

**PACIFIC WHALE
WATCH ASSOCIATION**



2021 SIGHTINGS & SENTINEL ACTIONS



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Bigg's killer whales. Credit: Erin Gless

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INTRODUCTION



Whale watchers viewing Bigg's killer whales. *Credit: Erin Gless*

Professional Whale Watching Activity in and Around the Salish Sea

Whale watching has been a popular activity in and around the Salish Sea for decades, educating and inspiring approximately 500,000 boat-based whale watchers each year (Seely et al., 2017). The Salish Sea refers to the inland waters of British Columbia and Washington including Puget Sound, the Strait of Juan de Fuca, the Strait of Georgia, and the waters surrounding the San Juan Islands.

The predominant species currently seen on professional whale watching tours in this region are killer whales, humpback whales, gray whales, and minke whales. Both salmon-eating resident killer whales and mammal-eating Bigg's (transient) killer whales can be seen, although Southern Resident killer whale presence has decreased significantly in recent years. Bigg's killer whales have become the predominant killer whale ecotype found in the area. Northern Resident killer whales are typically seen by whale watchers in the waters near north Vancouver Island, but do also occasionally enter the Salish Sea. Although rare, other whales such as fin whales, a sperm whale, and a beluga have been documented in Salish Sea waters in the last five years.

Whale sightings are possible throughout the year. Killer whales are non-migratory and can be seen during any month. Gray whales are typically seen in spring and early summer (February through June), although sightings in other months do occur. Humpback whales tend to be seen most frequently from April through December, and minke whales are most often encountered during the late spring, summer, and early fall. Due to weather conditions, the peak months of whale watching are considered to be April through October, but several operators offer tours year-round as weather permits.

The professional whale watching fleet in the region includes a variety of different vessel types including rigid hull inflatable boats (RHIB's), sailboats, monohull vessels, and catamarans. Tours can vary in length from a few hours to full-day specialty excursions and occasional overnight expeditions.

The Pacific Whale Watch Association

First 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. During the 2021 season, there were **29** PWWA member companies departing from **23** different ports throughout Washington and British Columbia.

Whale watching activity within the PWWA is highly collaborative, with open sharing of information among members. PWWA operators communicate whale sightings, sentinel actions, other pertinent information with each other using a variety of tools. These include an encrypted UHF radio channel, a PWWA members-only Facebook group, and the private PWWA App. Such tools allow for the confidential sharing of real-time whale sightings among the trained professionals of the PWWA.



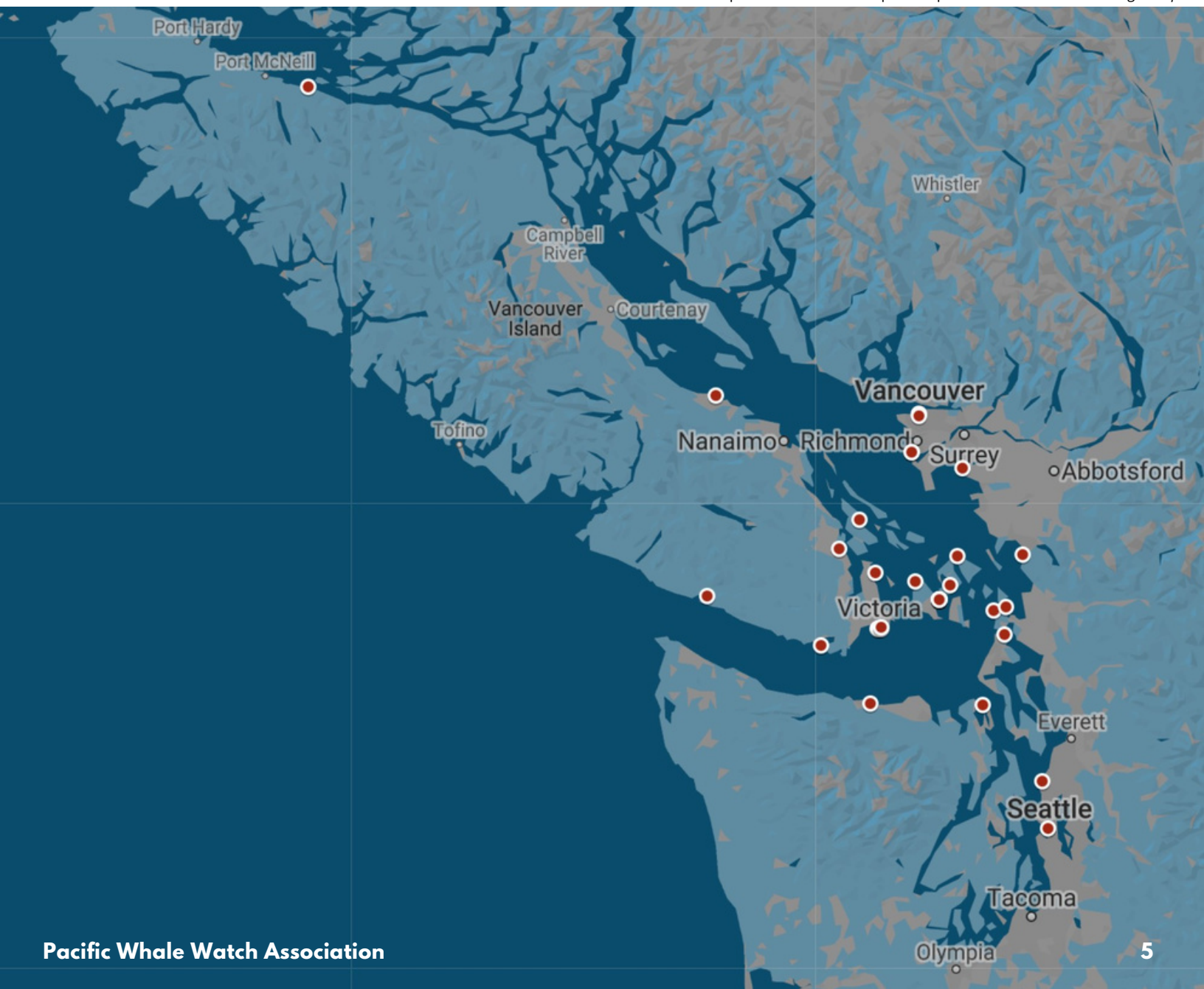
Washington PWWA Members

All Aboard Sailing
Anacortes Whale Watching 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

British Columbia PWWA Members

BC Whale Tours
Eagle Wing Whale Watching Tours
Five Star Whale Watching
Ocean Ecoventures
Orca Spirit Adventures
Prince of Whales
Salt Spring Adventure Co. LTD
Sidney Whale Watching
Sooke Whale Watching
Springtide Whale Watching & Eco Tours
Steveston Seabreeze Adventures
Vancouver Whale Watch
White Rock Sea Tours
Wild Whales Vancouver

Map of current PWWA departure ports. Credit: PWWA and Google Maps



PWWA APP



Guests view a group of Bigg's killer whales in the San Juan Islands. *Credit: All Aboard Sailing*

The PWWA App

One of the most important tools used by PWWA operators is the PWWA App. This private app was developed and released 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 record wildlife sightings and coordinate the whale viewing efforts of the PWWA fleet. The PWWA App allows authorized users to view wildlife reports, sentinel actions, and other navigational alerts on their Apple or Android devices for up to 48 hours after each report is made.

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, 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 App is also utilized by select researchers, commercial vessel pilots, marine mammal observers, and the Canadian Coast Guard's Marine Mammal Desk. There are also protocols in place to provide access for oil spill response and whale disentanglement teams, if and when necessary.

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. In addition to wildlife sightings, users also report sentinel actions and 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 when possible.

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 ID's, and interesting behavioral notes. It 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.

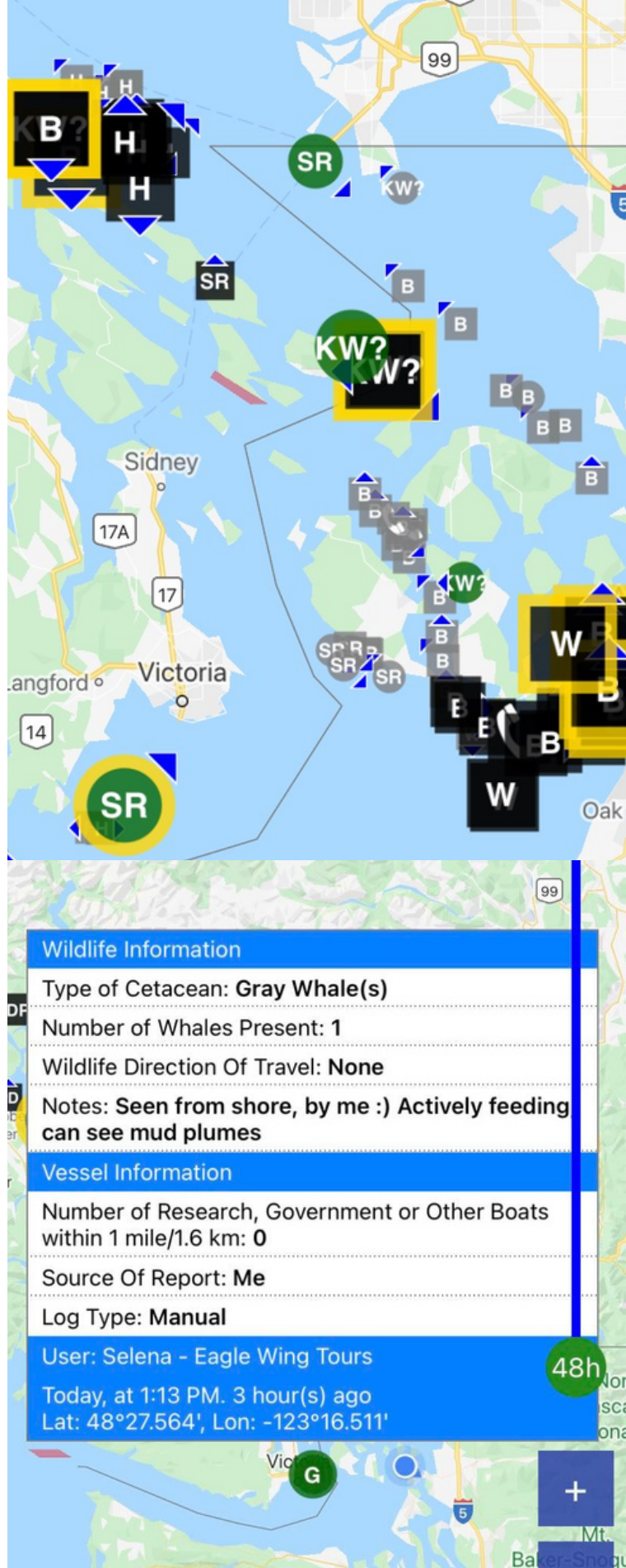
Users may also make **manual** entries using an approximate location to share secondhand or shore-based sightings. Users are encouraged to make manual entries only if they come from a reliable source or if they themselves are viewing animals from shore. These reports are distinguished in the PWWA App 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, humpbacks, and gray whales) are the predominant species reported, smaller cetaceans such as Dall's porpoise and Pacific white-sided dolphins, or other noteworthy marine mammals such as sea otters and elephant seals, are also reported when appropriate. Unusual 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
- Matriline or individual ID's of animal(s) if known
- Travel direction of animal(s)
- Interesting behavioral notes
- Presence of law enforcement at time of sighting



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 that PWWA App users documented in 2021 include:

- Stopping speeding vessels near whales
- Proactively warning vessels of whales nearby
- Contacting military authorities to halt exercises
- Reporting sick or entangled animals to appropriate authorities
- Removing harmful debris from the water

