

OCEANWATCH

SPOTLIGHT

COVID-19: A Story of Marine Mammals



📷 Ocean Wise, Caitlin Birdsall | *Humpback whale tail flukes.*


ocean wise®

AUTHORS Amber Dearden, Jennifer Chapman, Aroha Miller (contributions from Valeria Vergara, Marty Haulena, Lindsay Akhurst, Lauren Dares, Amy Rowley)

REVIEWERS Peter Ross, Lance Barrett-Lennard, Anna Posacka, Marie Noël, Jessica Schultz

Overview

First observed in early December 2019, COVID-19, caused by the novel coronavirus SARS-CoV-2, rapidly spread across the globe, heavily impacting everything from frontline healthcare systems through to businesses and entire industries.

While the focus has largely been on the public health impacts and government responses to the pandemic, the environmental consequences are increasingly evident. The potential impacts of COVID-19 on our oceans are being highlighted by different organizations. The global community must make use of the vast expertise and data available to strengthen our understanding of how our relationship with the oceans is shifting during this time. This understanding will be vital for constructing more conscious care and management for oceans and marine species when we emerge into our new normal.

While there is a lot we don't yet know, we do know that some changes are affecting marine mammals, such as humpback whales, orcasⁱ and sea lions. These changes result from a reduction in marine vessel traffic and consequently reduced underwater noise on marine mammals; the impacts of increased plastic litter because of our responses to the pandemic; and reductions in data collection by researchers and citizen scientists that could negatively impact measures to protect marine mammals. We delve into how each of these examples are unfolding right now, and highlight the connection between human activities and the ocean.

ⁱ Killer whales, also known as orcas, are the largest species of dolphin in the world.

COVID-19-induced changes in human activities are impacting marine mammals.



Introduction

COVID-19, caused by the novel coronavirus SARS-CoV-2,¹ was declared a global pandemic on March 11, 2020.² The ramifications have been felt around the world with unprecedented changes observed, from country-wide lock downs to overwhelmed health care systems.

Some countries (e.g., France,³ Spain⁴) imposed fines for leaving the house for non-essential reasons. As borders closed, the tourism industry ground to a halt; mass gatherings were cancelled; and shared outdoor spaces were closed in many places (e.g., public beaches in Australia⁵, federal and provincial parks across Canada⁶⁻⁹). Schools and universities shut down and took to online learning; businesses closed their doors or staff began to work from home; and hospitals geared up to care for waves of patients.

One immediate and obvious result of these closures was the dramatic declines in traffic on the roads, in the skies and on the seas. What could this global slow down mean for our oceans?

THREE INDIRECT IMPACTS OF COVID-19 ON MARINE MAMMALS

1
Reduced
Marine Vessel
Traffic

2
Impact of
Plastic
Pollution

3
Changes in
Citizen Science
Data Collection

Impact 1

Marine Traffic

Over the past 20 years, oceans across the world have seen a four-fold increase in marine traffic.¹⁰ Advances in technology, and the development and expansion of international trade, shipping and tourism industries have meant not only more vessels on the water, but also larger and faster vessels, which can result in greater noise production.¹¹

Although the extent of the impacts from these busy ocean highways are still being investigated, we know they exist and that they have detrimental effects on marine mammals. Marine mammals are a particularly vulnerable group due to the amount of time they spend near the surface. Where their habitat overlaps with vessel traffic, marine mammals are at high risk of ship strikes, which often result in severe injury or death.^{12,13}



Tracey Saxby | A cargo ship traveling through the waters of British Columbia.

Due to the critical role sound plays for many marine mammals, underwater noise generated by these marine vessels leads to negative impacts. Noise can travel almost 4.5 times faster and much further underwater than it can in air.^{14,15} Underwater, low frequency noise (less than 100 Hz) typically emitted by engines and propellers of large commercial vessels, can travel hundreds or even thousands of kilometres.¹¹

Cetaceans, a group of marine mammals that includes whales, dolphins and porpoises, rely on acoustics for many aspects of their lives. They use a multitude of vocalizations to communicate and stay in touch with one another, and they use echolocationⁱ to navigate and to detect group members, predators and food. When the ocean gets too noisy, all these sensory activities are impaired. For example, it becomes increasingly difficult to use their sonar effectively to locate prey (Figure 1).

The current pandemic has resulted in a large reduction in marine vessel traffic.¹⁶⁻¹⁸ Cetacean researchers agree that, given the impact underwater noise has on these species, a reduction in marine traffic would be a welcome reprieve for these species.¹⁹

