

Experience in developing and operating a marine Citizen Science Program in the Strait of Georgia, Canada

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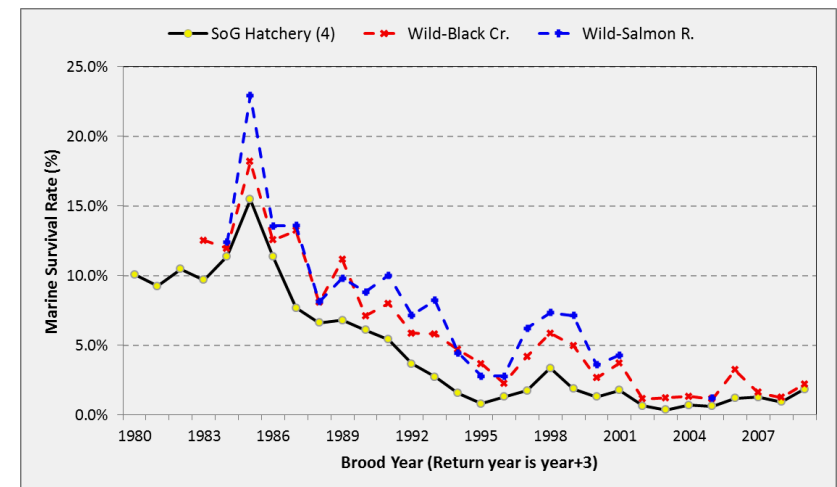
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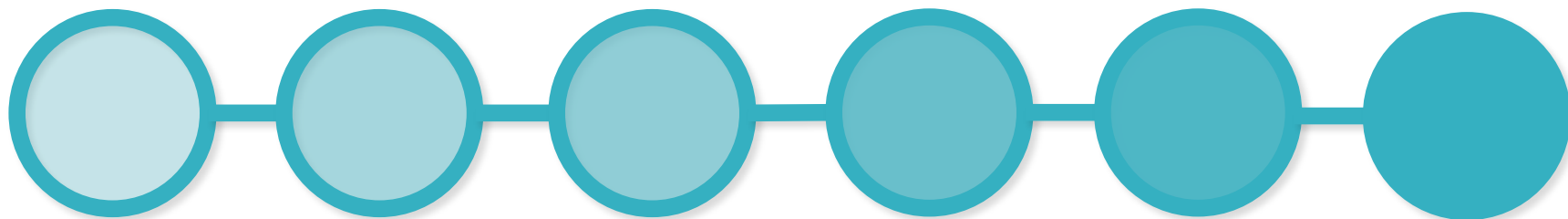
PICES 2019: Connecting Science and Communities in a Changing North Pacific



- 90 to 95% decline in Strait of Georgia Chinook and Coho fisheries in the 90s... with little recovery since that time.
- Resulted in major loss of \$\$ to local communities
- Numerous other ecological changes observed around the Strait of Georgia

Early marine survival of Pacific salmon in the Strait of Georgia is the likely cause but mechanisms not understood.





150+ participants 60+ entities \$20 million 5 years 2 countries 1 question

What are primary factors affecting juvenile Chinook, coho & steelhead survival in the Salish Sea marine environment?



SALISH SEA
MARINE SURVIVAL PROJECT



SSMSP-Hypotheses

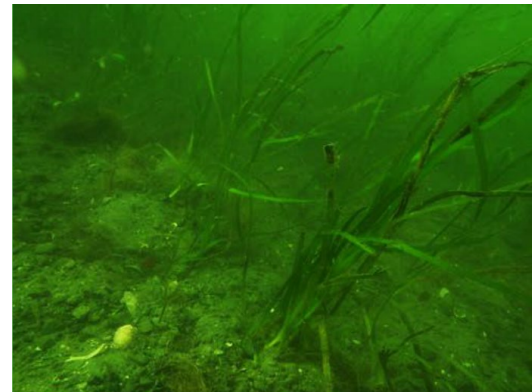
A. Bottom-up processes (growth linked to survival)



B. Top-down processes



C. Ecosystem quality



Objectives

- To achieve oceanographic monitoring of the Strait of Georgia at a temporal and spatial scale not done before
- To examine how changes in ocean temperatures, oxygen content, salinity, and nutrients impact the food web of Phytoplankton → Zooplankton → Salmon
- To determine the prevalence of harmful algal blooms throughout the Strait of Georgia
- To determine the timing and propagation of the spring bloom throughout the Strait

Data Collection Methods



Research Vessels

Wide geographical coverage
Limited access=Low Resolution
Expensive to operate



Fixed Infrastructure

High resolution
Long time series

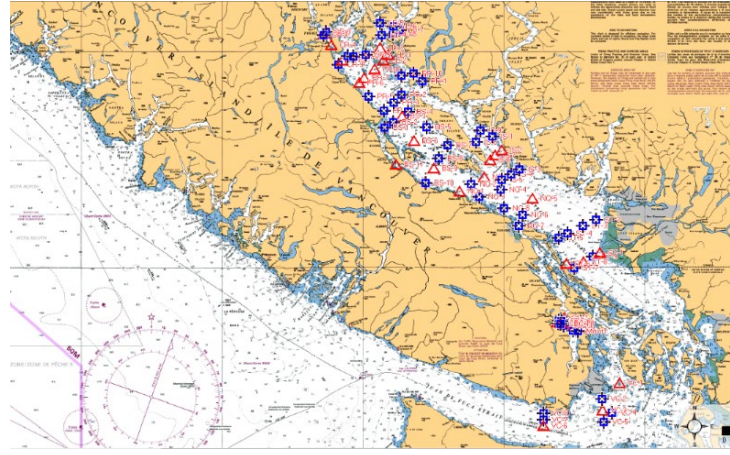
Limited geographical coverage
Expensive to install



