

**PACIFIC WHALE
WATCH ASSOCIATION**



2022 SIGHTINGS & SENTINEL ACTIONS

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A group of Bigg's killer whales. Credit: Sara Hysong-Shimazu, Maya's Legacy

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INTRODUCTION



A PWWA vessel views Bigg's killer whales. *Credit: Vancouver Whale Watch*

The Pacific Whale Watch Association

Established in 1994 as the Whale Watch Operators Association Northwest (WWOANW), the Pacific Whale Watch Association (PWWA) is a community of ecotourism professionals with a shared commitment to education, conservation, and responsible wildlife viewing in Washington State and British Columbia.

The PWWA was originally formed by regional whale watch operators as a means of sharing sightings information and establishing voluntary guidelines at a time when whale watching in the area was relatively new and laws pertaining to whales and vessels did not yet exist. Since that time, formal regulations have been implemented in both Washington and British Columbia, many based on the PWWA's original recommendations. The PWWA's primary functions have evolved to include not only the sharing of wildlife sightings and promotion of sustainable whale watching practices, but also contributing toward ongoing wildlife research, participating in conservation advocacy efforts, and conducting educational outreach both on and off the water.

The peak season for PWWA whale watching activity is typically April through October, but several operators offer wildlife tours year-round as weather permits. The PWWA fleet comprises a

variety of vessel types including rigid hull inflatable boats (RHIB's), sailboats, monohull vessels, catamarans, and kayaks. Tours vary in length from a few hours to full-day specialty excursions or even overnight expeditions.

Whale watching activity within the PWWA is highly collaborative, with open sharing of information among members. PWWA operators communicate whale sightings, sentinel actions (detailed later in this report), and other pertinent information with each other using a variety of exclusive tools. These tools include an encrypted UHF radio channel, a members-only social media group, and the private PWWA App.

As benefits of membership, PWWA companies are also provided with resources to help stay current with frequently changing whale watching regulations and best-available marine mammal science. These resources include annual driver and naturalist training sessions, access to private online discussion forums, bi-weekly membership newsletters, and access to a literature library of relevant peer-reviewed scientific articles.

During the 2022 whale watch season, there were **30** PWWA member companies departing from **23** different locations throughout Washington and British Columbia. There are currently **14** PWWA members based in British Columbia and **16** based in Washington State.

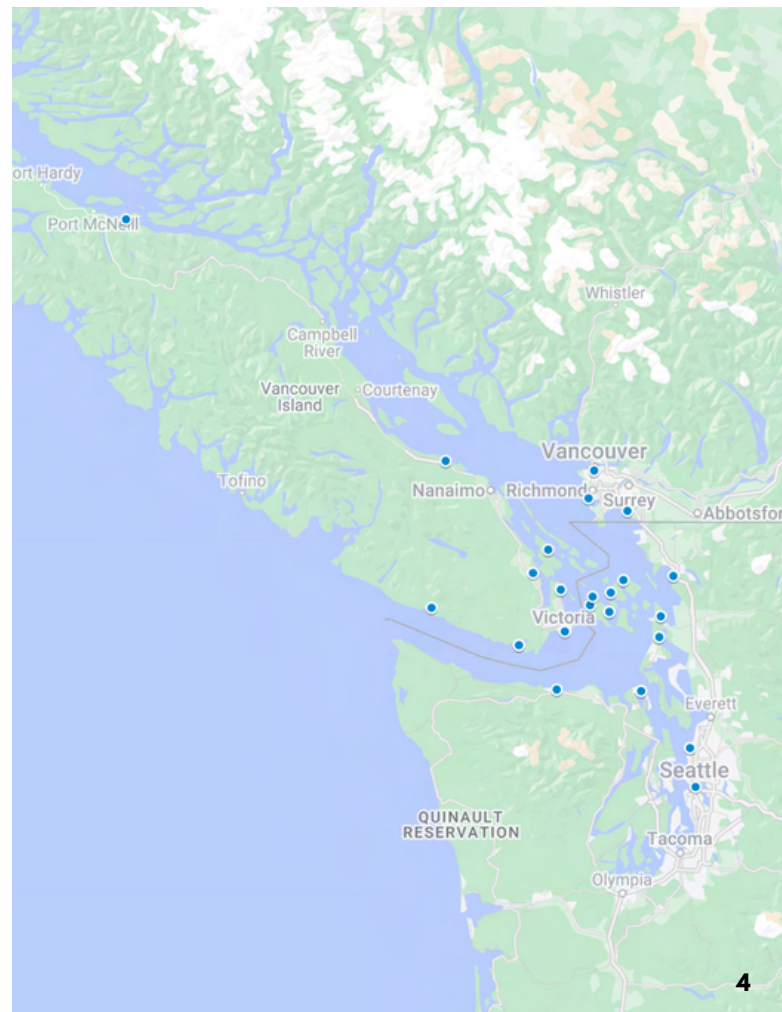


British Columbia PWWA Members

- BC Whale Tours
- Eagle Wing Whale & Wildlife Watching Tours
- Five Star Whale Watching
- Ocean EcoVentures
- Orca Spirit Adventures
- Prince of Whales
- Salt Spring Adventures
- Sidney Whale Watching
- Sooke Whale Watching
- SpringTide Whale Watching & Eco Tours
- Steveston Seabreeze Adventures
- Vancouver Whale Watch
- White Rock Sea Tours
- Wild Whales Vancouver

Washington PWWA Members

- All Aboard Sailing
- Anacortes Whale Watching Tours
- Blue Kingdom Tours
- Deception Pass Tours
- Deer Harbor Charters
- FRS Clipper
- Island Adventures Whale Watching
- Maya's Legacy Whale Watching
- Outer Island Excursions
- Puget Sound Express
- San Juan Cruises
- San Juan Excursions
- San Juan Outfitters
- San Juan Safaris
- Spirit of Orca Whale & Wildlife Tours
- Western Prince Whale & Wildlife Tours



Map of 2022 PWWA departure ports.
Credit: Google Maps

PWWA APP



A PWWA vessel in the Strait of Juan de Fuca. Credit: Jake Hawley, Orca Spirit Adventures

The PWWA App

One of the most important tools used by PWWA operators is the PWWA App. This private app was developed by Johannes Krieger, co-owner of PWWA member company San Juan Excursions, in the summer of 2018. It was designed as a means to more effectively share and record wildlife sightings and coordinate whale viewing efforts of the PWWA fleet. The PWWA App allows authorized users to view and report real-time wildlife sightings, sentinel actions, and other navigational alerts on their Apple or Android devices.

The PWWA App has revolutionized whale watching operations in the Salish Sea and northern Vancouver Island regions. In addition to its use within the PWWA, whale watch operators with the North Island Marine Mammal Stewardship Association (NIMMSA) and Campbell River Association of Tour Operators (CRATO) also currently utilize the PWWA App to communicate among membership in their respective operating regions.

Beyond these professional whale watching organizations, the PWWA has also granted app access to a growing number of non-PWWA members including researchers, commercial vessel pilots, ferry captains, marine mammal observers, emergency responders, educators, and

the Canadian Coast Guard's Marine Mammal Desk. The PWWA provides access to authorized non-PWWA users free of charge.

PWWA App Reporting Procedures

All users of the PWWA App are expected to contribute their real-time wildlife sightings. This expectation also extends to researchers and other authorized users outside of the professional whale watching community when possible. In addition to wildlife sightings, users also report sentinel actions and pertinent navigational alerts in the PWWA App as they occur.

PWWA operators are asked to make an entry in the PWWA App when they first arrive on scene with whales and when they depart. Additional entries throughout the encounter are encouraged. Each operator is asked to log their whale sightings, even if they are not the first vessel to locate wildlife. This keeps the fleet informed of updated whale locations, individual IDs, and interesting behavioral notes. A wildlife entry in the PWWA App is not a **unique** sighting. The same animal or group of animals may be reported multiple times in a day. The primary goal of the PWWA App is to provide real-time sightings information of cetaceans and other notable wildlife.

Providing frequent updates of the same whale or group of whales also helps PWWA operators to voluntarily regulate the number of professional vessels near whales at a given time.

Most entries in the PWWA App are **GPS** entries. GPS entries include the time and date of each sighting and the GPS coordinates of the reporter at the time the entry is logged. If a user is in a remote area with poor cellular reception, the details and location of the sighting will be saved at the time the entry is made and uploaded once reception is restored. This ensures that the details of the sighting are accurately captured no matter where the operator is at the time.

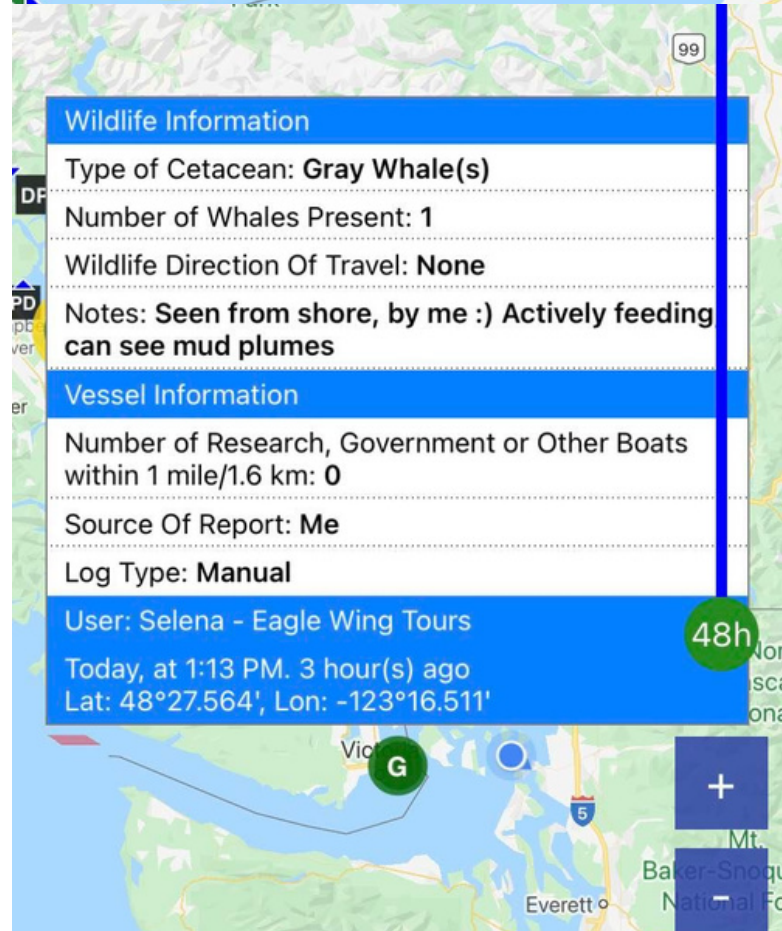
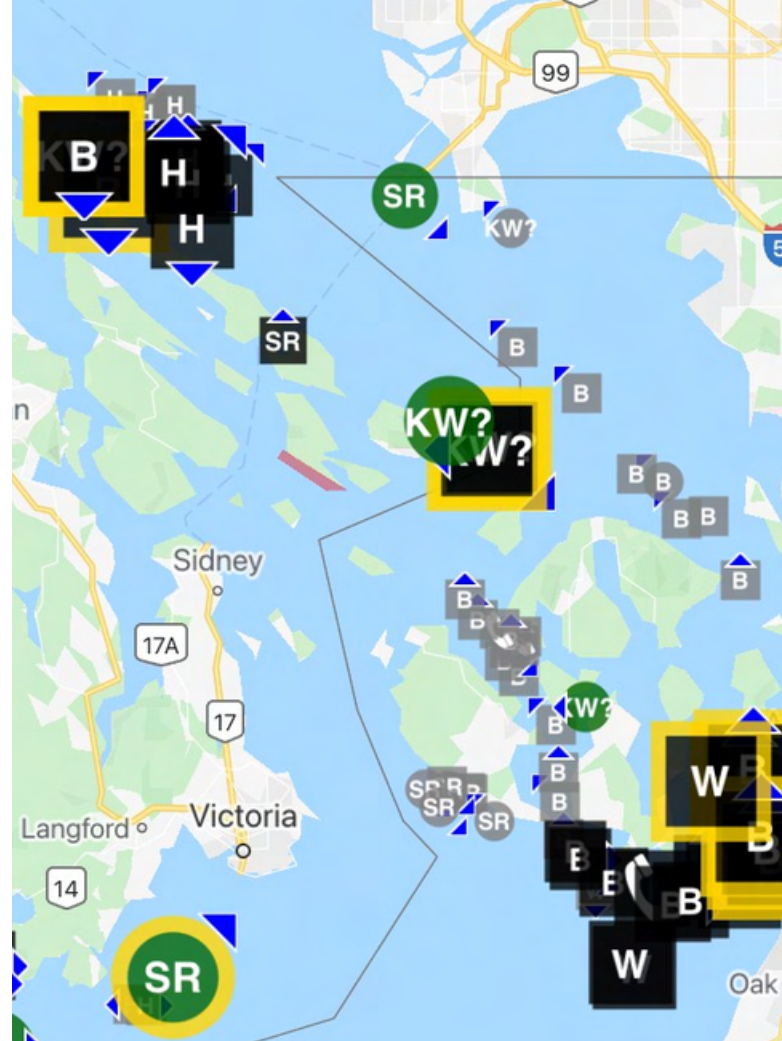
Users may also make **manual** entries using an approximate location to share secondhand or shore-based sightings. Users are encouraged to make manual entries only if they come from a reliable source or if they themselves are viewing animals from shore. These reports are distinguished in the PWWA App from GPS reports by the shape of icon that appears on the screen (square for GPS, circle for manual).