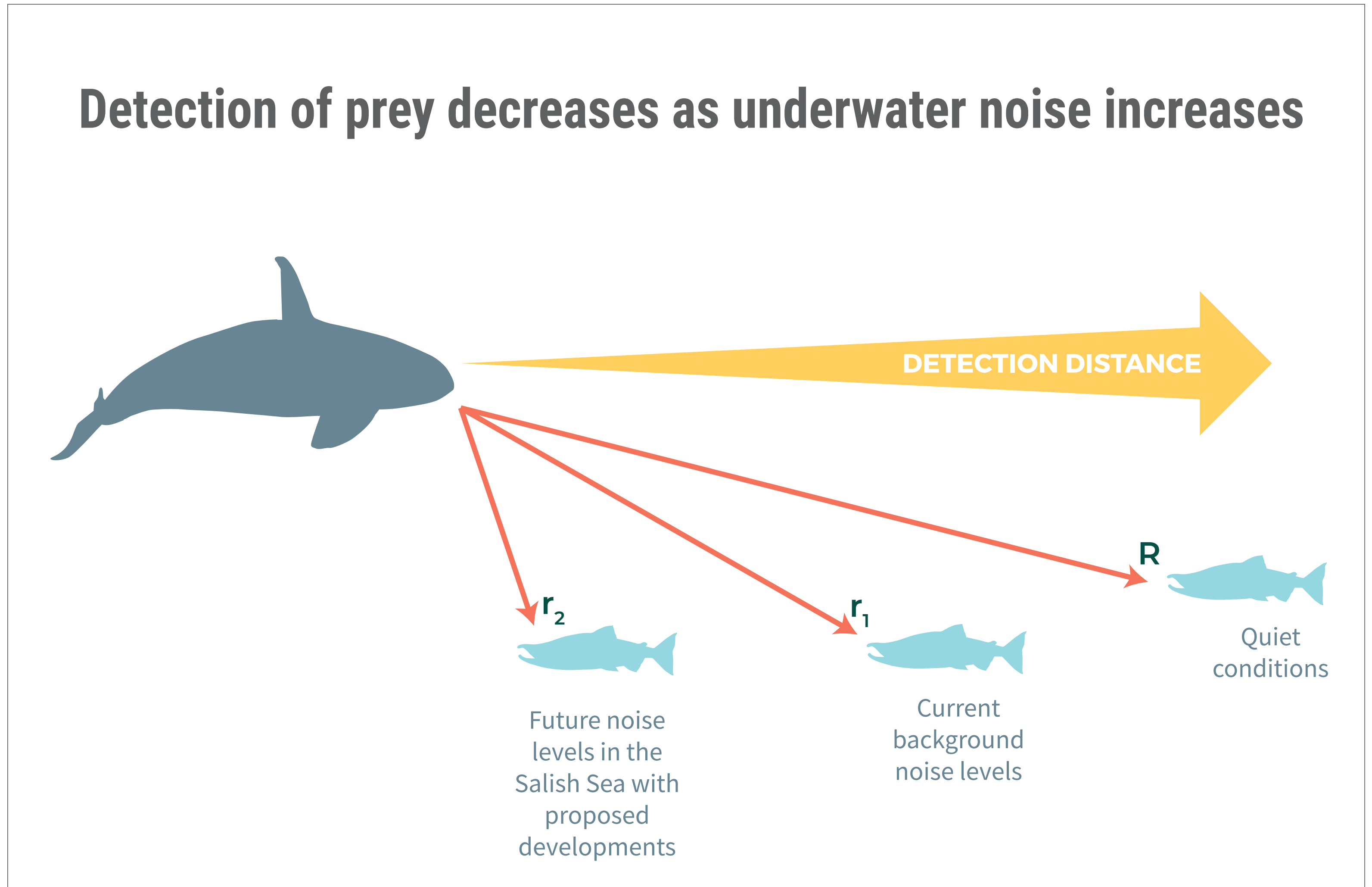


Figure 1. The hypothetical reduction in detection distance of prey for killer whales using echolocation under increasing underwater noise levels. R represents the detection distance under quiet conditions, r_1 represents the detection distance under current background noise levels, and r_2 represents the detection distance predicted to occur if noise levels increase in the future as a result of increased commercial shipping.⁹

ⁱ Echolocation – location of objects using reflected sound.

Spotlight 1

Underwater Noise During COVID-19

Underwater noise has been likened to an acoustic smog that hampers the ability of cetaceans to locate prey, find a mate, and even to find their own families, especially for young calves, which may ultimately lead to their death.²⁰ When underwater noise is too loud, cetaceans change their migration paths, may avoid critical feeding and nursing sites,²¹ use more energy searching for food,²² and have higher levels of the stress hormone cortisol.²³

Since the end of February 2020, large international shipping companies, such as Maersk, cancelled a considerable number of trips to and from Asia.¹⁹ Almost all cruise lines (e.g., Princess Cruise Lines, Royal Caribbean) stopped sailing the seas.¹⁸ Locally, the number of BC Ferries sailings were reduced by about 80% from the start of April.²⁴ The Port of Vancouver saw a marked decrease in container shipping activity since the pandemic started.²⁵

Loud underwater seascapes can prevent beluga mothers and calves from regaining contact if they become separated, with potentially dire consequences for the calf (Vergara et al. 2019).



Curious how this reduction in marine traffic may be changing the underwater soundscape, David Barclay and his research team at Dalhousie University looked at data collected during 2019 and the first part of 2020. They looked at recordings from hydrophonesⁱⁱ on the seafloor off the west coast of Vancouver Island and in the Strait of Georgia, B.C. Unsurprisingly, the reduction in marine vessel traffic has been reflected in reductions in underwater noise in both the deep ocean and near shore waters on Canada's Pacific coast. A consistent drop in underwater noise in the 100 Hz range (typically emitted by large commercial vessels) has been seen between January – April 1st, 2020.²⁵ Because noise in this range is known to negatively impact marine mammals, a reduction in underwater noise can only be positive for marine mammals in the area.

Fewer marine vessels has resulted in a decrease in underwater noise.



ⁱⁱ Hydrophone – an instrument that detects and records underwater noise from all directions.