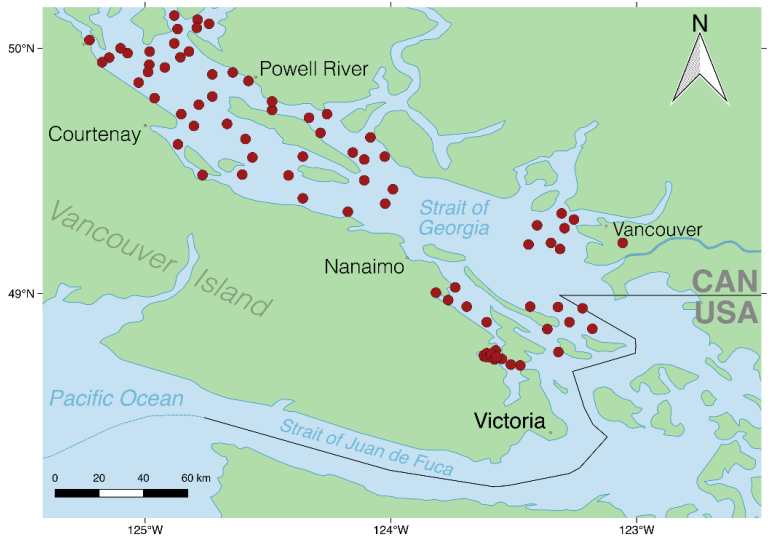
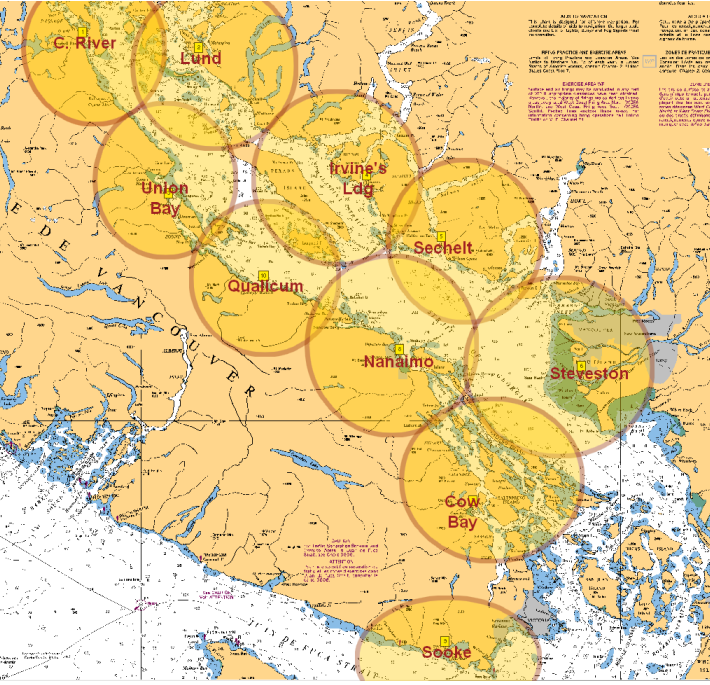
Why use Citizen Oceanographers?

2015 Program

- To allow for oceanographic sampling and monitoring in the Strait of Georgia at a *spatial scale not possible before*
- How?
- Using small boats “sampling everywhere at once”



