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Pacific Region

Canadian Science Advisory Secretariat
Science Advisory Report 2026/026

TRENDS IN GROWTH AND POPULATION ESTIMATES OF THE SEA OTTER (*ENHYDRA LUTRIS*) IN BRITISH COLUMBIA 1977-2024

Sea otter mother and pup. Photo: Matthew Morgan Henderson

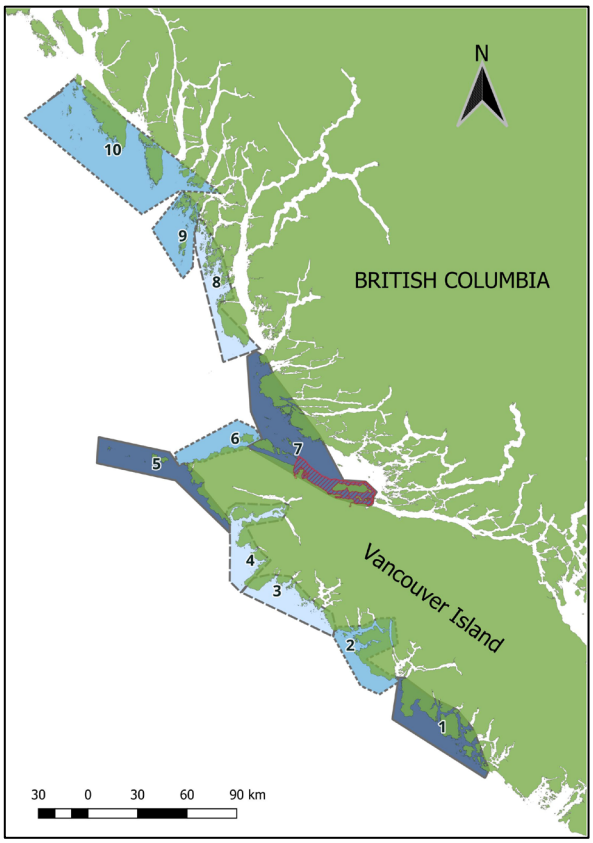

Figure 1. Ten sub-regions encompassing the surveyed, occupied range of sea otters in BC by 2024. Range expansion in 2022 indicated by red hatched polygon. Sub-region formatting denotes average annual growth rates (2018-2023): low (<3.5% per year; pale blue, long dash outline), medium (3.5 to <7.0% per year, blue, short dash outline), and high (≥7.0% per year, dark blue, solid line). Polygon numbers correspond to sub-regions in Table 1.

CONTEXT

Sea otters (*Enhydra lutris*) were hunted to near extinction across the Pacific Rim during the maritime fur trade that lasted from the mid-1700s to the early 1900s. The last sea otters

endemic to British Columbia (BC) were extirpated no later than 1931. Canada's current sea otter population are descendants of animals from Alaska, reintroduced to Checleset Bay on the west coast of Vancouver Island during three translocation efforts in 1969, 1970 and 1972.

The sea otter was assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as threatened in 2000 and listed as threatened under the *Species at Risk Act* (SARA) in 2003. In 2007 the species was reassessed by COSEWIC as special concern, and down-listed to special concern under SARA in 2009. As required under SARA, a management plan with conservation measures was developed and posted on the Species at Risk Public Registry in 2014.

Population surveys provide time series data with which to assess trends in abundance and growth. The "Management Plan for the Sea Otter (*Enhydra lutris*) in Canada" identifies sea otter surveys as a high priority conservation measure. The BC sea otter population has been surveyed at regular intervals since 1977. Since the previous assessment, which was based on data from 1977 to 2017, additional surveys were conducted in 2018 through 2024. Analyses including these latest data provide estimates of recent abundance and of Potential Biological Removal (PBR). The new analyses also provide updates on growth trends in the population. These findings are presented here as science advice concerning the sea otter population in BC.