Impact 2

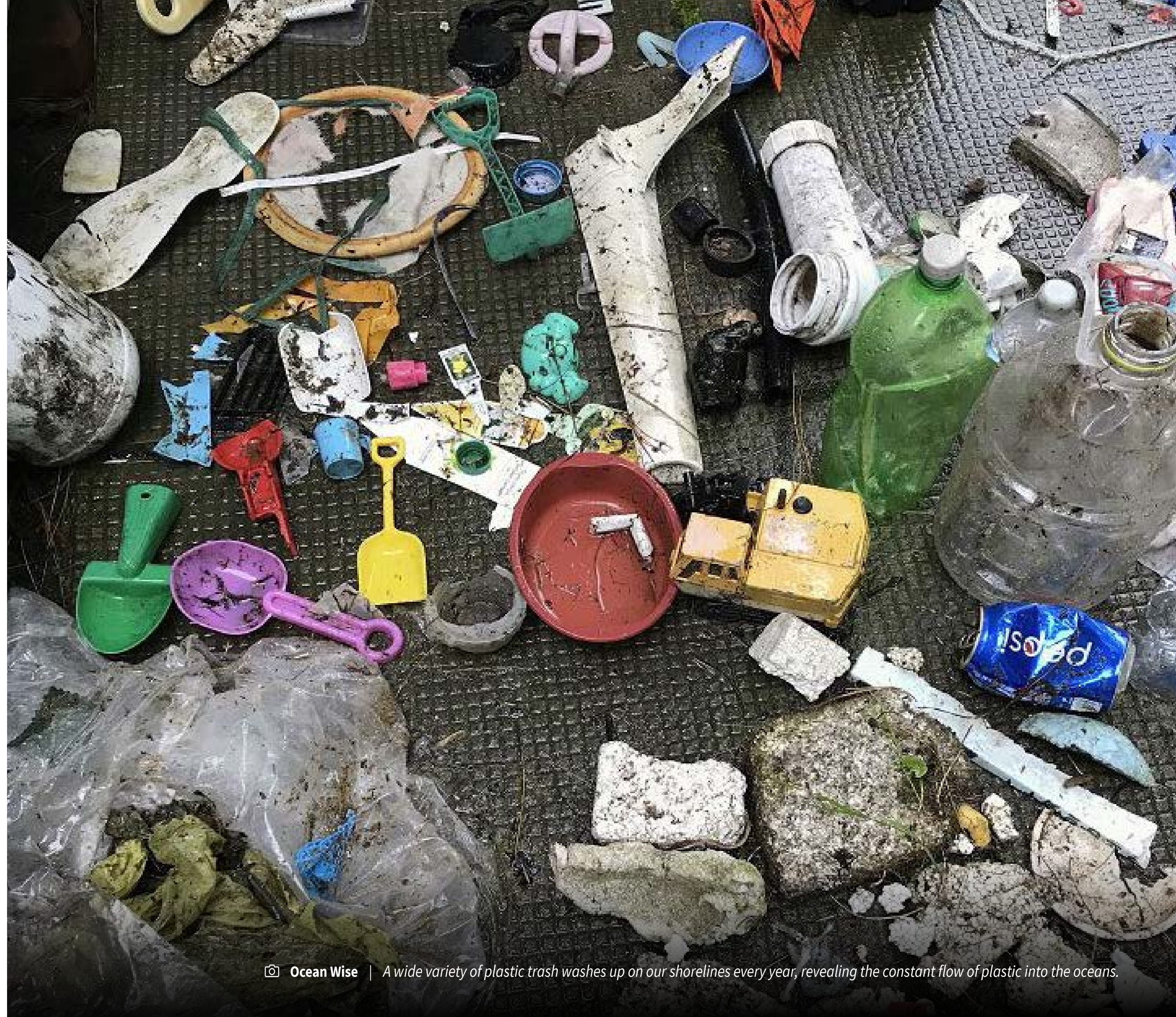
Plastic Pollution Doesn't Take A Break

Plastic pollution in the marine environment is a global issue. At least 400 million tonnes of plastic are produced around the world every year, and demand is still growing.²⁶⁻²⁸ The amount of land-based plastic entering the oceans is estimated to be up to 13 million metric tons per year.²⁹ Most plastics are used for just minutes before being thrown away.²⁸ This single use habit hasn't been put on hold during the pandemic.

The current health crisis has resulted in strict protocols to minimise the spread of COVID-19, which includes shops and restaurants reverting to single use disposable plastics items, and supermarkets refusing reusable shopping bags for a period.³⁰⁻³² Vital supplies of personal protective equipment (PPE), important for human health, also contribute to the plastic waste stream.³³

Once plastic enters the marine environment, it becomes considerably more difficult to recover. The issue is complicated further because most plastic materials do not readily biodegrade. Instead plastics simply break down into smaller and smaller fragments, until, when they are less than 5 mm in size, they become known as microplastics. Plastics – both microplastics and larger fragments – are often mistaken for food by marine animals, which can result in malnutrition, starvation or even death.³⁴⁻³⁷

As if this wasn't bad enough, entanglement of marine mammals in marine debris is also a concern. Lost, discarded and abandoned fishing lines, nets or rope, also known as ghost fishing gear—most of which is made from plastic—are often responsible for marine entanglements,³⁸ as are plastic packing straps, used to secure freight and goods.³⁹



Spotlight 2

COVID-19 Impacts Capacity To Rescue Marine Mammals

Responding to and rescuing entangled marine mammals is a costly, difficult, and labour intensive operation. The COVID-19 pandemic impacted the ability to observe, report, and respond to entangled pinnipeds. Staff at the Ocean Wise Marine Mammal Rescue Centre (MMRC) in Vancouver, rescue, rehabilitate and release over 150 marine animals each year. The majority of patients are seal and sea lion pups that are abandoned on beaches. These rescues require members to collect the pups. However, entanglements of seals and sea lions are also responded to.

COVID-19 reduced the capacity to respond to entangled marine mammals

The current pandemic resulted in the temporary closure of the MMRC, from late March until June 10th, 2020 resulting in a considerable reduction in staff over this period. With the centre closed, capacity was severely limited to respond to marine mammal abandonment, injuries or entanglements safely.

Responding to entanglements requires multiple people to locate the mammal(s) in distress and disentangle and treat the animal. These can be dangerous rescue operations because pinnipeds are large wild animals.



📷 Ocean Wise, Neil Fisher | A plastic strap cutting into the neck of a sea lion.

In March 2020, a planned sea lion survey and multi-day disentanglement trip was cancelled due to the pandemic. Between March and mid-May of 2020, the MMRC received nine calls reporting entangled sea lions. Six could not be responded to due to the closure of the centre, including one that was located on Federal park land, which was closed at the time due to the pandemic. One case was responded to with extra precautions and PPE. This impact (six sea lions), plus the cancelled trip, represents missed entanglement rescues on just a small region of the B.C coast.

In addition to a lack of capacity to respond during the pandemic, fewer boats out on the water (e.g., commercial fishermen, tour operators) mean the number of injured and entangled marine mammals has likely been under-reported.



📷 Ocean Wise, Neil Fisher | MMRC team work to disentangle a sea lion with a plastic packing strap cutting into its neck.