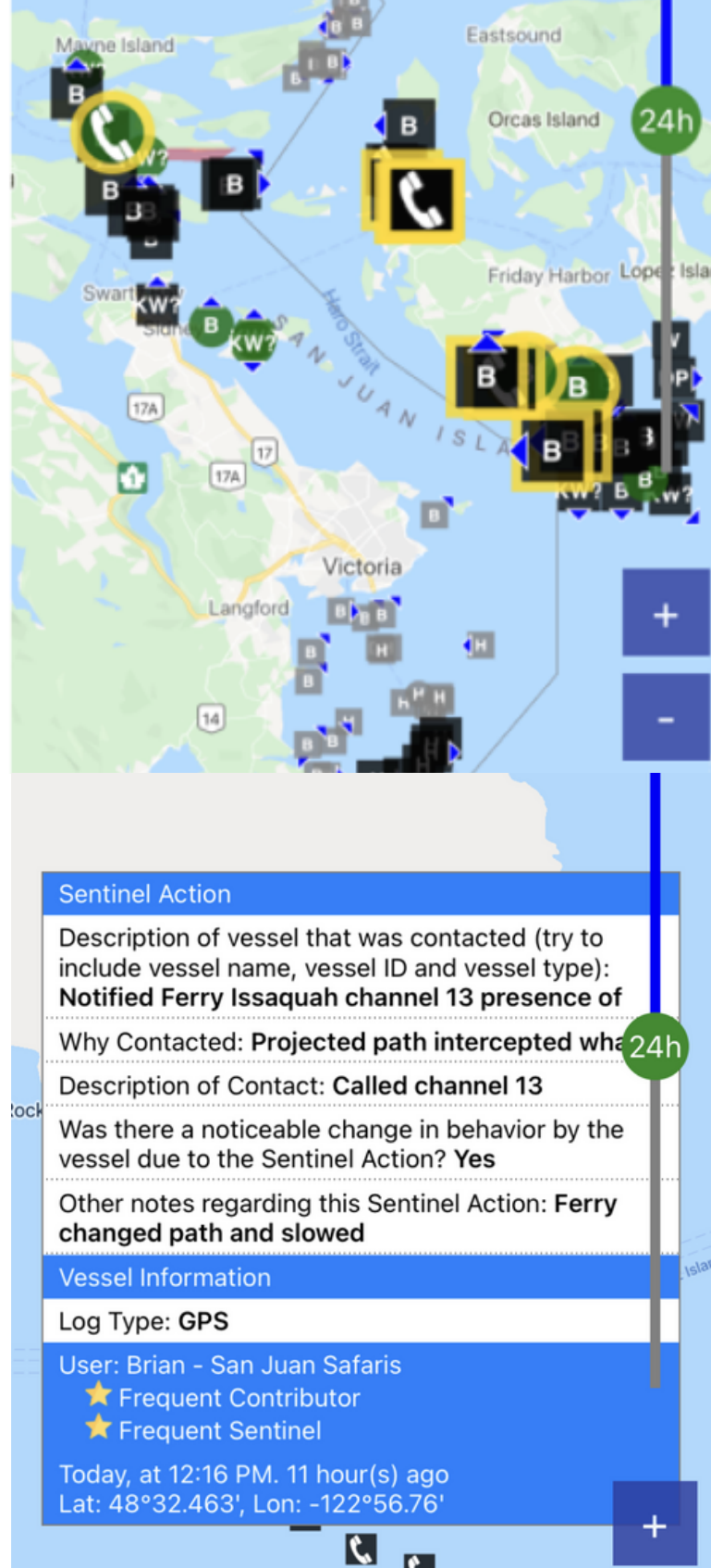
For sentinel action reports, some of the information collected by users includes:

- Description of the sentinel action
- Reason that intervention was necessary
- 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
- Whether or not law enforcement was present

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 2021 include:

- Logs or other large hazards in the water
- Warnings of swimmers or divers in the vicinity
- Notification of scheduled military exercises
- Fishing gear set in a high traffic area
- Location of a reported entangled whale



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

WHALE SIGHTINGS



Bigg's killer whales surfacing. Credit: Erin Gless

2021 PWWA App Summary

Throughout 2021, there were **19,304** entries logged collectively by users of the PWWA App. Of all entries logged in 2021, **18,386 (95%)** were reports of whales or other wildlife.

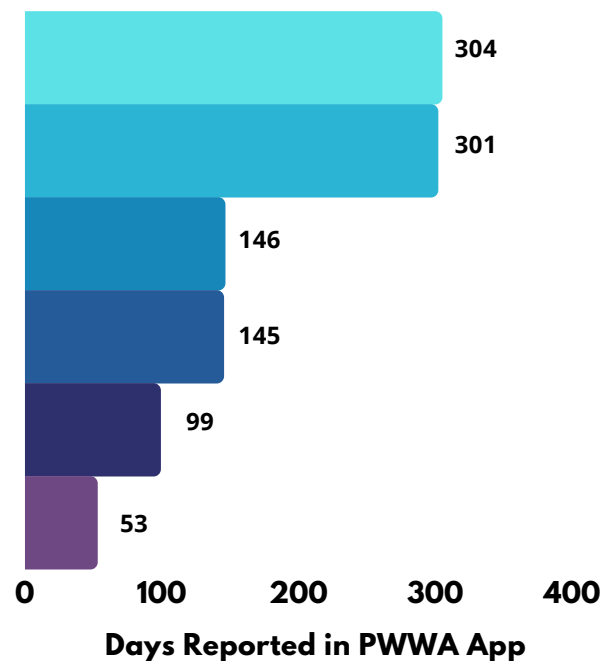
Excluding entries made by partners with Campbell River Association of Tour Operators (CRATO), North Island Marine Mammal Stewardship Association (NIMMSA), research organizations, and approved commercial vessel operators, PWWA members logged **13,451** whale and wildlife sightings, accounting for **73%** of total wildlife reports to the PWWA App.

Of the wildlife entries logged by PWWA members, **1,438 (11%)** were **manual** entries and **12,013 (89%)** were firsthand **GPS** logs created while actively viewing from a PWWA vessel.

For the remainder of this report, only entries made by PWWA captains, naturalists, and crew have been included.

While the sightings contributed by non-PWWA colleagues, researchers, and maritime partners are extremely valuable, the intent of this report is to isolate and summarize the sightings activity and sentinel action contributions of the PWWA exclusively.

Bigg's killer whales were reported by PWWA members to the PWWA App on **304** days of 2021. Humpback whales were reported on **301** days. Gray whales were reported on **146** days followed closely by minke whales on **145** days. Southern Resident killer whales were reported to the PWWA App on **99** days of 2021 and Northern Resident killer whales were reported on **53** days. It is important to note that each whale type could have been present for more days of 2021 yet not observed by PWWA members.



BIGG'S KILLER WHALES



Bigg's killer whales. Credit: Erin Gless

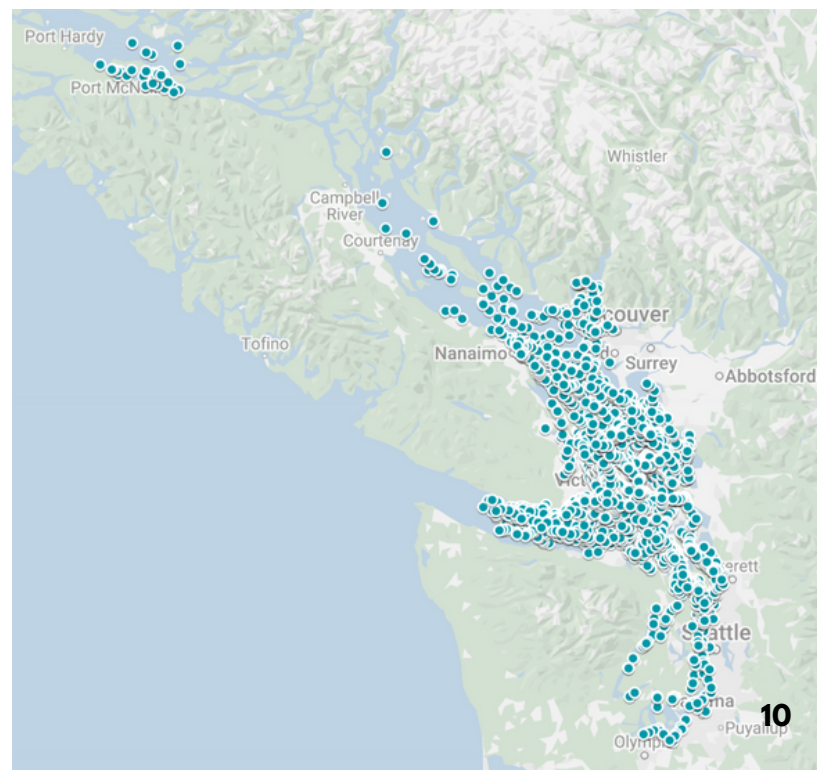
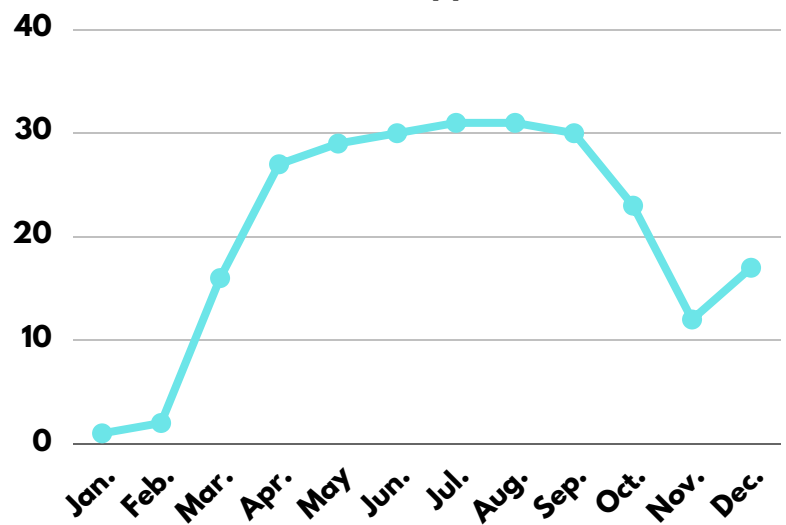
Bigg's Killer Whales

Bigg's (transient) killer whales were the most documented whales in 2021 with **5,575** entries in the PWWA App across **304** total days. Of those, **4,973 (89%)** were firsthand GPS entries from PWWA vessels logged while on scene with whales.

Bigg's killer whales were observed in all 12 months of the year, with nearly daily sightings from April through September. The steep declines in sightings in the earliest and latest months of the year are likely due to reduced whale watching efforts and inclement weather. Orca Behavior Institute, an independent research organization who 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 **329** days of 2021 (M.W. Shields, personal communication, January 3, 2022).

The Bigg's killer whale population has grown at an average annual rate of **4.1%** since 2012 (Towers et al., 2019) and **11** new calves were confirmed to have been born to local Bigg's killer whales in 2021. The current population is estimated to be approximately **360-370** animals.

