

**Spatial and Temporal Changes in Bigg's "Transient" Killer Whale (*Orcinus orca rectipinnis*)  
Distribution Within the Central Salish Sea from 2001-2025**

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## **Abstract**

Within the central Salish Sea, Bigg's "transient" killer whales (*Orcinus orca rectipinnis*) have become an increasingly common occurrence, but little published research is available on their spatial and temporal shifts. This paper aims to categorize the changes in the distribution of Bigg's killer whales throughout the central Salish Sea region by compiling and analyzing public sighting records from 2001 to 2025. Metadata was taken from sighting records publicly available on Orca Network, a 501(c)(3) nonprofit organization, and unique sightings were sorted by major region. 3,875 unique encounters were documented over 2,849 unique days, with a mean sighting frequency of 155 sightings per year. Sightings increased from 38 in 2001 to 385 in 2024. Temporal variation on a monthly scale was observed, with the greatest number of sightings occurring in late spring (April-September) and late summer (August-September), with a decline in July sightings that coincides with peak harbor seal (*Phoca vitulina*) pupping seasons in the Puget Sound Region. A spatial change has been documented since 2001 as well, with an increasing area of habitat use within the central Salish Sea. A potential cause for this could be an increase in both prey availability and Bigg's population size. A larger-scale or range-wide spatial and temporal analysis would be beneficial in contextualizing the changes and trends observed in this paper to determine what factors may be playing the biggest role in determining changes.

**Keywords:** Habitat Use, Temporal Change, Spatial Change, San Juan Islands, Southern Gulf Islands

## Introduction

The Salish Sea is a glacially carved, transboundary inland sea that encompasses the Straits of Georgia and Juan de Fuca to the north and west, respectively, and the Puget Sound to the south (Sobocinski 2021). It covers a total of 17,803 km<sup>2</sup> of marine and estuarine waters, is fed by 12 major rivers throughout its range, and supports nearly 9 million people between both Washington State and British Columbia (Sobocinski et al. 2022, Sobocinski 2021). Made up of two main basins, the Puget Sound to the south and the Strait of Georgia to the north, numerous underwater sills further break up the salish sea into 10 subbasins– North Strait of Georgia, South Strait of Georgia, San Juan Archipelago, West Strait of Juan de Fuca, East Strait of Juan de Fuca, Whidbey, Admiralty Inlet, Hood Canal, Central Puget Sound, and South Puget Sound (Sobocinski 2021).

Bigg's "transient" Killer Whales (*Orcinus orca rectipinnis*) are a mammal-eating subspecies of killer whale found in the North Pacific Ocean from inland waters to the continental shelf (Morin et al. 2024, Shields et al. 2018, Houghton et al. 2015, Ford and Ellis 2014, Ford et al. 2008, Baird and Dill 1995). Compared to the resident subspecies (*Orcinus orca ater*), which also inhabit the waters of the Salish Sea, Bigg's are larger and more robust, with a broader range that is not as seasonal as residents, though some seem to exhibit seasonal fidelity (Morin et al. 2024, Shields et al. 2018, Houghton et al. 2015, Ford and Ellis 2014, Baird and Dill 1995).

In the Eastern North Pacific, Bigg's are grouped into three stocks– the Gulf of Alaska and Bering Sea Region Transients (GABs), AT1 or Chugach Transients (AT1s), and West Coast Transients (WCTs)– ranging from the Bering Sea to southern California (Fig. 1) (McInnes et al. 2023, Muto et al. 2021). Within the WCT stock, two potential subpopulations have been identified– the inner coast transients and outer coast transients (OCTs) (McInnes et al. 2021). These subpopulations occasionally travel together, but have different diet and habitat preferences, with Inner coast transients being found within 10 km of shorelines with preferred prey of pinnipeds

and small cetaceans, while outer coast transients are found in deeper pelagic waters near the continental shelf and prey on pinnipeds, large cetaceans, and oceanic dolphins (McInnes et al. 2024, McInnes et al. 2021).

Within the Salish Sea, both subpopulations of transients have been identified, with the population of west coast transients in the Salish Sea region having been monitored since the 1970s (Towers et al. 2019, Towers et al. 2012, Ellis et al. 2008, Ford and Ellis 1999, Bigg et al. 1987, Bigg et al. 1976). Since the 1990s, Bigg's presence in the Salish Sea has increased, but little research has been published on their seasonal or preferred habitat use and regional distribution, especially at a fine scale (Houghton et al. 2015, Shields et al. 2018). This paper aims to determine the spatial and temporal changes in the distribution of Bigg's "transient" killer whale throughout the central Salish Sea region by compiling and analyzing public sighting records from 2001 to 2025 to identify trends in occurrence and habitat use.

## **Methods**

### ***Definition of Study Regions***

The Central Salish Sea was broken up into 7 unique regions for this study, based on the major waterways present (Table 1, Fig. 2). The Strait of Juan de Fuca (SJF) was defined as any location in the Western Strait of Juan de Fuca East of Jordan River, BC, to the Eastern Strait of Juan de Fuca from Salmon Bank along the southern end of San Juan Island, southeast along the mouth of Cattle Pass to Point Coville on Lopez Island and south to East Beach on Whidbey Island to across Admiralty Inlet to the Olympic Peninsula and Dungeness Spit.

Rosario Strait (RS) was defined as any point between the southern end of Matia Island and north of East Beach on Whidbey Island, including Bellingham Bay, Rosario Strait, and Guemes Channel.

Haro Strait and Boundary Pass were combined into one region (HB) defined as any region north of Salmon Bank to the north end of Moresby Island and across the mouth of Bedwell

Harbour, Swanson Channel, and Plumper Sound, and along the north sides of Sucia, Spieden, and Waldron Islands.

The Southern Gulf Islands (SOGI) were defined as any point west of Galiano Island and south of Porlier Pass through Saanich Inlet, and from Swartz Bay to the southern end of Portland Island, across the northern end of Moresby Island and Swanson Channel to the the mouth of Bedwell Harbour on Pender and South Pender Islands, and from Blunden Islet off the East end of South Pender Island to Saturna Island across the mouth of Plumper Sound.

