

# Update on DFO Science Activities in support of Southern Resident Killer Whale Recovery

January 8, 2020 – Vancouver BC



Government  
of Canada

Gouvernement  
du Canada

Canada



# OUTLINE

- Whale Detection and Collision Avoidance Program
- Marine Environmental Quality - Acoustics
- Marine Environmental Quality - Behavioural Research
- Contaminants of SRKW and their prey
- Chinook - Killer Whales Interaction Program
- Cetacean Research Program



# Ocean Protection Plan

## Whale Detection and Ship Collision Avoidance

Harald Yurk, Scientific Lead – Pacific region

Rianna Burnham, Postdoctoral Researcher

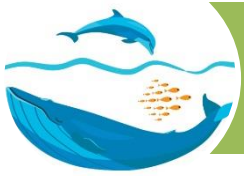
Pacific Science Enterprise Centre and Institute of Ocean Sciences



Government  
of Canada

Gouvernement  
du Canada

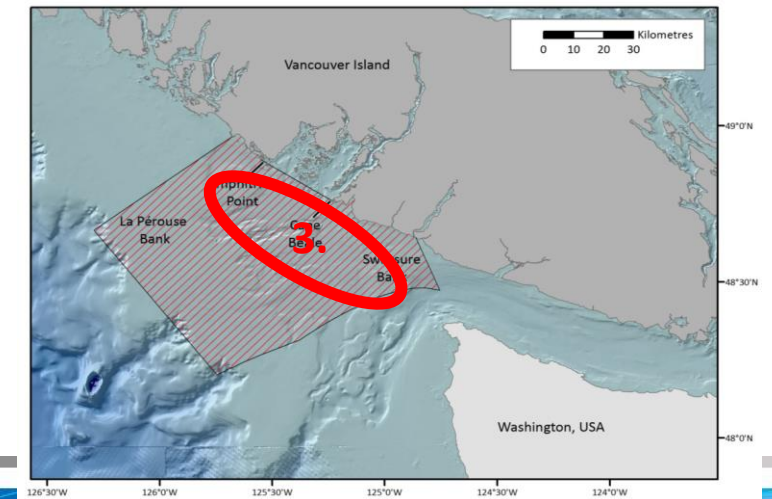
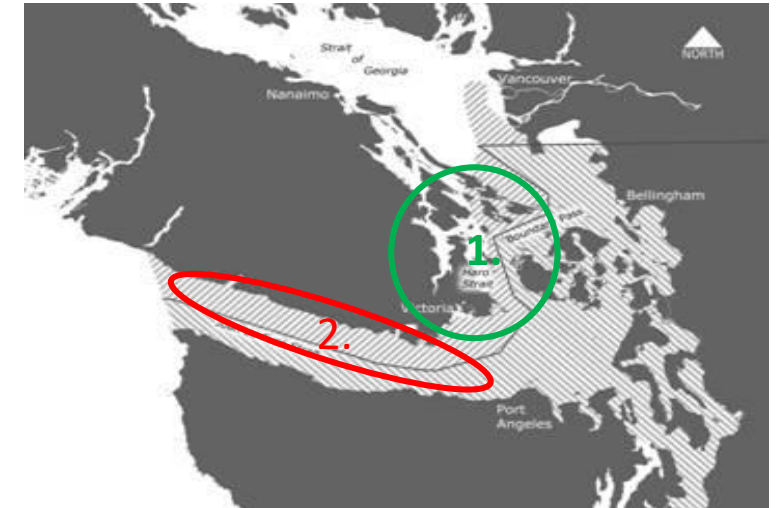
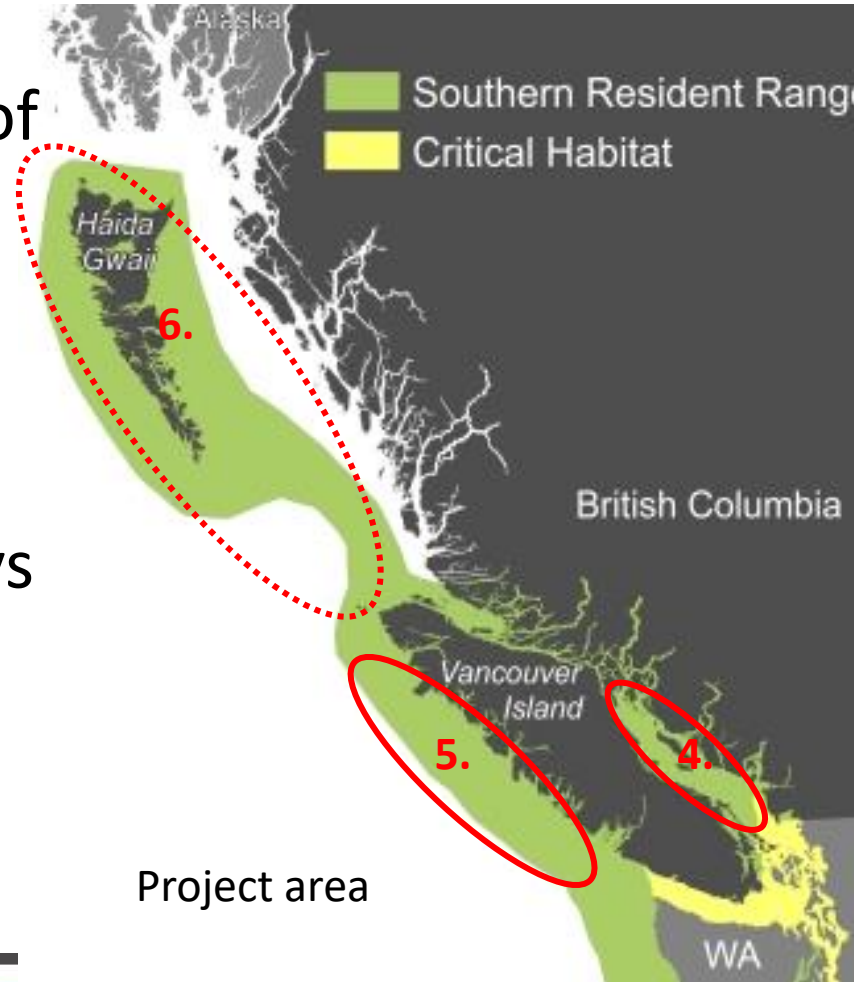
Canada