Days of Bigg's Killer Whale Reports in PWWA App in 2021



Map of 2021 PWWA GPS entries for Bigg's killer whales. Credit: PWWA App and Google Maps

HUMPBACK WHALES



Breaching humpback whale. Credit: Simon Pidcock, Ocean Ecoventures

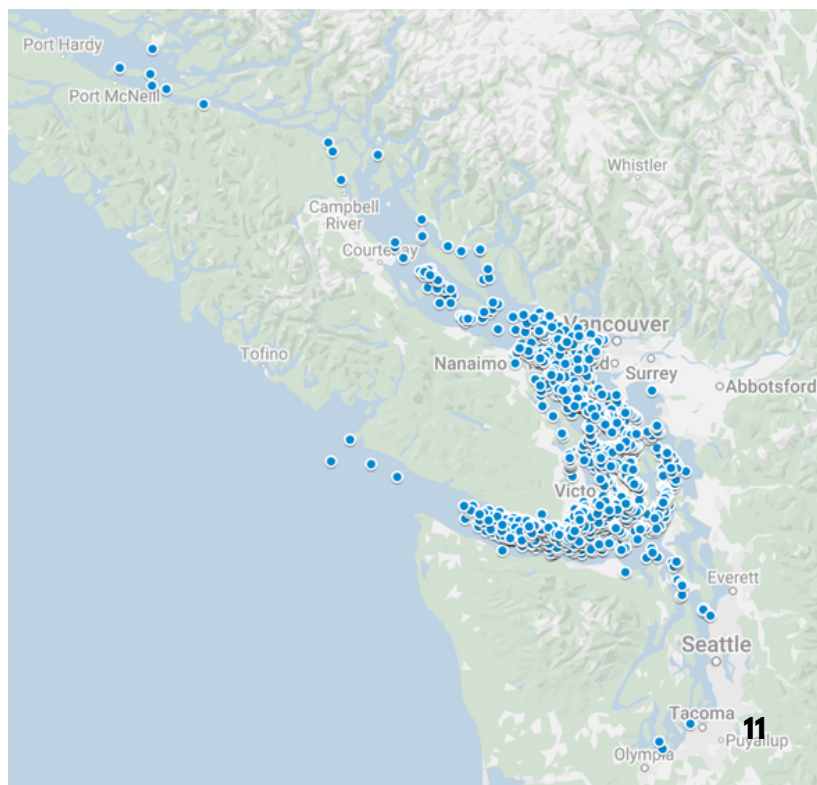
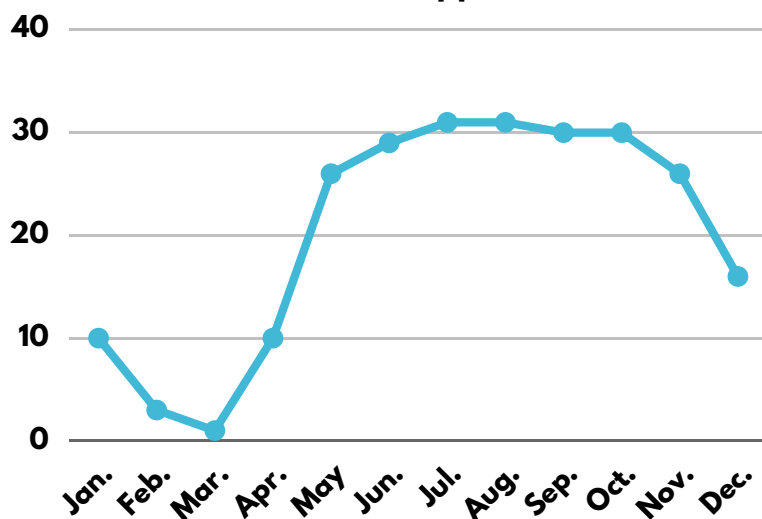
Humpback Whales

Humpback whales were the second most frequently reported whales in 2021 with **4,629** PWWA App entries across **301** days. Of those, **3,860 (83%)** were firsthand GPS entries from PWWA vessels. Humpback whales were reported by PWWA members at least once during each month of the year and were observed nearly daily May through November.

As with Bigg's killer whales, the number of humpback whales utilizing the Salish Sea also continues to grow. PWWA members documented **21** calves in the region throughout the 2021 season. This is the highest number recorded since humpback whales began to repopulate the area in the late 1990's (M. Malleson, personal communication, Oct. 04, 2021).

Utilizing individual fluke ID matching, Salish Sea humpback whales have been identified as belonging primarily to breeding stocks in Hawaii and Mexico. A small number of Salish Sea humpbacks have been matched to the population which breeds in Central America. At least **12** humpbacks that feed in the Salish Sea have been matched to more than one breeding ground in their lifetime - **9** to both Hawaii and Mexico, and **3** to both Mexico and Central America.

Days of Humpback Whale Reports in PWWA App in 2021



Map of 2021 PWWA GPS entries for humpback whales. Credit: PWWA App and Google Maps

GRAY WHALES



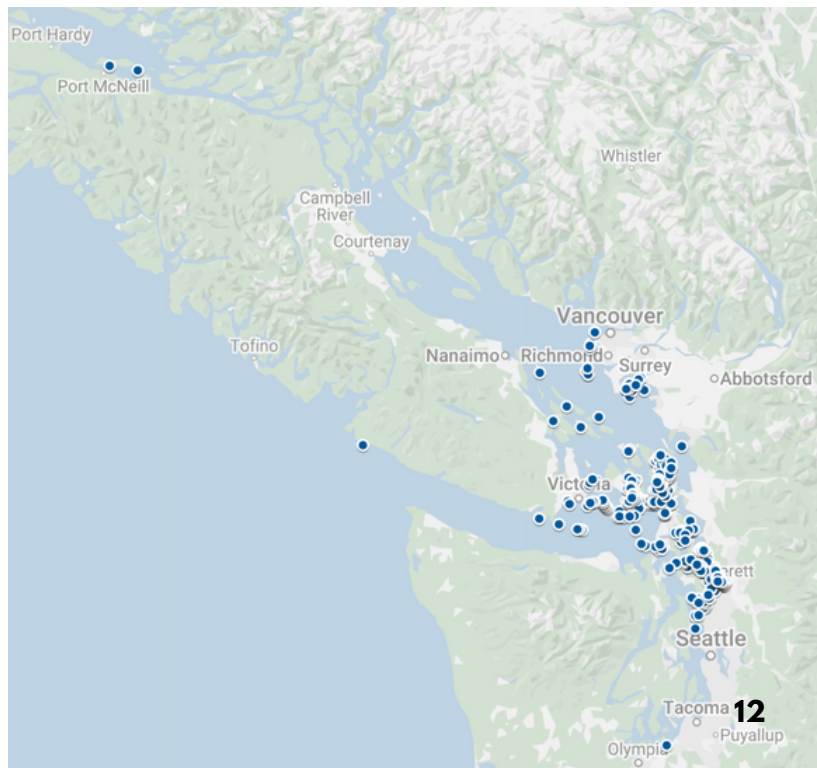
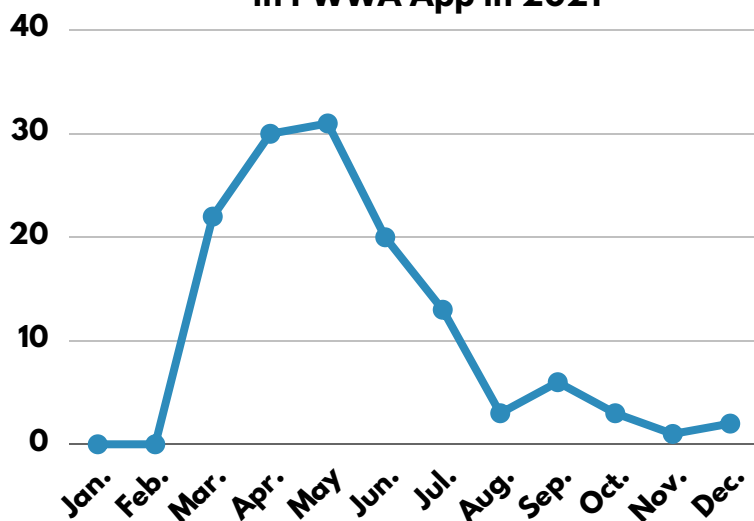
Gray whale flukes. Credit: Justine Buckmaster, Puget Sound Express

Gray Whales

There were **841** entries to the PWWA App for gray whales in 2021 spanning **146** days. **743 (88%)** of gray whale entries were firsthand GPS reports from PWWA vessels while on scene. There was at least one PWWA App report of gray whales in the area during every month except January and February. This is likely due to reduced whale watching effort during those months. Local sightings group Orca Network documented gray whales in Puget Sound during January and February 2021.

Gray whales recently experienced, and may still be experiencing, an Unusual Mortality Event (UME). From 2016 to 2021, there was a 24% decline in the overall gray whale population (Stewart and Weller 2021). Despite the significant decline, the gray whale population in the Eastern North Pacific is still estimated at more than 20,000 animals. As a likely symptom of the UME, PWWA operators observed that the seasonal group of gray whales known as "Sounders", typically observed in spring, returned to the area to feed earlier than usual and stayed later into the season. Several gray whales identified as not belonging to the "Sounders" group were also documented throughout the 2021 season.

Days of Gray Whale Reports in PWWA App in 2021



Map of 2021 PWWA GPS entries for gray whales. Credit: PWWA App and Google Maps

MINKE WHALES



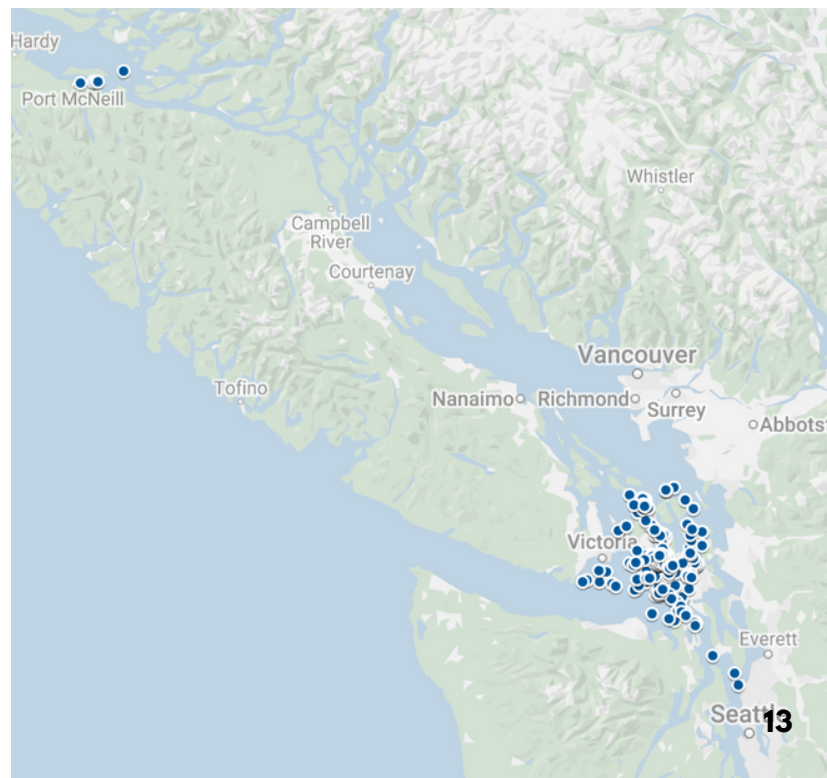
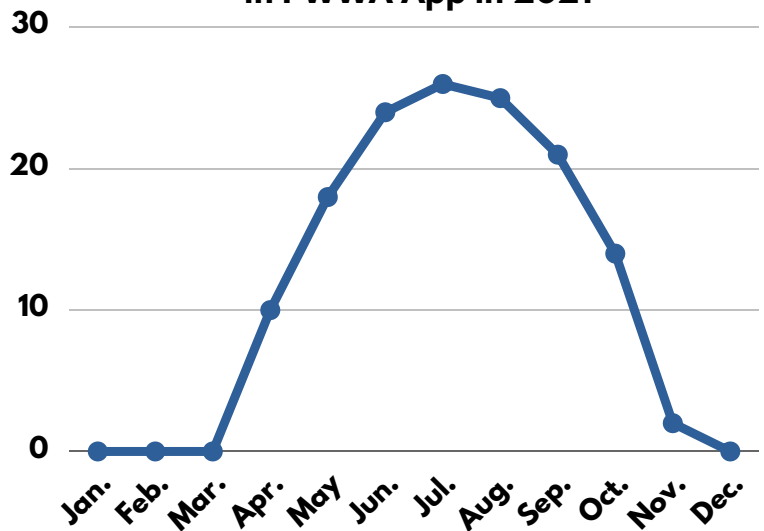
Surfacing minke whale. Credit: Tyson Reed, Island Adventures Whale Watching

Minke Whales

PWWA members logged **673** minke whale entries in the PWWA App in 2021 spanning **145** days. Of those, **620 (92%)** were firsthand GPS reports from PWWA vessels. Minke whales were reported at least once during the months of April through November. While the absence of minke whales outside of these months could possibly be attributed to reduced whale watching effort during winter months, a previous study found that most minke whale observations in the Salish Sea occurred during June through September (Dorsey et al. 1990).

