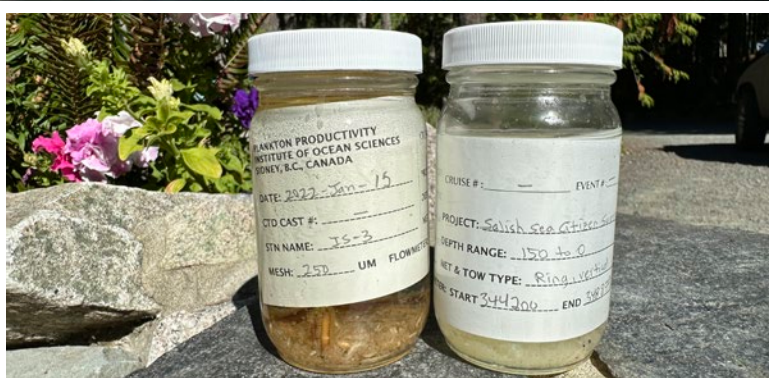
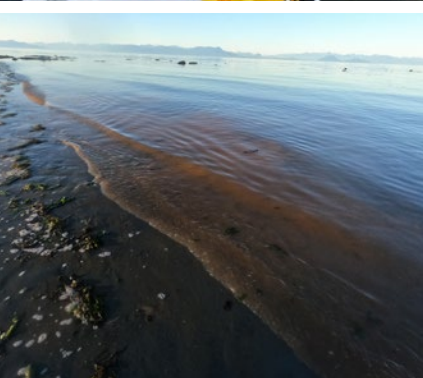




PACIFIC SALMON
FOUNDATION



CITIZEN SCIENCE OCEANOGRAPHY

NEWSLETTER

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The PSF Citizen Science Oceanography program is well over halfway through its ninth year and we are just beginning to learn so much from this important work. Lots of new and exciting things are happening, namely, a new partnership and a new Citizen Scientist! In addition, we have our long-standing Citizen Science crews, who continue to work diligently to get out on the water to collect data. It's the people who are out on the water, doing the work, (often in unfavorable weather conditions) that really are the backbone of this program. PSF held the annual Citizen Science Symposium in June this year which provided a great opportunity to recognize and thank everyone involved for their hard work and dedication.

PACIFIC SALMON FOUNDATION PARTNERS WITH SNUNEYMUXW FIRST NATION MARINE DIVISION TO COLLECT OCEANOGRAPHY DATA.

PSF is excited to announce that we are partnering with Snuneymuxw First Nation (SFN) Marine Division to collect oceanographic data within Snuneymuxw First Nation territory. Data collected by SFN will be compiled with the data collected by the PSF Citizen Science Oceanographic Program and will be included in the [Strait of Georgia Marine Atlas](#). SFN Marine Division staff will be collecting nutrients, phytoplankton, and biotoxin samples, as well as Secchi depths. SFN is also collecting CTD data as part of the [Ocean Networks Canada Community Fishers Program](#).

These data will help contribute to the monitoring and understanding of changes in ocean conditions over time both within Snuneymuxw territory, as well as throughout the Salish Sea. Collecting these important oceanographic data can help to monitor climate change impacts and environmental changes that can affect ecosystem health at local and regional scales.

While the data collected by SFN will complement the Citizen Science Oceanographic program, PSF recognizes and acknowledges that Snuneymuxw First Nation is an independent, sovereign Nation and any involvement of SFN staff or community members is as such. Snuneymuxw First Nation is one of the few Nations that have a pre-Confederation treaty with the Crown – the treaty of 1854¹.



Members of the SFN Marine Division, Megan and Roy, collecting oceanographic samples in Snuneymuxw territory on June 26, 2023

The Snuneymuxw Marine Division oversees the natural ecosystems in their territorial waters for the benefit of local fish and all marine creatures living in and passing through their waters.