This Science Advisory Report is from the regional peer review on December 2-4, 2025, on the Distribution and Abundance Trends for the Sea Otter (*Enhydra lutris*) Population in British Columbia 1977-2024. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- In 2018-2024, sea otters were surveyed from boats to update abundance estimates and areas of occupancy in British Columbia.
- Areas that comprise the longest occupied portion of the range were surveyed every year, whereas the remainder of the survey area was completed over multiple years.
- Comparison of boat-based counts with Uncrewed Aerial Vehicle (UAV) images of sea otter rafts (groups) were used to calculate and apply a correction for observer bias to survey counts for the entire time series (1977-2024).
- The time series was analyzed for growth trends and abundance estimates up to 2023 at two levels: coast-wide (total area surveyed) and by sub-regions (according to contiguous geography and similar years of occupancy).
- Estimated abundance in 2023 was 12,058 sea otters (95% CI = 11,048-13,717) coast-wide, and the average annual growth rate was 4.6% per year during 2018-2023.
- Sub-regional annual growth rates were between 2.0% and 8.1% for 2018-2023. This slower growth (compared to previous assessments) likely reflects that all sub-regions have been occupied for over 15 years, and several may be nearing, or at, carrying capacity.
- Potential Biological Removal (PBR) was calculated as 583 sea otters per year for the coast-wide survey area.
- Recognizing that sea otter populations are structured at finer spatial scales, and therefore sensitive to local depletion, PBR was also calculated for the sub-regions and ranged from 24 to 200 animals, reflecting local abundances.

- Range expansion into Queen Charlotte Strait on the eastern side of Vancouver Island was documented in surveys in 2022.
- Observations of sea otters outside the current recognized occupied range are used to inform future survey coverage. Such observations have led to collaborative survey efforts suggesting range expansion into other areas including Haida Gwaii and southwest Vancouver Island.
- While increased abundance and range expansion have necessitated conducting the coast-wide survey over multiple years, completing it within a 2-year period would reduce uncertainty in estimates of population abundance and growth trends.

BACKGROUND

Sea otters occupy shallow coastal areas and are limited with respect to habitat by their diving abilities and preferred foraging depth (<40 m), with the result that most sea otters are found within 1 to 2 km of shore. Sea otters occupy small home ranges within which they forage on invertebrates and rest and groom in floating aggregations called rafts. In BC, sea otter rafts can include as many as 300 animals and are segregated into male rafts, and female and pup rafts.

Because rafts form habitually in the same locations, shifts in their distribution is an indicator of range expansion events for growing populations. The periphery, or frontal edge of the range, tends to be occupied first by a male raft. It is these range-edge male rafts that precipitate range expansion. In subsequent years, females appear and form rafts in the new area. Individual male sea otters are often seen outside of what is considered the occupied range. Multiple lines of evidence from research in other regions examining individual diets, movements, and genetics indicate that sea otters exhibit strong site fidelity, have small home ranges of less than 25 km^2, and exhibit limited dispersal. These characteristics suggest that intrinsic demographic processes (density-dependent natural mortality and emigration events) are expected to operate at smaller spatial scales than the entire BC coast. For this reason, population trends are assessed at sub-regional levels as well as for the total occupied range of the BC coast.

ASSESSMENT

Methods

Sea otters are counted in their known range along consistent routes that follow the coastline and cover preferred habitats. Surveys are undertaken from May to September and represent the distribution of the sea otter population in those months. Surveys do not account for winter observations that suggest fine-scale movements of some otters to nearby sheltered areas, such as heads of inlets. Since 1988, a standardized approach has been used to count sea otters by following these routes with observers on a small boat, with the addition in some years of surveys from helicopter or Coast Guard ship. The approach of following consistent routes relies on characteristics of sea otter behaviour and biology that result in their distribution being predictable. Thus, an underlying assumption of the survey methodology is that by carrying out the surveys in a consistent manner among years, sampling error is relatively constant over time and therefore the counts provide a reliable index of population abundance and trends.