PWWA captains and naturalists have contributed numerous photographs to researchers in recent years to help learn more about Salish Sea minke whales. Preliminary findings of Dr. Frances Robertson suggest that the number of individual minke whales in the Salish Sea is small (approximately **44** animals have been identified from 2005-2020), and that animals show high site-fidelity. A few individual minke whales have sightings histories in the Salish Sea spanning nearly 40 years. (F. Robertson, personal communication, Jan. 28, 2022).

Days of Minke Whale Reports in PWWA App in 2021



Map of 2021 PWWA GPS entries for minke whales. Credit: PWWA App and Google Maps

SOUTHERN RESIDENTS



Tail-slapping Southern Resident killer whale. *Credit: Erin Gless*

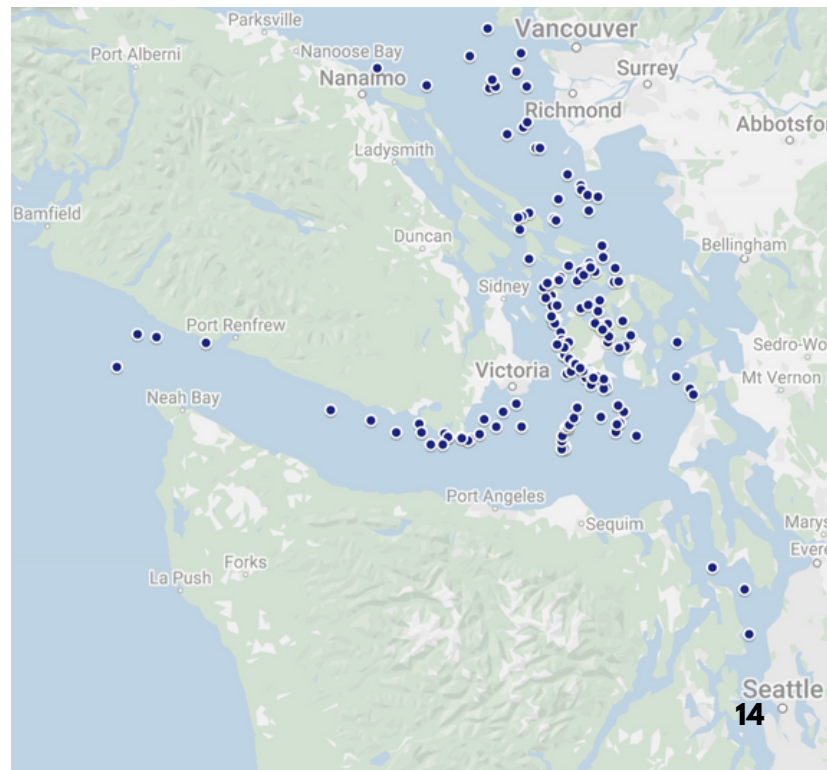
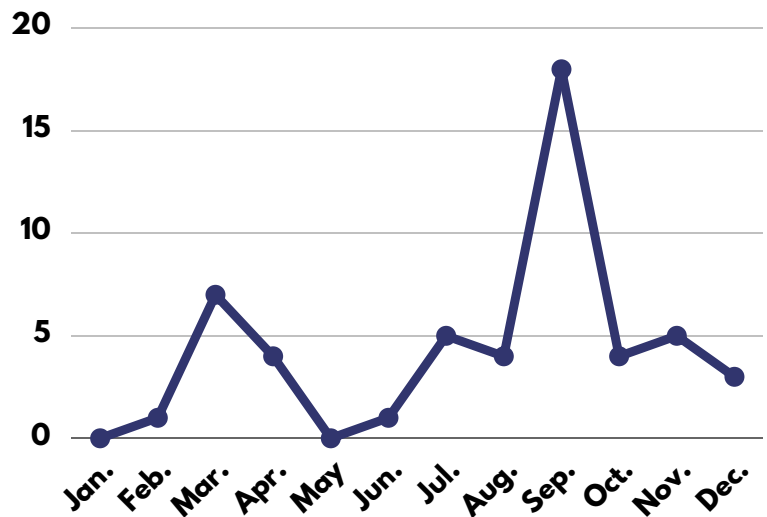
Southern Resident Killer Whales

As an endangered population with just **73** individuals in 2021, Southern Resident killer whales (SRKW) are of special concern in the Salish Sea. In recent years, SRKW presence in the region has shifted. SRKW now spend less overall time in inland waters, and are utilizing the area less during the summer months when SRKW sightings were traditionally most abundant. This shift is likely due to declines in spring Chinook from the Fraser River (Shields et al., 2018).

Professional viewing of SRKW's is heavily restricted on both sides of the US/Canada border under the Sustainable Whale Watch Agreement in Canada and the Commercial Whale Watching License Program in Washington.

There were **251** total Southern Resident killer whale entries logged into the PWWA App in 2021 spanning **99** days. Due to the current restrictions in place on the professional viewing of SRKW, it is important to note that of all PWWA App entries pertaining to SRKW, only **134 (53%)** were firsthand **GPS** entries spanning **52** days, with many of those encounters with SRKW being unintentional. The remaining **117** entries (**47%**) were secondhand or shore-based **manual** reports. If SRKW are reported through various research or shore-based sources, PWWA App users will often create a manual entry to help inform the fleet of the SRKW's location.

Days of Southern Resident Killer Whale Reports in PWWA App in 2021



Map of 2021 PWWA GPS entries for Southern Resident killer whales. *Credit: PWWA App and Google Maps*

Sustainable Whale Watch Agreement

In British Columbia, as part of an interim order first implemented by Transport Canada on June 1, 2019, the viewing distance for all orcas was changed from the previous distance of 200 meters to an increased distance of 400 meters 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 do not intentionally view Southern Resident killer whales in BC waters. Vessels that have entered into this voluntary agreement are issued an **authorized vessel flag**.



Authorized vessel flag. Credit: Soundwatch

Commercial Whale Watching License Program

In Washington, the Commercial Whale Watching License Program (CWWLP) was implemented on January 1, 2021. This program prohibits commercial viewing of Southern Resident killer whales from closer than 1/2 nautical mile (1,013 yards) except during the months of July, August, and September between the hours of 10:00 to 12:00 or 15:00 to 17:00. The program also prohibits viewing any SRKW's that are deemed vulnerable by WDFW or under the age of one year old. In addition, the program allows no more than three professional license-holders to view any single group of SRKW at one time. These restrictions apply only to licensed whale watching vessels and do not apply to other classes of vessel including ferries, cargo ships, or recreational boats.

If encountered outside of the approved viewing windows, once whales are identified as SRKW's, professional whale watch vessels may not approach closer than 1/2 nautical mile. During the approved months and times, vessels must comply with the year-round Washington state regulations which require slowing to no more than 7 knots within 1/2 nautical mile of SRKW's and may not approach closer than 300 yards from the sides or 400 yards in front of or behind a group of SRKW (Protection of southern resident orca whales 2019).

In 2021, there were 17 days on which SRKW's were present in Washington waters during an approved viewing window, amounting to less than 60 hours of potential viewing time from a distance of less than 1/2 nautical mile.



Visual representation of the days on which professional viewing of SRKW could occur within 1/2 nautical mile of SRKW in Washington waters during 2021 under the new Commercial Whale Watching License Program. On four days, viewing was possible during only one of the two potential viewing windows due to the location of SRKW. Credit: PWWA

NORTHERN RESIDENTS



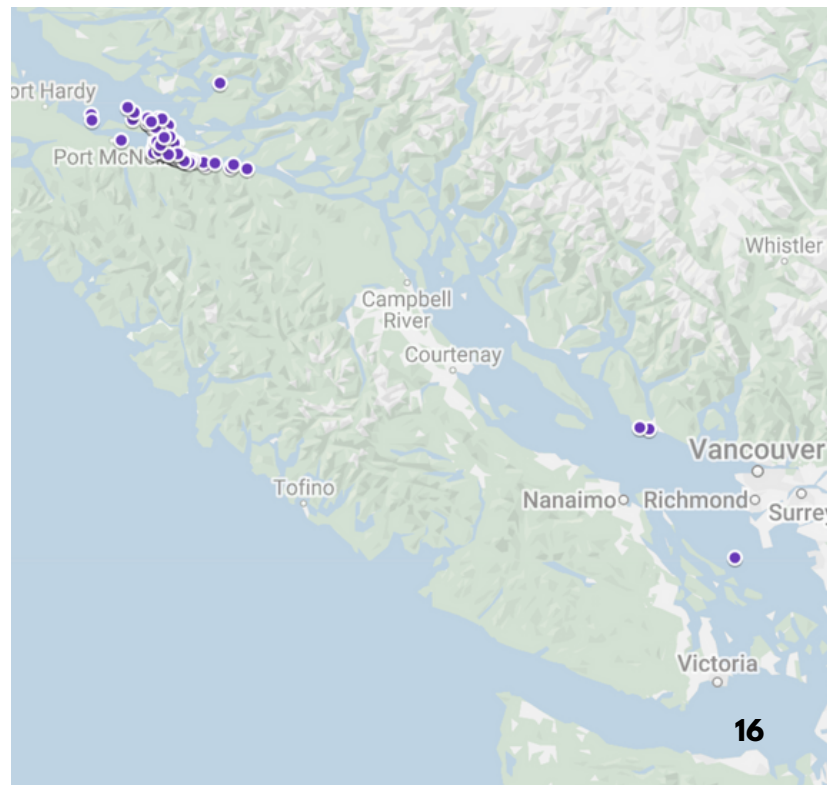
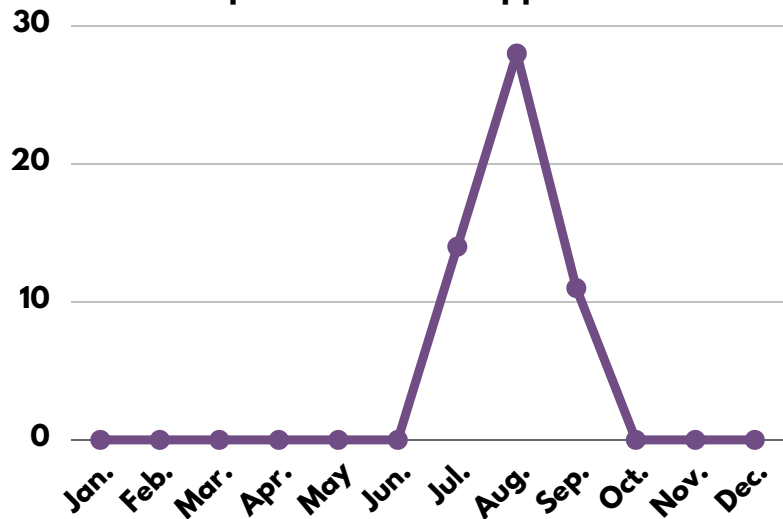
Northern Resident killer whale. Credit: Valerie Messier, Prince of Whales

Northern Resident Killer Whales

PWWA members logged **133** entries in the PWWA App for Northern Resident killer whales (NRKW) in 2021 across **53** days. Of those, **114 (86%)** were firsthand GPS-based reports with a PWWA vessel present.