2016-2017 Program



 Government of Canada / Gouvernement du Canada

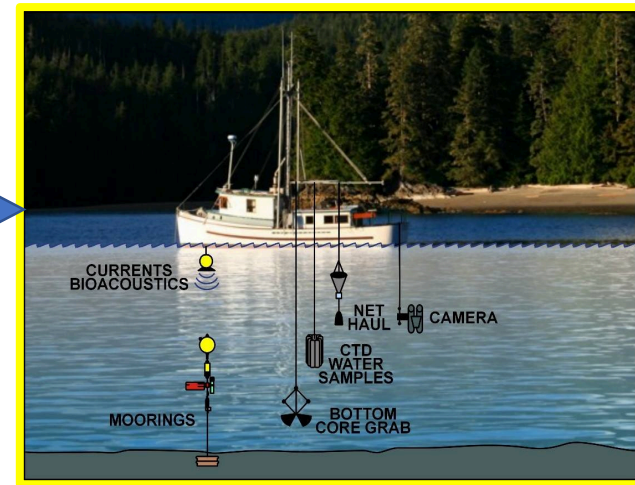





Science on the Coastal Margin



Methods

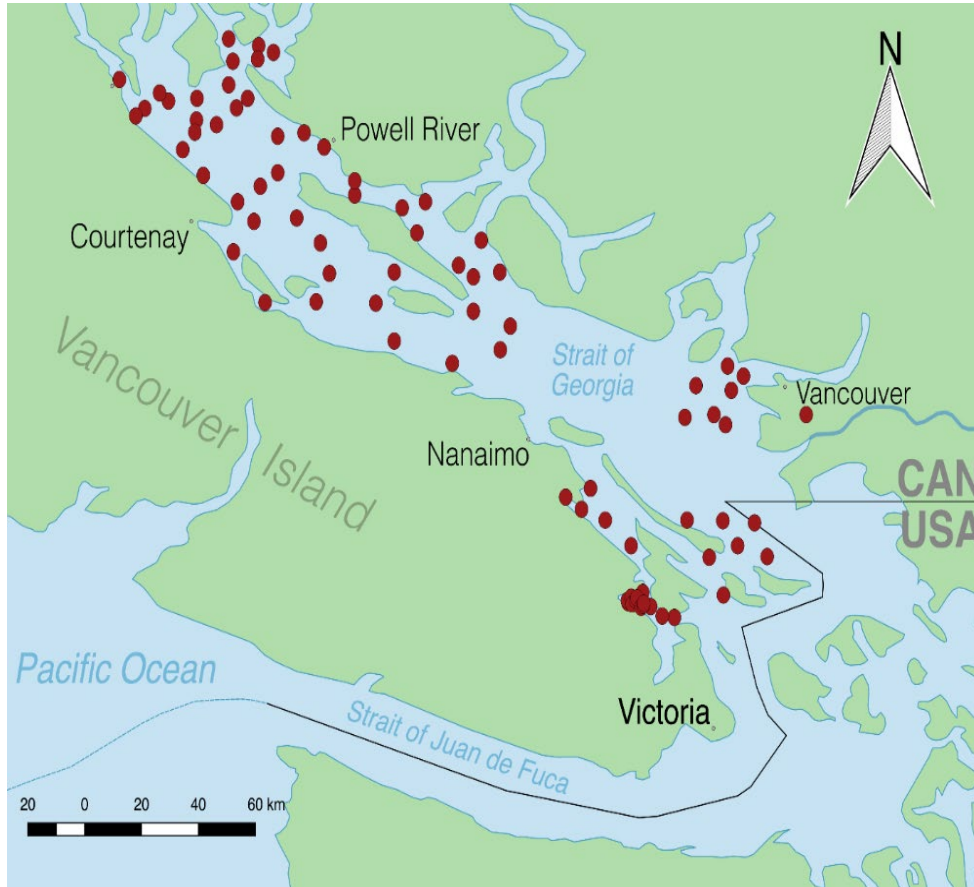


- PEOPLE!
- Equip Boats
- Training modules
- Training video
- Audits
- Feedback



PSF Citizen Science Oceanography Program

Pacific Salmon Foundation, Ocean Networks Canada, DFO, UBC



Sampling Plan

2015 - 2019

February – October (now year-round)

~ 2/3 times a month

~ 80 stations

CTD (temperature, salinity, depth, DO, fluorescence) to 150m or bottom

Secchi

Phytoplankton (surface, 5m, 10m, 20m)

~10 stations

Nutrients (surface & 20m) – nitrate + nitrite, silicate, phosphorus

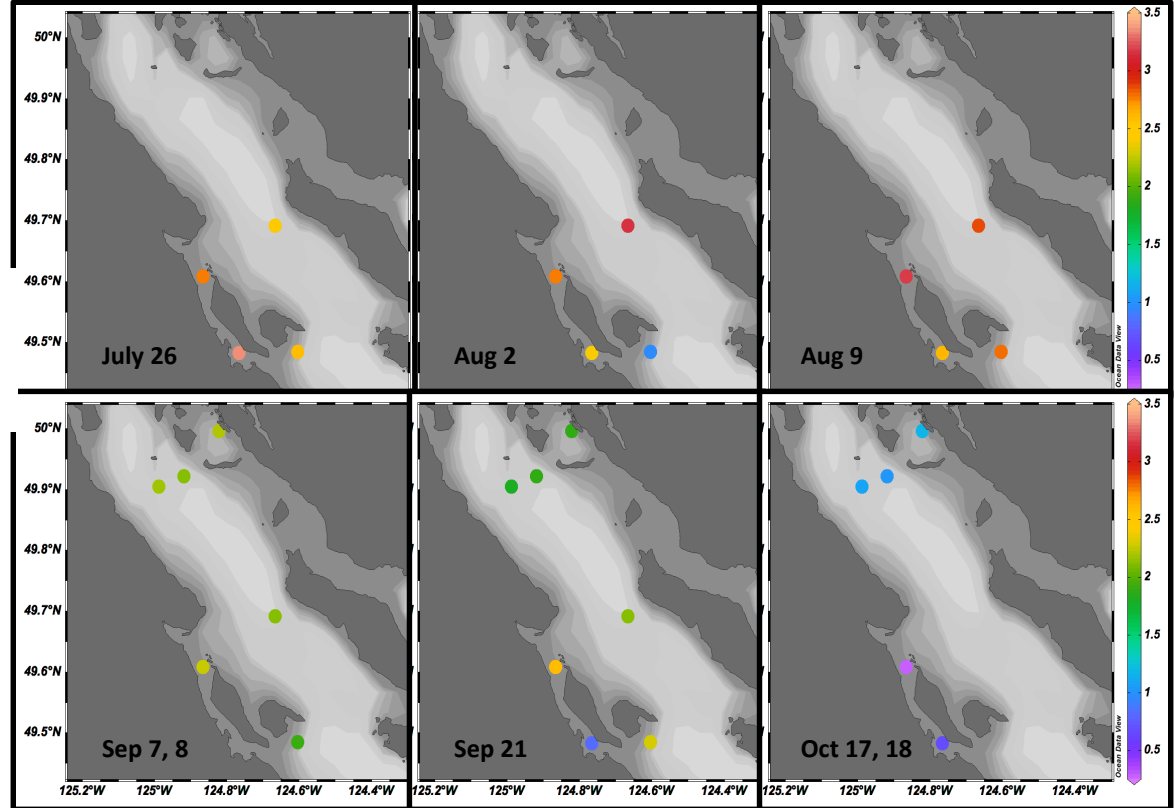
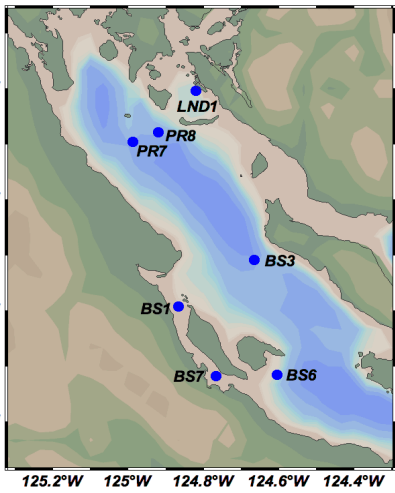
Chlorophyll a (5m)