For logistical reasons, the sea otter range in BC was divided into *segments* that are areas that can typically be surveyed in a single day. The presence of a raft of sea otters in an area during a survey, typically a large group of males, was used to denote established occupancy. This criterion was used to identify range expansion events. Newly surveyed areas where occasional single sea otters were encountered were not considered occupied and not included in the

population count. As of 2024, there were 26 survey segments. The three longest-occupied, contiguous segments that encompass the Checleset Bay reintroduction site are referred to as the index areas.

Until 2017, the entire occupied sea otter range was surveyed between May and September in a given year. As such, the survey results from all segments could be summed yearly to provide an estimate of abundance, since all segments had been surveyed in the same year. Since 2018, as a result of continued range expansion, DFO employed a rotational approach in which the entire range was surveyed over a period of 3-4 years, while still maintaining annual survey effort in the index areas. This rotational approach results in gaps in the time series because not all survey segments were surveyed in the same year. Therefore, a new analytical step was added to fill these gaps by interpolating missing survey segment values.

Observer error associated with counting the number of sea otters in rafts is also a source of uncertainty, especially since otters in rafts can make up a large proportion of a survey total. To address this error, traditional boat counts were paired with Uncrewed Aerial Vehicle (UAV) counts of the same rafts to estimate observer error and then to develop and apply a correction factor to raft counts made during boat-based surveys. Surveys made before 1988, and surveys completed since 1988 but made from aerial or elevated platforms (helicopter, Coast Guard ship), were not corrected.

Data from the 26 survey segments were grouped into 10 *sub-regions* according to contiguous geography and similar years of sea otter occupancy. Sub-regions do not represent fully distinct populations (nor do segments); however, it was assumed that otters within sub-regions experience similar demographic processes and environmental conditions. Logistic and exponential population models (Nichol et al. In Prep.[1]) were fit to abundance data over the time series for each sub-region to compute an annual finite growth rate for the 5-year period 2018-2023. Data from the segments surveyed in 2024 informed the trends where applicable, but model estimates were only provided up to 2023 to reduce the uncertainty resulting from forecasting some sub-regions too many years beyond their last survey. The coast-wide annual growth rate was also estimated by summing the modelled values of annual abundance of all sub-regions.

Results

Abundance

The coast-wide sea otter population size estimated for 2023 was 12,058 (95% CI 11,048-13,717). Sub-regional abundance ranged from 513 (95% CI 364-722) to 2,714 (95% CI 2,588-2,882) (Table 1).

Range Expansion

Range expansion was documented during surveys in 2022 into Queen Charlotte Strait on the Vancouver Island side (Figure 1).

Sub-regional population growth trends

Annual growth rates among sub-regions ranged from 2.0% to 8.1% per year in the 5-year period 2018-2023 (Table 1, Figure 2).

[1] Nichol, L.M., Doniol-Valcroze, T., Foster, E.U., and McKay, K. In Prep. Distribution and Abundance Trends for the Sea Otter (*Enhydra lutris*) Population in British Columbia 1977-2024. DFO Can. Sci. Advis. Sec. Res. Doc.

Coast-wide population growth trend

The annual rate of growth for all of BC, was 4.6% per year over the period 2018-2023 (Figure 3).

Table 1. Coast-wide and Sub-regional abundance (median and 95% confidence intervals) in 2023 and mean annual growth rates for 2018-2023.