Reporting Wildlife Sightings

The majority of entries in the PWWA App are wildlife sightings. While larger cetaceans (killer whales, minke whales, humpback whales, and gray whales) are the predominant species reported, smaller cetaceans, such as Dall's porpoise, harbor porpoise, and Pacific white-sided dolphins, or other noteworthy marine mammals, such as sea otters and elephant seals, are also reported when appropriate. Reports of uncommon bird sightings are also encouraged in the PWWA App.

For wildlife reports, some of the details collected by the PWWA App from each user include:

- Type of wildlife
- Number of animals present
- Individual IDs of animal(s) if known
- Travel direction of animal(s)
- Interesting behavioral notes
- Other vessels present



Screenshots of the PWWA App showing wildlife sightings.
Credit: PWWA App

Reporting Sentinel Actions

Sentinel actions are defined by the PWWA as actions taken by professional whale watchers during the course of a tour to protect or benefit whales and other wildlife. Examples of sentinel actions documented by PWWA members in 2022 include:

- Stopping other vessels from speeding near whales
- Proactively warning vessels of whales nearby so they can adjust course as needed to avoid collisions
- Contacting military authorities to halt exercises
- Reporting sick or entangled animals to appropriate authorities
- Removing harmful debris from the water

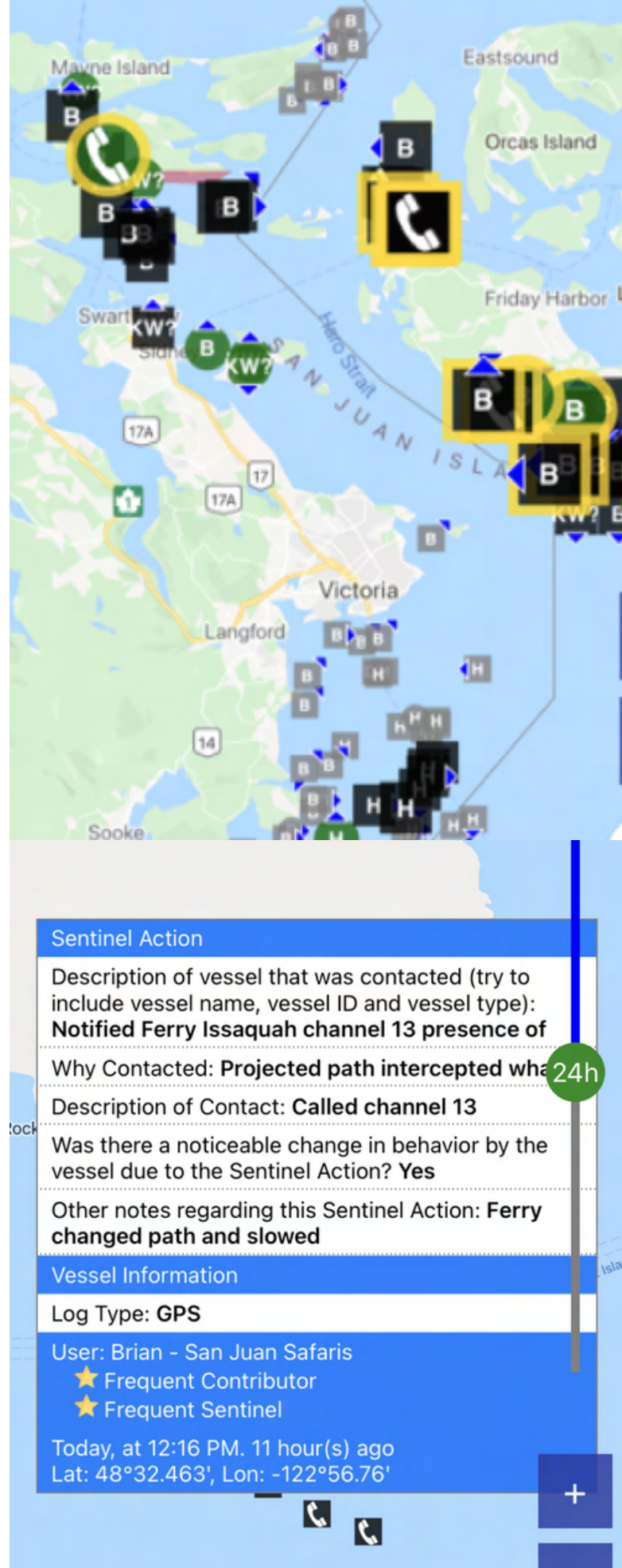
For sentinel action reports, some of the information collected by users includes:

- Description of the sentinel action
- Reason that intervention was necessary
- Species involved (if vessel-related)
- Means of contact used
- Whether there was a positive change in behavior as a result of the intervention
- Description of the vessel(s) contacted for vessel-related sentinel actions

Reporting "Important" Alerts

The final type of report that can be logged in the PWWA App are "important" alerts. These are miscellaneous notifications that are of urgent interest to the fleet. Some sample "important" alerts from 2022 include:

- Logs or other large hazards in the water
- Warnings of swimmers or divers in the vicinity
- Fishing gear set in a high-traffic area
- Advisories of scheduled military exercises
- Notifications of research or rescue activities
- Location of an entangled or injured animal



Screenshots of the PWWA App showing sample sentinel actions.
Credit: PWWA App



A PWWA vessel watches a humpback whale. *Credit: Mollie Naccarato, Sooke Coastal Explorations*

2022 PWWA App Modifications

Based on PWWA member suggestions collected after the 2021 season, several modifications were made to the PWWA App for 2022.

To facilitate more efficient recording and data analysis, the process of logging sentinel actions was streamlined to utilize clickable options rather than the previous method which required crew members to enter information into a text field. Instead of typing a description of the sentinel action, class of vessel contacted, form of debris collected, etc., PWWA crew members now simply click on the desired option from a provided list. This dramatically reduced the amount of time necessary to document sentinel actions in the PWWA App. There are still optional text fields available if PWWA App users wish to enter additional information about an incident, or if there is no pre-existing option that best describes a particular sentinel action.

Other changes to the sentinel action feature included the addition of an option to select which cetacean species was involved in each sentinel action and offering two different options for reactive sentinel actions — speeding vessels in the immediate vicinity, or vessels too close to whales but *not* speeding.

PWWA App Training

As the PWWA App is still relatively new, especially the sentinel action feature which was introduced in mid-2020, ongoing training of PWWA App users is important to maintain the quality of data collected through the app.

The PWWA includes instruction on proper PWWA App logging procedures for wildlife sightings and sentinel actions in its annual spring training meetings. The association also distributes regular reminders to PWWA members throughout the season to ensure consistency across the fleet. In addition, the association also briefs authorized third-party users of the PWWA App on optimal logging procedures upon granting them PWWA App access.

PWWA App Availability

The PWWA App is not available to the public, but qualified maritime professionals and researchers who demonstrate that access to real-time whale sightings will provide a tangible benefit to local whales can apply for complimentary access.

WILDLIFE SIGHTINGS

Bigg's killer whales surfacing. Credit: Rachel Rodell, Puget Sound Express

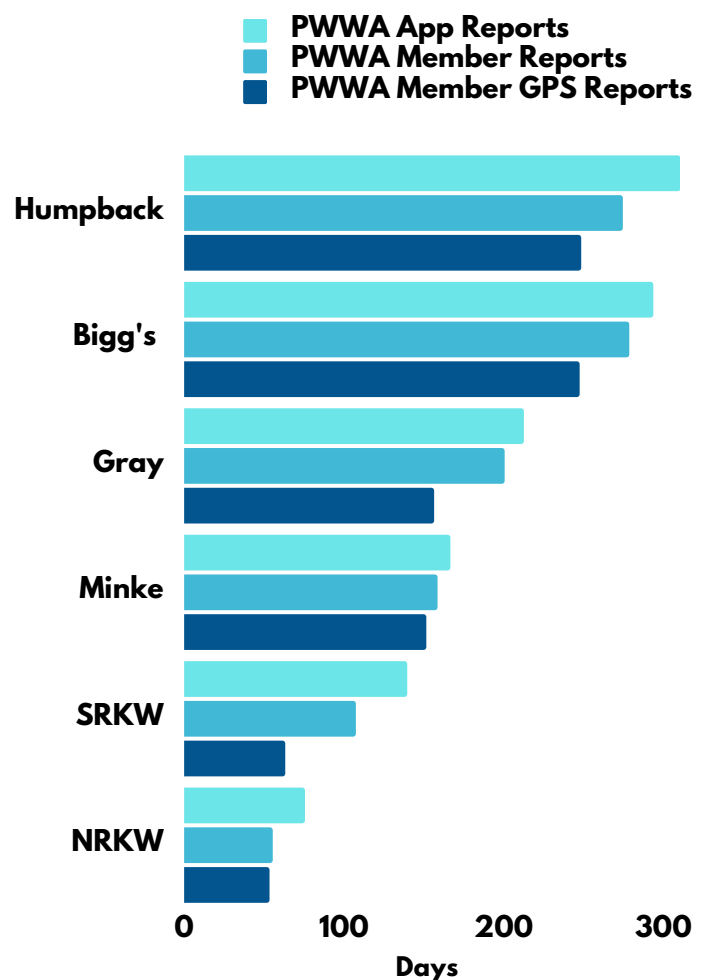
2022 Whale Presence at a Glance

Humpback whales and Bigg's killer whales were the two most frequently reported cetaceans to the PWWA App in 2022. They were followed by gray whales, minke whales, and Southern Resident killer whales (SRKW). Northern Resident killer whales (NRKW) were reported least frequently in 2022.

After analyzing reports from *all* users including members of PWWA, NIMMSA, CRATO, and authorized users in the research, transportation, and emergency response sectors throughout Washington and British Columbia, humpback whales were reported on **310** days, Bigg's killer whales on **293** days, gray whales on **212** days, minke whales on **166** days, SRKW on **139** days, and NRKW on **75** days.

When only examining entries made to the PWWA App by captains, naturalists, and crew members of the PWWA, Bigg's killer whales were reported on **278** days, humpback whales on **274** days, gray whales on **200** days, minke whales on **158** days, SRKW on **107** days, and NRKW on **55** days.

If including exclusively GPS-based PWWA App entries made by PWWA vessels during the course of a professional whale watching tour, humpback whales were observed on **248** days, Bigg's killer whales on **247** days, gray whales on **156** days, minke whales on **151** days, SRKW on **63** days, and NRKW on **53** days.



It is important to note that each whale type may have been present on additional days but not observed or documented in the PWWA App. Additionally, while PWWA App users are encouraged to only create a manual entry if the report comes from a reliable source or if they themselves are watching from shore, not every manual report can be verified.