The Strait of Georgia (SG) was defined as any region north of Matia Island, including along the north end of Patos and Sucia Islands and south of the north end of Galiano Island.

San Juan and President Channels were combined into one region (SJPR) and defined as anything north of Whale Rocks through Cattle Pass, to the west side of Spieden Channel and the waters around the northern end of Orcas Island between the shoreline of Orcas, the south ad southeast sides of Waldron Island and the south and southwest sides of Sucia Island to the south and southwest side of Matia Island.

The interisland region (INIS) was defined as anything east of Cayou and Upright Channels and west of Obstruction, Lopez, and Thatcher Passes, including East, West, and Lopez Sounds.

### ***Data Compilation***

Sightings data was gathered from publicly available sightings archives from between April 2001 and August 2025, maintained and updated by Orca Network, a 501(c)(3) nonprofit organization. Due to uncertainty in identification ability by reporters, the only sightings used were either confirmed to be of Bigg's by having a group or individual's ID listed, or if the sighting had come from a researcher or naturalist, regardless of whether an individual's ID was provided. Relevant sighting information was often not held in one report alone, so multiple reports were condensed into one entry, as long as they were of the same group. Metadata was compiled on the

date of the sighting, the group, groups, or individual present, and the location in the form of written descriptions or, in rare cases, coordinates.

A unique sighting was defined as the first record of a matriline, lone individual, or group of matriline and/or lone individuals within a single day, with their sighting region being determined by their first known location. For example, if the T124Ds and T018s were seen in the Strait of Juan de Fuca off Sooke and moved East into Haro Strait before the T117s, there would be two sightings taken from this encounter– the T124Ds and T018s in the Strait of Juan de Fuca and the T117s in Haro Strait– even though they joined together part way through the encounter. If the same groups were seen the next day, that was counted as another unique sighting. The same applies for groups that split apart throughout the course of a day. If the T018s, instead of joining the T117s, went south into Admiralty Inlet and the Puget Sound region, there would still only be two encounters counted– the T117s in Haro Strait and the T018s and T124Ds in the Strait of Juan de Fuca.

### ***Analysis***

Data analysis was completed in R version 4.4.3 (2025-02-28 ucrt) -- "Trophy Case" using the packages ggplot2 and dplyr. Bias was addressed by standardizing effort as Sightings per Unit of Effort (SPUE) following Elliser et al. (2017).

### **Results**

During the 24-year data period from April 2001 to August 2025, 3,875 unique encounters were documented on 2,849 unique days. The mean sighting frequency was 155.0 (SD  $\pm$  94.2) sightings per year, with a minimum sighting count of 38 in 2005 and a maximum sighting count of 385 in 2024 (Fig. 3).

Seasonally, Bigg's presence was greatest in the Salish Sea during late spring (April-September) and late summer (August-September), with a decline in sightings in July (Fig. 4). The mean number of sightings throughout the year was as follows: January 12.88 sightings

(SD  $\pm$  8.2), February 5.04 sightings (SD  $\pm$  4.0), March 10.24 sightings (SD  $\pm$  7.4), April 15.24 sightings (SD  $\pm$  8.8), May 15.5 sightings (SD  $\pm$  10.3), June 17.12 sightings (SD  $\pm$  16.5), July 14.48 sightings (SD  $\pm$  16.4), August 21.68 sightings (SD  $\pm$  15.8), September 19.48 sightings (SD  $\pm$  14.7), October 10.24 sightings (SD  $\pm$  8.6), November 7.12 sightings (SD  $\pm$  5.0), and December 5.96 sightings (SD  $\pm$  4.1) (Fig. 5). Additionally, the percentage change of sightings fluctuated from year to year (Fig. 6), with a mean change of 9.8% (SD  $\pm$  29.6%)

Of the 7 regions defined in this study, only 5 (HB, SG, SJF, SJPR, and SOGI) were used between 2001-2005 (Fig. 7). After 2005, the number of regions used increased to 6 with the inclusion of RS, and from 2011 onward, all 7 sites were used. Two notable exceptions to the 6-site-rule were 2007 and 2009, where sightings occurred in INIS, though neighboring years (2006, 2008, and 2010) had no INIS sightings. The three most common regions for sightings were the Strait of Juan de Fuca, followed by Haro Strait and Boundary Pass, then San Juan and President Channels (Fig. 8). The percentage of cumulative sightings within each region was as follows: SJF 37.5% of sightings (n=1435), HB 24.5% of sightings (n=948), SJPR 13.5% of sightings (n=523), SG 8% of sightings (n=309), RS 7.4% of sightings (n=287), SOGI 5.4% of sightings (n=211), and INIS 3.3% of sightings (n=127).

The mean sightings per region over the 24 years were calculated as: HB 39.4 sightings per year (SD  $\pm$  24.6), INIS 5.1 sightings per year (SD  $\pm$  7.6), RS 11.5 sightings per year (SD  $\pm$  13.2), SG 12.4 sightings per year (SD  $\pm$  8.9), SJF 57.4 sightings per year (SD  $\pm$  21.5), SJPR 20.9 sightings per year (SD  $\pm$  19.6), and SOGI 8.4 sightings per year (SD  $\pm$  7.5).

To determine the amount of bias introduced by an unequal distribution of sighting effort, SPUE was calculated as the unique number of sighting days divided by the number of sightings in that month or year (Table 2, Table 3). An increase in effort was found to occur both on a monthly scale, with the highest effort from June to September (Fig. 9) and on a yearly scale, with a variation in effort from year to year (Fig. 10). The mean yearly SPUE was 1.30 sightings per day

(SD  $\pm$  0.14) and the mean monthly SPUE was 1.33 sightings per day (SD  $\pm$  0.14).