Region/Sub-region number and names of segments within	Abundance 2023 (95%CI)	Annual growth rate 2018-2023
Coast-wide	12,058 (11,048-13,717)	4.6%
1 Hesquiat Peninsula, Hesquiat Harbour, Clayoquot Sound	1,471 (811-2,431)	7.1%
2 Nootka Island, Nuchatlitz Inlet, Catala Island, Esperanza Inlet	1,727 (1,406-2,125)	3.5%
3 Checleset Bay, Mission Group, Kyuquot Sound	2,714 (2,588-2,882)	2.0%
4 Brooks Bay, Quatsino Sound	1,183 (946-1,815)	2.0%
5 Kains Island to Cape Scott, Scott Islands	665 (399-1,024)	7.7%
6 Cape Scott to Hope Island	1,024 (575-1,981)	4.7%
7 Queen Charlotte Strait East, Smith Sound, Masterman Island to Pearse Group	692 (442-1,092)	8.1%
8 Simonds and Tribal Groups, Kildidt Sound, Calvert Island	513 (364-722)	2.4%
9 Cape Mark, McMullins and Goose Groups	1,257 (754-2,129)	6.3%
10 Seaforth Channel, Price Island, Aristazabal Island	558 (405-861)	3.5%

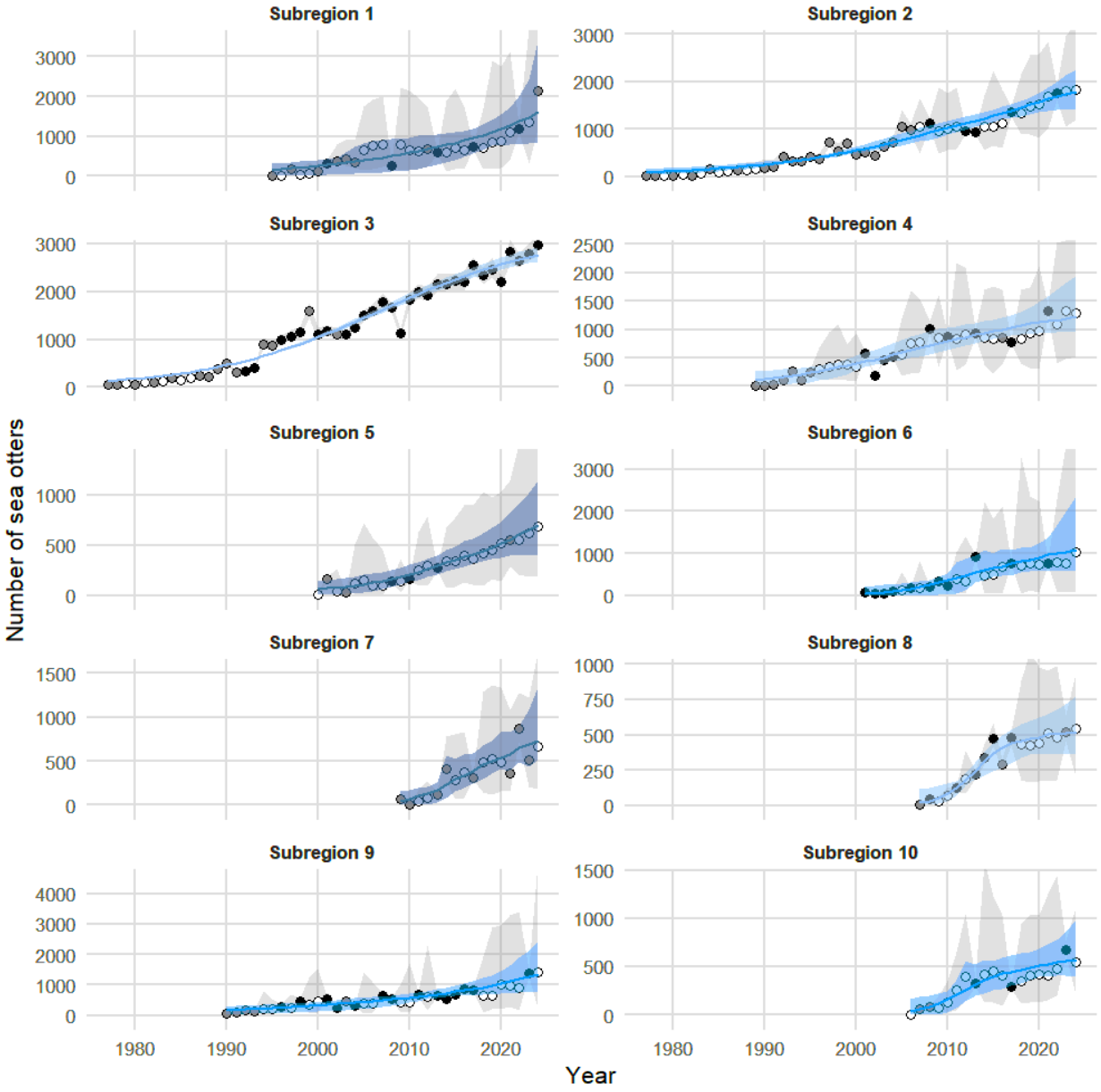