HUMPBACK WHALES



A humpback whale dorsal fin. Credit: Bethany Shimasaki, Western Prince

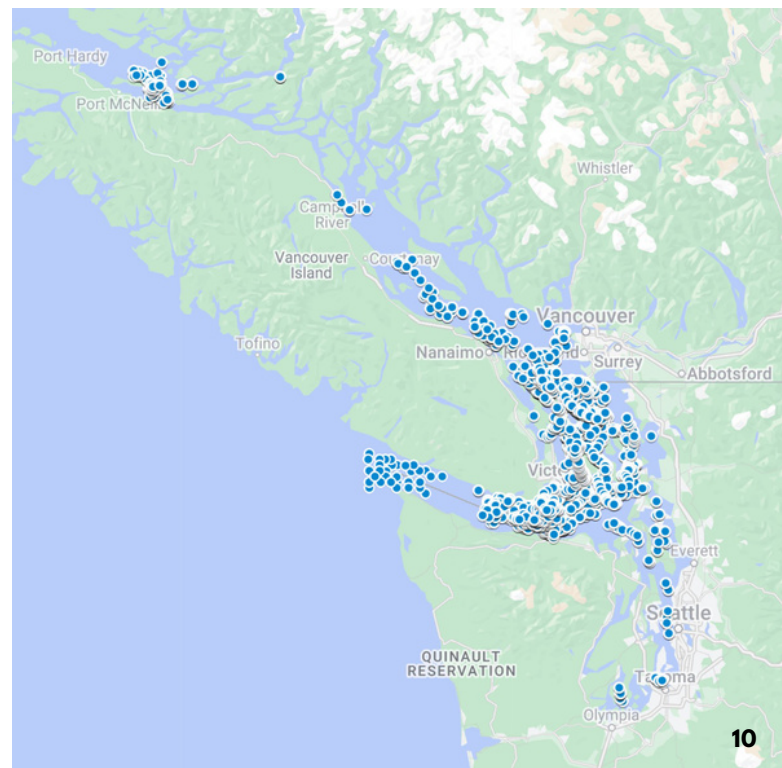
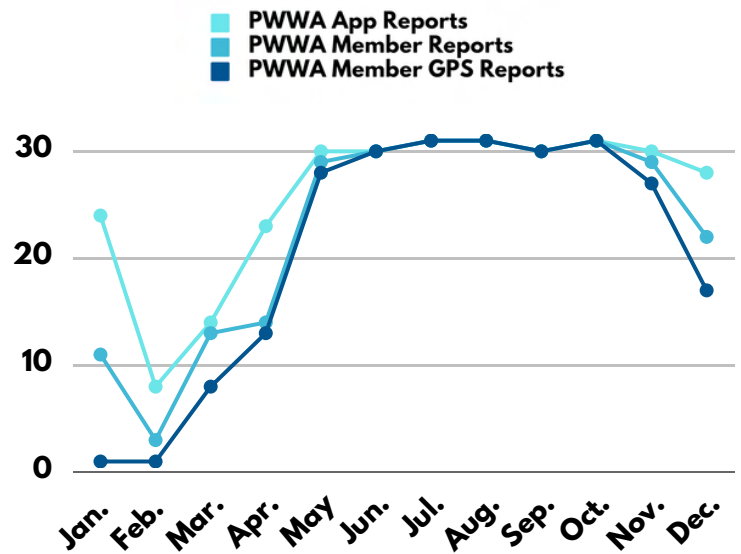
Humpback Whales

Humpback whales (*Megaptera novaeangliae*) were the most frequently reported species to the PWWA App in 2022. The PWWA App received **14,368** total entries of humpback whales spanning **310** days of the year. **9,397 (65%)** of those entries were reported by PWWA crew members across **274** days. Of PWWA member entries, **8,296 (88%)** were firsthand GPS entries made from a PWWA vessel during **248 days** of 2022. Humpback whales were reported by PWWA members at least once during every month of the year, and were observed nearly daily May through November.

The number of humpback whales utilizing the waters in and around the Salish Sea continues to grow. According to the Canadian Pacific Humpback Collaboration (CPHC), a record 34 calves were documented in the Salish Sea during the 2022 season. The CPHC also shared that at least 396 individual humpback whales were photographed in 2022, the highest number since monitoring of Salish Sea humpback whales first began.

Regional humpback whales have been identified as belonging primarily to breeding stocks in Hawaii and Mexico. A small number of Salish Sea humpbacks belong to the population which breeds in Central America, and a handful of individuals have been matched to more than one breeding ground in their lifetime.

2022 Humpback Whale Days



Map of 2022 PWWA GPS entries for humpback whales. Credit: PWWA App and Google Maps

BIGG'S KILLER WHALES



Bigg's killer whales. Credit: Melisa Pinnow, San Juan Excursions

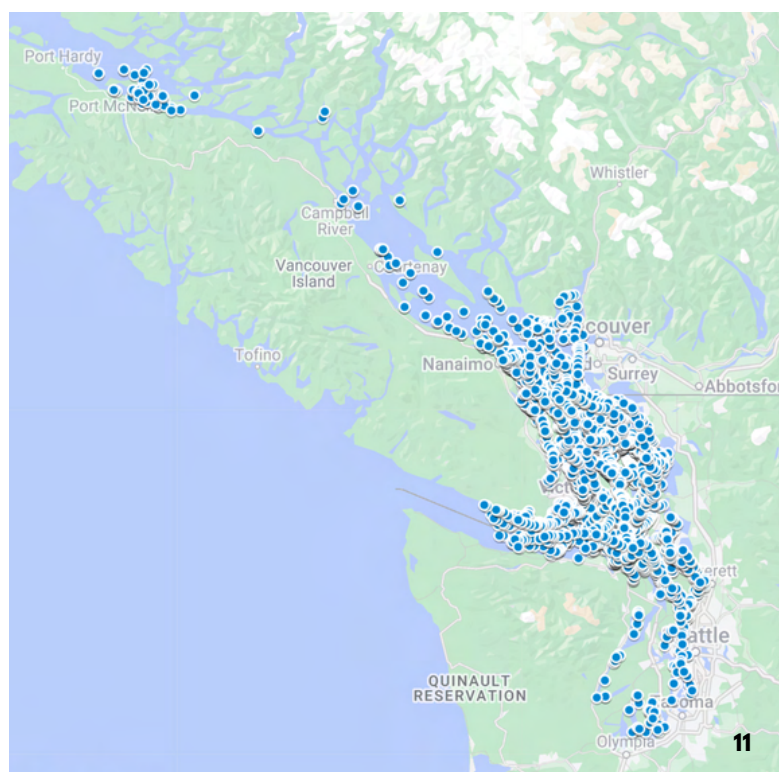
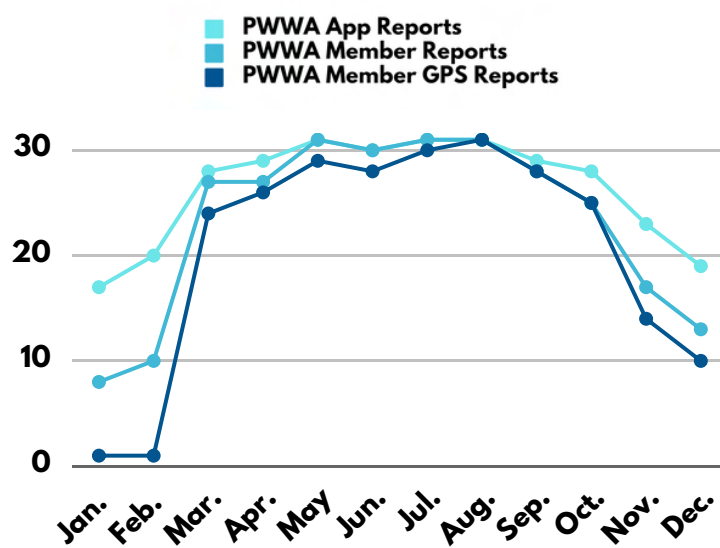
Bigg's Killer Whales

The PWWA App received **10,300** total entries of Bigg's killer whales (*Orcinus orca*) spanning **293** days of 2022. **8,846 (86%)** of those entries were made by PWWA crew members across **278** days. **8,118 (92%)** of PWWA crew member entries were firsthand GPS entries made from aboard a PWWA vessel during **247** days.

Bigg's killer whales were observed in all 12 months of the year, with nearly daily sightings from March through October. The steep declines in PWWA reports in winter months are likely due to reduced whale watching effort and inclement weather. Orca Behavior Institute (OBI), an independent research organization that compiles sightings from professional whale watch vessels, shore-based whale watchers, and various other sources, reported that Bigg's were present in the Salish Sea on at least **328** days of 2022. OBI also confirmed a record-breaking **1,222** unique Bigg's sightings. A unique sighting is a sighting of a specific group of Bigg's killer whales on a specific day. This was approximately 150 more unique Bigg's killer whale sightings than OBI confirmed in 2021.

According to research group Bay Cetology, the coastal Bigg's population welcomed **10** calves in 2022, eight born in 2022 and two born in late 2021 but not observed until 2022. The group estimates the current coastal Bigg's killer whale population in and around the Salish Sea to be approximately **370** animals.

2022 Bigg's Killer Whale Days



Map of 2022 PWWA GPS entries for Bigg's killer whales. Credit: PWWA App and Google Maps

GRAY WHALES



Gray whale. Credit: Mollie Naccarato, Sooke Coastal Explorations

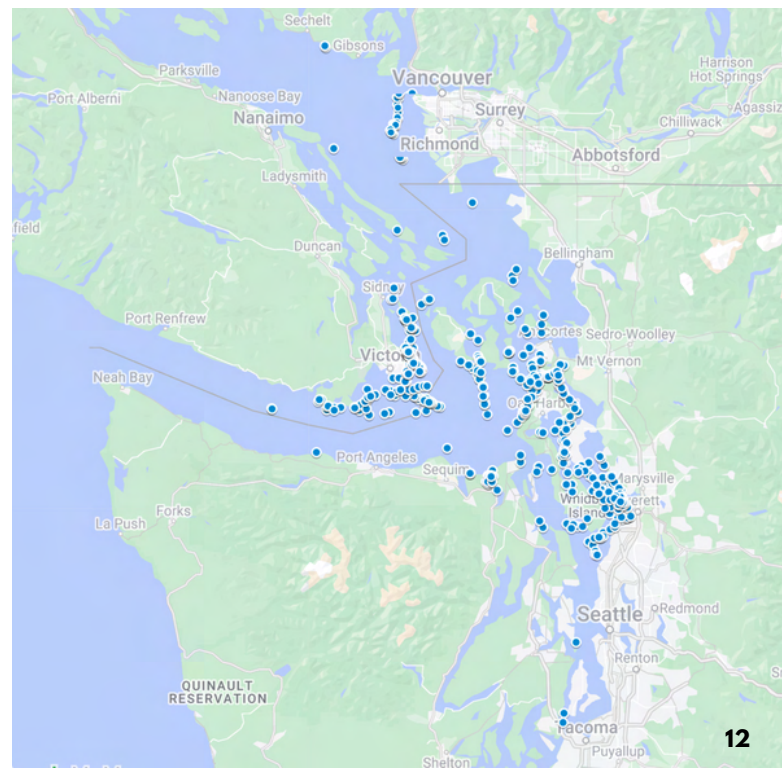
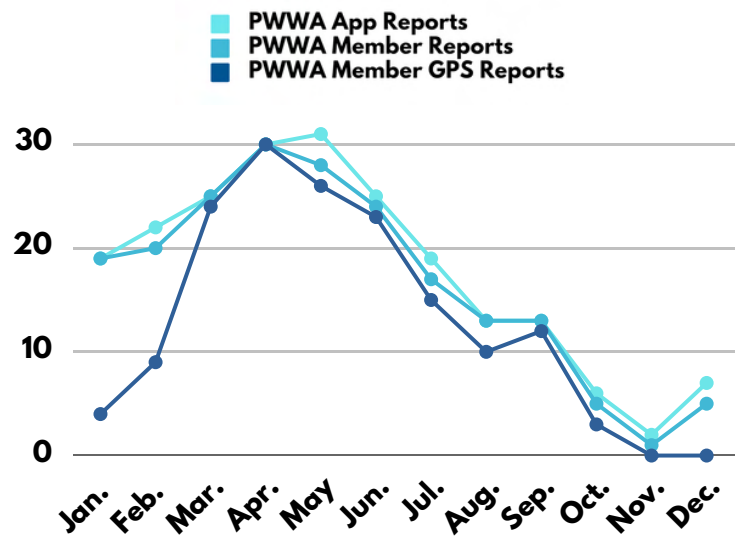
Gray Whales

Gray whales (*Eschrichtius robustus*) accounted for **1,260** entries in the PWWA App spanning **212** days in 2022. **1,174 (93%)** of those entries were reported by PWWA crew members across **200** days. Of PWWA member entries, **884 (75%)** were firsthand GPS entries made from a PWWA vessel during **156** days of the year.

Eastern North Pacific (ENP) gray whales recently experienced, and may still be experiencing, an Unusual Mortality Event (UME) throughout their range of Alaska to Mexico. From 2016 to 2022, there was a 38% decline in the overall ENP gray whale population, decreasing from approximately 26,960 individuals in 2016 to 16,650 individuals in 2022 (Eguchi et al. 2022). ENP gray whales underwent a similar UME in 1999-2000, after which the population was able to successfully recover. Experts continue to investigate potential causes of the UME and monitor the ENP gray whale population closely.

In likely response to the UME, PWWA operators observed that in 2022, the seasonal group of gray whales known as "Sounders", historically observed in spring, returned to the area to feed earlier than usual and stayed later into the season. Several new gray whales that were not part of the "Sounders" group were also documented throughout the 2022 season. One gray whale, CRC-2440, arrived in January 2022 and is believed to have stayed in the Salish Sea for the entire year.