Field Operations

Ocean Acidity

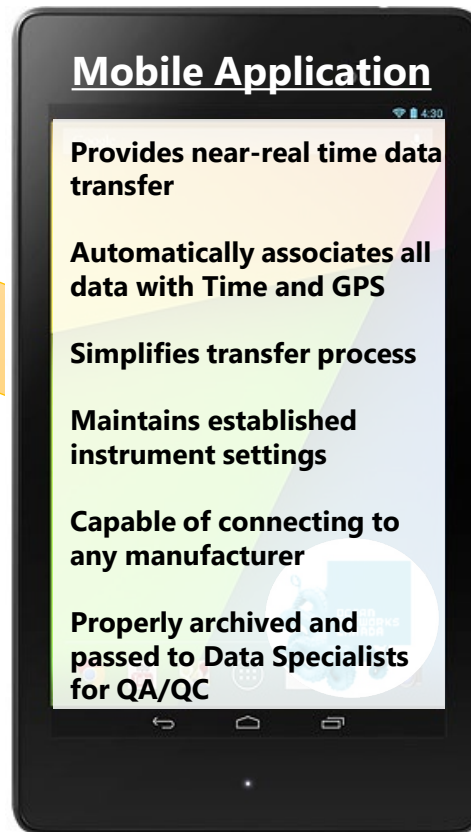
eDNA?