Figure 2. Sub-regional growth trends for sea otters in BC. Lines represent modeled values coloured with one of three shades of blue denoting average annual growth rates (2018-2023): Low (<3.5% per year, pale blue), medium (3.5 to <7.0% per year, blue), high (≥7.0% per year, dark blue). Shaded blue bands represent the uncertainty around the fitted model. Black circles represent years in which all segments in the sub-region were surveyed. Grey circles represent years in which the total count is a mix of segments surveyed and segment counts that were interpolated. Open circles represent estimated counts in all segments of the sub-region in that year. Grey bands represent the uncertainty associated with yearly survey estimates.

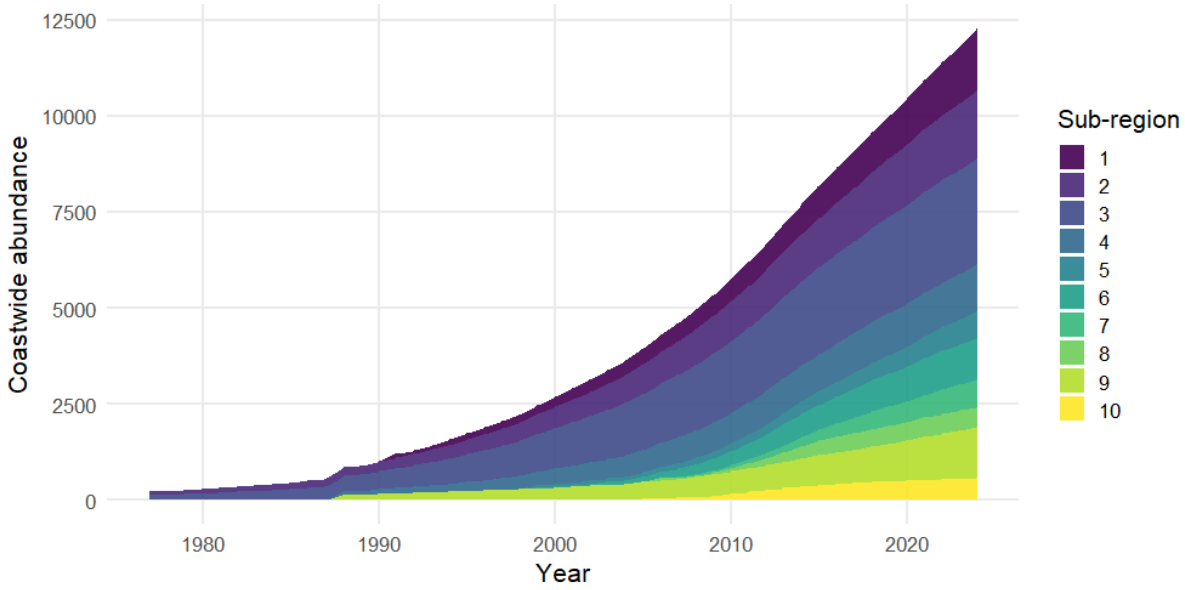

Figure 3. Coast-wide total population trends 1977 to 2023 calculated by summing sub-regional population models. Stacked colours indicate the contributions of each sub-region.