## Discussion

Over the 24-year dataset, both spatial and temporal distribution changes were found to have occurred. Since 2001, sightings have been increasing throughout the Central Salish Sea region, though there is some annual variation that may be explained, in part, by reporter ability. The Strait of Juan de Fuca had the highest percentage of sightings at 37.5% over 24 years, with an increase in sightings occurring in neighboring regions as time progressed. The strait of Juan de Fuca (SJF) has consistently been the highest sighting location region, with Haro Strait and Boundary Pass (HB) following as second highest, and San Juan and President Channels following as third as time increased (Fig. 7). This potentially could indicate a radiation effect from the outer coast to the inner coastal waters of the Salish Sea through the Strait of Juan de Fuca, a theory also suggested by Shields et al. (2018). It should be noted, however, that the SJF was also the largest of the study regions, with HB the second largest. This trend can likely be explained, in part, by bias introduced from the differing region sizes.

Seasonal changes in abundance within the central Salish Sea were also observed, with bimodal peaks in late spring and late summer, with a decrease in July, a pattern observed in Houghton et al. (2015), Baird and Dill (1995), and to a lesser extent, Shields et al. (2018). These peaks coincide with harbor seal (*Phoca vitulina*) pupping season in the central Salish Sea, and the July decrease coincides with the pupping season in the Puget Sound region (NOAA Fisheries, 2022). As harbor seals are a main prey source for Bigg's, it may be that they time their movements around the abundance of harbor seals in a given region (Ford and Ellis 2014, Ford et al. 2008, Ford et al. 1998). This pattern has also been observed in Glacier Bay, Alaska, during June and July, also possibly explaining the decrease seen in the central Salish Sea during July (Ford and Ellis 2014, Matkin et al. 2007, Baird and Dill 1995). It is also likely that, with an

increase in prey availability, there is simply an increase in Bigg's presence as a way of taking advantage of new prey abundance (Shields et al. 2018).

Additionally, spatial-temporal changes may be influenced by the steadily increasing Bigg's population, with ~634 individuals identified and presumed alive within their range and a low mortality rate (Finwave 2025, Young et al. 2023, Ford et al. 2019). A large population requires a larger range, and several individual matriline have increased the range in which they're sighted to encompass larger areas (Shields et al. 2018).

Notably, effort has also changed during the time period analyzed, with fewer sightings correlating to an increase in poor weather conditions throughout the later winter months (November to February), and an increase from June to September, correlating with peak commercial whale watching season (Fig. 9) (Frayne and Ogle 2024). Similarly, effort has increased since 2019, correlating with the introduction of a 1000-yard approach distance set for the critically endangered southern resident killer whales, who had previously been the main group of whales that tour operators observed (Washington State Legislature 2019).

Overall, an increase in Bigg's sightings has been documented since 2001, with a radiation in sightings occurring from the Strait of Juan de Fuca into the broader central Salish Sea. Both an increase in prey and Bigg's abundance have likely played a role in this increase, though there is bias due to changes in effort.

Future research would benefit from a larger study region, either expanding to include the Puget Sound region and northern Salish Sea or the whole WCT range to provide a clearer understanding of spatial changes, as this study only focused on a relatively small portion of their range. Additionally, comparing spatial and temporal trends to various environmental factors, including prey availability and sighting effort, would be beneficial to clarify the relationship between prey and predators, as well as accounting for potential bias in effort.

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## **Literature Cited**

- Allen, B. M. and R.P. Angliss. 2014. Alaska Marine Mammal Stock Assessments, 2013. NOAA Technical Memorandum NMFS-AFSC-277. NOAA Alaska Fisheries Science Center, Seattle.
- Baird, R. W., & L. M. Dill. 1995. Occurrence and behaviour of transient killer whales: Seasonal and pod-specific variability, foraging behaviour, and prey handling. *Canadian Journal of Zoology* 73:1300–1311.
- Bigg, M. A., I. B. MacAskie, and G. M. Ellis. 1976. Abundance and movements of killer whales off eastern and southern Vancouver Island with comments on management. Ecological Reserves Collection, Victoria.
- Bigg, M. A., G. M. Ellis, J. K. B. Ford, K. C. Balcomb. 1987. Killer Whales: A Study of Their Identification, Genealogy, and Natural History in British Columbia and Washington State. Phantom Press & Publishers Inc., Nanaimo, British Columbia.
- Ellis, G. M., J. R. Towers, and J. K. B. Ford. 2008. Transient killer whales of British Columbia and Southeast Alaska: photo-identification catalogue 2008. Fisheries and Oceans Canada Pacific Biological Station Cetacean Research Program, Nanaimo.

- Elliser, C. R., K. H. MacIver, and M. Green. 2018. Group characteristics, site fidelity, and photo-identification of harbor porpoises, *Phocoena phocoena*, in Burrows Pass, Fidalgo Island, Washington. *Marine Mammal Science* 34:365–384.
- Finwave . 2025. Bigg’s Killer Whales. Bay Cetology. Accessed 23 August 2025 at: [finwave.io](https://finwave.io)
- Ford, J. and G. Ellis. 2014. You Are What You Eat: Foraging Specializations and Their Influence on the Social Organization and Behavior of Killer Whales. Pages 75-98 in *Primates and Cetaceans: Field Research and Conservation of Complex Mammalian Societies* (J. Yamagiwa and L. Karczmarski, Eds.). Springer, Tokyo, Japan.
- Ford, J. K. B., and G. M. Ellis. 1999. *Transients: Mammal-Hunting Killer Whales*. UBC Press, Vancouver, British Columbia.
- Ford, J. K. B., G. M. Ellis, and J. W. Durban. 2008. An Assessment of the Potential for Recovery of West Coast Transient Killer Whales Using Coastal Waters of British Columbia. Canadian Science Advisory Secretariat. Department of Fisheries and Oceans Canada, Ottawa.
- Ford, J. K., G. M. Ellis, L. G. Barrett-Lennard, A. B. Morton, R. S., Palm, R. S., and K. C. Balcomb III. 1998. Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. *Canadian Journal of Zoology* 76:1456–1471.
- Frayne, A., C. Ogle, E. Casellas, J. Hoy, M. S. Plaza. 2025. 2024 Soundwatch Program Annual Contract Report. Soundwatch Public Outreach /Boater Education Project Update Report. The Whale Museum, Friday Harbor.
- Houghton, J., R. W. Baird, C. K. Emmons, and M. B. Hanson. 2015. Changes in the occurrence and behavior of mammal-eating killer whales in southern British Columbia and Washington State, 1987–2010. *Northwest Science* 89:154–169.