Impact 3

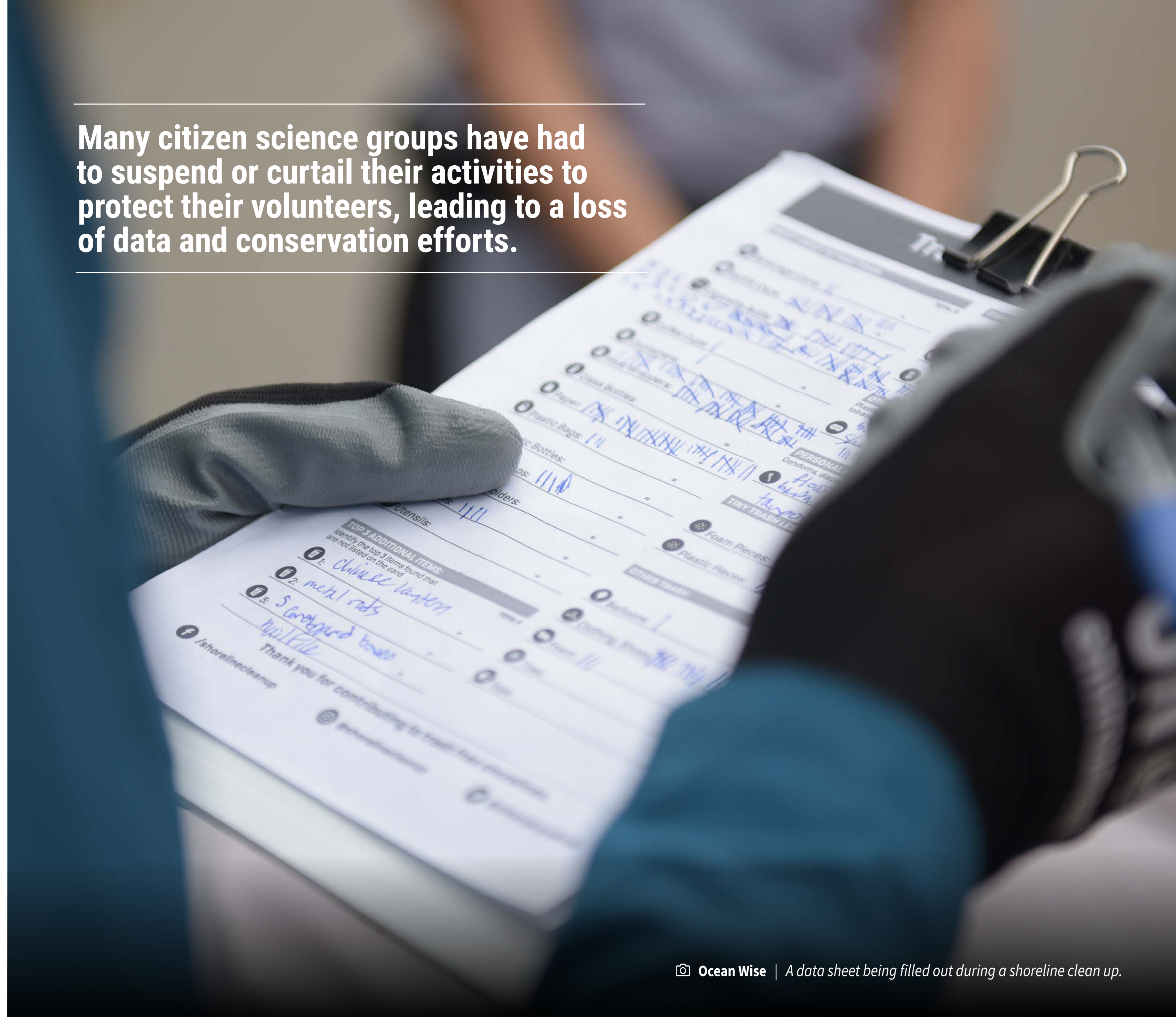
Changes in Citizen Science Due to Public Health Measures

Citizen science projects are typically conducted by volunteers who spend their free time carrying out activities that they enjoy and that contribute to their local communities. This may be participating in monthly bird counts, helping to release salmon fry to re-populate local waterways, restoration of critical marine habitats such as eelgrass or estuaries, beach clean ups, or monitoring marine species in order to gather valuable data.

However, the global health crisis has resulted in lockdowns, with people advised to stay at home in accordance with public health guidelines. Many groups have had to suspend or severely curtail their activities to ensure physical distancing measures are respected and volunteers are protected.⁴⁰

The impact of a reduction in these activities is broad, from a lack of social interaction for volunteers, to a loss of important data such as distribution and movement of marine species. However, lockdowns have also been accompanied by an increase in wildlife sightings in and around cities, such as sightings of humpback whales in the waters around metropolitan Vancouver, Canada.^{41,42} Whether this is a result of the overall slowdown in our lives providing the opportunity to look more closely, or because there is less human activity allowing animals to enter spaces they previously avoided is unclear. But how is this change in human behaviour impacting citizen science?

Many citizen science groups have had to suspend or curtail their activities to protect their volunteers, leading to a loss of data and conservation efforts.



Spotlight 3

Reported Cetacean Sightings During COVID-19

Sightings of marine mammals never fail to spark delight. The British Columbia Cetacean Sightings Network (BCCSN) collects data from volunteer observers who report their cetacean sightings. These reports provide valuable information about species distribution and abundance and provide real-time information for the Whale Report Alert System (WRAS). The WRAS was designed to mitigate the risk of vessel traffic, such as ship strikes or underwater noise disturbance, to cetaceans. The WRAS alerts pilots of large commercial vessels when they are within 10 nautical miles of a reported cetacean location, allowing the pilots to change course or take other actions to avoid striking or disturbing whales.⁴³

Sightings reported to the BCCSN provide near real-time alerts on cetacean sightings to ship pilots via the WRAS, so they can take action to avoid whale strikes.

Between March 2020, when the pandemic was declared, and May 2020, the most recent complete month at the time of writing, total cetacean sightings reported to the BCCSNⁱⁱⁱ were almost halved compared to the same period in 2019. The number of active observers who reported sightings during the same period was also down almost 20% (Figure 2).

The number of sightings reported from land was 66% higher in 2020 compared to 2019 (172 in 2019; 287 in 2020). The number of sightings reported from the sea (i.e., from observers on boats) in 2020 decreased by 64% compared to the same period in 2019 (653 in 2019 compared to 234 for 2020)^{iv, v}.

This shift in sighting platform (sea or land) is likely a result of changes in observer behaviour due to public health regulations, such as the shut down of tourism operations and reduced ferry sailings, which influences the number and location of reported sightings. Thus, sightings are likely being missed – a major concern because these data directly protect marine mammals from ship strikes and disturbance.