To learn more about Snuneymuxw First Nation visit:
www.snuneymuxw.ca

🦋 On December 23, 1854, the Snuneymuxw People entered the Snuneymuxw Treaty of 1854 to preserve and protect Snuneymuxw villages, enclosed fields, waterways, harvesting and gathering, and the rights to hunt and fish as formerly forever and always. Often referred to as a trade and commerce treaty, the Snuneymuxw Treaty of 1854 is protected under section 35 of the Constitution Act, 1982. The Ancestors were brilliant to protect the Snuneymuxw way of being by entering into the strongest treaty agreement available to Canada. 🦋

Cover photos by Mitch Miller (top, left and right) and Nicole Frederickson (centre)

1. Snuneymuxw First Nation. Nation. Accessed: 31 July 2023. www.snuneymuxw.ca/nation/

PSF HOLDS THE 2023 ANNUAL CITIZEN SCIENCE OCEANOGRAPHY PROGRAM SYMPOSIUM

PSF held the annual Citizen Science Symposium on June 8th, 2023 at the Sidney Pier Hotel and Resort in Sidney, BC. This was the first in-person symposium since 2019.

The purpose of the symposium was to:

- ▶ Bring together the crews to provide an opportunity to network and share information with their fellow Citizen Scientists.
- ▶ Provide PSF staff an opportunity to recognize and acknowledge the hard work and dedication of the Citizen Scientists.
- ▶ Invite partner researchers and data analysts to report on and share key findings from the Citizen Science data.
- ▶ Learn about how the Citizen Science data are being used and potential future research.

WHAT HAVE WE LEARNED TO DATE

Information collected by the Cit Sci program is filling several data gaps, as well as increasing our understanding of changing ocean conditions in the Salish Sea over time. Below is a summary of some of the key things that we have learned to date from the PSF Citizen Science data.

BIOTOXINS:

- ▶ Diarrhetic Shellfish Poison (DSP) and other biotoxins are present year-round. This was not well known prior to Cit Sci data collection. People can become sick from eating shellfish contaminated with DSP.
- ▶ The concentrations of some DSP biotoxins appear to be correlated with water temperature and/or the appearance of associated harmful algae (Dinophysis), suggesting an increase in the production of algae and/or biotoxins at higher temperatures, depending on the location and time of year.
- ▶ Domoic acid was less abundant in Cit Sci samples in 2022 compared to 2021 when domoic acid concentrations peaked twice, in spring and summer. Consuming shellfish contaminated with domoic acid can be fatal to humans although levels in Cit Sci water samples were below those associated with accumulation in shellfish.
- ▶ Yessotoxin and saxitoxins, which can cause Paralytic Shellfish Poisoning (PSP), were more abundant in Cit Sci samples in 2022 compared to 2021 as were harmful algae (*Prorocentrum reticulatum*) that produce yessotoxin.
- ▶ PSP toxins tend to be approximately 10 times higher in the Cit Sci samples collected from Cowichan Bay, a 'hot-spot'² for the harmful algae (*Alexandrium*) that produce them, than those on the Sunshine Coast.



Attendees of the PSF Citizen Science Oceanography Program Symposium, held in Sidney BC on June 8th, 2023.



Isobel Pearsall, PSF Marine Science Program Director presenting at the PSF Cit Sci symposium on June 8th, 2023.



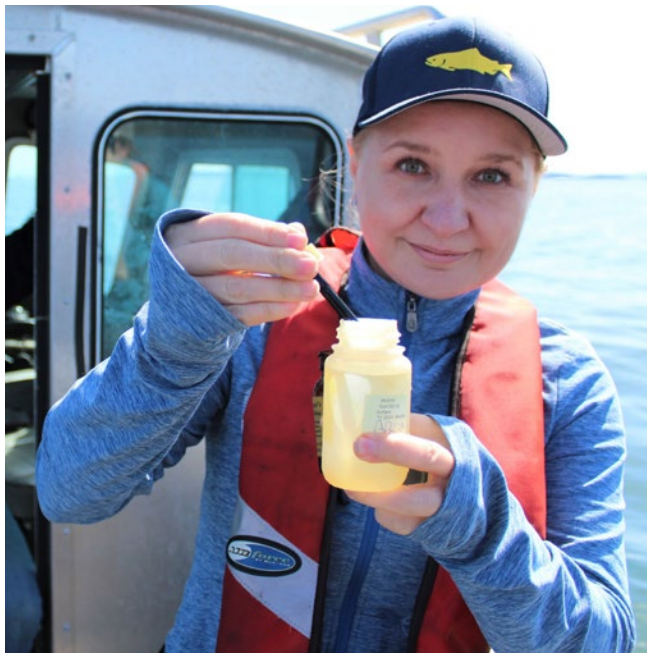
Biotoxin, phytoplankton and nutrient samples collected by PSF Citizen Scientists.