2022 Gray Whale Days



Map of 2022 PWWA GPS entries for gray whales. Credit: PWWA App and Google Maps

MINKE WHALES



Surfacing minke whale. Credit: Ken Rea, Spirit of Orca

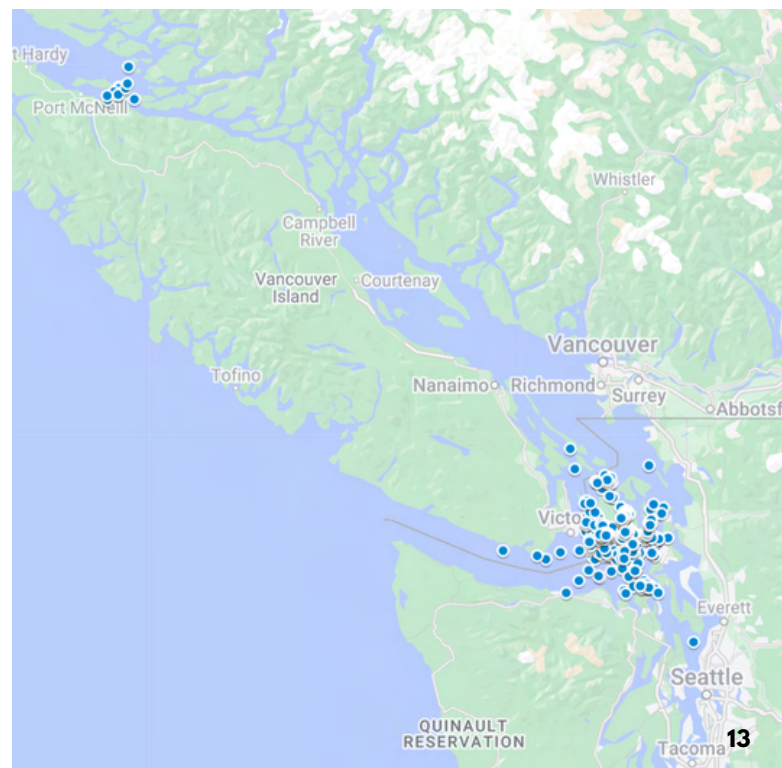
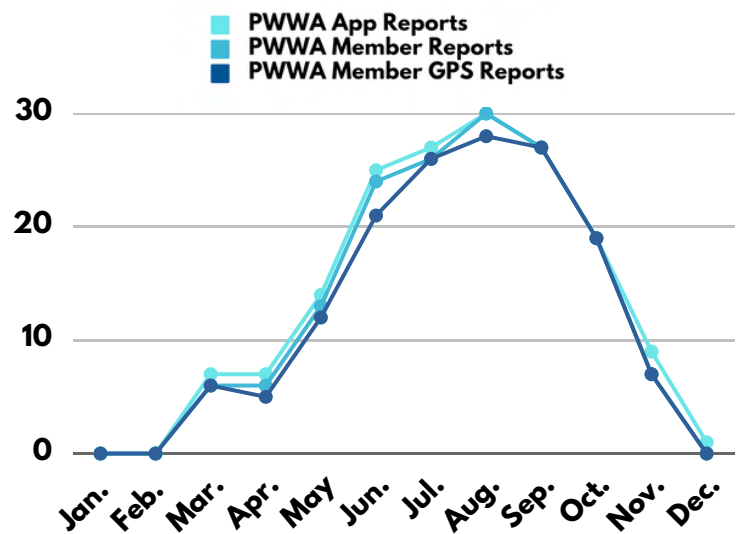
Minke Whales

PWWA App users logged **827** minke whale (*Balaenoptera acutorostrata*) entries across **166** days in 2022. Of those, **787 (95%)** were logged by PWWA crew members spanning **158** days. Of the PWWA crew entries, **718 (91%)** were firsthand GPS entries from PWWA vessels on **151** days of 2022. Minke whales were reported at least once during the months of April through November. While it's difficult to account for search effort, anecdotally, PWWA captains shared a sense that consistent minke whale sightings began later in the 2022 season than is typical.

The Salish Sea is a feeding ground for a small but consistent group of minke whales. The Northeast Pacific Minke Whale Project has identified **44** Salish Sea minke whales between 2005-2020, and they believe there are only 10-12 individual minke whales present in the Salish Sea each year.

Sadly, October 2022 saw the loss of two well-known minke whales in the region. The first, an adult female identified as SJ20-32 "Allie Pacino" who was initially photographed in 2010, was found deceased on October 5 near Washington's Lopez Island. A necropsy revealed she had been struck and killed by a large ship. Just two days later on October 7, another adult minke whale, SJ20-15 "Zeke", first photographed in 1982, was attacked by two Bigg's killer whale families, the T65As, and T99s near Smith Island in Juan de Fuca Strait.

2022 Minke Whale Days



Map of 2022 PWWA GPS entries for minke whales. Credit: PWWA App and Google Maps

SOUTHERN RESIDENTS



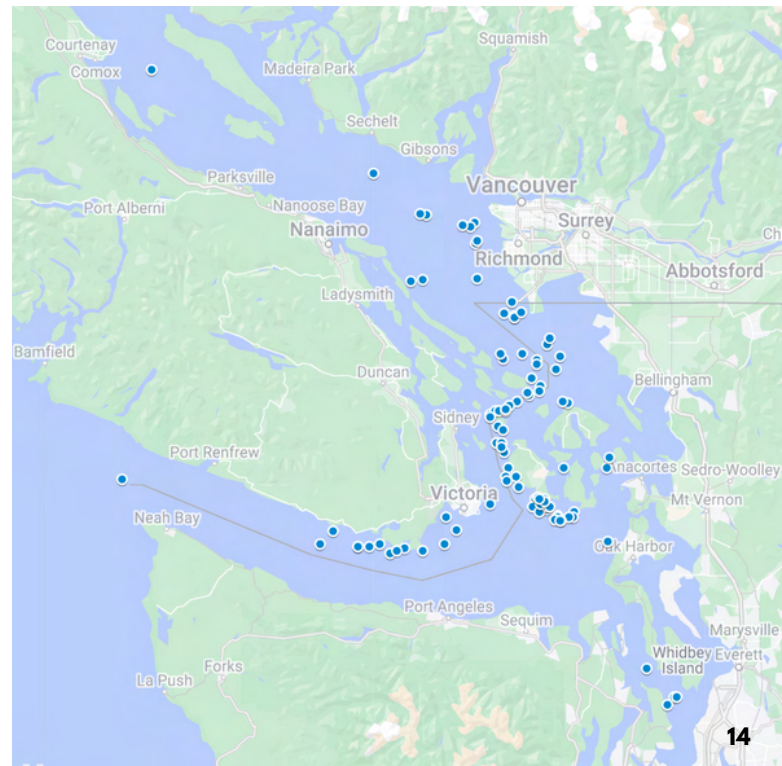
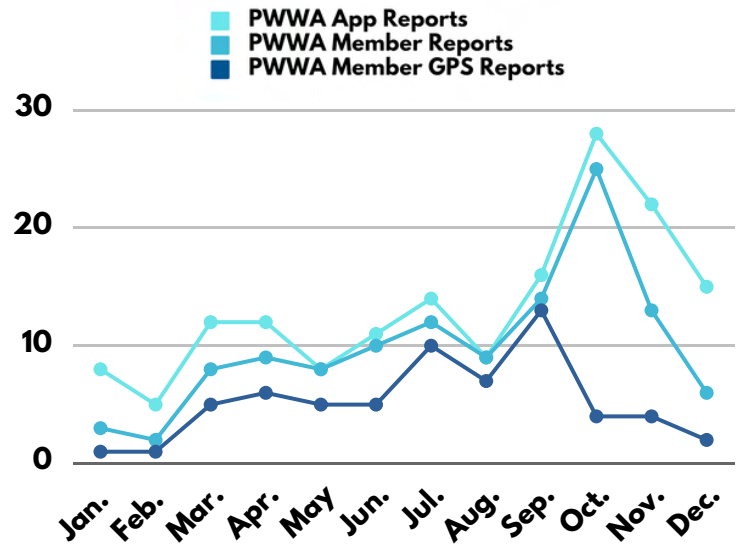
The J19's. Credit: Sara Hysong-Shimazu, Maya's Legacy (taken from shore)

Southern Resident Killer Whales

There were **1,001** total Southern Resident killer whale (SRKW) entries logged into the PWWA App in 2022 spanning **139** days. Of those, only **322 (32%)** were made by PWWA crew members on **107** days. Due to the current restrictions on professional viewing of SRKW through the Sustainable Whale Watch Agreement (SWWA) in BC and Commercial Whale Watching License Program (CWWLP) in Washington, it is important to note that only **139** entries (**14%**) on **63** days were firsthand GPS entries made from aboard a PWWA vessel within one mile of SRKW during a professional whale watch tour. **862** SRKW entries (**86%**) in the PWWA App were either secondhand reports logged by PWWA members, or reports logged by researchers, boater education groups, or shore-based observers who are authorized to use the PWWA App. Most GPS-based entries made by PWWA crew were the result of incidental encounters or were logged from a distance of at least 1/2 nautical mile (1,013 yards) in Washington waters in accordance with the CWWLP.

According to the Center for Whale Research, there were **73** individuals in the Southern Resident killer whale population in October 2022. This included two female calves born in 2022: J59 and K45. K45 is the first calf successfully born to K Pod since 2011. While these births are encouraging, Southern Residents remain nutritionally stressed due to a lack of Chinook salmon in their core habitat (Couture et al. 2022).

2022 Southern Resident Days



Map of 2022 PWWA GPS entries for Southern Resident killer whales.

Credit: PWWA App and Google Maps

Sustainable Whale Watch Agreement (BC)

In British Columbia, as part of an interim order first implemented by Transport Canada on June 1, 2019 aimed toward protecting SRKW, the viewing distance for all orcas was changed from 200 metres to an increased distance of 400 metres in the waters south of Campbell River to Ucluelet. Transport Canada's Sustainable Whale Watch Agreement (SWWA) offers qualified professional whale watch operators the ability to continue viewing non-Southern Resident killer whales from the prior distance of 200 meters if they agree to not intentionally view Southern Resident killer whales in BC waters. Vessels that have entered into this voluntary agreement are issued an **authorized vessel flag**, are required to report incidental SRKW encounters, and must utilize an onboard Automatic Identification System (AIS).



2022 authorized vessel flag. Credit: Five Star Whale Watching

Whale Watching License Program (WA)

In 2021, Washington Department of Fish and Wildlife (WDFW) implemented the Commercial Whale Watching License Program (CWWLP) requiring any tour operator who takes guests to view marine mammals in inland Washington waters to obtain a commercial whale watching license. The program requires that licensed vessels utilize AIS, that captains complete mandatory driver training, and that crew report any encounters with SRKW from closer than 1/2 nautical mile (1,013 yards). The program prohibits commercial viewing of Southern Resident killer whales from closer than 1/2 nautical mile except during the months of July, August, and September between the hours of 10:00 AM to 12:00 PM or 3:00 PM to 5:00 PM.

The program also prohibits viewing any SRKW's that are deemed "vulnerable" by WDFW or that are under the age of one year old. These restrictions currently apply only to licensed whale watching vessels and do not apply to other classes of vessel. Ferries and cargo ships are exempt from distance regulations, and recreational vessels may view Southern Residents from a distance of 300 yards at any time of year (Protection of Southern Resident orca whales 2019).

On June 30, 2022, prior to the start of the approved professional viewing season for Southern Resident killer whales, WDFW released the 2022 list of "vulnerable" individuals based on criteria developed by WDFW and Sealife Response, Rehabilitation, and Research (SR3). The list included two calves under the age of one year old (J59 and K45), one pregnant individual (L72), and 12 animals deemed by SR3 to be "vulnerable" based on body condition (J27, J36, J44, J49, J56, L54, L83, L90, L94, L110, L116, and L117).

WDFW's licensing program prohibits the viewing of calves, pregnant individuals, and "vulnerable" individuals within the SRKW population, but also prohibits the viewing of any individual within one mile of calves, pregnant individuals, or "vulnerable" animals. As a result, WDFW's licensing rules essentially precluded the professional viewing of Southern Resident killer whales in Washington from a distance of closer than 1/2 nautical mile (1,013 yards) during the 2022 season.