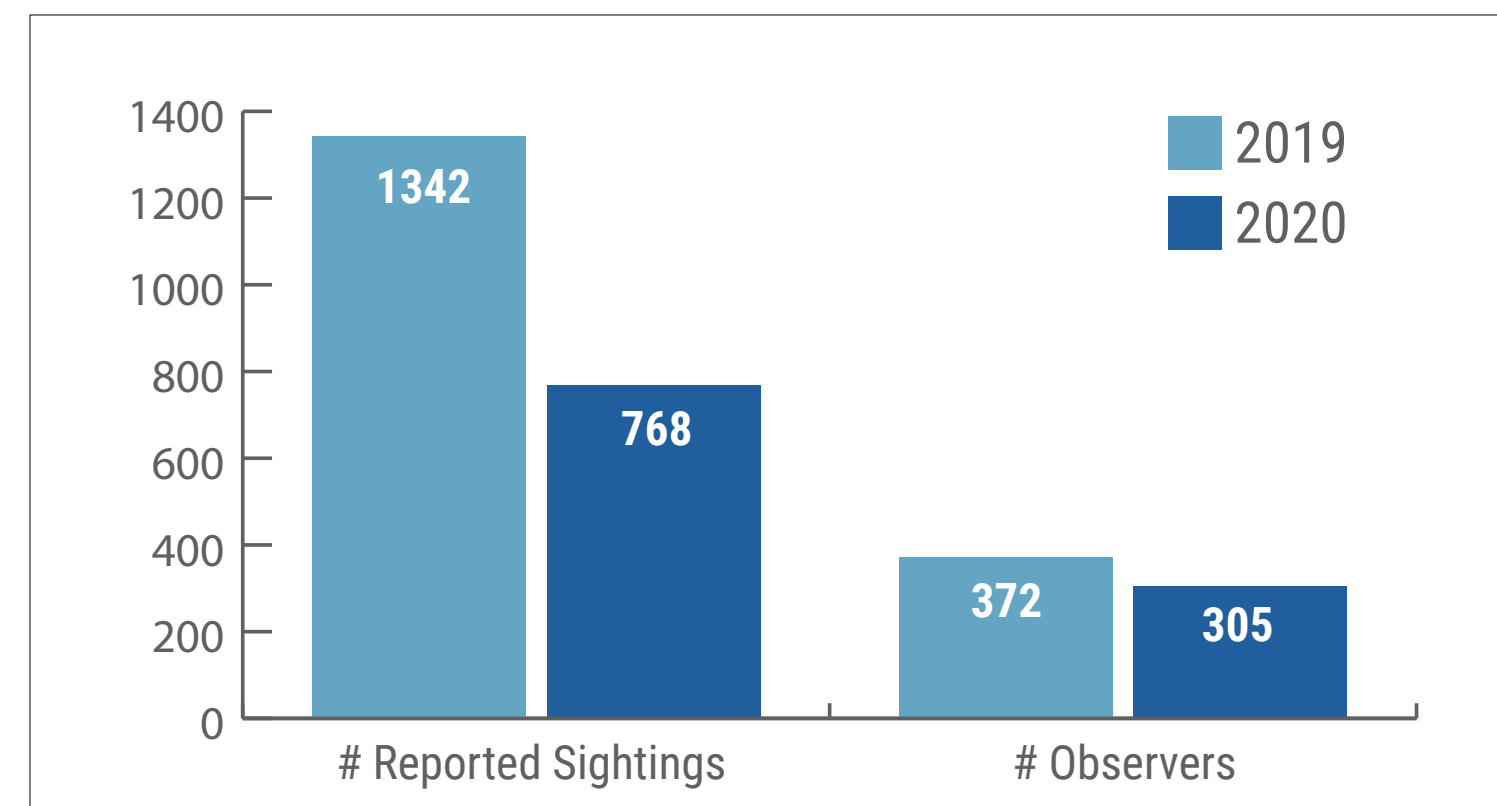


Figure 2. The total number of reported cetacean sightings and number of observers for the period March to May 2019 and 2020.

The number of reported cetacean sightings in 2020 is down by almost half compared to the same period in 2019, negatively impacting the protection of cetaceans from ship strikes via the WhaleReport Alert System.



© Rhys Sharry | A humpback breaching in British Columbian waters.

ⁱⁱⁱ It is worth noting that other cetacean sighting networks had to cancel their season due to COVID-19 (e.g., the Alaska Beluga Monitoring Partnership) or historically have very low sightings at this time of year due to cetacean migration and low observer effort spread over a very large area (e.g., Nova Scotia whale sightings database).

^{iv} A caveat to note is that these changes in sightings may not reflect changes in cetacean distribution.

^v These numbers only include WhaleReport sighting data because email/webforms do not include sighting platform.

Ocean Watch spoke with Amy Rowley, Research Assistant with BCCSN, about the impacts of COVID-19 to her work.

What impacts has COVID-19 had on the way you conduct your work?

“We’ve been quite lucky that a lot of our work can be done remotely. The BCCSN relies on an army of volunteer observers who report their cetacean sightings, so we are still receiving sightings every day, even while we’re working from home. However, a large part of our work is going out into the community to spread the word about the cetaceans that live here, the threats they’re facing, and how to help. With face-to-face outreach obviously on hold, we’ve had to adapt to a more virtual approach. We’ve also had to pause our field projects, such as shore-based harbour porpoise surveys in the Gulf Islands and cetacean surveys from BC Ferries, because of the pandemic.”

What impacts have you seen on the data you have been receiving since COVID-19?

“A big proportion of our sighting reports come from people working in ecotourism and the marine industry, which were both heavily impacted by the COVID-19 lockdown. Ecotourism has been practically non-existent so far this season, and they’re usually a dedicated and highly-informed observer group. Aside from a reduction in the overall number of sightings reports, we’re missing some of the higher-resolution data like killer whale ecotype^{vi} or matriline^{vii} and individual whale ID that most recreational observers can’t distinguish.”

One thing that’s been really encouraging is how coastal citizens have stepped up. We’ve seen a big increase in shore-based sightings from recreational observers out walking on the coast, and lots of new observers reporting for the first time.”