Northern Residents were only reported to the PWWA App by PWWA members during the months of July, August, and September, a reflection of the seasonal PWWA whale watching effort in the regions where NRKW's are most often encountered. All but three reports of NRKW's entered by PWWA members in the PWWA App were supplied by crewmembers of a single PWWA company that departs from Telegraph Cove, BC. This company departs May through September and operates in the waters north of Vancouver Island and the northernmost portions of the Salish Sea. There were, however, three NRKW encounters documented within the lower Strait of Georgia. These three entries were made by PWWA operators between July 16 and July 18, 2021 near Vancouver.

Days of Northern Resident Killer Whale Reports in PWWA App in 2021



Map of 2021 PWWA GPS entries for Northern Resident killer whales. Credit: PWWA App and Google Maps



SENTINEL ACTIONS

The Whale Warning Flag indicates that whales are in the vicinity. *Credit: Island Adventures Whale Watching*

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. In the past, however, all evidence supporting this principle has been anecdotal.

In an effort to quantify these types of protective interventions, a new feature was recently introduced to the PWWA App to document sentinel actions. The sentinel action feature was first trialed by PWWA crewmembers in the latter half of 2020, but 2021 was the first full year in which the PWWA App's sentinel action feature was available to all PWWA App users. Throughout the 2021 season, PWWA members were encouraged to document any sentinel actions they performed in the PWWA App. Similar to wildlife sightings, sentinel action reports include timestamps and capture the precise GPS location of each action.

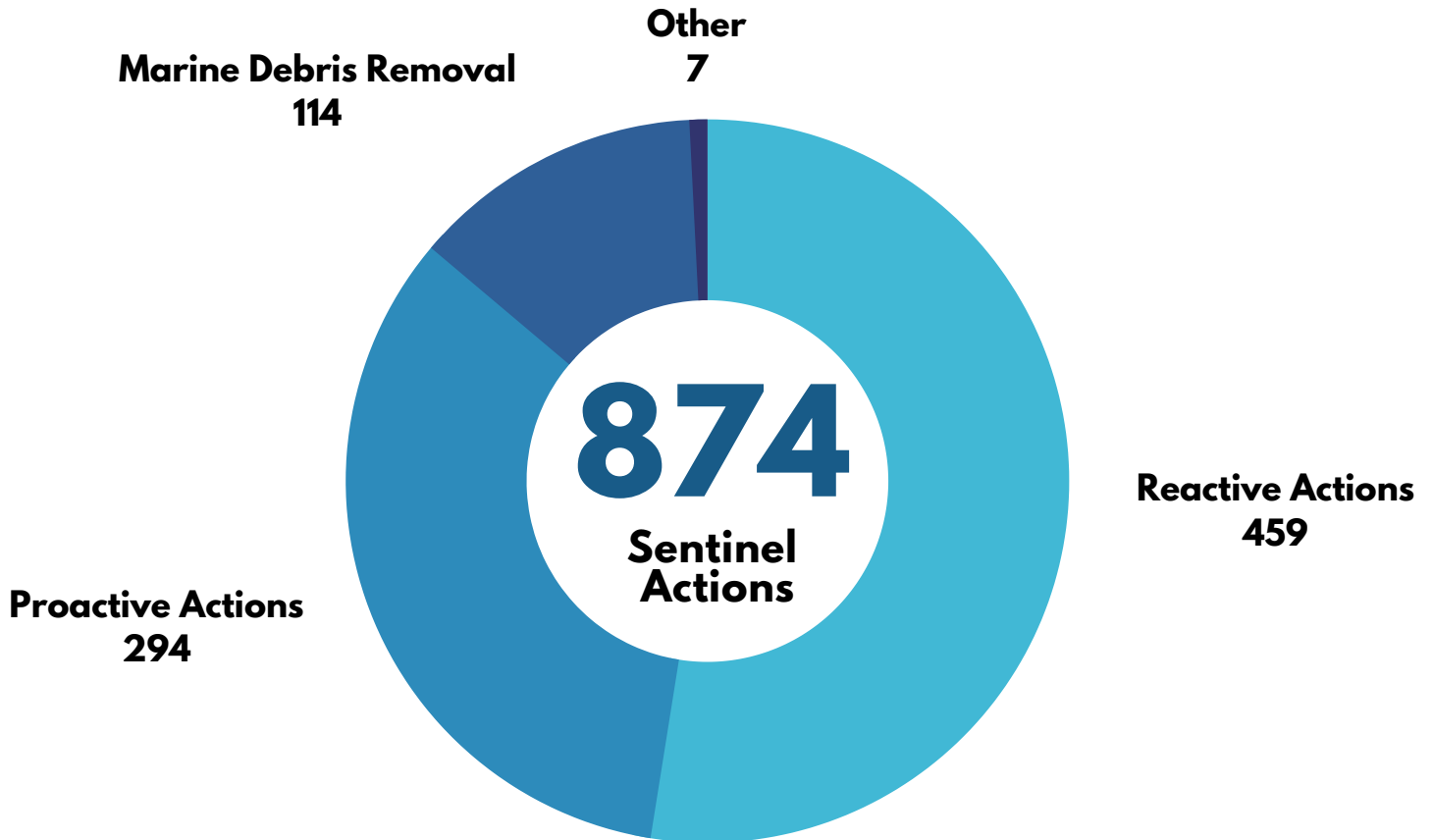
With more whales in the area than in recent history, PWWA operators undertook and documented **874** sentinel actions during the 2021 season. PWWA members were able to positively change the behavior of other boats around whales in at least **70%** of interventions, resulting in a quieter and safer environment for the whales. The following analysis examines 2021 PWWA sentinel actions in more detail.

Passive Sentinel Actions

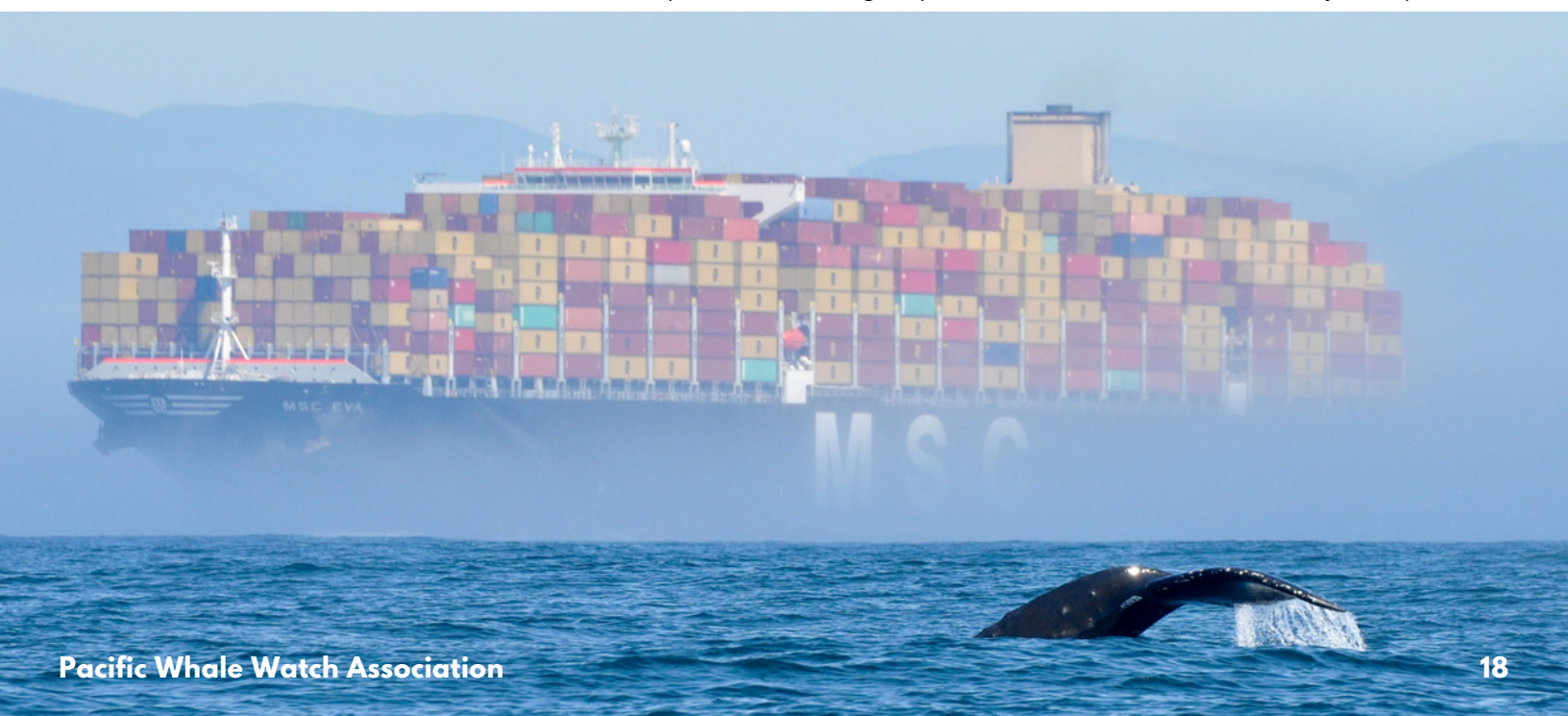
This analysis does not include possible *passive* sentinel actions. The PWWA App is currently utilized by Canada's Marine Mammal Desk and various marine mammal observers, commercial vessel pilots, and cetacean researchers. It is likely that actions are taken by these user groups to operate more safely near whales as a result of their direct access to real-time sightings through the PWWA App without additional communication with PWWA operators being necessary.

2021 Sentinel Action Summary

PWWA members logged **874** sentinel actions in 2021. Most sentinel actions were **reactive** and involved stopping other vessels that were traveling too fast near whales and/or too close to whales during **459** documented incidents (**53%**). The second most common sentinel actions reported to the PWWA App were **proactive** warnings to vessels of whales nearby with **294** incidents reported (**33%**). Removal of potentially harmful marine debris, such as balloons or derelict fishing gear, was documented **114** times (**13%**), and there were **7** sentinel actions (**1%**) categorized as "other". All 7 of the "other" sentinel actions involved reporting potentially entangled, sick, or injured wildlife to appropriate authorities.