NORTHERN RESIDENTS



Northern Resident killer whales. Credit: Brendon Bissonnette, Prince of Whales

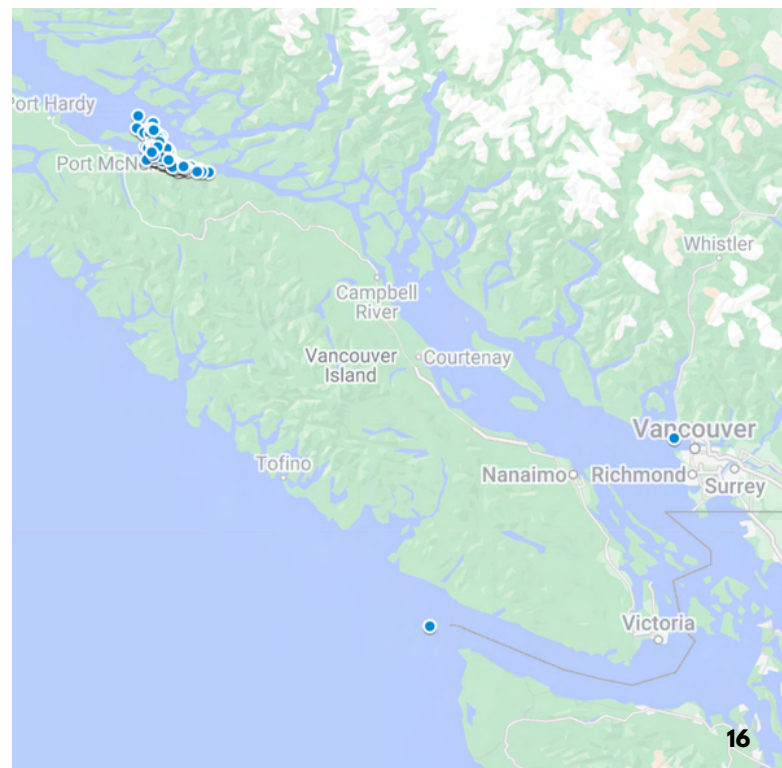
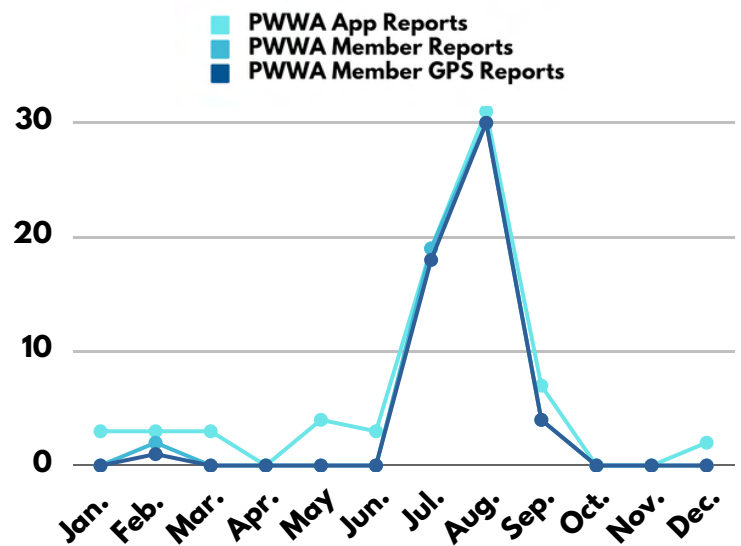
Northern Resident Killer Whales

The PWWA App received **327** entries for Northern Resident killer whales (*Orcinus orca*) in 2022 across **75** days. Of those, **198 (60%)** were made by PWWA crew members on **55** days, **191 (96%)** of which were firsthand GPS-based reports with a PWWA vessel present on **53** days of 2022.

In 2022, Northern Resident killer whales (NRKW) were documented almost exclusively by one PWWA member company that has a seasonal departure location in Telegraph Cove, BC on north Vancouver Island. There were, however, two NRKW sightings farther south. On February 7, a PWWA crew member documented the A42 matriline near Vancouver, BC. Later in the year, G clan was sighted northwest of Cape Flattery, WA from aboard a PWWA vessel.

Passive acoustic monitoring off the outer coast of Washington and Oregon from 2014 to 2017 detected Northern Resident killer whales in US waters during every month of the year with two peaks in occurrence, one between February and April and the other between August and October. (Emmons et al. 2021). The majority of detections were of G clan, but all three NRKW clans were detected during the course of monitoring. The outer coast region is currently within range of only one PWWA vessel which began departing seasonally from Port Renfrew, BC in summer 2017.

2022 Northern Resident Days



Map of 2022 PWWA GPS entries for Northern Resident killer whales. Credit: PWWA App and Google Maps

NOTEWORTHY WILDLIFE



Ollie the sea otter naps in the kelp. Credit: Yves Trottier, SpringTide Whale Watching

Noteworthy Wildlife

In addition to sharing cetacean sightings, PWWA App users are encouraged to document any reports of other noteworthy wildlife. In 2022, PWWA members logged **1,257** entries for non-cetacean wildlife in the region including various species of pinnipeds, otters, and rare birds. Below are some of the species of note that were observed by PWWA operators in 2022.

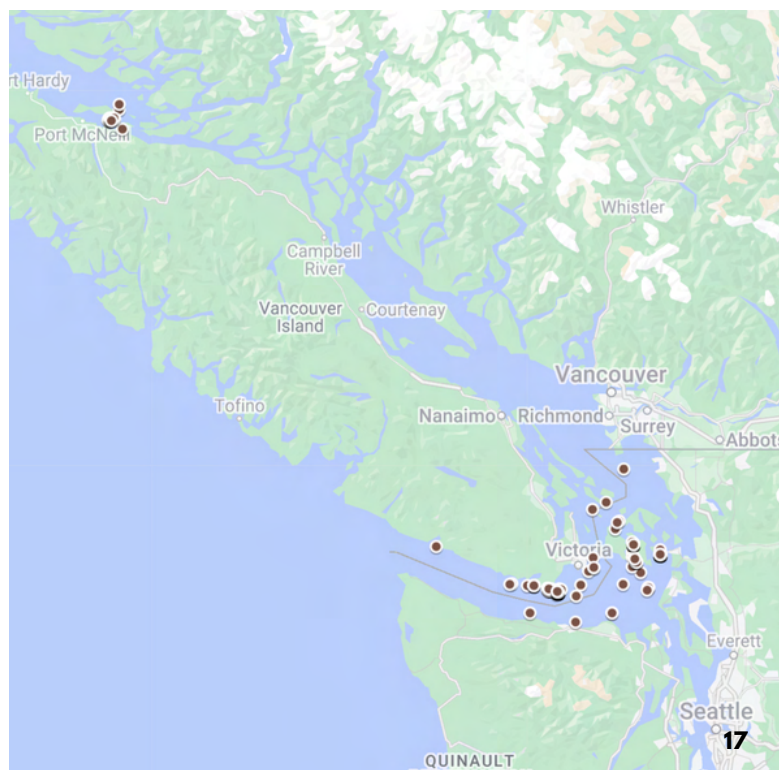
Sea Otters

Sea otters (*Enhydra lutris*), were once hunted to the brink of extinction due to commercial demand for their dense fur coats. Seen regularly on the outer coast of Washington and British Columbia as well as near north Vancouver Island, until recently, sea otter sightings within the region's inland waters were exceptionally rare.

In 2022, PWWA members logged **378** entries for sea otters in the PWWA App. Of those, **353 (93%)** of the reports were made from within the Salish Sea and **25 (7%)** came from the north Vancouver Island area. As sea otter sightings are common near north Vancouver Island, PWWA operators in that geographic region typically only report large rafts of sea otters to the PWWA App and therefore it should be assumed that sea otters are encountered more frequently in that locale than is reported in the PWWA App.

For years, the only sea otter known within the Salish Sea was a lone male nicknamed "Ollie" who took up residence near Race Rocks Ecological Reserve in 2015. Recently, however, additional sea otters are beginning to appear in inland waters.

While **126 (36%)** of the Salish Sea sea otter entries were reported as being Ollie at Race Rocks, numerous other reports throughout Juan de Fuca Strait, the southern Gulf Islands, and the San Juan Islands were of other otters verified to be different individuals through photo-identification. In several cases, these sea otters were seen in the same general location over a series of days, weeks, and in one case, months.



Map of 2022 PWWA GPS entries for sea otters.
Credit: PWWA App and Google Maps



Risso's dolphins. Credit: Ashley Keegan, Wild Whales Vancouver

Risso's Dolphins

Routinely seen in deeper waters on the outer coast of Washington and British Columbia, Risso's dolphins (*Grampus griseus*) are rarely documented in the region's inland waters. In 2022, however, PWWA operators reported Risso's dolphins on **5** days.

A group of approximately 18 individuals was seen by a PWWA member from shore on January 21, 2022 off Nanaimo, BC. PWWA vessels relocated the group inside Vancouver Island's Saanich Inlet on January 29. Later in the year, a smaller group of four individuals was seen by several PWWA operators on July 29 off Galiano Island in the Strait of Georgia. The same group of four individuals was later reported by PWWA vessels on August 6 in the Strait of Juan de Fuca north of Port Angeles, WA.

Nazca Boobies

On July 23, 2022, PWWA operators spotted a subadult Nazca booby (*Sula granti*) south of Trial Island, BC. The bird was seen again by PWWA operators the following day, July 24, northeast of Race Rocks Ecological Reserve. These tropical birds are typically found in eastern Pacific waters from Mexico to Peru. This was only the third confirmed sighting of a Nazca booby in British Columbia.

On August 17, 2022, a PWWA captain received a report from a shore-based birder of a Nazca booby hitching a ride aboard a barge in Puget Sound.

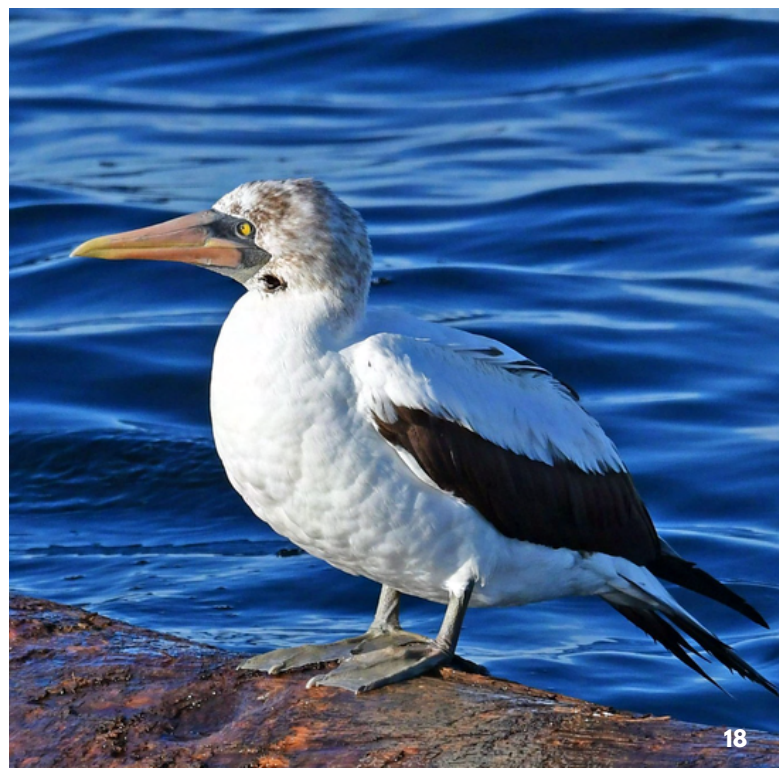
Nazca booby.

Credit: Matt Stolmeier, Outer Island Excursions

Fortunately, the captain was able to locate and photograph the bird shortly after receiving the report. Based on photographs, it was determined to be an older individual than the BC animal.

This was the third confirmed sighting of a Nazca booby in Washington. The first record was August 14, 2020 near Seattle and the second, also near Seattle, was July 20, 2022. It's believed the July 20 animal was the juvenile Nazca booby observed near Vancouver Island a few days later.

Boobies are thought to have gotten their name from the Spanish word "bobo" meaning "silly" or "foolish" because they waddle awkwardly on land.



SENTINEL ACTIONS



Guests view Bigg's killer whales in the San Juan Islands. *Credit: Ellie Sawyer, Maya's Legacy*

PWWA Sentinel Actions

The PWWA has long observed that the presence of professional whale watch vessels can positively influence the behavior of other nearby boats. PWWA operators help model proper operating behavior and routinely communicate with ferries, cargo ships, military vessels, and recreational boaters to alert them of whale presence. These exchanges frequently result in other vessels slowing down and/or changing course near whales, but evidence supporting this "sentinel effect" has historically been mostly anecdotal.

In an effort to quantify these types of protective interventions, the "sentinel action" feature was added to the PWWA App in mid-2020. PWWA members are strongly encouraged to document any sentinel actions they perform during the course of their tours. Similar to wildlife sightings, sentinel action reports include timestamps and capture the precise GPS location of each protective action.

Passive Sentinel Actions

The mere presence of professional whale watching vessels can positively influence other boaters without the need for direct contact from the whale watch operator. Independent researchers in the Salish Sea found that the number of dangerous

recreational boating incidents in the vicinity of killer whales was reduced from **6.60** incidents per hour in the **absence** of professional whale watch vessels to **2.65** incidents per hour in the **presence** of professional whale watch vessels (Shields 2022).

The following analysis of sentinel activity does not account for any possible passive sentinel actions, or dangerous recreational boating incidents that were prevented due to the visible presence of a PWWA vessel.

Additionally, the PWWA App is utilized by an increasing number of authorized third-party users such as Canada's Marine Mammal Desk, military marine mammal observers, commercial vessel pilots, ferry and water taxi captains, and cetacean researchers. It is likely that precautions are taken by these user groups as a result of their direct access to real-time sightings through the PWWA App to operate more safely near whales without the need for additional communication with PWWA operators, although there is not a way to quantify that effect at this time.