**Amy Rowley,
Research Assistant,
BCCSN**

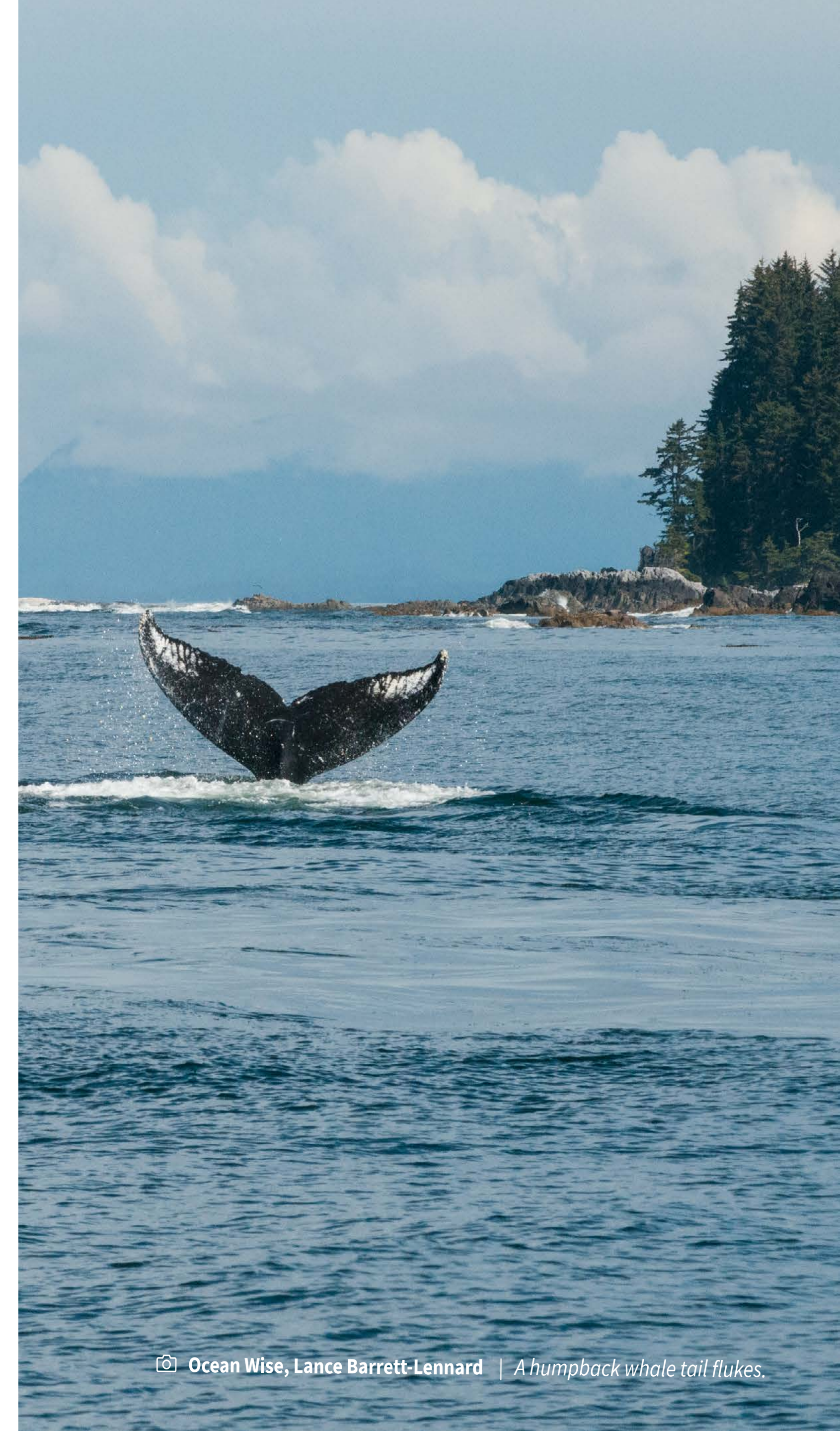
What do you think are the implications for your long-term database?

“I don’t think this will have a huge effect on the overall value of our dataset. The BCCSN has data spanning more than 20 years. This includes more than 120,000 sightings. Because cetaceans are long-lived animals of habit that operate on complex, multi-year cycles, this data set is less affected by short-term data issues than others might be.

In the case of vulnerable populations, such as the endangered southern resident killer whales, the more information we have about their distribution and habitat use the better. However, we’re unlikely to see big changes over this time frame. It’s certainly something we’ll have to keep in mind when comparing data from this year to other years, as the reduced number of observers on the water will be a major factor, especially in certain locations. 2020 will always be the COVID-19 year!”

What do you think might change going forward, if anything? What would you like to see change?

“A silver lining of this unusual time has been the increase in people exploring local areas and appreciating nature. People have been getting in touch to ask where they can spot whales from shore and getting excited about whales seen close to urban areas. I hope we can maintain that enthusiasm and sense of stewardship once life returns to something closer to normal.”



^{vi} Ecotype – Distinct populations of the same species with different ecological niches.

^{vii} Matriline – A stable social unit including all of the descendants of an adult female.

Conclusion

COVID-19 has illustrated our connectedness – to each other, to nature, and to the oceans – as it spread across the globe within months, changing the way people live, and highlighting the impacts human activities have on other species. The effects of our actions are vast and wide ranging, impacting entire ecosystems all the way down to individual species.

For cetaceans, quieter waters likely support better communication and hunting, but by contrast, reduced staffing of rescue crews have left distressed animals without aid, and likely unable to survive. A reduction in the number of cetacean sighting reports means less data are available for real-time avoidance of ship strikes and other disturbance via the WRAS.

What we do collectively post-pandemic remains to be seen, but we hope that people will choose to tread more lightly on our planet. Our actions – from our individual, organization and industry choices, through to government decisions – need to be carefully managed to mitigate and lessen the detrimental effects on the species with whom we share this Earth.



What can you do?

Individual and Organization Actions

- ❑ Help contribute to monitoring wildlife by joining a local citizen science group or downloading the WhaleReport app for [iOS](#) or [Android](#).
- ❑ Read [A Mariner's Guide to Reporting Whale Entanglements](#) in Western Canada to learn who to call should you encounter an entangled whale (call 1800 465 4336, or VHF channel 16).
- ❑ Download [ID guides for otters and pinnipeds of B.C.](#) to learn how to distinguish seal, sea lion, and otter species, and how to report incidents and animals in distress.
- ❑ [Be Whale Wise](#) and keep your distance from marine wildlife when you are on the water – follow [Marine Mammal Viewing Guidelines in Canada](#), and be [aware of important areas](#) for the protection of southern resident killer whales in British Columbia.
- ❑ Avoid contributing to marine traffic by reducing unnecessary consumption (the majority of shipping is for the transport of goods).
- ❑ Support the Marine Mammal Rescue Centre by donating at <https://rescue.ocean.org>.
- ❑ Reduce plastic consumption habits.
- ❑ Individuals piloting recreational boats can slow down to help reduce underwater noise.
- ❑ Boaters should follow [Green Boating practices](#); marinas should encourage adherence to the same practices.