2. Esenkulova et al., 2022. [Frontiers | Harmful Algae and Oceanographic Conditions in the Strait of Georgia, Canada Based on Citizen Science Monitoring](https://doi.org/10.3389/fmar.2022.888888) (frontiersin.org)

DID YOU KNOW?

Amnesic Shellfish Poisoning (ASP), Diarrhetic Shellfish Poisoning (DSP), and Paralytic Shellfish Poisoning (PSP) are human illnesses that are caused by certain types of biotoxins. PSP and ASP are more serious, as they can be lethal to humans and marine mammals. For more information on these illnesses and the associated biotoxins that cause them, visit:

<https://inspection.canada.ca/food-safety-for-consumers/fact-sheets/specific-products-and-risks/fish-and-seafood/toxins-in-shellfish/eng/1332275144981/1332275222849>



Svetlana Esenkulova, PSF Biologist, collecting a water sample to be analyzed for phytoplankton and the presence of harmful algae.



Zooplankton samples collected by the PSF Irvine's/Sechelt Citizen Science Patrol.

PHYTOPLANKTON/HARMFUL ALGAE:

- ▶ To date, two peer reviewed papers utilizing PSF harmful algae data have been published; results of PSF Citizen Science harmful algae sample analysis were included in numerous technical reports and presented at conferences and meetings.
- ▶ Annual observations are summarized in the report included in the State of the Pacific Ocean, DFO.
- ▶ Results of 2022 sampling revealed TWO Spring blooms (mid-February and mid-April), several summer blooms and a high frequency of occurrence of harmful algae.
 - > Harmful algal bloom taxa that formed dense blooms (>100 cells per mL) in some of the past years, all did so in 2022.
 - > There were thick, vivid orange blooms of *Noctiluca scintillans* (up to 1000 cells per mL) at the beginning of August at a few coastal areas.
 - > *Alexandrium* and *Dinophysis* (PSP and DSP causing taxa) were abundant.
 - > *P. reticulatum* (yessotoxin producer) was unusually very abundant in July-August.
- ▶ Based on 8 years of observations, *Alexandrium* was more abundant in warmer months, however in warmer years affected by El Niño, the occurrence of *Alexandrium* was lower (~25%) compared to non-El Niño years. This observation is potentially very significant and requires further investigation.

[Check out our last Citizen Science newsletter that featured harmful algal blooms.](#)

WHAT IS ALEXANDRIUM?

Alexandrium is a type of dinoflagellate algae and can produce toxic harmful algal blooms. Many species in the genus *Alexandrium* produce potent neurotoxins that can cause Paralytic Shellfish Poisoning. *Alexandrium* can cause harmful effects at very low concentrations and can even result in fish/shellfish, fish/shellfish and marine mammal deaths, and food web disruptions.



Photo by Svetlana Esenkulova

ZOOPLANKTON:

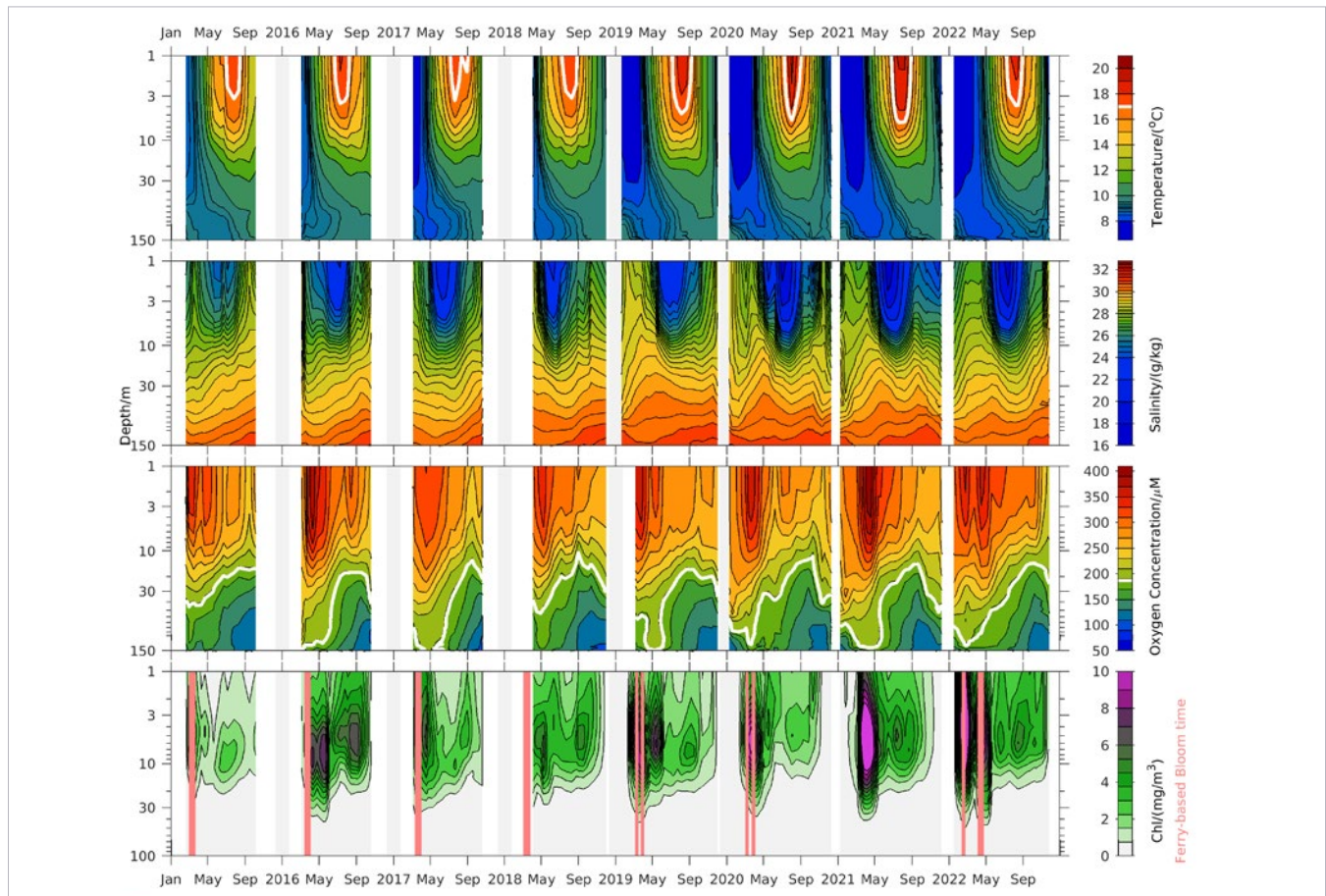
- ▶ DFO's sampling program does not collect nearshore zooplankton samples. PSF Citizen Scientists collect samples from the nearshore environment, which DFO can use to supplement their analysis.
- ▶ In 2022, total zooplankton biomass:
 - > Was greater than the long-term average biomass in the Central and Northern Strait of Georgia, and,
 - > Peaked in July, consistent with peak summer timing during the last three years.
- ▶ Increased sampling frequency and new plankton productivity measurements in the Salish Sea are supplementing juvenile salmon survival projections.

HYDROGRAPHY:

- ▶ In the Strait of Georgia, spring conditions measured at Cit Sci stations over the past 8 years are generally favorable for salmon down to approximately 75 metres from the surface.
- ▶ However, by late summer, favorable dissolved oxygen and water temperature conditions for juvenile salmon are limited to the upper 5 to 20 metres of the

water column. Shallower than 5 metres, water temperatures are too warm and below 20 metres oxygen levels are too low to support the best growth rates. But some juvenile salmon may still be hiding below 20 metres to avoid predation!

- ▶ In 2022 Strait of Georgia conditions followed this general pattern, with coldest deeper waters in spring, followed by warmer, more saline, and oxygen-deficient deep waters in summer/fall. But added to this cycle are small year-to-year changes. For example, the observed trend in recent years is for water below 100 metres to be a little colder and fresher, and become a little less oxygenated compared to the long-term mean conditions. Surface salinities were also a little lower, matching the above-average summer Fraser inflow of the last 3 years.
- ▶ Not shown here is that there appears to be a correlation between these changes in ocean conditions (i.e., temperature, salinity, summer chlorophyll) in the Strait of Georgia and broader climate trends covering the North Pacific. These trends are generally referred to by names like the Pacific Decadal Oscillation, the North Pacific Gyre Oscillation, and of course the El Niño/La Niña Southern Oscillation.



Strait-wide trends in water properties (temperature, salinity, oxygen concentration, chlorophyll a) from 2015–2022. Note that depth axis is logarithmically scaled so that near-surface variations are emphasized.



Nicole Frederickson, Manager, PSF Citizen Science Oceanography Program, getting ready to deploy the CTD. Photo taken by Svetlana Esenkulova.