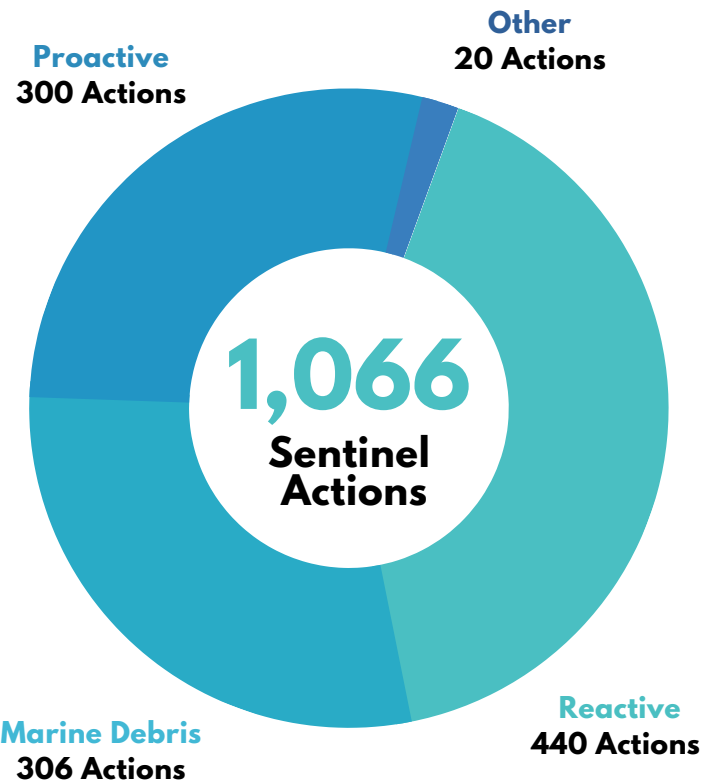
2022 Sentinel Action Summary

In 2022, PWWA captains, naturalists, and crew members documented **1,066** sentinel actions during the course of their whale watching tours.

The most common sentinel actions in 2022 were **reactive** sentinel actions. This category of sentinel actions involves direct contact with other vessels that are traveling too fast and/or too close in the immediate vicinity of whales. Communication during reactive sentinel actions often occurs via VHF radio, a quick blast of a ship's horn, or waving of the Whale Warning Flag. **440 (41%)** of the documented sentinel actions in 2022 were reactive actions.

Proactive warnings to other vessels alerting them of whales nearby accounted for **300** reported sentinel actions (**28%**). Proactive sentinel actions involve contacting vessels *before* they enter the immediate vicinity of whales. These interactions tend to occur primarily over VHF radio.

Removal of potentially harmful marine debris was documented during **306** sentinel actions (**29%**). Examples of harmful debris include balloons, derelict fishing gear, and plastic bags.

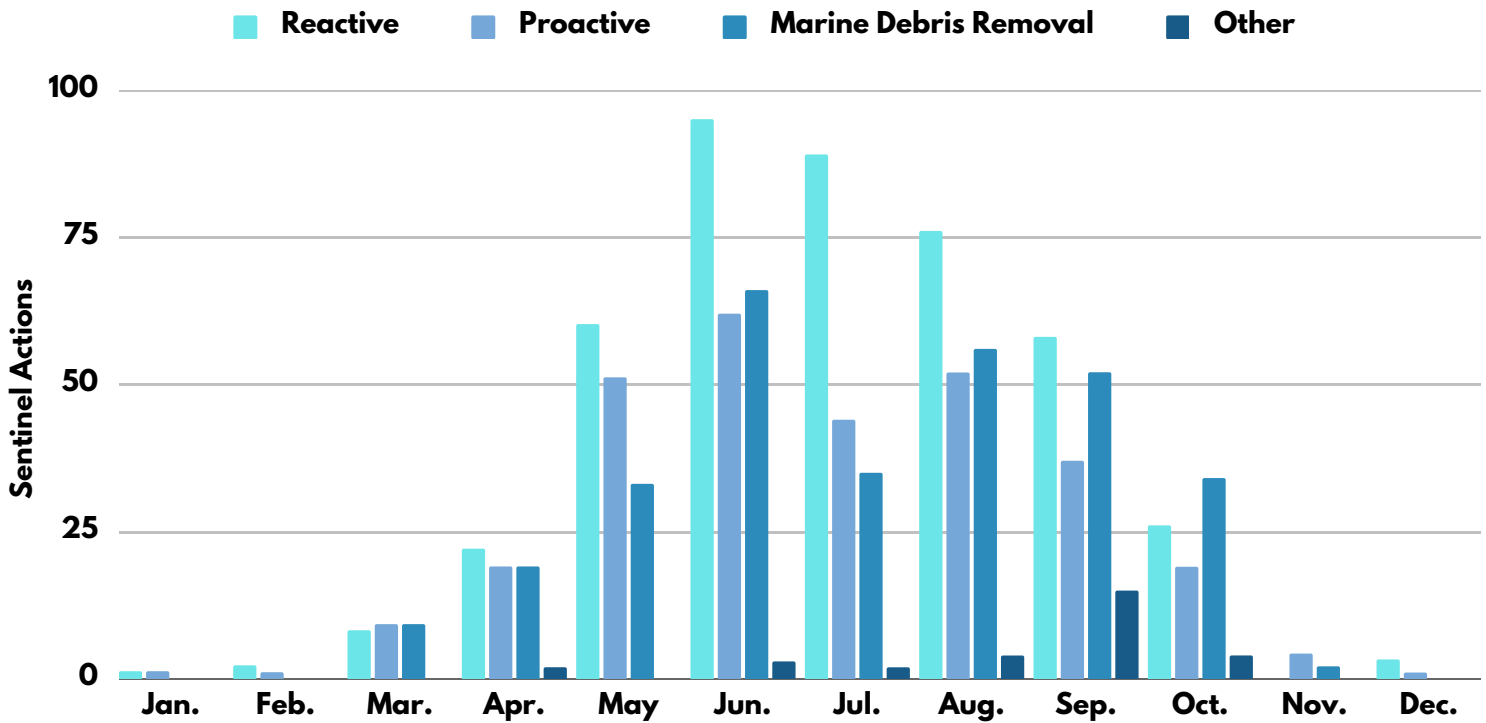


There were **20** sentinel actions (**2%**) categorized as "other" during 2022. Examples of "other" sentinel actions included reporting injured or entangled wildlife to authorities and notifying boaters or anglers that they were in restricted marine areas.

A PWWA vessel views a Bigg's killer whale. Credit: Ellie Sawyer, Maya's Legacy



2022 PWWA Sentinel Actions by Month



2022 Sentinel Actions by Month

When examined by month, the number of sentinel actions performed is relatively lower during the winter, moderate during the spring and fall, and higher during the summer. This is consistent with general trends of PWWA whale watching activity in that most companies operate April through October, peaking in the summer months. Some PWWA companies offer a limited tour schedule in November and December, and only a few operate

tours year-round as weather permits. It therefore stands to reason that more sentinel actions would be logged at times when more PWWA vessels are operating on the water, and less sentinel actions would be logged at times when PWWA vessels are scarce.

In addition to being the peak months for professional whale watching presence, the summer is also the season with the most recreational boating traffic and highest amount of ferry activity throughout Washington and British Columbia. This means there are more vessels on the water that might require intervention in the presence of whales.

June was the month with the most overall sentinel actions reported, with **226** total actions. This included **95** reactive interventions with vessels traveling too fast and/or too close to whales, **62** proactive warnings to vessels of whales nearby, **66** marine debris removals, and **3** sentinel actions categorized as "other".



PWWA crew members remove harmful marine debris.
Credit: Orca Spirit Adventures

Vessel-Related Sentinel Actions

Of the **1,066** sentinel actions reported to the PWWA App in 2022, **740 (69%)** involved interactions with other vessels. Contact was made through VHF radio, a ship's horn, or waving of a flag or arms. Of the vessel-related sentinel actions, **440 (59%)** were *reactive* sentinel actions involving contact with vessels in the immediate vicinity of whales and **300 (41%)** were *proactive* interventions warning vessels of whales in their eventual path.

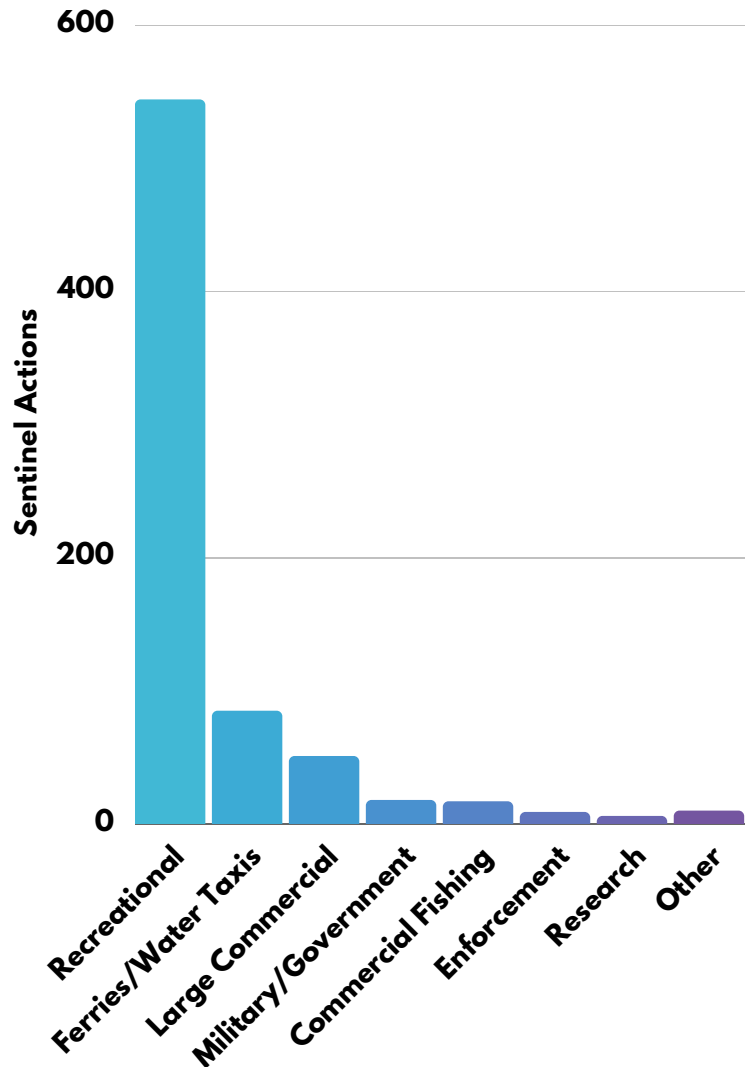
Recreational vessels were the category of vessel contacted most frequently, accounting for **544 (73.5%)** of vessel-related sentinel actions. Ferries and water taxis were the second most frequently contacted vessels with **85 (11.5%)**. Large commercial vessels such as container ships and tankers were contacted during **51** sentinel actions (**6.9%**) and military or other government vessels were contacted during **18** sentinel actions (**2.4%**). Commercial fishing vessels were contacted **17** times (**2.3%**), enforcement vessels were contacted **9** times (**1.2%**) and research vessels were contacted **6** times (**0.8%**). Vessels categorized as "other" were contacted **10** times (**1.4%**).

The overwhelming majority of vessel-related sentinel actions involved Bigg's killer whales with **526** sentinel actions (**71%**). Humpback whales were present during **147** vessel-related sentinel actions (**20%**). **19** vessel-related sentinel actions involved gray whales (**2.5%**), **8** involved minke whales (**1%**) and **6** involved Northern Residents (**<1%**). There were **15** vessel-related sentinel actions involving Southern Resident killer whales (**2%**), but this relatively low number is almost certainly a reflection of the current restrictions on the professional viewing of Southern Residents. If professional whale watch vessels were allowed to view Southern Resident killer whales, there would likely be many more sentinel actions in their presence.



The Whale Warning Flag indicates whales are near.
Credit: San Juan Safaris

2022 Vessel-Related PWWA Sentinel Actions by Vessel Category



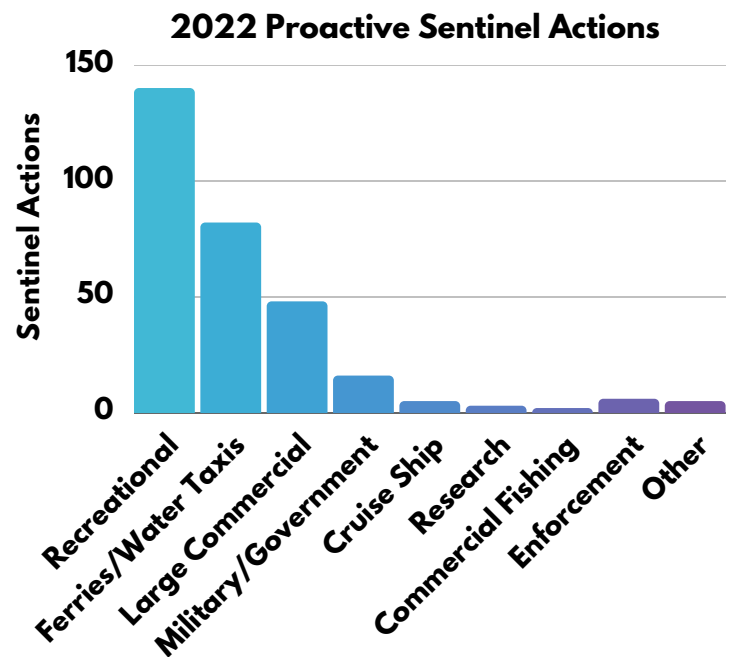


Humpback whales surface in the Strait of Georgia. Credit: Jane Wilson, Ocean EcoVentures

Proactive Sentinel Actions

When examining 2022's **300** *proactive* sentinel actions, interventions that provided advance warning to vessels of whales in the vicinity, **135 (45%)** involved ferries/water taxis or commercial vessels such as cargo ships, oil tankers, cruise ships, and tugs. Combined, those vessel categories contribute at least **92.7%** of regional underwater noise in the Salish Sea (MacGillivray et al. 2016). Temporary reductions in speed of those vessel categories are therefore likely to result in a decrease in underwater noise exposure for whales in the vicinity, as vessel speed has been shown to be the most important predictor of noise levels received by whales (Houghton et al. 2015).