Government Actions and Policy

- ❑ Enforce vessel slow downs and ship engine/hull maintenance to reduce underwater noise.
- ❑ Enforce vessel distancing from whales.
- ❑ Require manufacturers to make data on the underwater noise output of their boat propulsion systems (i.e., outboard engines and stern drives) publicly available as a condition of sale in Canada.
- ❑ Develop and implement cetacean-oriented marine spatial planning strategies, such as the establishment of shipping lanes that take marine mammal movements, distribution, and migratory routes into account, and avoid key habitats.
- ❑ Support the creation of ocean management plans to protect habitats and species with the goal of healthy oceans.



📷 Ocean Wise | Dr. Valeria Vergara, one of Ocean Wise's researchers, studying beluga and their calves in the St Lawrence Estuary.

References

- World Health Organization. Naming the coronavirus disease (COVID-19) and the virus that causes it [Internet]. 2020 [cited 2020 May 22]. Available from: [https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-\(covid-2019\)-and-the-virus-that-causes-it](https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it)
- Cucinotta D, Vanelli M. WHO Declares COVID-19 a Pandemic. *Acta Biomed.* 2020;91:157–60.
- Reuters. COVID-19 France: French people need to fill out a form to leave the house during coronavirus lockdown. *National Post* [Internet]. 2020; Available from: <https://nationalpost.com/news/world/covid-19-france-french-people-need-to-fill-out-a-form-to-leave-the-house-during-coronavirus-lockdown>
- Govan F. What are the penalties for breaching Spain's lockdown? And can you appeal? *The Local es* [Internet]. 2020; Available from: <https://www.thelocal.es/20200417/how-much-can-you-be-fined-for-breaching-spains-lockdown-and-how-to-appeal>
- Marcus L. Australia closes beaches as Covid-19 lockdown continues over Easter. *CNN travel* [Internet]. 2020; Available from: <https://www.cnn.com/travel/article/australia-beaches-closed-covid19-lockdown-in-tl-hnk/index.html>
- Rocca R. Coronavirus: Closure of Ontario provincial parks extended to end of May. *Global News* [Internet]. 2020; Available from: <https://globalnews.ca/news/6868030/coronavirus-ontario-provincial-parks-closure/>
- Azpiri J. Coronavirus: B.C. closes all provincial parks ahead of Easter long weekend. *Global News* [Internet]. 2020; Available from: <https://globalnews.ca/news/6793851/coronavirus-b-c-closes-all-provincial-parks-ahead-of-easter-long-weekend/>
- Rowe DJ. Quebec parks closed to minimize the risk of spreading COVID-19. *CTV News* [Internet]. 2020; Available from: <https://montreal.ctvnews.ca/quebec-parks-closed-to-minimize-the-risk-of-spreading-covid-19-1.4861788>
- Fletcher R. National parks closing to visitors amid COVID-19 pandemic as Parks Canada says “stay home.” *CBC News* [Internet]. 2020; Available from: <https://www.cbc.ca/news/canada/calgary/parks-canada-closing-parks-to-visitors-covid-19-pandemic-1.5508233>
- Tournadre J. Anthropogenic pressure on the open ocean: The growth of ship traffic revealed by altimeter data analysis. *Geophys Res Lett.* 2014;41:7924–32.
- Heise K. Underwater noise interferes with marine animal communication. In: Bodtker K, editor. *Ocean Watch BC Coast Edition.* 2018. p. 218.
- Redfern J, Becker E, Moore T. Effects of variability in ship traffic and whale distributions on the risk of ships striking whales. *Front Mar Sci.* 2020;Feb 6, 202.
- Carretta J V., Muto MM, Greenman J, Wilkinson K, Lawson D, Viezbicke J, et al. Sources of human-related injury and mortality for U.S. Pacific West Coast marine mammal stock assessments, 2011-2015. In: *Proceedings of the NOAA Technical Memorandum, NOAA-TM-NMFS-SWFC-579, La Jolla, CA.* 2017.
- De Brabandere S. What do you hear underwater? [Internet]. *Scientific American.* 2019 [cited 2020 Jun 17]. Available from: <https://www.scientificamerican.com/article/what-do-you-hear-underwater/#:~:text=Thus sound waves travel much,than they do in air.&text=Sound keeps its energy longer,can travel thousands of miles,%0Aaccessed June 17th 2020>
- National Oceanic and Atmospheric Administration. How far does sound travel in the ocean? [Internet]. National Ocean Service website. 2019 [cited 2020 Jun 17]. Available from: <https://oceanservice.noaa.gov/facts/sound.html>
- MAERSK. COVID-19 Blanking Announcement – Asia to North Europe Services [Internet]. 2020 [cited 2020 May 20]. Available from: <https://www.maersk.com/news/articles/2020/03/24/covid-19-blanking-announcement-asia-to-north-europe-services>
- McVeigh K. Silence is golden for whales as lockdown reduces ocean noise. *The Guardian* [Internet]. 2020; Available from: <https://www.theguardian.com/environment/2020/apr/27/silence-is-golden-for-whales-as-lockdown-reduces-ocean-noise-coronavirus>
- Sampson H. All major cruise lines halt sailings temporarily in response to coronavirus. *The Washington Post* [Internet]. 2020; Available from: <https://www.washingtonpost.com/travel/2020/03/12/princess-viking-cruise-lines-halt-all-sailings-temporarily-response-coronavirus/>
- Vergara V. Quiet oceans: has the COVID-19 crisis reduced noise in whale habitats? *Ocean Wise aquablog* [Internet]. 2020; Available from: <https://www.aquablog.ca/2020/04/quiet-oceans-has-the-covid-19-crisis-reduced-noise-in-whale-habitats/>