Data Transfer-ONC's Community Fishers App



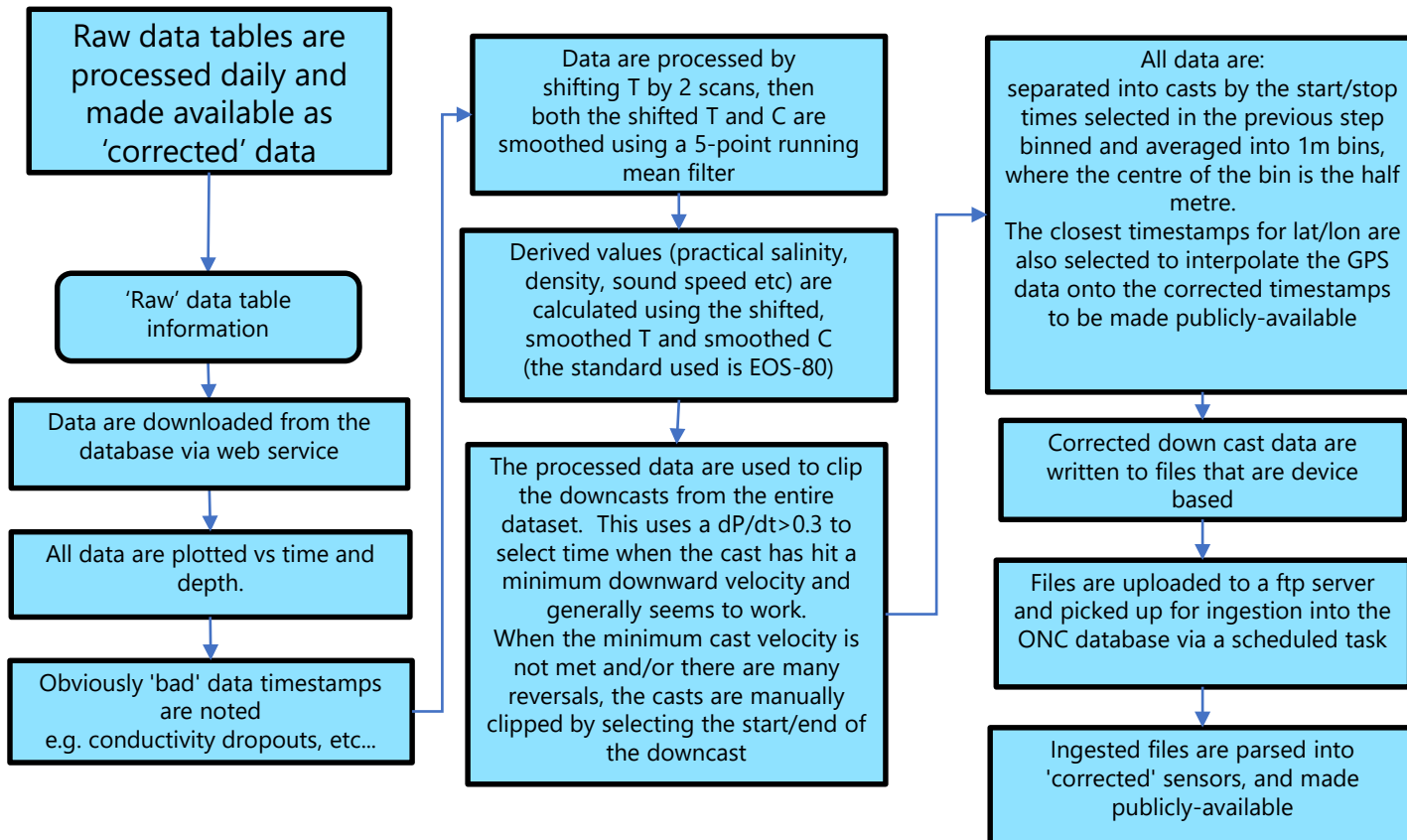
Remote Area
Data Collection



Shared Data Access



Data Collection & Transfer – Mobile App



Data

2015 - 2019

CTD ~6000 CTD casts

Secchi ~12000 reading

Phytoplankton >8000 samples

Nutrients ~8000 samples

Zooplankton ~400 samples

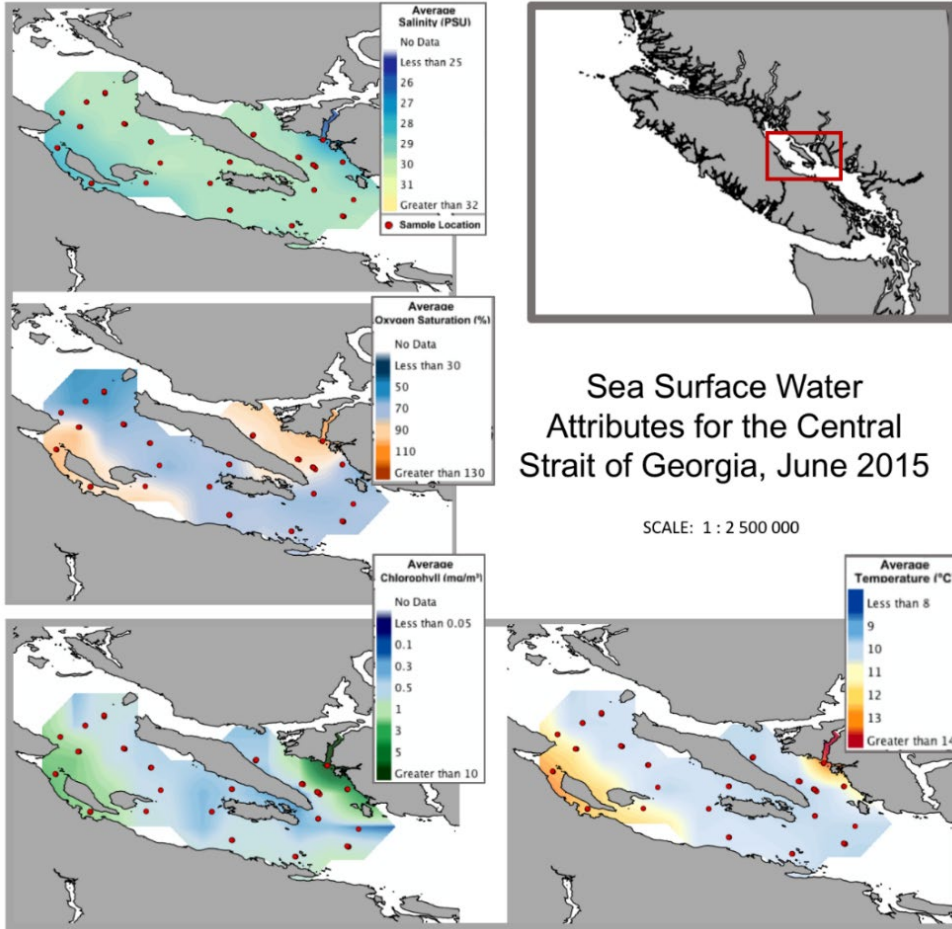
<http://www.oceannetworks.ca>

<http://sogdatacentre.ca/>

Sampling Years	Sample Dates	Vessel Trips	CTD casts	Nutrients	Phyto/HABS	Chlorophyll	Secchi Recordings	Zooplankton	Total Samples
2015	19	150	1,132	2,264	1,381	193	2,088	146	7,204
2016	22	199	1,445	1,587	2,064	349	2,825	60	8,330
2017	21	197	1,420	1,529	1,934	340	2,814	54	8,091
2018	24	205	1,160	1,621	2,037	362	2,903	69	8,152
2019*	15	80	578	794	872	156	1,127	45	3,572
5 years	101	831	5,735	7,795	8,288	1,400	11,757	374	35,349

* 2019 data is compiled of only 15 dates so far, more data to be collected.

How We are Using Data from the Citizen Science Program?



SAMPLE ANALYSES:

Nutrients & Chlorophyll- IOS

Phytoplankton-Svetlana Esenkulova

Zooplankton- IOS

CTD data-ONC



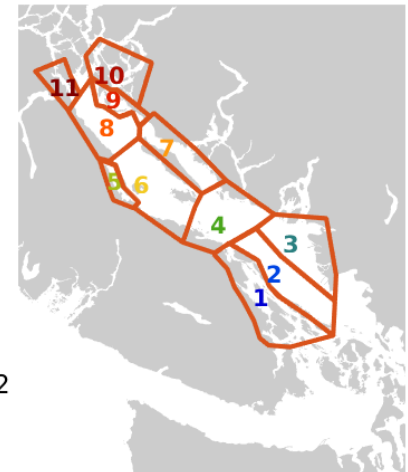
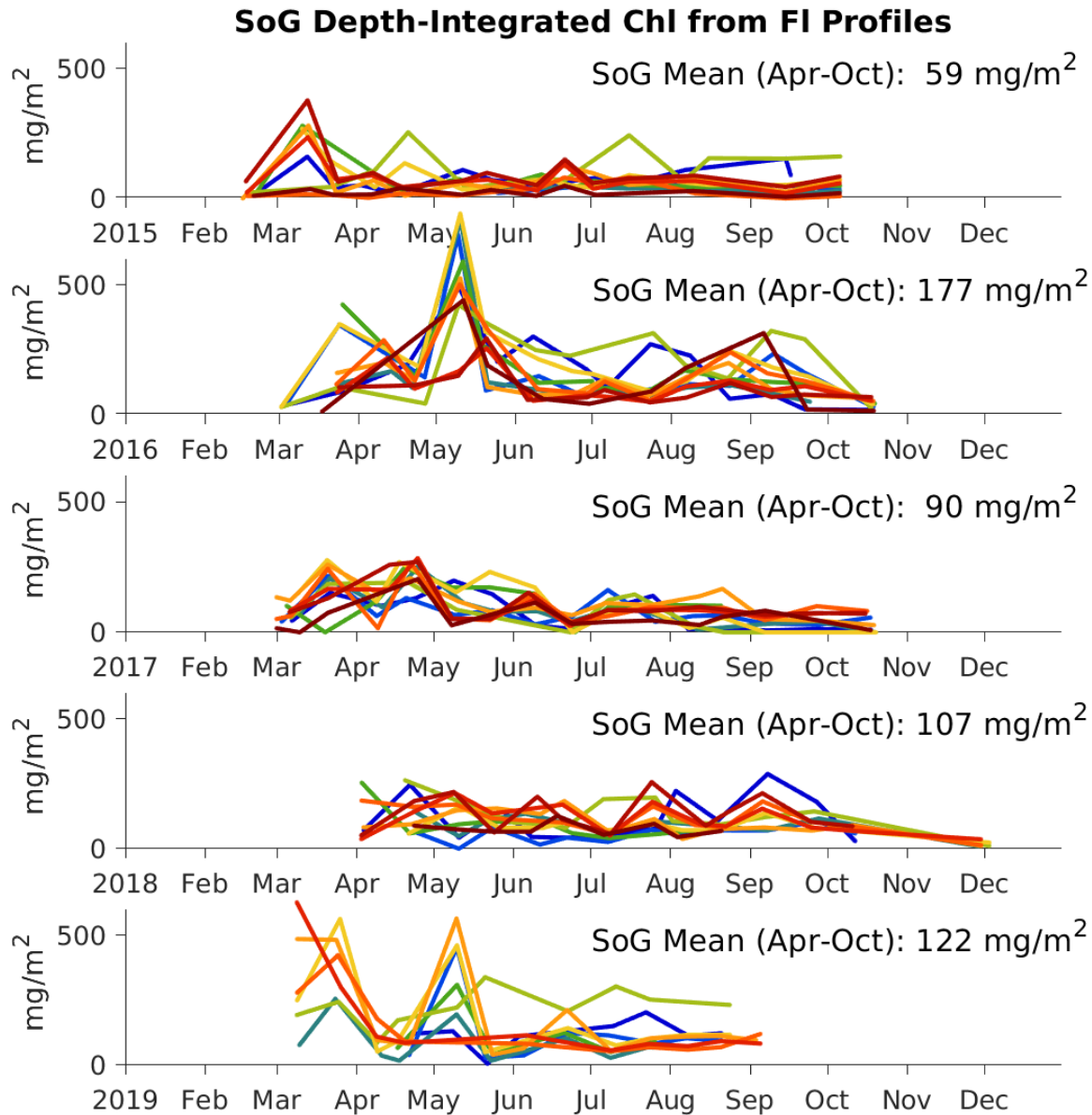
Photo by K. Young

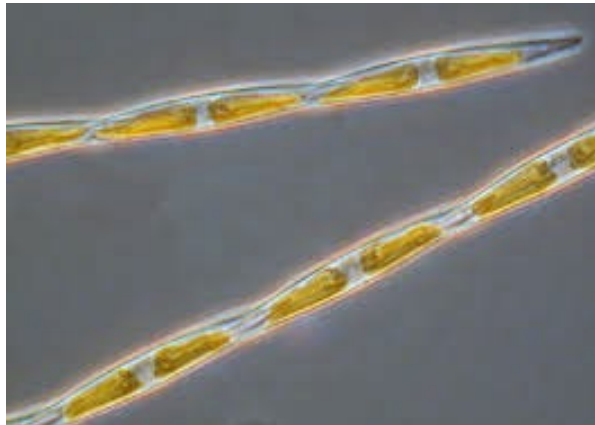
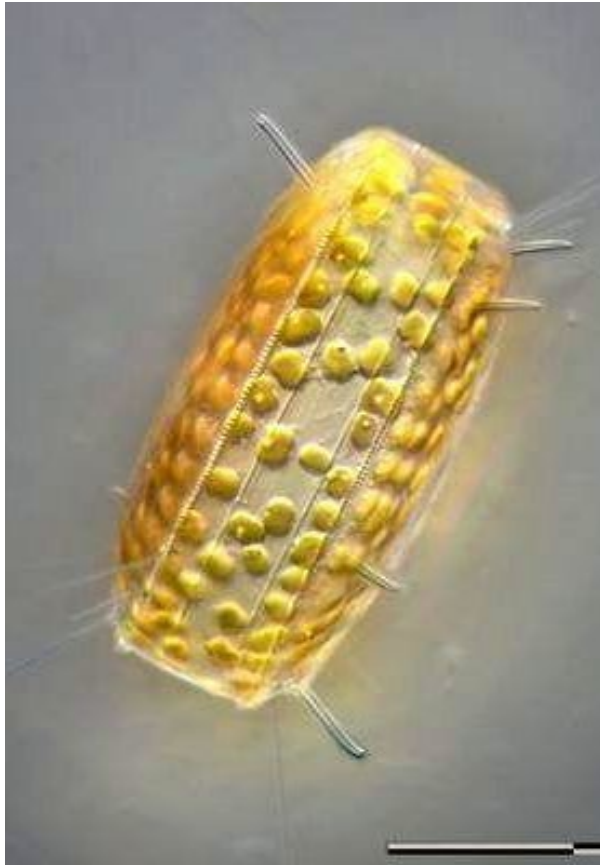
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Chlorophyll from CTD- 2015-2019