150 proactive sentinel actions (**50%**) in 2022 involved recreational vessels, an increase over 2021 during which **40%** of proactive actions involved recreational vessels and **53%** involved large commercial traffic and ferries. While it's difficult to compare across years given the numerous variables involved, it's possible that the proportion of large commercial vessels requiring proactive communication is decreasing as more commercial mariners utilize technology such as the PWWA App and other regional tools designed to alert professional operators of whale presence automatically without the need for direct contact



from whale watch vessels. Analysis of future years can help determine if this is a trend.

In 2022, the most common method of communicating with other vessels during proactive sentinel actions was over public VHF radio channels, accounting for **197 (66%)** proactive interventions. This was followed by the waving of arms or the Whale Warning Flag during **69 (23%)** actions, and using a short blast of a ship's horn in **21 (7%)** of actions.



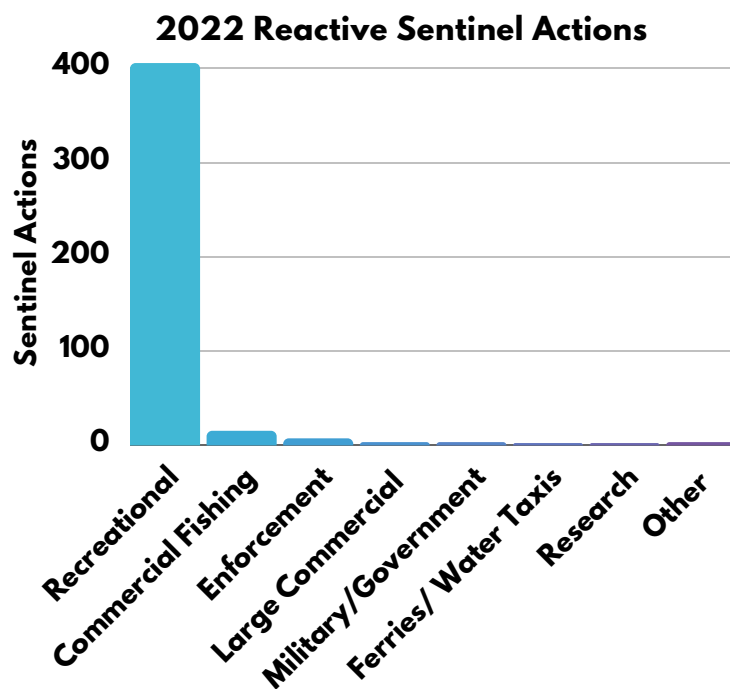
A Bigg's killer whale swims near recreational vessels. Credit: Mollie Naccarato, Sooke Coastal Explorations

Reactive Sentinel Actions

Of the **440** reactive sentinel actions, **392 (89%)** involved vessels speeding in the immediate vicinity of whales. Only **48 (11%)** reactive sentinel actions involved vessels traveling too close to whales at slow speeds. Vessels traveling at high speeds in the vicinity of whales can pose an imminent threat. High-speed vessels generate more underwater sound (Houghton et al., 2015), and are also at greater risk of striking a whale. While viewing whales, PWWA operators frequently observe boating behavior that warrants intervention.

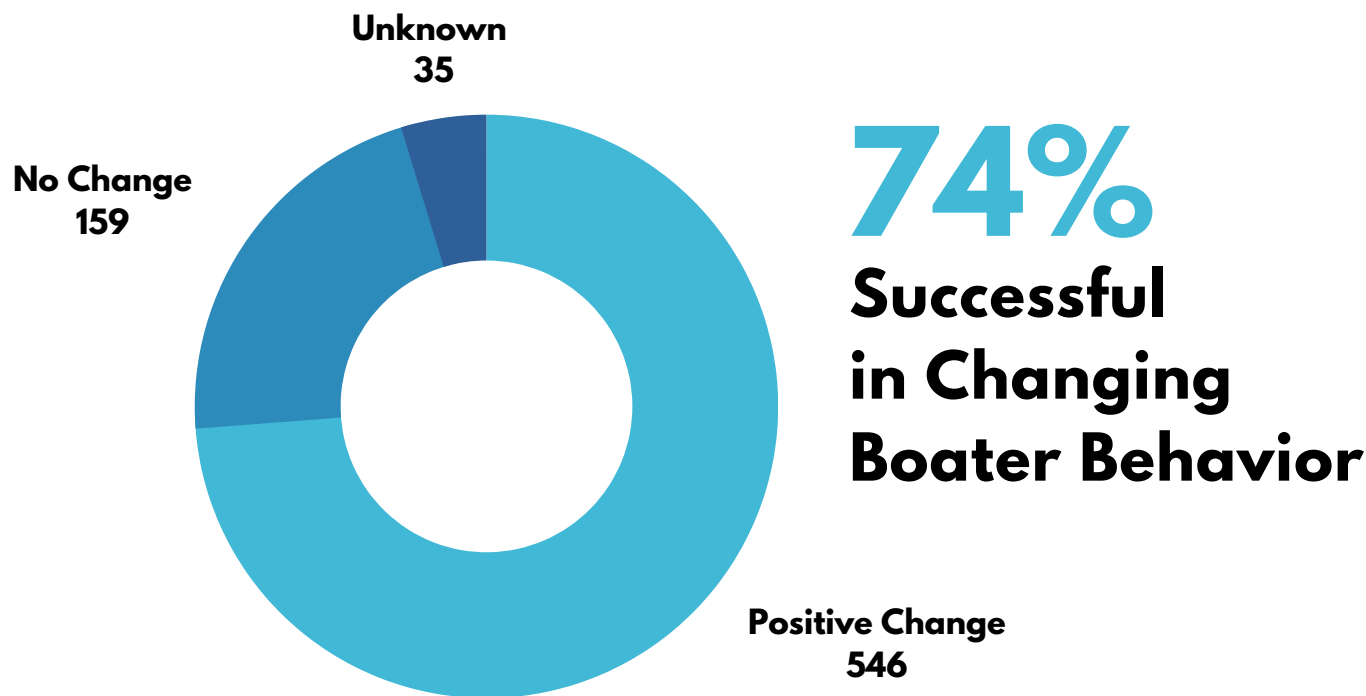
While recreational vessels accounted for **73.5%** of the total vessel-related sentinel actions, when examining only the *reactive* sentinel actions documented during 2022, **405 (92%)** involved recreational vessels. While recreational vessels contribute only **2.8%** of regional underwater noise (MacGillivray et al. 2016), small vessels traveling at high speed in close proximity to whales can pose a risk of ship strike or foraging disturbance.

The boater education group Soundwatch found that only **50%** of recreational boaters contacted in 2021 were aware of boating regulations around whales (Frayne, 2022). While this was an improvement over 2020 during which **26%** of boaters reported awareness of rules, there is still a



clear need for further education and outreach within the recreational boating community.

The most common means of communicating with other vessels during reactive sentinel actions in 2022 was by waving arms or a flag. This method was used during **342 (78%)** interventions. This was followed by horn blasts, used during **171 (39%)** interventions, and VHF radio, used during **55 (13%)** proactive sentinel actions.



Change in Vessel Behavior After Contact

Of the **740** vessel-related sentinel actions the PWWA documented in 2022, PWWA crew members observed a positive change in vessel behavior after **546** of the incidents (**74%**). A positive change in behavior was characterized by the contacted vessel stopping, slowing, and/or diverting after communication with the PWWA operator. There was no noticeable change in behavior after **159** of the incidents (**21%**). It was unknown whether there was a positive change in behavior after **35** sentinel actions (**5%**). For *proactive* contacts, such as hailing ferries or cargo vessels to alert them of whales in their path, PWWA members logging such contacts are sometimes not able to remain in the area to confirm whether behavior was modified or not, accounting for an unknown result.

Of the **440** *reactive* incidents that specifically involved vessels traveling toward whales at high speed and/or inappropriate distances, PWWA operators were successful in achieving a positive behavior change in **304** cases (**69%**). Of the **300** *proactive* sentinel actions documented in 2022, PWWA operators were successful in positively modifying the behavior of vessels contacted during **242** interactions (**80%**).

A total of **392 (89%)** reactive sentinel actions involved contacting vessels traveling at high-speed near whales. It's likely that the lower success rate for reactive sentinel actions compared to proactive sentinel actions is attributed to having less time to potentially contact and influence vessels in the moment. Proactive sentinel actions often involve slower-moving vessels in the distance who have more time to receive a warning and alter their behavior.

A PWWA naturalist waves the Whale Warning Flag.
Credit: Danielle Carter





A PWWA vessel stops to collect a piece of polystyrene foam. Credit: Ellie Sawyer, Maya's Legacy

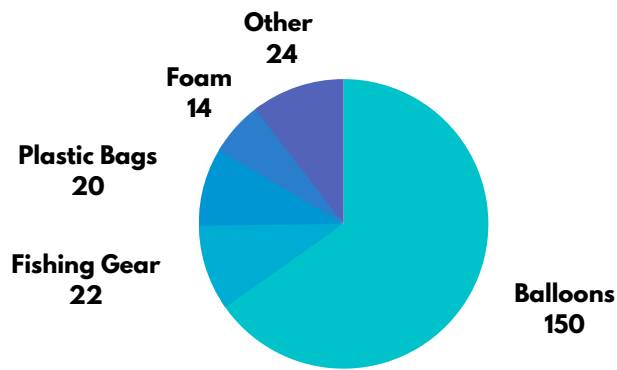
Marine Debris Removal

PWWA crew members documented **306** sentinel actions involving marine debris removal in 2022.

During the 2022 season, PWWA crew members were asked to document not just when they retrieved marine debris, but to also, if possible, document the type of debris that was collected. Crewmembers documented the type of item(s) removed during **230** sentinel actions (**75%**).

Balloons were the most common items retrieved, constituting **150 (49%)** of the debris-related sentinel actions. In many examples, clusters of balloons rather than single balloons were retrieved, therefore the number of balloons removed was greater than 150. Derelict or discarded fishing gear was collected in **22** sentinel actions (**7%**), plastic bags were removed in **20** sentinel actions (**6.5%**), and polystyrene foam products were collected in **14** sentinel actions (**4.5%**). Items categorized as "other" were collected during **24** sentinel actions (**8%**). Some of the miscellaneous items collected included fenders, buckets, plastic bottles, and car tires.

2022 Marine Debris Removal by Type



A PWWA naturalist retrieves a bunch of Mylar balloons. Credit: Puget Sound Express



This entangled Steller sea lion was reported to local authorities. *Credit: Val Shore, Eagle Wing Tours*

Other Sentinel Actions

Sentinel actions not involving vessel contacts or marine debris removal are logged as "other" in the PWWA App. In 2022, the PWWA documented **20** sentinel actions characterized as "other". Most "other" sentinel actions involved reporting sick, injured, or entangled animals to proper authorities. Additional examples included notifying anglers they were fishing in restricted areas and, in one instance, preventing a recreational drone operator from illegally flying over marine mammals in Canada.

One of the most noteworthy cases of an "other" sentinel action involved a Steller sea lion on Whale Rocks near San Juan Island with a packing strap around its neck. On July 3, 2022, PWWA members reported the distressed animal to the San Juan County Marine Mammal Stranding Network (SJCMMSN). In the following days, PWWA members provided updates on the animal's location, and on July 14, responders with SJCMMSN, SeaDoc Society, and Sealife Response, Rehabilitation, and Research (SR3) were able to successfully remove the plastic from the animal's neck. Rescuers determined that without intervention, the entanglement would have been lethal.



Another successful rescue resulting from a PWWA sentinel action was the disentanglement of humpback whale BCY0946 "Slits". On October 14, 2022, a PWWA vessel located and reported an entangled humpback whale near Texada Island in the Strait of Georgia. The PWWA vessel remained on scene for more than an hour until Fisheries and Oceans Canada's (DFO) Marine Mammal Rescue Team could arrive. The DFO rescue team was successful in disentangling the whale, removing 90 metres of polysteel rope, a yellow buoy, and prawn fishing gear.

An entangled humpback whale is successfully freed. *Credit: Fisheries and Oceans Canada*

COLLABORATION



A research vessel observes a killer whale under permit. *Credit: Val Shore, Eagle Wing Tours*

Research Collaboration

Washington and British Columbia are home to numerous research organizations studying the marine environment and its inhabitants. Funding and resource limitations, however, mean that marine scientists often spend just a few weeks in the field each year. The PWWA is fortunate to have a year-round presence on the water and routinely collaborates with marine researchers whose work might benefit from access to PWWA sightings, behavioral observations, and/or imagery.