- Matkin, D. R., J. M. Straley, C. M. Gabriele. 2007. Killer Whale Feeding Ecology and Non-Predatory Interactions with other Marine Mammals in the Glacier Bay Region of Alaska. Pages 155-158 in Proceedings of the Fourth Glacier Bay Science Symposium. (J. F. Piatt and S. M. Gende, Eds). U.S. Geological Survey Scientific Investigations Report 2007-5047. U.S. Geological Survey, Juneau.
- McInnes, J. D., C. R. Mathieson, P. J. West-Stap, S. L. Marcos, V. L. Wade, J. E. Moore, S. L. Mesnick, L. M. Dill. 2023. Identification catalog and field guide for transient (Bigg's) killer whales of Monterey Bay and California waters. NOAA Southwest Fisheries Science Center, La Jolla.
- McInnes, J. D., C. R. Mathieson, P. J. West-Stap, S. L. Marcos, P. A. Olson, A. W. Trites. 2021. Transient killer whales of central and northern California and Oregon: a catalog of photo-identified individuals. NOAA Technical Memorandum NMFS-SWFSC-644. NOAA Southwest Fisheries Science Center, La Jolla.
- McInnes, J. D., A. W. Trites, C. R. Mathieson, M. E. Dahlheim, J. E. Moore, P. A. Olson, and K. M. Lester. 2024. Evidence for an oceanic population of killer whales (*Orcinus orca*) in offshore waters of California and Oregon. *Aquatic Mammals* 50:93–106.
- Muto, M. M., V. T. Helker, B. J. Delean, N. C. Young, J. C. Freed, R. P. Angliss, N. A. Friday, P. L. Boveng, J. M. Breiwick, B. M. Brost, M. F. Cameron, P. J. Clapham, J. L. Crance, S. P. Dahle, M. E. Dahlheim, B. S. Fadely, M. C. Ferguson, L. W. Fritz, K. T. Goetz, R. C. Hobbs, Y. V. Ivashchenko, A. S. Kennedy, J. M. London, S. A. Mizroch, R. R. Ream, E. L. Richmond, K. E. W. Sheldon, K. L. Sweeney, R. G. Towell, P. R. Wade, J. M. Waite, and A. N. Zerbini. 2021. Alaska marine mammal stock assessments, 2020. NOAA Technical Memorandum NMFS-421. NOAA Alaska Fisheries Science Center, Seattle.

- Morin, P. A., M. L. McCarthy, C. W. Fung, J. W. Durban, K. M. Parsons, W. F. Perrin, B. L. Taylor, T. A. Jefferson, and F. I. Archer. 2024. Revised taxonomy of eastern North Pacific killer whales (*Orcinus orca*): Bigg's and resident ecotypes deserve species status. *Royal Society Open Science*, 11:231-368.
- NOAA Fisheries. 2022. Harbor seals pupping timeframes along the West Coast. NOAA Fisheries, Silver Spring.
- Washington State Legislature. 2019. SB 5577 - 2019-20 Concerning the protection of southern resident orca whales from vessels. Washington State Legislature, Olympia.
- R Core Team. 2025. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. Accessed at:  
<https://www.R-project.org/>
- Shields, M. W., S. Hysong-Shimazu, J. C. Shields, and J. Woodruff. 2018. Increased presence of mammal-eating killer whales in the Salish Sea with implications for predator-prey dynamics. *PeerJ* 6.
- Sobocinski, K. 2021. The State of the Salish Sea. Salish Sea Institute Western Washington University, Bellingham.
- Sobocinski, K. L., C. D. Harvell, N. J. K. Baloy, G. Broadhurst, M. N. Dethier, A. Flower, and J. R. Delaney. 2022. Urban seas as hotspots of stress in the Anthropocene ocean: The Salish Sea example. *Elementa: Science of the Anthropocene* 10.
- Towers, J. R., G. M. Ellis, and J. K. B. Ford. 2012. Photo-identification catalogue of Bigg's (transient) killer whales from coastal waters of British Columbia, northern Washington, and southeastern Alaska. Canadian data report of fisheries and aquatic sciences 1241. Department of Fisheries and Oceans Canada Cetacean Research Program, Nanaimo.
- Towers, J. R., G. J. Sutton, T. Shaw, M. Malleon, D. Matkin, B. Gisborne, J. Forde, D. Ellifrit, G. M. Ellis, J. K. B. Ford, T. Doniol-Valcroze. 2019. Photo-identification catalogue,

population status, and distribution of Bigg's killer whales known from coastal waters of British Columbia, Canada. Canadian technical report of fisheries and aquatic sciences 3311. Department of Fisheries and Oceans Canada Cetacean Research Program, Nanaimo.

Wickham, H. 2016. ggplot2: Elegant Graphics for Data Analysis. ISBN 978-3-319-24277-4.

Accessed at:

<https://ggplot2.tidyverse.org>

Wickham, H, R. François, L. Henry, K. Müller, D. Vaughan. 2025. dplyr: A Grammar of Data Manipulation. R package version 1.1.4. Accessed at:

<https://dplyr.tidyverse.org>.

Young, N. C., A. A. Bower, M. M. Muto, J. C. Freed, R. P. Angliss, N. A. Friday, B. D.

Birkemeier, P. L. Boveng, B. M. Brost, M. F. Cameron, J. L. Crance, S. P. Dahle, B. S.