UCN

British Columbia salmon farmers on alert after Grieg's toxic algae disaster

By Jason Hufferman - June 8, 2018 17:00:00PT



A microscopic algal bloom like the one that killed half of Grieg's farmed salmon off the coast of British Columbia. Photo courtesy of Microscopic Observations.

Marine Harvest officials might have breathed a small, collective sigh of relief last week, but none of the salmon farmers operating off the coast of British Columbia, Canada, can really relax.

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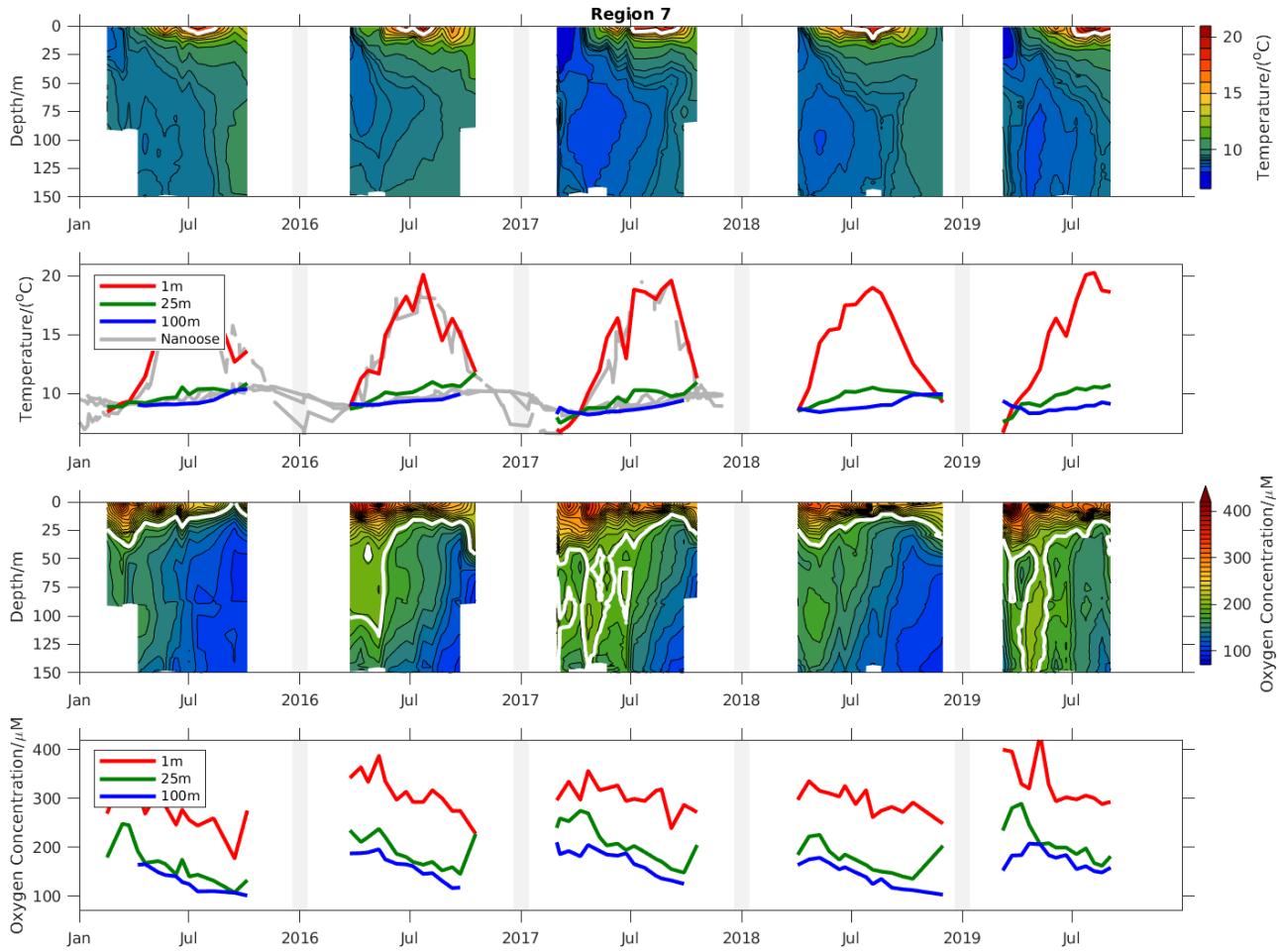
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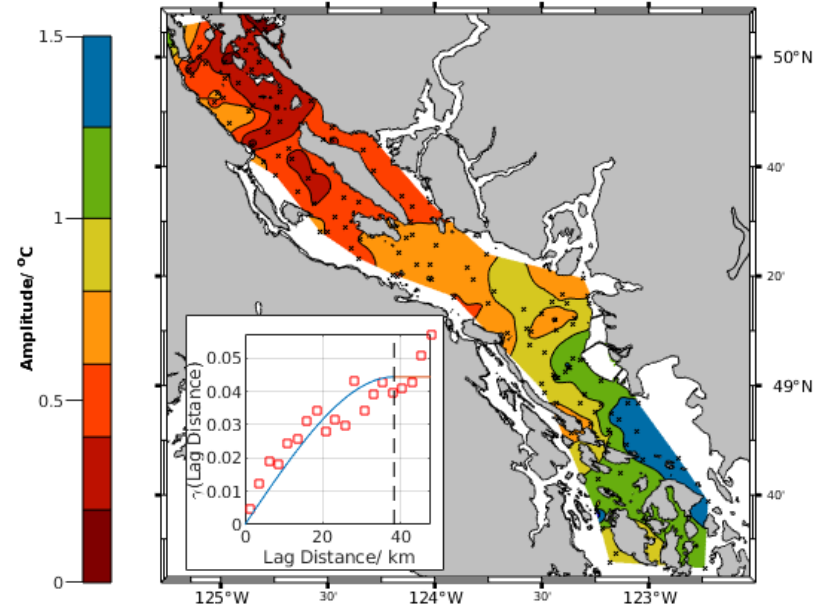
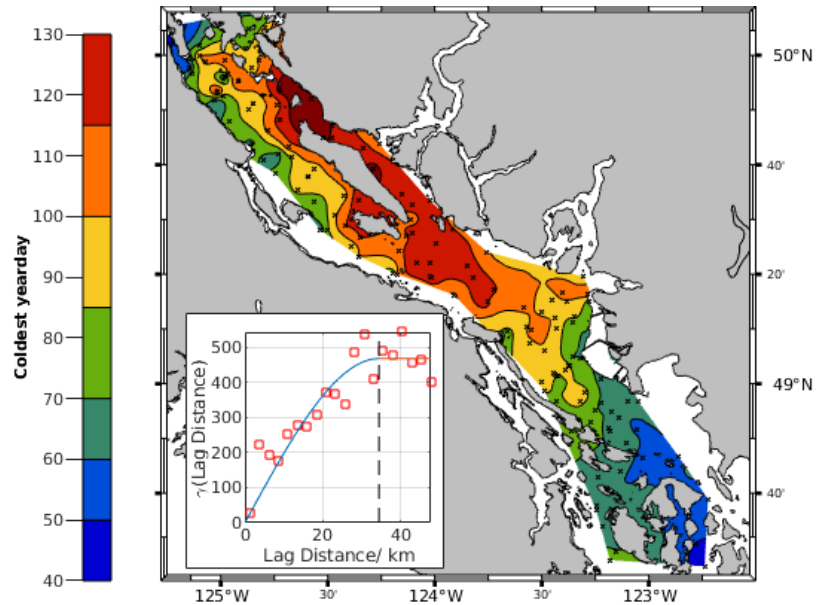
AlgaePrime
Algae-Fed Salmon Takes