To assist with photo-identification and cataloging efforts, PWWA crew members contribute a significant volume of photographs to local researchers each year. For example, Bigg's killer whale photographs are submitted to Bay Cetology, humpback whale photographs to Humpback Whales of the Salish Sea and the Canadian Pacific Humpback Collaboration, gray whale photographs to Cascadia Research Collective, and minke whale photographs to the Northeast Pacific Minke Whale Project.

In 2022, the PWWA also collaborated with Pacific Mammal Research (PacMam) to document large aggregations of harbor porpoise (*Phocoena phocoena*), and with The Salish Sea School to monitor seasonal presence of tufted puffins (*Fratercula cirrhata*).

While most PWWA scientific contributions come in the form of photographs and sightings data, a recent study investigating the diets of Salish Sea humpback whales allowed crew members to directly participate in field sample collection. 13 of the 18 fecal samples analyzed for the study were collected opportunistically by professional whale watch vessels during the course of their tours (Reidy et al. 2022).

A research vessel observes a killer whale under permit. *Credit: Bethany Shimasaki, Western Prince*





A Soundwatch vessel monitors boaters around whales. *Credit: Bethany Shimasaki, Western Prince*

Education Collaboration

There are two prominent boater education groups in Washington and British Columbia: Soundwatch in Washington waters and Straitwatch in BC. These groups monitor vessel activity in the vicinity of whales and educate boaters of proper boating behavior. While these two groups observe boaters around all species of whales, special priority is given to protecting Southern Resident killer whales when they are present due to their status as an endangered population.

In an effort to help Soundwatch and Straitwatch more efficiently carry out their duties on the water during the 2022 whale watching season, the PWWA granted the two organizations direct access to the PWWA's Southern Resident killer whale sightings through the PWWA App. PWWA operators had previously communicated with Soundwatch and Straitwatch using VHF radio, but the PWWA App allowed for more concise and effective delivery of sightings information. This access also provided Soundwatch and Straitwatch with access to manual app reports of Southern Resident killer whales, including secondhand reports of Southern Residents in the area and shore-based reports from PWWA observers on land.

In addition to receiving Southern Resident killer whale sightings, Soundwatch and Straitwatch crew members were also asked to log their own Southern Resident killer whale sightings in the PWWA App. This allowed PWWA vessels to avoid inadvertent encounters with Southern Resident killer whales and remain compliant with BC's Sustainable Whale Watch Agreement and Washington's Commercial Whale Watching License Program.



A Straitwatch vessel approaches a boater. *Credit: John Boyd, Western Prince*



Recovery crane and barge as seen from San Juan Island. Credit: WA Dept. of Ecology

Sunken Vessel Aleutian Isle

On the afternoon of August 13, 2022, the PWWA was notified by a NOAA representative of an emergency unfolding off Washington's San Juan Island. The 58-foot purse-seiner *Aleutian Isle* had sunk 200 yards off the island's western coast, and while crew were safely rescued, concerns soon shifted to the approximately 2,500 gallons of diesel fuel onboard the vessel. Alarmingly, that was the same day that members of all three Southern Resident killer whale pods entered the Salish Sea from the open Pacific Ocean. In fact, 69 of the 73 remaining individuals in the Southern Resident population were approximately 15 miles away from the disaster site at the time of the sinking.

To assist responders in monitoring the area for wildlife, the PWWA provided several members of the Unified Command, including NOAA, WDFW, and Washington Department of Ecology, with direct access to real-time whale sightings through the PWWA App. Access was also granted to Canadian responders with the Western Canada Marine Response Corporation.

On September 17, the vessel was raised from the seafloor and towed to San Juan Island's Mitchell Bay where divers could more easily access the vessel and offload the fuel and water onboard.

Finally, after 42 days, the *Aleutian Isle* was successfully hoisted onto a salvage barge on September 21, 2022.

This event served as a stark reminder of how vulnerable the Salish Sea, and endangered Southern Resident killer whales, are to manmade disasters. The event also sparked discussion on how to better prepare for future crises.

Oikomi pipes are a tool used to deter whales from an area. Credit: WA Dept. of Ecology



ENFORCEMENT



A law enforcement vessel approaches a recreational boat. *Credit: Ellie Sawyer, Maya's Legacy*

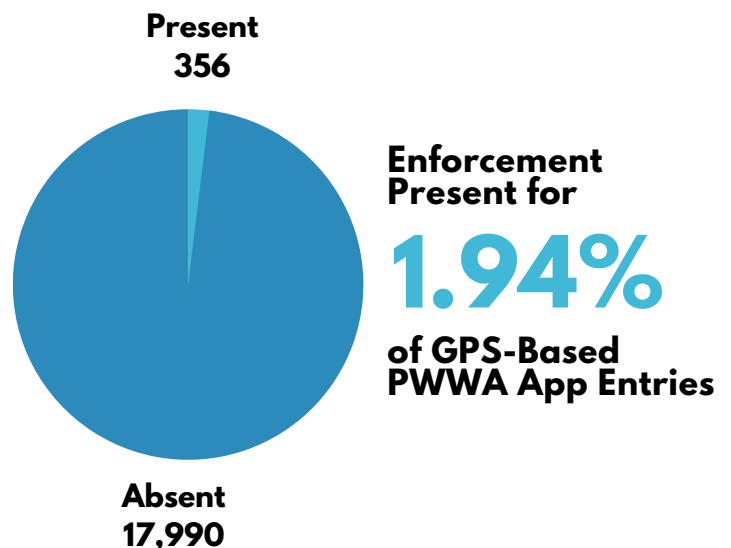
Law Enforcement

The waters in and around the Salish Sea are expansive, and it is not uncommon to have multiple whales or groups of whales distributed throughout the region on a single day. This creates challenges for the law enforcement agencies which are responsible for protecting whales and enforcing vessel regulations in their vicinity. Current resources simply do not allow for law enforcement officers to be present with all whales at all times.

In an effort to quantify local law enforcement activity, PWWA App users are asked to note whether or not enforcement is visibly present during PWWA wildlife encounters. Numerous agencies have been tasked with enforcing whale-related vessel regulations in and around the Salish Sea including the National Oceanic and Atmospheric Administration (NOAA) and Washington Department of Fish and Wildlife (WDFW) in Washington and Transport Canada, Fisheries and Oceans Canada (DFO), Royal Canadian Mounted Police (RCMP), and Parks Canada in British Columbia. At this time, the PWWA App does not distinguish which agency or agencies are present, simply whether or not there is a visible law enforcement vessel or aircraft in the vicinity of whales at the time of the encounter.

Law Enforcement Presence

Of **18,346** GPS-based whale entries to the PWWA App during which at least one PWWA vessel was on scene, law enforcement was noted as being present during **356** entries (**1.94%**). While PWWA App entries do not differentiate which specific law enforcement agency was present, mapping indicated a balanced presence on either side of the US/Canadian border. It's important to emphasize that this percentage is based on observations of PWWA operators during whale watching tours and not necessarily indicative of enforcement presence on the water in general.



2022 GPS-Based PWWA App Entries with Enforcement Present

Whale Type	Total PWWA GPS Entries	Law Enforcement Present	% Presence
Northern Resident Killer Whales	191	15	7.85%
Southern Resident Killer Whales	139	10	7.19%
Bigg's Killer Whales	8,118	254	3.13%
Humpback Whales	8,296	72	0.80%
Minke Whales	718	4	0.56%
Gray Whales	884	1	0.11%

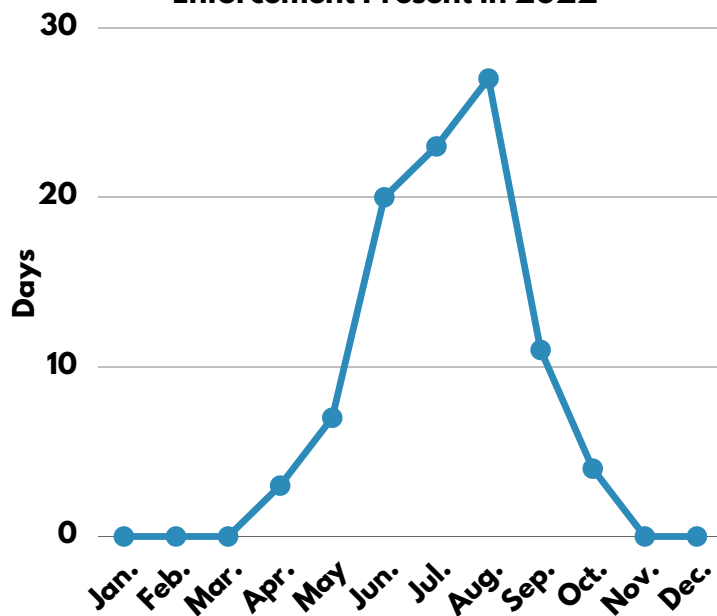
Law Enforcement Presence by Species

Based on GPS-based PWWA App entries, law enforcement was most likely to be present during encounters with Northern Resident killer whales, with at least one law enforcement vessel present during **7.85%** of entries. Law enforcement was present during **7.19%** of Southern Resident killer whale entries, and during **3.13%** of Bigg's killer whale entries. Law enforcement was present least frequently during encounters with the region's baleen species: humpback whales (**0.80%**), minke whales (**0.56%**), and gray whales (**0.11%**). It's important to note that given current restrictions on the professional viewing of Southern Residents, the sample size is quite small. It's possible law enforcement vessels were with Southern Residents more frequently in 2022 and there were simply no PWWA vessels present to observe them.

Days of Law Enforcement Presence

PWWA operators documented the presence of law enforcement *somewhere* in the Salish Sea or northern Vancouver Island regions on **95 days** of 2022 (**26%**). Law enforcement was most likely to be present during the summer months of June, July, and August, being documented on **20 days**, **23 days**, and **27 days** respectively. Reduced PWWA activity must be taken into account during winter months. The absence of documented whale encounters with law enforcement present does not necessarily mean there were no law enforcement officers on the water during those months, simply that they were not observed by PWWA operators.

GPS-Based PWWA App Entries with Law Enforcement Present in 2022



Collaborative Opportunities

The PWWA encourages increased communication between PWWA operators and law enforcement officers to maximize efficiency and identify where law enforcement presence would be most beneficial throughout each day. Priority should be given to endangered Southern Resident killer whales (SRKW) on days they are present, followed by whales traveling in heavily trafficked areas. The PWWA also sees a need for increased law enforcement presence outside of the summer months which were once considered peak season for SRKW. Southern Residents are now more likely to visit in the fall and winter, and the PWWA can help notify enforcement when SRKW are in the vicinity so they can be present on days they may not have otherwise planned to patrol.

SUMMARY



PWWA guests watching Bigg's killer whales. Credit: Bethany Shimasaki, Western Prince

2022 Summary

Humpback whales were the most frequently reported whales to the PWWA App in 2022, documented on **310** days. Bigg's killer whales were reported on **293** days, gray whales on **212** days, minke whales on **166** days, Southern Resident killer whales on **139** days, and Northern Resident killer whales on **55** days. Due to strict regulation of their viewing, Southern Resident killer whales were physically encountered by PWWA operators on far fewer days than they were reported in the PWWA App. **90%** of all Southern Resident entries in the PWWA App were secondhand reports or reports logged by researchers, boater education groups, or shore-based observers.

During 2022, PWWA captains, naturalists, and crew documented **1,066** sentinel actions. The most frequently documented sentinel actions were *reactive* sentinel actions (**440 actions, 41%**) involving stopping, slowing, or diverting vessels traveling too fast and/or too close to whales. **300** sentinel actions (**28%**) were *proactive* sentinel actions to warn nearby vessels of whales in the area. Collection of potentially harmful marine debris, such as balloons and derelict fishing gear, accounted for **304** sentinel actions (**29%**), and incidents classified as "other", such as reporting entangled or potentially injured marine life, made up the remaining **20** sentinel actions (**2%**).

For the **740** sentinel actions involving interactions with other vessels, PWWA members were successful in achieving a positive change in behavior in **74%** of encounters. Recreational vessels were the most frequently contacted category of vessel, involved in **544** vessel-related sentinel actions (**73.5%**). June was the busiest month for sentinel actions in 2022, with **226** sentinel actions documented.

Law enforcement was present during at least one PWWA whale encounter on **95** days of 2022. Of **18,346** firsthand GPS entries for cetaceans in the PWWA App, law enforcement was reported as being present during **356** entries (**1.94%**). Law enforcement was most likely to be present with Northern Resident killer whales (present during **7.85%** of encounters) followed by Southern Resident killer whales (**7.19%** of encounters), and Bigg's killer whales (**3.13%** of encounters). Law enforcement was least likely to be present during encounters with baleen species such as humpback whales (**0.80%** of encounters), minke whales (**0.56%** of encounters), and gray whales (**0.11%** of encounters). Law enforcement presence was observed most frequently during the peak whale watching months of June, July, and August.



A PWWA vessel views a Bigg's killer whale. *Credit: Bethany Shimasaki, Western Prince*

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