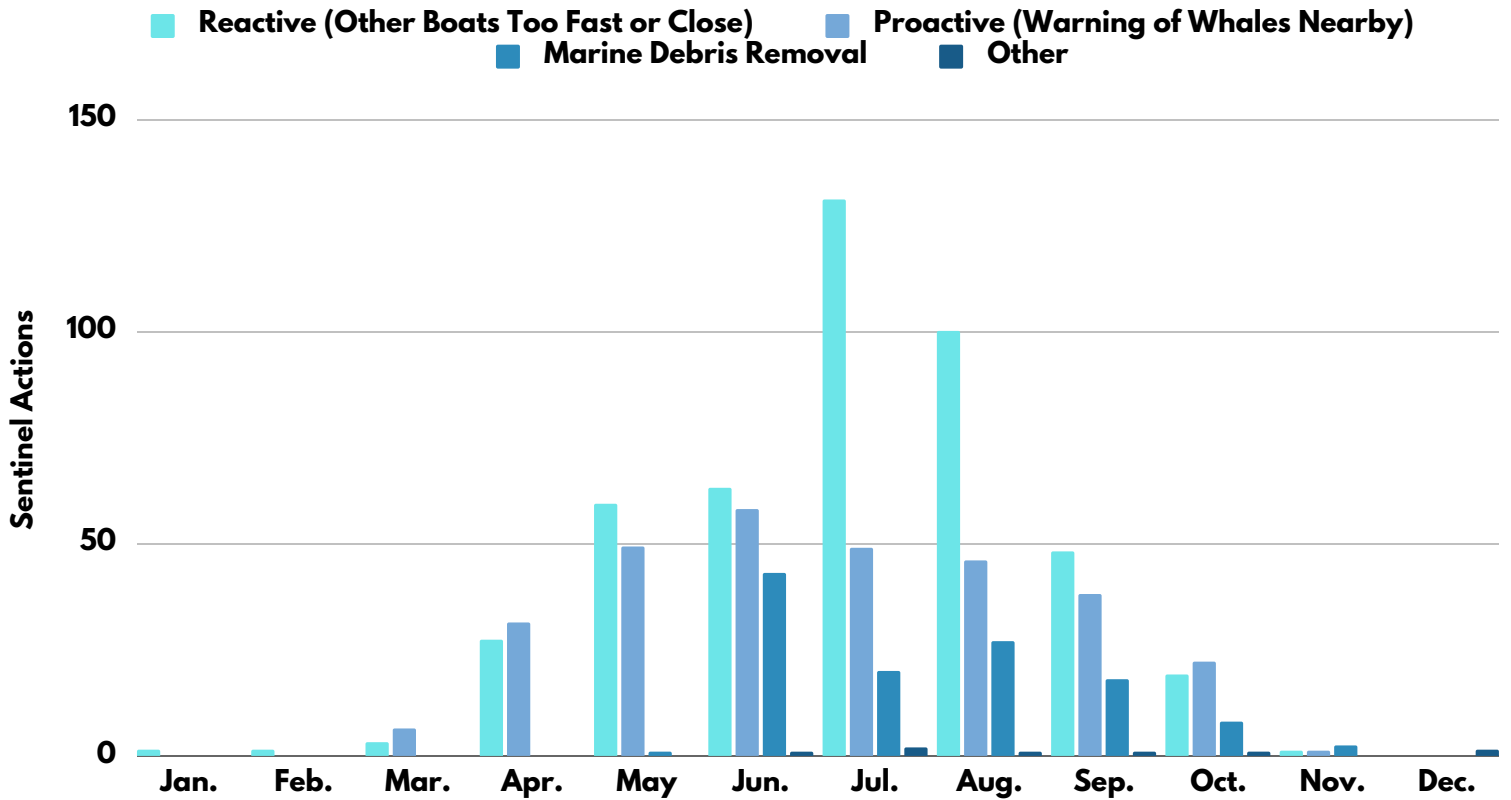
Humpback whale and cargo ship in Juan de Fuca Strait. Credit: Matt Burnaby, Orca Spirit Adventures



2021 Sentinel Actions by Month

When examined by month, the number of sentinel actions performed each month is relatively lower during the winter, moderate during the spring and fall, and higher during the summer. This reflects general trends of professional whale watching activity in that most companies operate April through October, peaking in the summer months. Some PWWA companies offer limited tours in November and December, and only a few operate tours year-round as weather permits. It should stand 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.

2021 PWWA Sentinel Actions by Month



July was the month with the most overall sentinel actions reported (**202** actions) including **131** reactive interventions with vessels traveling too fast and/or too close to whales. The maximum number of marine debris removal actions in a single month was **43** during the month of June. Several PWWA operators noted removing large bunches of balloons that month decorated with graduation messaging. June is the end of the school year for many local high schools and universities.

Crew members retrieve harmful Mylar balloons.
Credit: Eagle Wing Tours

Vessel-Related Sentinel Actions

Of the **874** sentinel actions reported to the PWWA App in 2021, **753 (86%)** involved directly contacting other vessels. Contact could be made through VHF radio, a ship's horn, waving of a flag or arms, or in some cases, physically maneuvering the whale watching vessel to prevent an oncoming vessel from striking whales.

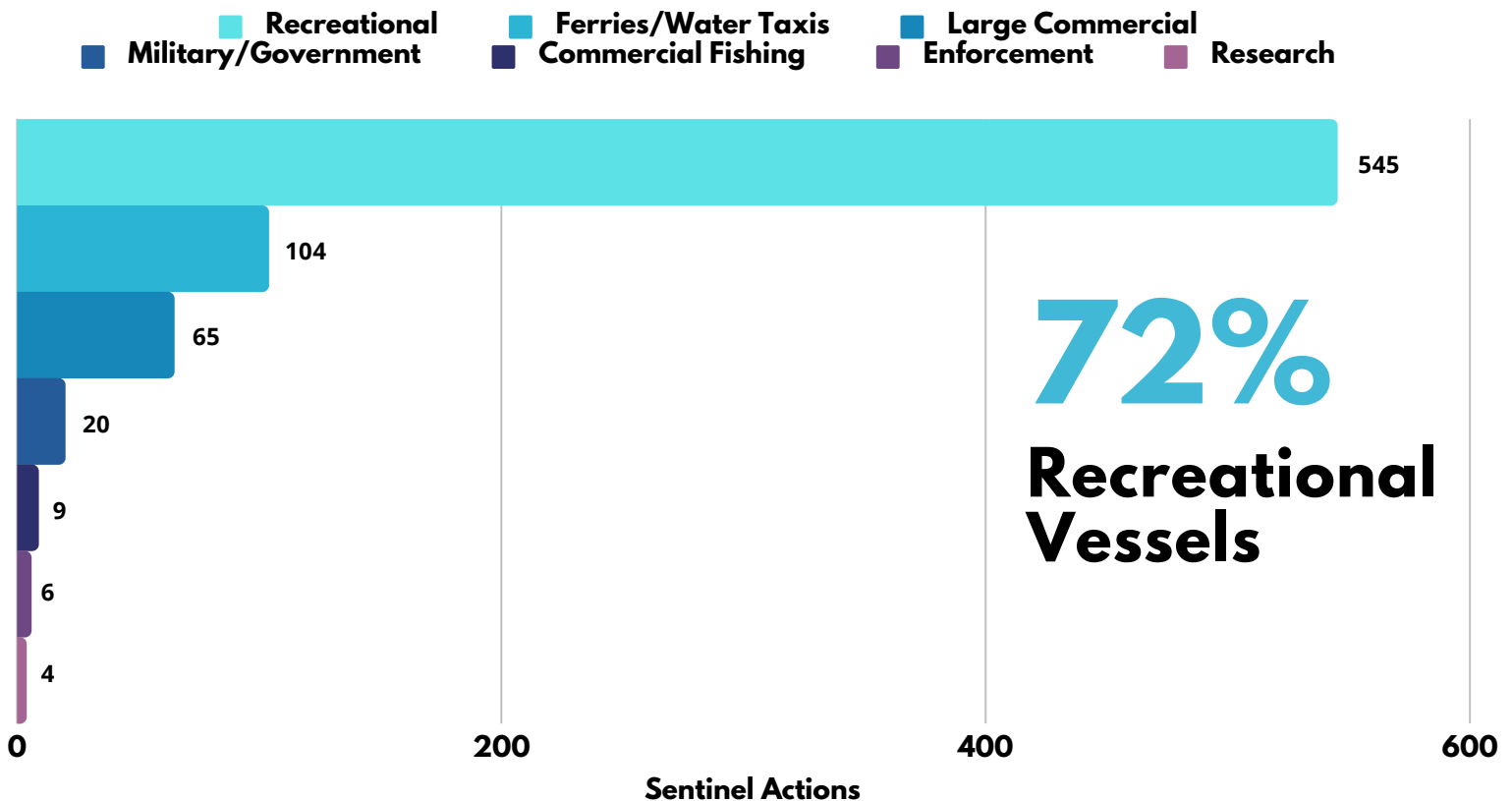
Recreational vessels were the category of vessel contacted most frequently, accounting for **545** sentinel actions (**72%**). Ferries and water taxis were the second most frequently contacted vessels with **104** sentinel actions (**14%**). Large commercial vessels such as container ships and tankers were contacted during **65** sentinel actions (**8.6%**) and military or other government vessels were contacted during **20** sentinel actions (**2.6%**). Commercial fishing vessels were contacted **9** times (**1.2%**), enforcement vessels were contacted **6** times (**0.8%**) and research vessels were contacted **4** times (**0.5%**).

The number of sentinel actions performed is not necessarily equivalent to the number of vessels influenced by the sentinel action. In the additional notes for several entries, it was indicated that more than one vessel was contacted as part of a single sentinel action.



The Whale Warning Flag indicates whales are near.
Credit: Western Prince

2021 Vessel-Related PWWA Sentinel Actions by Vessel Category





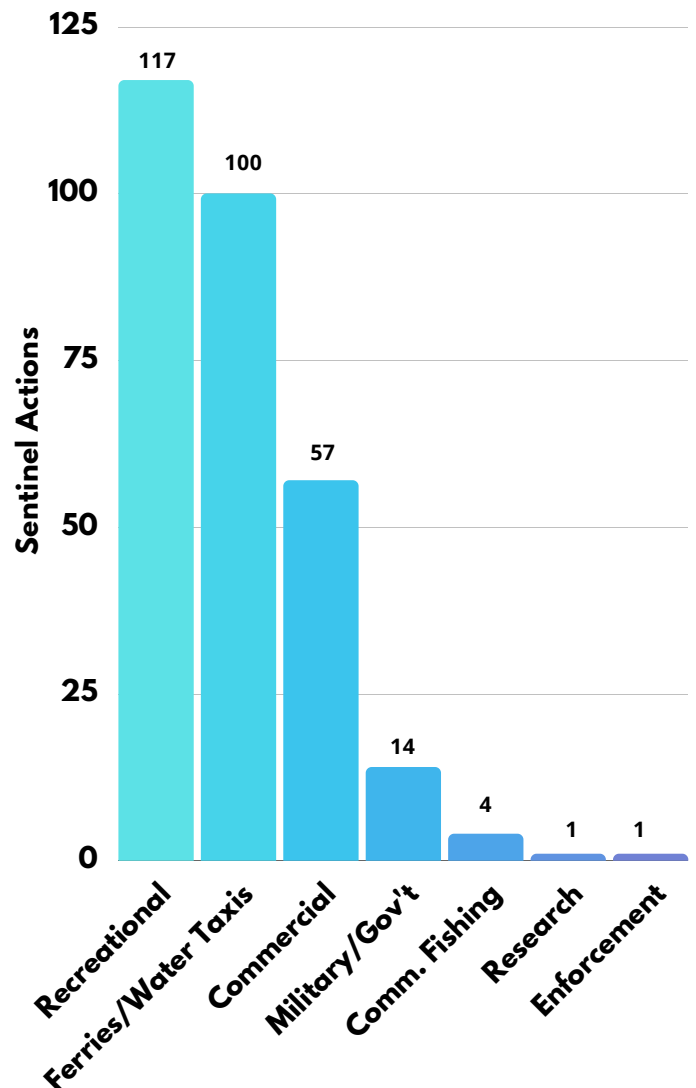
Bigg's killer whales surface near a commercial tug. Credit: Alan Niles, Maya's Legacy

Proactive Sentinel Actions

When examining 2021's **294** *proactive* sentinel actions, interventions that provided advance warning to vessels of whales in the vicinity, more than half (**53%**) involved ferries or commercial vessels such as cargo ships, oil tankers, and tugs. This is not unexpected given that those vessels typically operate at slower speeds compared to other vessel categories. They are also visible from a greater distance in addition to utilizing the Automatic Identification System (AIS), allowing them to appear on navigation screens even if still several miles away. Their slower speeds and greater visibility provide PWWA operators with more time to reach out and positively influence behavior *before* vessels come into close range with whales.

