South Coast ^c	July 24–August 19	1.64 (CV 8.67%)	1,257	2,076 (1,746–2,468)
		Northeast Coast	July 9–July 14	2.55 (CV 16.02%)	324	825 (598–1,140)
		Sandwich Bay, Labrador	July 14	"	0	0
	Total	-	-	2,287	4,700	(5,033–6,714)
Atlantic Canada	2019–2021	Total	-	-	10,327	25,183 (22,548–28,126)

Sources: ¹ Mosnier et al. 2023, ² Lidgard et al. 2023, ³ Hamilton et al. 2023

^a counts obtained from the archipelago of Saint Pierre et Miquelon (SPM), France (674 seals) are not included in the totals for the NLS

^b pupping period

^c moulting period

LIST OF MEETING PARTICIPANTS

Name	Affiliation
Abraham, Christine	DFO - Science, National Capital Region
Albuquerque, Cristiane	Parks Canada Agency
Aulanier, Florian	DFO - Science, Quebec Region
Barreau, Emmanuelle	DFO - Science, Quebec Region
Bordeleau, Xavier	DFO - Science, Quebec Region
Bowen, Don	Emeritus; DFO - Science, Maritimes Region
Brown, Tanya	DFO - Science, Pacific Region
Buren, Alejandro	Instituto Antártico Argentino
Cabrol, Jory	DFO - Science, Quebec Region
den Heyer, Cornelia	DFO - Science, Maritimes Region
Doniol-Valcroze, Thomas	DFO - Science, Pacific Region
Ferguson, Steve	DFO - Science, Ontario and Prairie Region
Giard, Samuel	DFO - Science, Quebec Region
Gosselin, Jean-Francois	DFO - Science, Quebec Region
Goulet, Pierre	DFO - Science, Newfoundland Labrador Region
Guldborg Hansen, Rikke	Greenland Institute of Natural Resources
Hamilton, Charmain	DFO - Science, Newfoundland Labrador Region
Hammill, Mike	Emeritus; DFO - Science, Quebec Region
Harvey, Valérie	DFO - Science, Quebec Region
Irani, Alymuhammad	DFO - Science, Quebec Region
Khan, Sarah	NMRWB
Lang, Shelley	DFO - Science, Newfoundland Labrador Region
Lapointe St-Pierre, Mathilde	Makivik Inc
Le Mer, Charline	DFO - SARA Program, Quebec Region
Lesage, Véronique	DFO - Science, Quebec Region
Lidgard, Damian	DFO - Science, Maritimes Region
MacConnachie, Sean	DFO - Science, Pacific Region
Majewski, Sheena	DFO - Science, Pacific Region
Matthews, Cory	DFO - Science, Ontario and Prairie Region
Mosnier, Arnaud	DFO - Science, Quebec Region
Nanayakkara, Lushani	DFO - CSAS, National Capital Region
Nordstrom, Chad	DFO - Science, Pacific Region
Pellerin, Mathieu	DFO - Resource Management, Quebec Region
Provencher St-Pierre, Anne	DFO - Science, Quebec Region
Rioux, Ève	DFO - Science, Quebec Region
Sauvé, Caroline	DFO - Science, Quebec Region
Sawatsky, Chantelle	DFO - Science, Ontario and Prairie Region
Settingington, Lisa	DFO - CSAS, National Capital Region
Simard, Yvan	DFO - Science, Quebec Region

**Stock Assessment of Atlantic Harbour Seals
(*Phoca vitulina vitulina*) in Canada for 2019–2021**

National Capital Region

Name	Affiliation
Smith, Heather	DFO - Science, National Capital Region
Tucker, Strahan	DFO - Science, Pacific Region
Van de Walle, Joannie	DFO - Science, Quebec Region
Watt, Cortney	DFO - Science, Ontario and Prairie Region
Wright, Andrew	DFO - Science, Arctic Region
Wright, Brianna	DFO - Science, Pacific Region
Yurkowski, Dave	DFO - Science, Ontario and Prairie Region

SOURCES OF INFORMATION

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Hamilton C.D., Goulet, P.J., Stenson, G.B., and Lang, S.L.C. 2023. [Counts and spatial distribution of harbour seals \(*Phoca vitulina*\) and grey seals \(*Halichoerus grypus*\) from an aerial survey of the coast of the Newfoundland Shelf and Sandwich Bay, Labrador during the summer of 2021](#). Can. Tech. Rep. Fish. Aquat. Sci. 3566 : v + 39 p.

Lidgard D., Dispas A., Mosnier A., Varkey P., Kehler, D. and den Heyer, C. 2023. [Distribution and counts of harbour \(*Phoca vitulina*\) and grey seals \(*Halichoerus grypus*\) on the Atlantic coast of Nova Scotia and Bay of Fundy from aerial and land surveys, 2019-2021](#). Can. Tech. Rep. Fish. Aquat. Sci. 3569 : vi + 88 p.

Mosnier, A., Dispas, A., and Hammill, M.O. 2023. [Spatial distribution and count of harbour seals \(*Phoca vitulina*\) and grey seals \(*Halichoerus grypus*\) in the Estuary and Gulf of St. Lawrence from an aerial survey conducted in June 2019](#). Can. Tech. Rep. Fish. Aquat. Sci. 3541 : v + 60 p.

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Center for Science Advice (CSA)
National Capital Region
Fisheries and Oceans Canada
200 Kent Street, Ottawa, ON K1A 0E6

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