Spring & Summer blooms & HABs

Temperature & DO- Malaspina Strait



Timing of Seasonal Cycle Stevens & Pawlowicz



Citizen Science Data is being used to study the following:

- Strategic Salmon Health Initiative: is there a relationship between level of stress (fish from areas temps $> 17^{\circ}\text{C}$ temp & $< 6\text{ppm O}_2$) and expression of disease states?
- Harmful algal blooms: How does water temperature/ salinity/ DO/nutrients affect prevalence of HABS?
- Migration Pathways of Pacific Salmon: Is there a relationship between water quality/hotspots of plankton & migration pathways?
- Kelp and Eelgrass Restoration: Characterizing turbidity and water properties in a number of estuaries around the Strait
- Juvenile Salmon Studies: Relating the distribution, diet and fish size for key juvenile salmon stocks to temperature, salinity and dissolved oxygen.
- Modeling Studies and Satellite Data: Data collected by the citizen science program is being used to validate 3D biological models of the Salish Sea, and to ground-truth satellite imagery with on-ground data

Partnering with 10 Coastal Communities

& organizations to build
a maritime awareness
information system



Government
of Canada

Gouvernement
du Canada

Canada

Transport Canada has provided funding for Citizen Science data collection with ONC using the model developed by PSF to between 4 and 6 communities across Canada through the OPP Program for Enhanced Maritime Situational Awareness (PEMSA)

DFO has provided funding for Iqaluit, Nu.

Other SoG community sampling programs

- Uvic Adult Diet Study- forage fish trends, winter diets
- Avid Anglers- Pacific salmon stock composition, year round, residency
- FN and Uvic- Kelp Mapping- Identifying Resilient Stocks
- Seachange- monitoring eelgrass populations
- WWF & VIU- forage fish embryo surveys

Summary

- Citizen Science is a very cost effective way to gather a large number of samples
- This collaborative program is now continuing for a fifth year, providing oceanographic information at a temporal and spatial scale not easily achieved with large traditional research vessels
- The data collected allow us to assess annual variation in physical/chemical oceanography, develop ecosystem models, validate satellite imagery, and understand spatial and temporal changes in productivity of the Strait of Georgia

Thank you!

Citizen Science Program

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Phyto questions

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