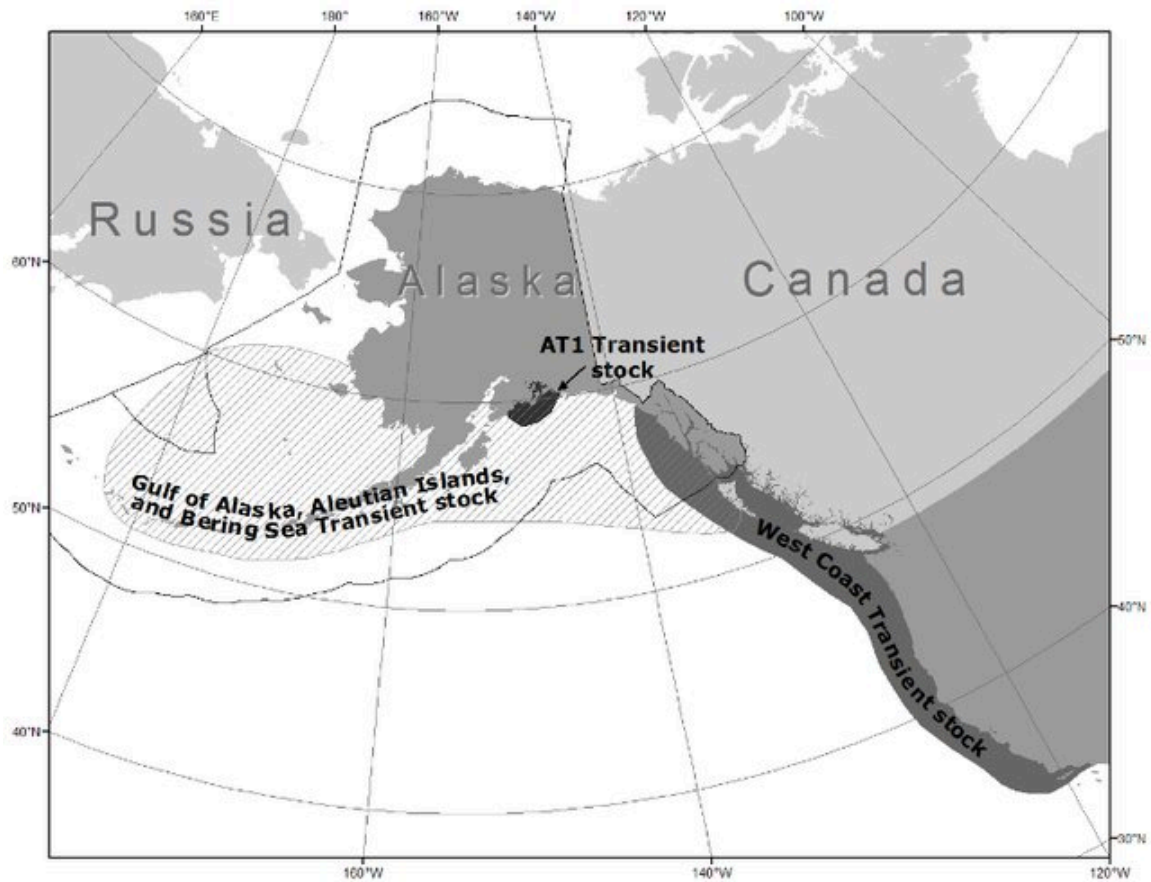
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Richmond, K. E. W. Sheldon, K. L. Sweeney, R. G. Towell, P. R. Wade, J. M. Waite, and

A. N. Zerbin. 2024. Alaska marine mammal stock assessments, 2023. NOAA Technical Memorandum NMFS-AFSC-493. NOAA Alaska Fisheries Science Center, Seattle.

Washington Department of Fish and Wildlife. 2024. 2024 southern resident killer whale vessel adaptive management legislative report. Washington Department of Fish and Wildlife, Olympia.

## Tables and Figures



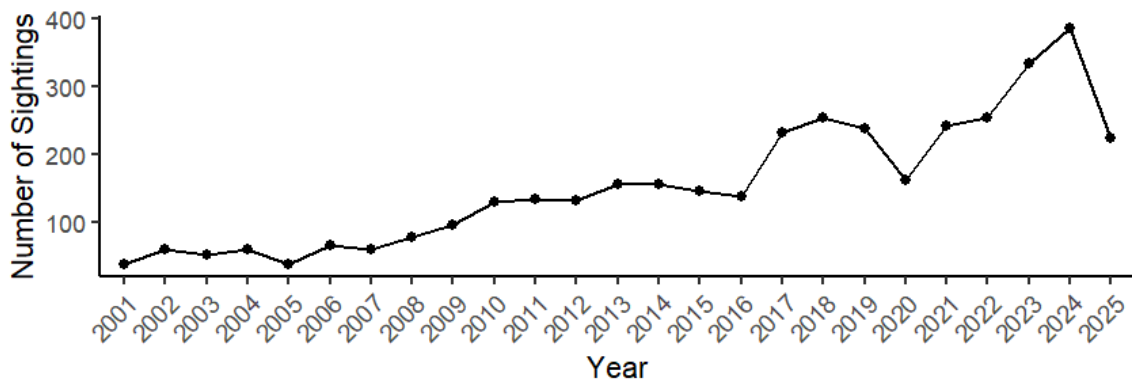
**Figure 1.** The approximate distribution of Bigg's Killer Whale stocks within the Eastern North Pacific. (Morin et al. 2021, Allen and Angless 2013). West Coast Transients have two subpopulations, inner coast whales who usually stay within 10 km of shore, and outer coast whales who are common >10 km from shore.

Region	Name	Major or Notable Waterways	Definition
SJF	Strait of Juan de Fuca	Eastern Strait of Juan de Fuca, Western Strait of Juan de Fuca	North of the Olympic Peninsula and south from Vancouver Island and the boundary set by Haro Strait and Boundary Pass (HB). West from the southern boundary of Rosario Strait (RS), Cattle Pass, Iceberg Point on Lopez, and Salmon Bank. East from Jordan River on the Olympic Peninsula
RS	Rosario Strait	Rosario Strait, Bellingham Bay, Padilla Bay, Hale Passage	South from Matia Island and north from Lawson Reef. East from the east side of Orcas, Blakely, Decatur, Lopez, and Obstruction Islands. West from mainland Washington State.
HB	Haro Strait and Boundary Pass	Haro Strait, Boundary Pass, Sidney Channel, Oak Bay	North from Discovery, Waldron, and Sucia Islands. South from Portland, South Pender, and Saturna Islands. East from Vancouver Island and west from Sucia Island and the west side of San Juan Island.
SOGI	Southern Gulf Islands	Saanich Inlet, Swanson Channel, Plumper Sound, Trincomali Channel, Stuart Channel, Sattelite Channel	South of Porlier Pass and North of Saanich Inlet. West of Galiano Island and east from Vancouver Island. Lower boundary set by Haro Strait and Boundary Pass (HB)
SG	Strait of Georgia	Strait of Georgia, Active Pass, Birch Bay, Semiamhoo Bay	North of Matia Island. South of Porlier Pass and Roberts Bank. East of Galiano, Mayne, and Saturna Islands. West of mainland British Columbia and Washington State.
SJPR	San Juan and President Channels	San Juan Channel, President Channel, Griffin Bay, Friday Harbor, Cattle Pass	North of Whale Rocks and the north side of Orcas Island. South of Spieden, Waldron, Sucia, Matia, Barnes, and Clark Islands. East of Cayou and Upright Channels. West through Spieden Channel.
INIS	Interisland	Cayou Channel, Upright Channel, Lopez Sound, East Sound, West Sound	East of Cayou and Upright Channels. West of Obstruction, Lopez, and Thatcher Passes. South of East and West Sounds. North of Lopez Sound.