CTD being lowered into the water to measure conductivity, temperature and dissolved oxygen and chlorophyll a. Photo taken by Svetlana Esenkulova.

HOW ARE THE CIT SCI DATA BEING USED:

- ▶ DFO has started using these data in Salmon Risk Assessments for Westcoast Vancouver Island Chinook.
- ▶ Climatology data collected by the Citizen Science program can be used to identify times/areas of favorable/unfavorable conditions for fish in the Strait of Georgia.
- ▶ Greig Oldford, PhD candidate at UBC, is using the Cit Sci data to create and evaluate a Strait of Georgia model to simultaneously evaluate multiple pathways of effects and hypotheses about drivers of long-term survival on juvenile coho and Chinook in the Strait of Georgia.
- ▶ Ocean Networks Canada is building on the PSF Citizen Science Program to expand their Community Fishers program. ONC identifies the PSF Cit Sci program as the “gold standard” of data collection.
- ▶ Biotoxin data collected in the Salish Sea by the Citizen Scientists are being compared to biotoxin data collected on the West Coast of Vancouver Island for differences in the presence and abundance of biotoxins between the two geographic areas.
- ▶ Biotoxin and water quality results are being used to help predict where and when fish and marine mammals may be exposed to biotoxins, including those known to cause them harm (e.g., domoic acid, saxotoxins).
- ▶ Dr. Andrew Ross, Institute of Ocean Sciences, plans to prepare and publish a scientific peer-reviewed paper based on biotoxin results from the PSF Citizen Scientists.
- ▶ PSF Citizen Science data are included in the annual [State of the Pacific Ocean \(SOPo\) reports](#), which are used to inform academics, researchers, and fisheries managers about important annual ocean conditions and changes over time in the Pacific region.

The symposium highlighted not only the value of the Citizen Science Oceanography program, but also shone light on the fact that while we are learning some important information from the data collected by the Citizen Scientists, there is more research that is needed to better understand the ecosystem impacts of environmental conditions in the Salish Sea.

FEATURED CITIZEN SCIENTIST: JAMES SHERRETT

SUNSHINE/ GIBSONS PATROL

James Sherrett is the newest member of the Citizen Science Oceanography Program. James recently took over the Sunshine/Gibsons Patrol. He learned about the program through an online fishing message board. James enjoys getting out on the ocean regularly to explore and fish, but he thought that joining the PSF Citizen Science program would be a great way to be involved in a larger project and contribute in a meaningful way.

While this is James' first year with the program, so far, he enjoys the opportunity to get out on the water and learn more about the ocean conditions around where he lives and fishes. Originally born and raised in Winnipeg, James has become an avid ocean fisherman since moving to BC.

When asked what salmon mean to him, he explains that salmon are the keystone species connecting all the life in the ocean. As a fisherman, he also loves to catch, eat, and share this coast with salmon. He is grateful and very aware of the nourishment that salmon provide to his family, as well as the surrounding ecosystem.

When James is not volunteering with the PSF Citizen Science Oceanography program he is involved with coaching kids' hockey and learning to play the drums. He also works in the technology sector and helps software startups with their early sales and marketing capabilities. He's worked in the software industry for the past 15 years and keeps active in the community with a portfolio of approximately 4 to 5 startups.

“Learn to do by doing. It is the best thing I've found to understand any topic.”

– Life advice from James



James and his son out on the water collecting samples for the Citizen Science Oceanography program.

When we asked James what he thought was the most significant thing that he has seen change in the world in his lifetime, he noted how computers have become the intermediaries to an ever-increasing percentage of human interactions. As someone who works in the tech sector, he recognizes the positive and not so positive consequences of this change. FaceTime for example, means his dad can tap a button and virtually “see” him from halfway across the country, but it also means that he is always expected to be reachable, making it difficult to unplug. Something many of us struggle with these days.

James has passed his love and passion for the ocean down to his son (pictured above), who recently came out to help James with the citizen science ocean sampling. After a day on the water helping to collect samples, his son decided that he would like to become a marine biologist when he grows up!

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**PACIFIC SALMON
FOUNDATION**

1385 West 8th Ave,
Vancouver, BC, V6H 3V9
Tel: 604-664-7664
Email: salmon@psf.ca

For further information, please contact:

Nicole Frederickson at nfrederickson@psf.ca
or Isobel Pearsall at pearsalli@psf.ca