An analysis on regional ocean noise contributors in the Salish Sea found that on average, ferries contribute **66.9%**, container ships, tankers, and other merchant ships contribute **14.1%**, and tugs contribute **11.7%** of the underwater noise in the waters where PWWA vessels operate. Combined, those vessel categories contribute **92.7%** of regional underwater noise (MacGillivray et al. 2016). A recent study found that reducing ship speed, and therefore ship noise amplitude, will help decrease the probability of ship noise disrupting SRKW foraging activity and may help to increase the proportion of accessible salmon (Williams et al., 2021).

2021 Proactive Sentinel Actions





A Bigg's killer whale breaches in Puget Sound. Credit: Erin Gless

Reactive Sentinel Actions

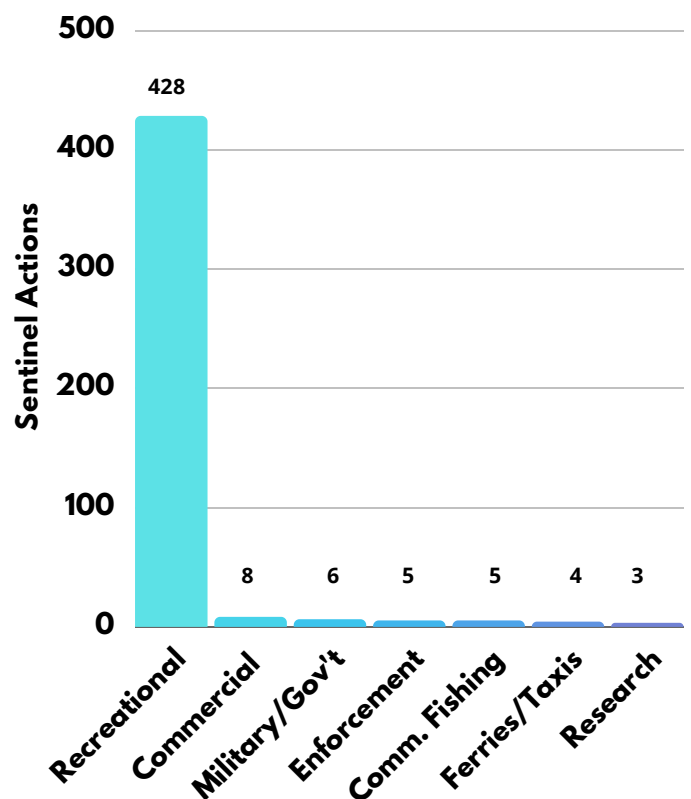
Vessels traveling at high speeds in the vicinity of whales can pose an imminent threat. High-speed vessels generate more underwater sound (Houghton et al., 2015), and are also at greater risk of striking a whale. PWWA operators frequently observe behavior by other boaters while viewing whales that warrants intervention.

While recreational vessels accounted for **72%** of total sentinel actions, when examining the **459 reactive** sentinel actions reported in 2021, **428 (93%)** involved recreational vessels.

The boater education group Soundwatch found that **72%** of recreational boaters contacted during their outreach efforts were unaware of boating regulations around whales (Frayne, 2021). This highlights the need for further education and outreach within the recreational boating community about whale regulations and whale presence in the area.

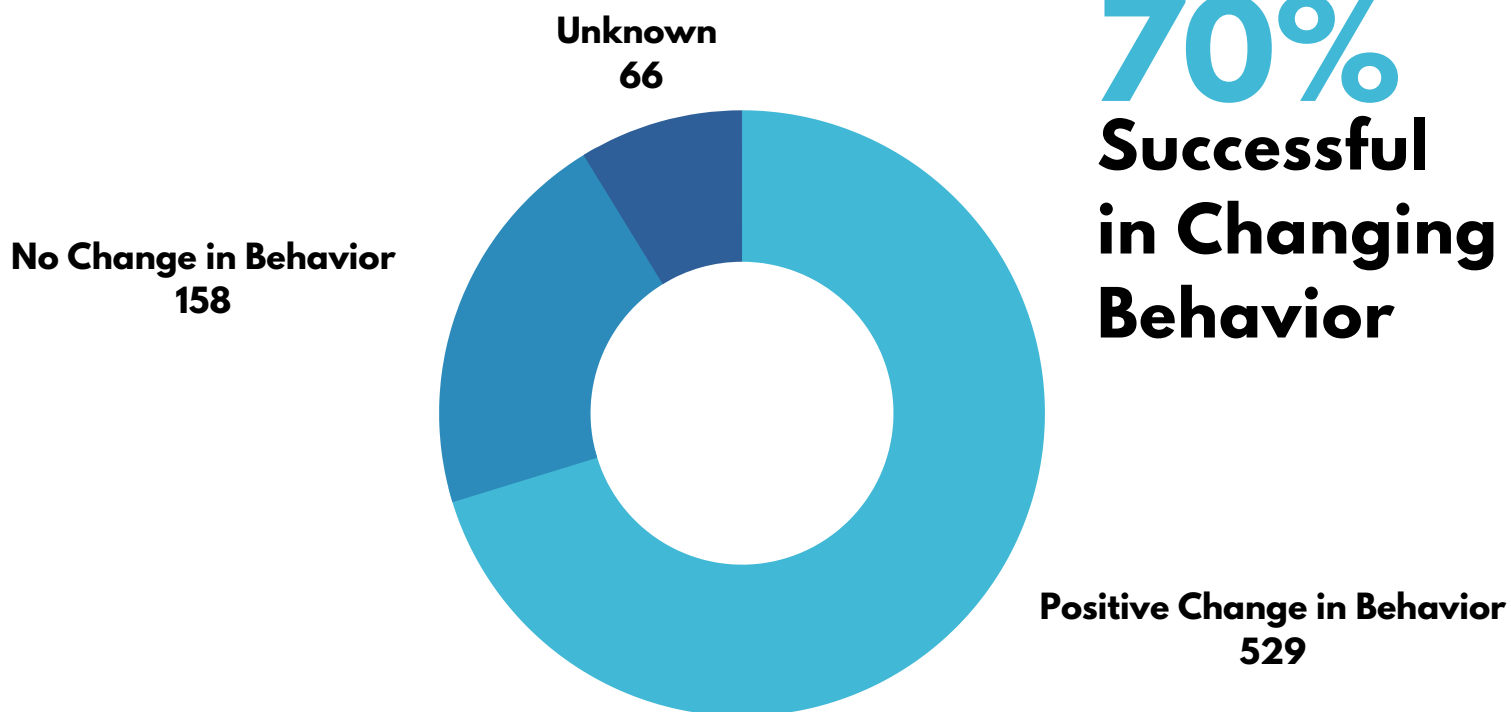
Leadership within the recreational boating community has been active in promoting the **Whale Warning Flag** and performing outreach at regional boating events. One persistent education challenge is that the rules for boaters operating near whales have changed several times in recent years and differ depending on the type of whale, which side of the border the boat is operating on, and whether the vessel is recreational or professional.

2021 Reactive Sentinel Actions



Change in Vessel Behavior After Contact

Of the **753** vessel-related sentinel actions the PWWA documented in 2021, PWWA crew members observed a positive change in vessel behavior after **529** of the incidents (**70%**). A positive change in behavior could be characterized by the contacted vessel stopping, slowing, and/or diverting after communication with the PWWA operator. There was no noticeable change in behavior after **158** of the incidents (**21%**). It was unknown whether there was a positive change in behavior after **66** sentinel actions (**9%**). 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 **459** *reactive* incidents that specifically involved vessels traveling toward whales at high speed and/or inappropriate distances, posing the most urgent threat to the animals, PWWA operators were successful in achieving a positive behavior change in **327** cases (**71%**).

A PWWA captain hails a vessel on the radio to alert them of whales ahead in their path.
Credit: Puget Sound Express

Law Enforcement Presence

When reporting a sighting in the PWWA App, users are asked to document whether or not law enforcement was present. Of **10,444** large whale sightings when at least one PWWA vessel was present, law enforcement was present during **293** logs (**2.81%**). While the PWWA App did not distinguish which specific law enforcement agency was present, mapping indicated a balanced presence on either side of the US/Canadian border.

Law enforcement was most likely to be present during encounters with Southern Resident killer whales, with at least one law enforcement vessel present for **23.1%** of PWWA App entries followed by Northern Residents with **10.5%** presence. During encounters with Bigg's killer whales, the whale type most frequently documented by PWWA members, law enforcement was present during **4.5%** of PWWA App entries. Law enforcement was reported to be present the least during encounters with the region's baleen species - humpback whales (**0.6%**), minke whales (**0.5%**), and gray whales (**0.4%**).

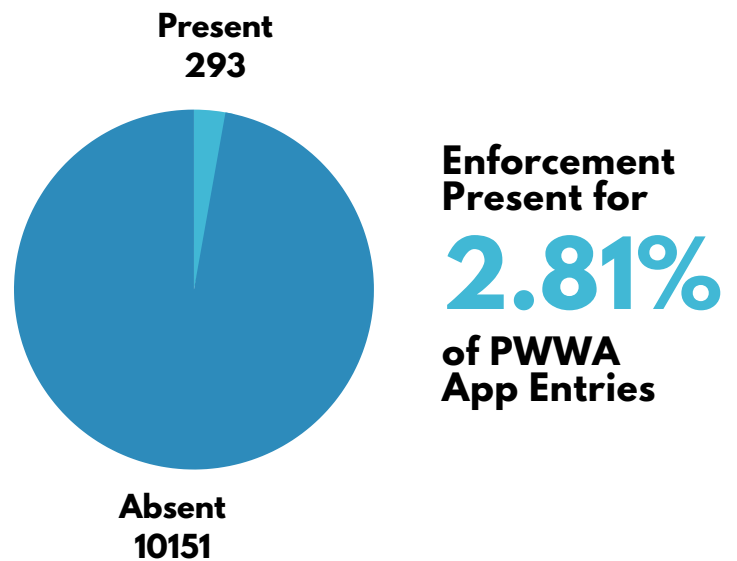
Days of Law Enforcement Presence

When examining the number of days that law enforcement was with whales, PWWA operators documented the presence of law enforcement during at least one encounter *somewhere* in the Salish Sea or northern Vancouver Island region on **105 days** of 2021 (**29%**). Law enforcement was most likely to be on the water near whales during the summer months of June, July, August, and September, being documented on **13** days, **23** days, **28** days, and **14** days of each month respectively.

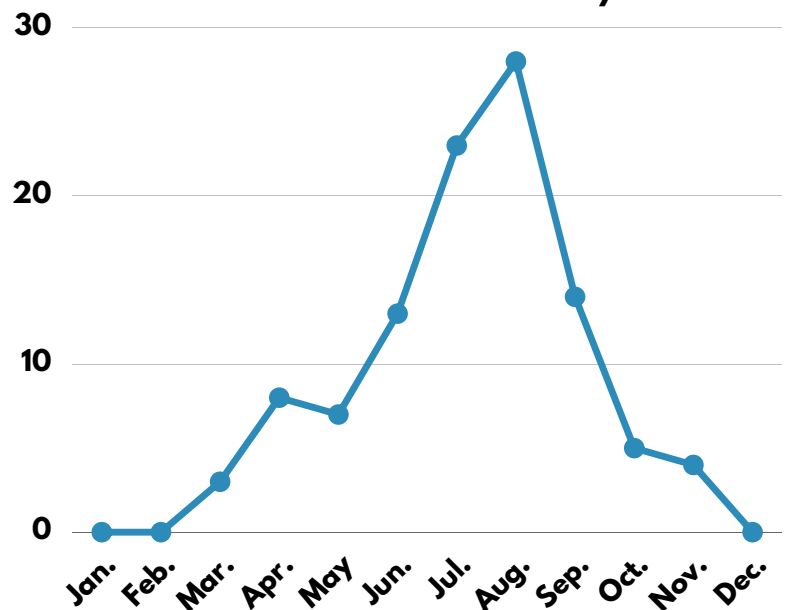
Reduced PWWA activity should be taken into account during winter months. The absence of documented whale encounters with law enforcement present does not mean there was no law enforcement on the water during those months.