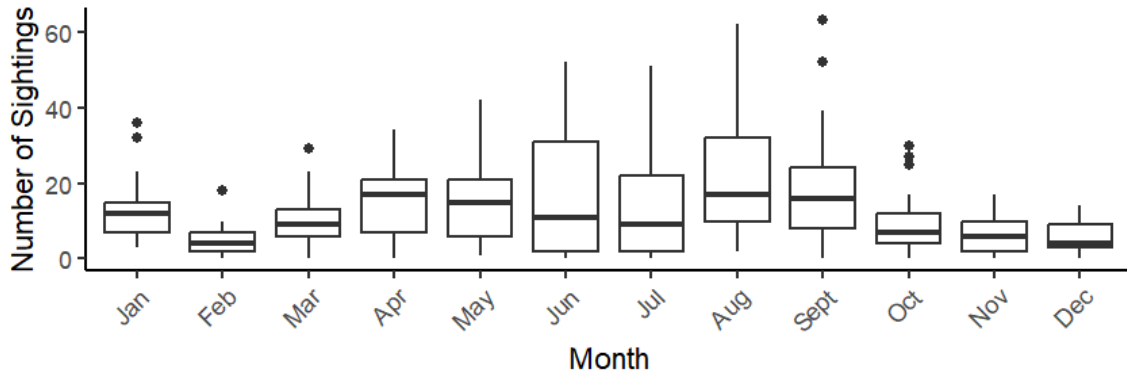
**Table 1.** Study region name, limits, and major or notable waterways for each of the regions used in this study.



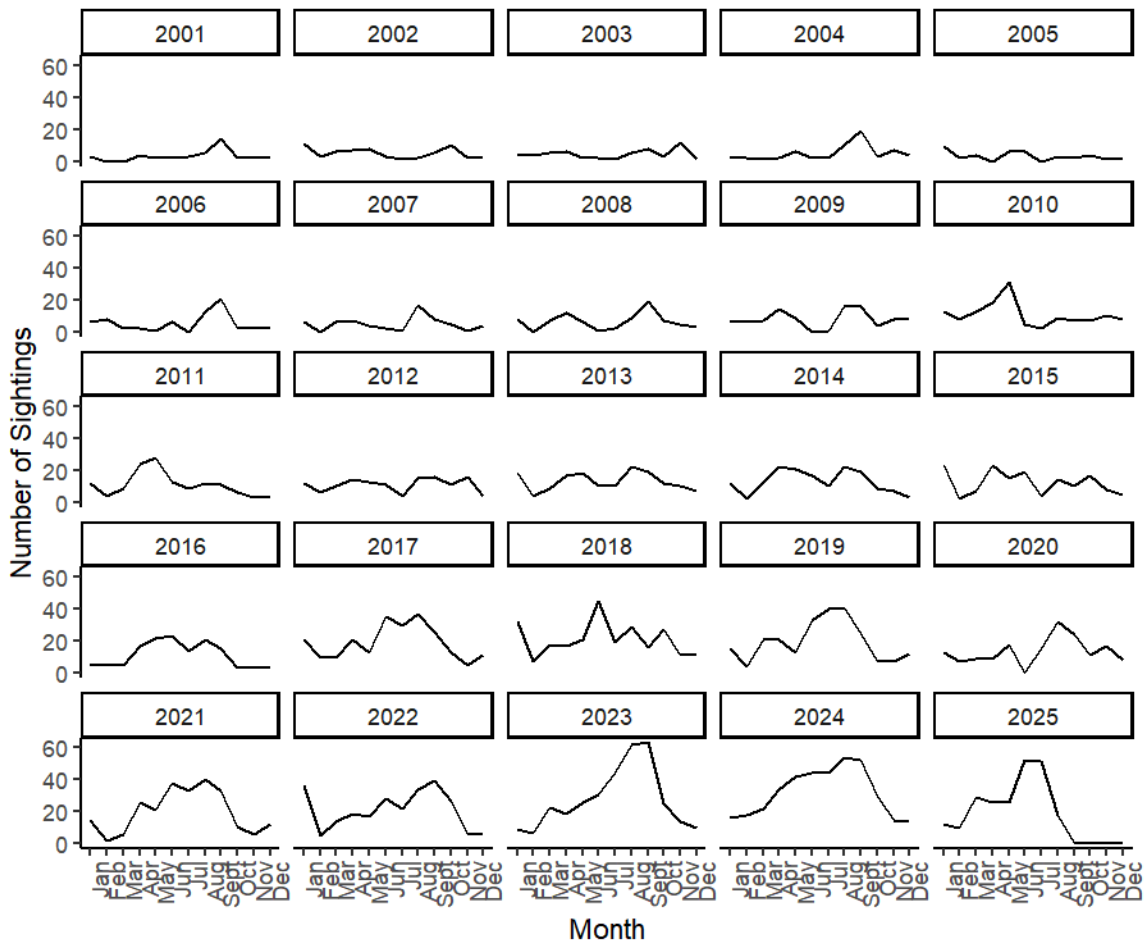
**Figure 2.** Map of the regions referenced in this study. Strait of Juan de Fuca (SJF), Haro Strait and Boundary Pass (HB), Southern Gulf Islands (SOGI), Strait of Georgia (SG), San Juan and President Channels (SJPR), Interislands (INIS), and Rosario Strait (RS).