Potential Biological Removal (PBR)

The maximum number of animals, excluding natural mortality, that may be removed per year while still allowing the population to reach or sustain its optimum sustainable level, was calculated by using:

$PBR = N_{min} \times ½ R_{max} \times F_R$

The minimum abundance N_{min} was calculated using the 20th percentile of 2023 abundance estimates for the coast-wide population, and for sea otter abundance estimates in each sub-region. The other parameters used were ½ R_{max} = 10.05% (half the maximum estimated rate of increase of 20.1% that was determined for unconstrained growth of the BC sea otter population in 1977-1995), and Recovery Factors F_R of 0.5 or 0.75, which were selected using the estimates of annual growth rates (2018-2023) to infer population status in each area relative to carrying capacity K (sub-regions estimated at or below 0.5K were assigned an F_R of 0.5, whereas sub-regions estimated above 0.5K were assigned an F_R of 0.75). Coast-wide and sub-regional *PBR* are given in Table 2. The coast-wide PBR is not a sum of the sub-regional PBR values. The coast-wide PBR was calculated using the 20th percentile of the coast-wide abundance estimate which incorporates the uncertainty in each sub-regional abundance estimate. Moreover, a Recovery Factor of 0.5 was used because coast-wide carrying capacity is unknown. For these reasons, the coast-wide PBR is lower and more precautionary than a sum of the sub-regional PBRs.

Table 2. Potential Biological Removal (PBR) calculated coast-wide and for each of 10 sub-regions.

Area	N_{min}	½R_{max}	F_R	PBR
Coast-wide	11,607	0.1005	0.50	583
Sub-region 1	1,248	0.1005	0.50	63
Sub-region 2	1,574	0.1005	0.75	119

Area	N_{min}	$½R_{max}$	F_R	PBR
Sub-region 3	2,660	0.1005	0.75	200
Sub-region 4	1,001	0.1005	0.75	75
Sub-region 5	525	0.1005	0.50	26
Sub-region 6	827	0.1005	0.50	42
Sub-region 7	567	0.1005	0.50	28
Sub-region 8	433	0.1005	0.75	33
Sub-region 9	1,017	0.1005	0.75	77
Sub-region 10	487	0.1005	0.50	24

Sources of Uncertainty

The process used to define sub-regions relied on knowledge of sea otter life history and spatial structure but is not replicable. The resulting growth rate estimates and PBR values may be sensitive to the survey segment grouping decisions. Future work could include a data-driven (replicable) approach to determine sub-regional boundaries.

The larger uncertainty associated with the corrected counts of raft sizes above 50 otters reflects the difficulty of counting larger groups, but may also arise from the small sample size of UAV-boat paired counts of large rafts. Additional UAV-boat paired data of rafts larger than 50 animals would help refine the correction factor and likely reduce uncertainty.

Year-to-year changes in sea otter counts within sub-regions may reflect movements of otters as well as sampling variance (e.g., a raft missed entirely) rather than local growth. This uncertainty is increased by the new multi-year survey approach. Shorter intervals between surveys and covering all segments within a sub-region in the same year would help reduce this variance, especially near range edges where raft movements may be more dynamic.

Availability and perception bias for non-rafted otters were not accounted for: single individuals may be missed because they are diving or because they are not detected even when at the surface. Those biases likely result in underestimating population abundance.

The population growth models (exponential and logistic) currently used do not account for environmental variability and random processes that affect year to year rates of growth; therefore, they underestimate uncertainty. In addition, the current approach cannot model declines in abundance. As more sub-regions approach or reach carrying capacity, models will need to incorporate annual variability (including declines) in response to environmental fluctuations.