- Vergara V, Mikus M, Wood J, Ames A, Lesage V, Michaud R. Mom, can you hear me? Impacts of underwater noise on mother-calf contact in endangered belugas. In: *Abstracts of the International Workshop on Beluga Whale Research and Conservation* [Internet]. Mystic, CT, USA; 2019. p. 55. Available from: <https://www.mysticaquarium.org/wp-content/uploads/2019/08/Abstracts.pdf>
- Lacy RC, Williams R, Ashe E, III KCB, Brent L J N, Clark CW, et al. Evaluating anthropogenic threats to endangered killer whales to inform effective recovery plans. *Sci Rep.* 2017;7:14119.
- Holt M, Noren D, Veirs V, Emmons CK, Veirs S. Speaking up: killer whales (*Orcinus orca*) increase their call amplitude in response to vessel noise. *J Acoust Soc Am.* 2009;125:EL27–32.
- Rolland RM, Parks SE, Hunt KE, Castellote M, Corkeron PJ, Nowacek DPSKW, et al. Evidence that ship noise increases stress in right whales. *Proc Biol Sci.* 2012;279:2363–8.
- BC Ferries. Keeping vital goods and services moving BC Ferries COVID-19 response [Internet]. 2020 [cited 2020 May 22]. Available from: <https://www.bcferries.com/about/projects/covid-19.html>
- Dugald J, Barclay D. Real-time observations of the impact of COVID-19 on underwater noise. *J Acoust Soc Am.* 2020;
- Geyer R, Jambeck JR, Law KL. Production, use, and fate of all plastics ever made. *Sci Advantages.* 2017;3:5.
- Deloitte L. *Economic Study of the Canadian Plastic Industry, Market and Waste: Summary Report to Environment and Climate Change Canada.* 2019.
- UNEP. *Marine plastic debris and microplastics – Global lessons and research to inspire action and guide policy change* [Internet]. Nairobi; 2016. Available from: <https://plasticoceans.org/wp-content/uploads/2017/11/UNEP-research.pdf>
- Jambeck JR, Geyer R, Wilcox C, Siegler TR, Perryman M, Andrady A, et al. Plastic waste inputs from land into the ocean. *Science* (80-) [Internet]. 2015;347:768–71. Available from: https://www.iswa.org/fileadmin/user_upload/Calendar_2011_03_AMERICANA/Science-2015-Jambeck-768-71_2_.pdf
- Dayman I. Single-use plastic ban delayed to reduce coronavirus risk at restaurants and cafes. *ABC News* [Internet]. 2020; Available from: <https://www.abc.net.au/news/2020-04-30/plastic-ban-delayed-to-help-cafes-reopen-amid-coronavirus/12200530>
- Evans A. Coronavirus: Starbucks bans reusable cups to help tackle spread. *BBC News* [Internet]. 2020; Available from: <https://www.bbc.com/news/uk-51767092>
- Shah M. Why coffee shops are banning reusable cups amid coronavirus concerns. *Global News* [Internet]. 2020; Available from: <https://globalnews.ca/news/6641187/coffee-shop-reusable-mug-coronavirus/>
- Picheta R. Coronavirus is causing a flurry of plastic waste. Campaigners fear it may be permanent. *CNN* [Internet]. 2020; Available from: <https://www.cnn.com/2020/05/04/world/coronavirus-plastic-waste-pollution-intl/index.html>
- Covernton GA, Collicutt B, Gurney-Smith HJ, Pearce CM, Dower JF, Ross P, et al. Microplastics in bivalves and their habitat in relation to shellfish aquaculture proximity in coastal British Columbia, Canada. *Aquac Environ Interact.* 2019;11:357–74.
- Desforges JP, Galbraith M, Ross P. Ingestion of microplastics by zooplankton in the Northeast Pacific Ocean. *Arch Environ Contam Toxicol.* 2015;69:320–30.
- Drever MC, Provencher JF, O'Hara PD, Wilson L, Bowes V, Bergman CM. Are ocean conditions and plastic debris resulting in a 'double whammy' for marine birds? *Mar Pollut Bull.* 2018;133:684–92.
- O'Hara PD, Avery-Gomm S, Wood J, Bowes V, Wilson L, Morgan KH, et al. Seasonal variability in vulnerability for Cassin's auklets (*Ptychoramphus aleuticus*) exposed to microplastic pollution in the Canadian Pacific region. *Sci Total Environ.* 2018;649:50–60.
- Thomas K, Dorey C, Obaidullah F. Ghost Gear: The abandoned fishing nets haunting our oceans [Internet]. 2019. Available from: <https://www.greenpeace.de/sites/www.greenpeace.de/files/publications/20190611-greenpeace-report-ghost-fishing-ghost-gear-deutsch.pdf>
- Vancouver Aquarium Marine Mammal Rescue an Ocean Wise Initiative. *Disentanglements* [Internet]. [cited 2020 May 22]. Available from: <https://rescue.ocean.org/disentangle>
- Pardee T. Bowen Island Fish and Wildlife Club. Personal communications. Bowen Island; 2020.
- DH Vancouver Staff. Humpback whale spotted breaching in Vancouver harbour near PNE (VIDEO). *Daily Hive News Vancouver* [Internet]. 2020; Available from: <https://dailyhive.com/vancouver/vancouver-whale-sighting-may-13-2020>
- Shepert E. This humpback whale was spotted in Vancouver waters. *Vancouver is awesome* [Internet]. 2020; Available from: <https://www.vancouverisawesome.com/vancouver-news/humpback-whale-spotted-vancouver-waters-2371628>
- Ocean Wise Research. Whale report alert system (WRAS) [Internet]. [cited 2020 May 27]. Available from: <https://research.ocean.org/project/whalereport-alert-system>

This project was undertaken with financial support from



sitka foundation



Cite this report as: Dearden A, Chapman J, Miller A, Vergara V, Haulena M, Akhurst L, Dares L, Rowley A. 2020. COVID-19: A story of marine mammals. *Ocean Watch Spotlight. Ocean Wise Conservation Association, Vancouver, Canada. 16 pg. ISBN: 978-1-7772408-4-4*

OCEANWATCH



📷 Ocean Wise, Caitlin Birdsall | *Humpback whale tail flukes.*