**Figure 3.** Number of sightings by year from April 2001 to August 2025. 2005 had the lowest number of sightings (n=38), while 2024 had the highest number of sightings (n=385).



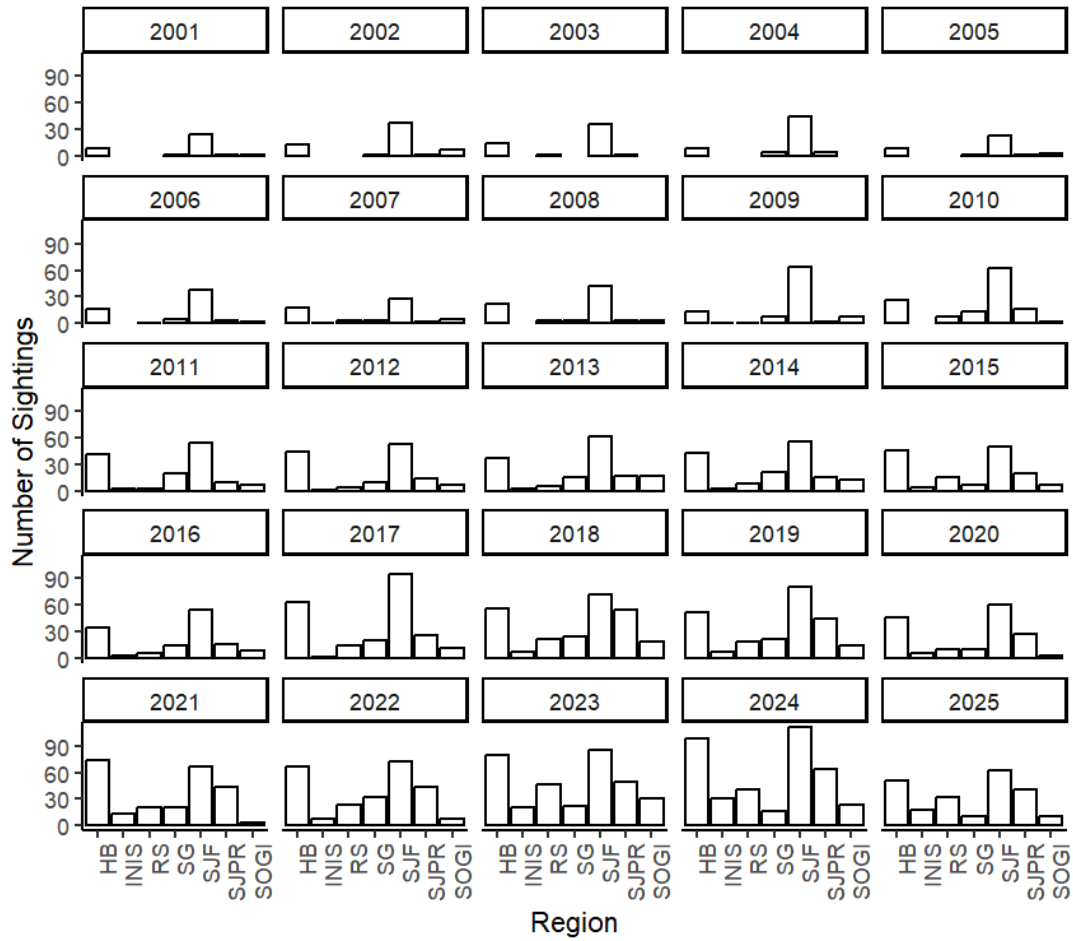
**Figure 4.** Cumulative sightings (n=3,875) by month from April 2001 to August 2025. A bimodal peak occurs in late spring (April-June) and late summer (August-September)



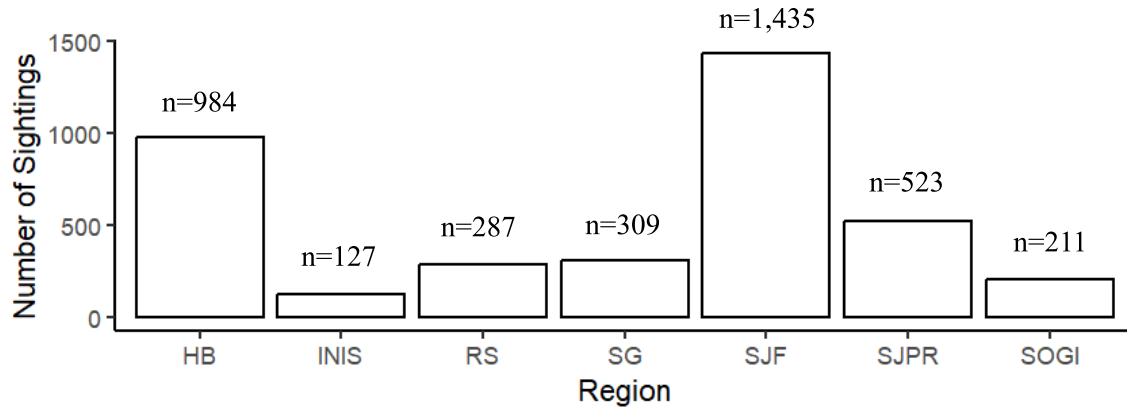
**Figure 5.** Monthly sightings (n=3,875) by year from April 2001 to August 2025. Sightings have increased from mostly occurring in late summer to a year-round distribution.



**Figure 6.** Percent change in the number of sightings from 2001 to 2025. Negative values indicate an overall decrease in sightings, while positive values indicate an increase.