CONCLUSIONS

The sea otter population in BC has grown, and its geographic range has expanded, since its initial reintroduction to BC in the 1960s-70s. Expansion has occurred into areas assumed to have been historically occupied by sea otters. Sea otter numbers are likely nearing or at carrying capacity in long-occupied areas. These sub-regional patterns reflect the expected pattern of density-dependent growth for this species. Among sub-regions and coast-wide, average annual growth rates (2018-2023) have slowed or remained similar to growth rates from the previous period (2013-2017). As a result, the difference between areas showing unconstrained growth (suggesting recent occupancy) and those showing signs of approaching

carrying capacity (expected for sub-regions with long occupancy) was less pronounced than in previous assessments. With an additional six years of occupancy since the previous assessment, seven of the 10 sub-regions have now been occupied for 25 years or more, and the remaining three have been occupied for more than 15 years. Thus, the lower annual average growth rates in the most recent 5-year period likely reflect that more of these sub-regions are approaching or at local carrying capacities, than in previous assessments.

Recognition of the sub-regional scale at which sea otter populations are structured has important implications for conservation and management of this species. Threats may affect different areas in different ways, and their effects may be mediated by small scale differences in population dynamics. Furthermore, the nature of sea otter dispersal means that the potential for recolonization in the event of local extirpation would be slow. For these reasons, the present assessment provides PBR at the sub-regional level as well as for the entire surveyed area in BC. These values reflect local abundance but also the uncertainty around the estimates and the recovery potential of each area.

ADDITIONAL CONSIDERATIONS

Maintaining a consistent level of survey effort has become increasingly challenging as the BC sea otter population grows and expands its range. In the early years of the time series, when the sea otter population was limited to a small area of Checleset Bay and a small area off Nootka Island, a sea otter survey could be accomplished in one to three days depending on weather. In comparison, in 2017, the last year the full range was surveyed in its entirety in one year, it took over 40 field days to complete. Since 2018, completing the coast-wide survey in one year has not been attempted and a rotational approach has been adopted. This design improves logistical feasibility and data quality by allowing surveys of smaller areas to be completed in the best available conditions. However, a disadvantage is that model-based interpolations are needed to fill gaps in the time series. Although the implementation of this framework has yielded the required abundance estimates and management metrics, completing all the segments within a sub-region in the same year, and completing all the sub-regions over a 2-year period instead of 3 or 4 years, would minimize reliance on model-derived estimates, and decrease uncertainty in the results.

Sea otter sightings contributed to DFO outside of what is considered to be the occupied range are used to inform subsequent survey plans. Such observations have also led to collaborative survey efforts in other areas including Haida Gwaii and southwest Vancouver Island. Additional collaborations will likely be needed to maintain regular coast wide survey coverage and to complete these over periods of 2-years.

In recent decades in BC and elsewhere, sea otters, their habitat and their prey have encountered environmental processes to which they have not previously been exposed to (e.g., intense heat waves and ocean warming, increasing ocean acidity, increased storm severity). These processes influence invertebrate recruitment, growth, and distribution, and thus their availability as prey for sea otters. Sea otter population growth is influenced by occupancy time and prey availability, through density-dependent effects on survival. It is unknown how much, or how quickly, future carrying capacity could change and how sea otter populations may respond to these environmental processes.

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ISSN 1919-5087
ISBN 978-0-660-99749-0 Cat. No. Fs70-6/2026-026E-PDF

Correct Citation for this Publication:

DFO. 2026. Trends in Growth and Population Estimates of the Sea Otter (*Enhydra lutris*) in British Columbia 1977-2024. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2026/026.

Aussi disponible en français :

*MPO. 2026. Tendances relatives à la croissance et estimation de la population de loutre de mer (*Enhydra lutris*) en Colombie-Britannique de 1977 à 2024. Secr. can. des avis sci. du MPO. Avis sci. 2026/026.*