2021 PWWA App Entries with Enforcement Present

Whale Type	Total GPS Entries	Law Enforcement Present	% Presence
Bigg's	4973	222	4.5%
Humpback	3860	22	0.6%
Gray	743	3	0.4%
Minke	620	3	0.5%
SRKW	134	31	23.1%
NRKW	114	12	10.5%



Days of PWWA App Entries with Law Enforcement Present in 2021 by Month



DISCUSSION



A PWWA naturalist scans for whales. Credit: Prince of Whales

2021 at a Glance

Bigg's killer whales were the most frequently reported whales to the PWWA App, documented on **304** days of 2021. Bigg's killer whales were followed by humpback whales (**301** days), gray whales (**146** days), minke whales (**145** days), Southern Resident killer whales (**99** days), and Northern Resident killer whales (**53** 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. Nearly half (**47%**) of all Southern Resident entries were *manual* entries made for the sake of situational awareness. Northern Resident killer whales were encountered primarily by PWWA operators in the northern Strait of Georgia and outside the Salish Sea near north Vancouver Island.

During 2021, the first complete year of using the PWWA App's sentinel action feature, PWWA captains, naturalists, and crew documented **874** sentinel actions. The most frequently documented sentinel actions were **reactive** sentinel actions (**53%**) involving stopping, slowing, or diverting vessels traveling too fast and/or too close to whales. **Proactive** sentinel actions to warn nearby vessels of whales in the area made up **33%** of all sentinel actions documented in the PWWA App. Collection of potentially harmful marine debris, such as balloons and derelict fishing gear, accounted for **13%** of sentinel actions with incidents classified as "other", such as reporting entangled or potentially injured marine life, making up the remaining **1%** of sentinel actions. For the **753** sentinel actions involving interactions with other vessels, PWWA members were successful in achieving a positive change in behavior in **70%** of all encounters.

Law enforcement was present during at least one whale encounter on **105** days of 2021. Of **10,444** firsthand *GPS* entries for killer whales, humpbacks, gray whales, and minke whales, law enforcement was reported as being present during **293** entries (**2.81%**). Law enforcement was most likely to be present with Southern Resident killer whales (**23.1%** of entries) followed by Northern Resident killer whales (**10.5%**), and Bigg's killer whales (**4.5%**). Law enforcement was least likely to be present during encounters with baleen species such as humpback whales (**0.6%**), minke whales (**0.5%**), and gray whales (**0.4%**). Law enforcement presence was most likely during the peak whale watching months of June through September.

Sightings Data and COVID-19

The global COVID-19 pandemic and related travel restrictions impacted PWWA whale sightings and sentinel actions in 2021. Internal travel restrictions within British Columbia did not ease until Summer 2021, causing many Canadian PWWA operators to delay the start of their seasons from March and April until May and June. At the same time, Washington operators were not permitted to cross into Canadian waters for the purposes of whale watching until the border reopened on August 9, 2021. With many Canadian operators off the water and Washington operators unable to enter Canadian waters, whale watching efforts in British Columbia for the first half of the year were limited. Many whales present in BC during that timeframe were likely unreported. In addition, the general decrease in travel in both Washington and BC throughout the year forced some PWWA members to reduce the number of tours offered and/or conclude their season earlier than anticipated, also influencing the overall number of sightings and sentinel actions.

An Evolving Industry

Professional whale watching in the Salish Sea began decades ago as a seasonal activity focused almost exclusively on Southern Resident killer whales. In recent years, however, in response to a changing regional ecosystem, professional whale watchers now have the opportunity to offer tours year-round and highlight many different whale species.

As activity on the water has shifted, so too has the Pacific Whale Watch Association's activity off the water. The PWWA has expanded education, conservation, and advocacy efforts to include all whale species in the area. While it is crucial to continue to support conservation and recovery of endangered Southern Resident killer whales, Chinook salmon, and other species at risk, it is equally important to ensure that the whales and other wildlife currently experiencing population growth remain protected from potential threats.

The PWWA recognizes the importance of raising awareness of how the Salish Sea and neighboring waters are being utilized by whales and routinely shares PWWA observations to help inform government policy. The PWWA has also expanded collaborative efforts with local research, government, non-government, and Indigenous partners to work together toward shared goals.

Whale watchers enjoy viewing a Bigg's killer whale. *Credit: Outer Island Excursions*





A PWWA vessel explores the Strait of Georgia. Credit: Wild Whales Vancouver

Enforcement and Education Collaboration

The Salish Sea is expansive, covering approximately 6,500 square miles (nearly 17,000 square kilometers). On any given day, it is not unusual to have multiple whales or groups of whales distributed throughout the region. Current resources do not allow for law enforcement officers to be present with all whales at all times. In 2021, law enforcement was present during **2.81%** of entries logged in the PWWA App, meaning that in many instances, professional whale watchers are the only vessels present to alert other boats to the presence of whales and influence their operating behavior. PWWA members performed **753** sentinel actions involving non-PWWA vessels and was successful in stopping, slowing, or diverting those vessels in **70%** of documented incidents, resulting in quieter underwater conditions and a reduced risk of ship strike for the whales.

The vessels contacted most frequently during documented sentinel actions in 2021 were recreational vessels (**72%**), indicating a need for continued outreach to the recreational boating community about not only whale watching guidelines, but also about the increased whale presence throughout the region and how to most effectively recognize when whales are in the area. The PWWA sees an opportunity to collaborate with law enforcement agencies and boater education groups such as Soundwatch (Washington) and Straitwatch (British Columbia) toward consistent messaging, particularly the encouragement of other vessels to keep watch for professional whale watchers and to slow down and remain vigilant in their presence.

The PWWA has many long-standing relationships with law enforcement officers and boater education organizations, but there is always room for growth. The PWWA welcomes more on-the-water engagement from law enforcement and boater education groups so that PWWA operators can provide valuable insight into where assistance may be needed most urgently on days when there are multiple groups of whales in the area. For example, endangered Southern Resident killer whales should likely be prioritized over other non-endangered whale types. Whales in heavily-trafficked areas may require more monitoring than whales in more remote locations where they are less likely to encounter vessel traffic. This type of communication and "triage" could help ensure the most effective use of enforcement and education resources.

Potential PWWA App Modifications

Through closely analyzing the 2021 wildlife sightings and sentinel actions reported to the PWWA App, several potential modifications that might enhance the PWWA App have been identified. An internal survey of PWWA App users revealed that many more sentinel actions are likely being performed but not logged in the PWWA App. While some vessels operate with multiple crew on board to assist with logging in the PWWA App, others have a single crew member who acts as both captain and naturalist during whale encounters.

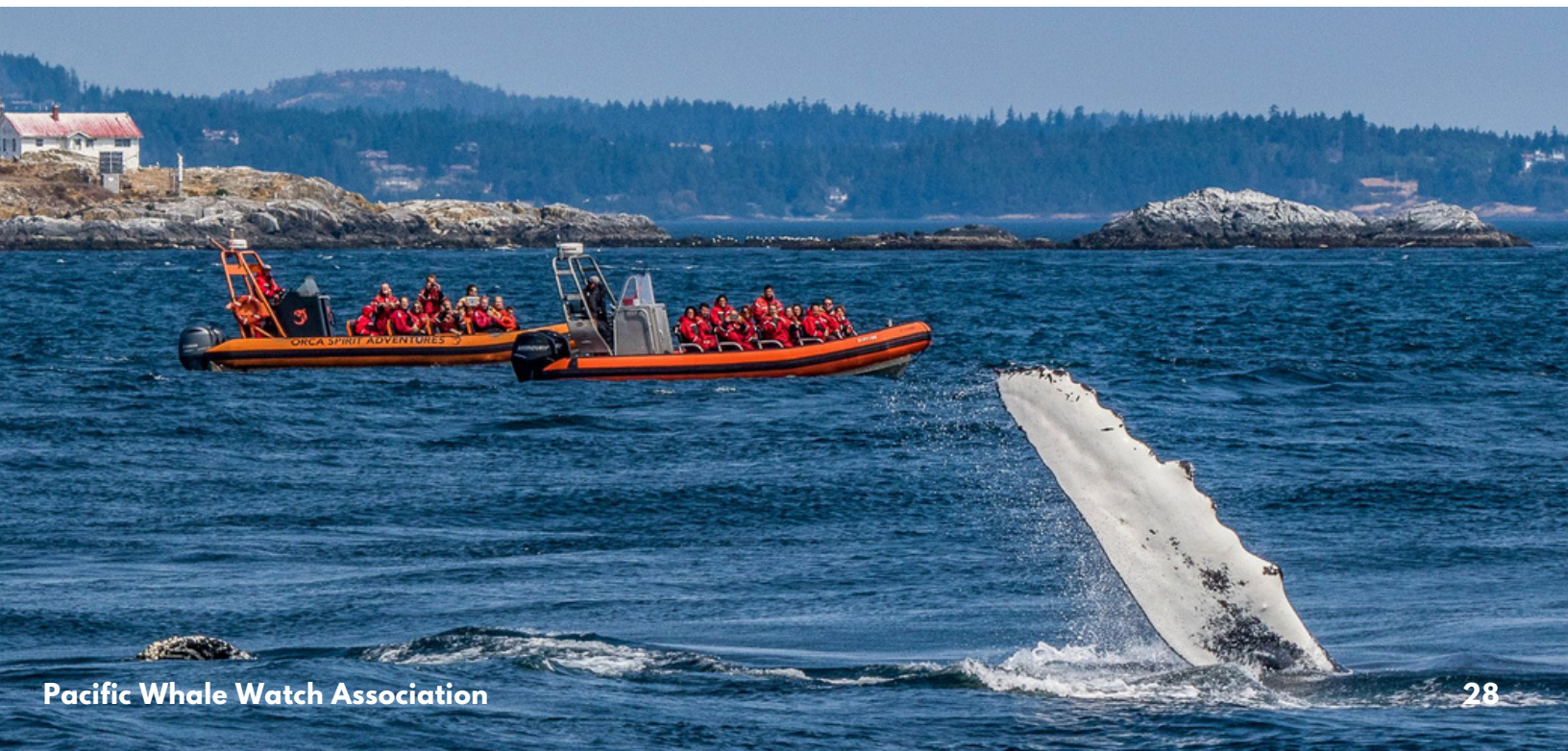
One suggestion to improve the sentinel action feature was to provide clickable options for the type of sentinel action and vessel(s) involved as opposed to the current text fields. This improvement would reduce the amount of time required to log sentinel actions. Another suggestion was to allow for sentinel action entries to be edited within a few hours of the incident. This way the action could be reported in real-time to capture the precise time and location, but additional details of the intervention could be entered after a tour's completion. It may also be beneficial to require that PWWA App users document the type of whale involved in each sentinel action to see if there are any interesting patterns that emerge, such as if some whales are more likely to require reactive interventions than others.

The suggestion of allowing for limited edits to PWWA App entries was also provided for wildlife sightings, particularly in regards to group size and individual identifications. This would allow crew members to make a PWWA App entry immediately upon locating whales to capture the time and GPS location, but then edit the entry within a few hours after they'd had sufficient time to accurately identify all animals involved in the encounter.

Internal PWWA App Training

As the PWWA App is still relatively new, especially the sentinel action feature, ongoing training of PWWA captains, naturalists, and crew in proper reporting procedures will continue to bolster the quality of the data collected through the PWWA App. The importance of reporting sentinel actions and wildlife sightings in the PWWA App will continue to be emphasized in PWWA member communications and during annual PWWA staff training.

PWWA vessels view a humpback whale. *Credit: Orca Spirit Adventures*





A humpback whale in the Strait of Juan de Fuca. *Credit: Erin Gless*

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