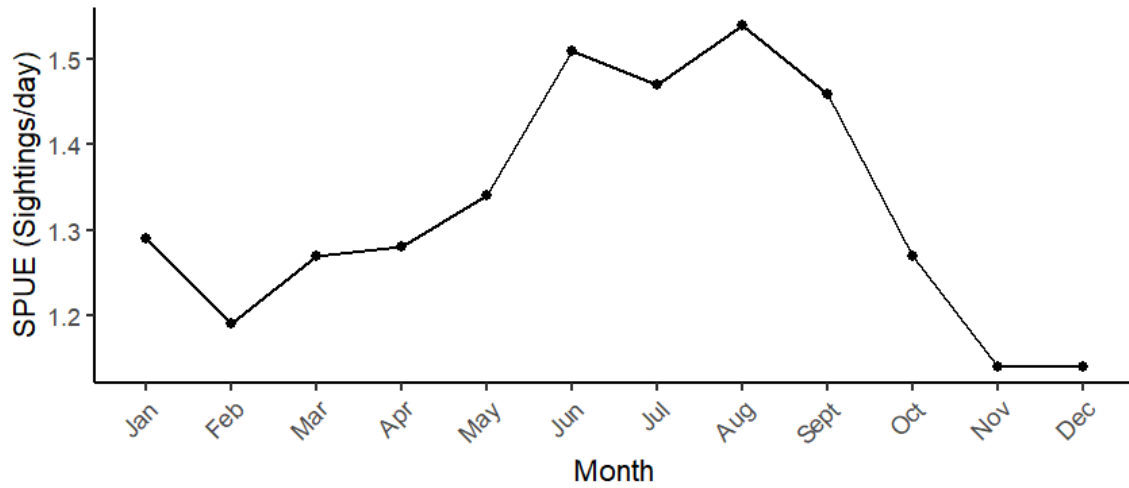
**Figure 7.** Sightings (n=3,875) by region (Haro Strait and Boundary Pass (HB), Interisland Rosario Strait (RS), Strait of Juan de Fuca (SG), Strait of Juan de Fuca (SJF), San Juan and President Channel (SJPR), and Southern Gulf Islands (SOGI)) split by year from April 2001 to August 2025. By 2011, all regions were being used annually, with radiation from the Strait of Juan de Fuca into neighboring areas.



**Figure 8.** Cumulative sightings (n=3,875) by region (Haro Strait and Boundary Pass (HB), Interisland Rosario Strait (RS), Strait of Juan de Fuca (SG), Strait of Juan de Fuca (SJF), San Juan and President Channel (SJPR), and Southern Gulf Islands (SOGI)) from April 2001 to August 2025.

Month	Sightings	Effort (Day)	SPUE
Jan	322	250	1.29
Feb	126	106	1.19
Mar	256	202	1.27
Apr	381	297	1.28
May	389	291	1.34
Jun	428	283	1.51
Jul	362	247	1.47
Aug	542	351	1.54
Sept	487	333	1.46
Oct	256	202	1.27
Nov	178	156	1.14
Dec	149	131	1.14

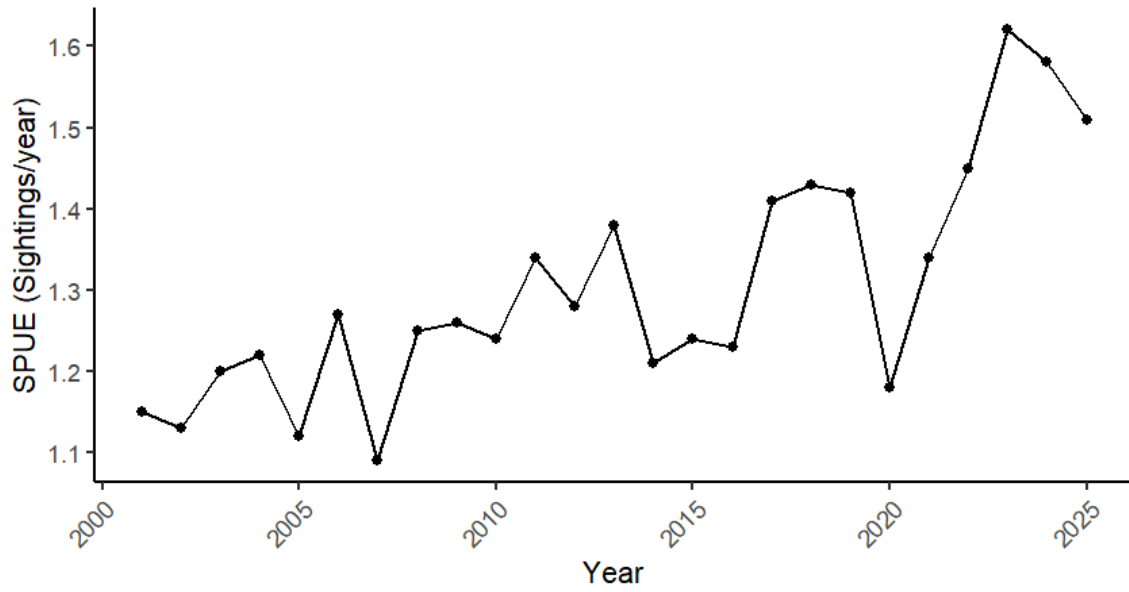
**Table 2.** Sightings per Unit of Effort (SPUE) for all years within the data period, defined as the number of sightings each month divided by the number of effort days each month.



**Figure 9.** Sightings per Unit of Effort (SPUE) for all years within the data period, defined as the number of sightings each month divided by the number of effort days each month.

Year	Sightings	Effort (Day)	SPUE
2001	39	34	1.15
2002	60	53	1.13
2003	53	44	1.20
2004	61	50	1.22
2005	38	34	1.12
2006	66	52	1.27
2007	61	56	1.09
2008	79	63	1.25
2009	97	77	1.26
2010	131	106	1.24
2011	134	100	1.34
2012	132	103	1.28
2013	156	113	1.38
2014	157	130	1.21
2015	147	119	1.24
2016	138	112	1.23
2017	232	165	1.41
2018	254	178	1.43
2019	239	168	1.42
2020	163	138	1.18
2021	243	182	1.34
2022	254	175	1.45
2023	333	206	1.62
2024	385	243	1.58
2025	224	148	1.51

**Table 3.** Sightings per Unit of Effort (SPUE), defined as the number of sightings each year divided by the number of effort days each year.



**Figure 10.** Cumulative Sightings per Unit Effort (SPUE), defined as the number of sightings each year by the number of effort days each year.