# Objectives

## Reducing the Threat of Collisions between Vessels and Whales

- Testing Whale Detection Tools
- Testing various ways to Alert Ships of Whale Presence





# 2019 Results

- Whale Tracking Network efficacy testing underway
- Automated Detector training and Call Classifier under development:
  - To be used to determine presence and absence of SRKW in recordings.
- Testing drift buoys as whale detection tools.
  - A Coastal Acoustic Buoy (CAB - developed by SMRU Consulting) equipped with automated detection software was tested successfully in protected but remote near-shore waters



# 2019 Results (con't)

- IR/Thermal Imaging Automated Detection System
  - successfully installed by researchers from the University of Erlangen (Germany) and started monitoring whale presence at the eastern entrance of Active Pass
- Predictive SRKW movement forecast model
  - In collaboration with researchers from SFU, uses physical and biological parameters to predict SRKW movement and is updated continuously via real-time detection (visual, acoustic, and mariner sightings)
- Testing of a Real-time Sightings and Ship Alert App
  - Testing of App developed by OceanWise has started



# Plans for 2020

- Continuing the activities from 2019
- Test the efficacy of:
  - an acoustic ocean glider as a tool for ship alerts of SRKW
  - Acoustic Profiling Buoys as a tool for ship alerts of SRKW in remote offshore areas
- Test the suitability of a whale tracking system based on bottom-mounted wirelessly interacting acoustic nodes

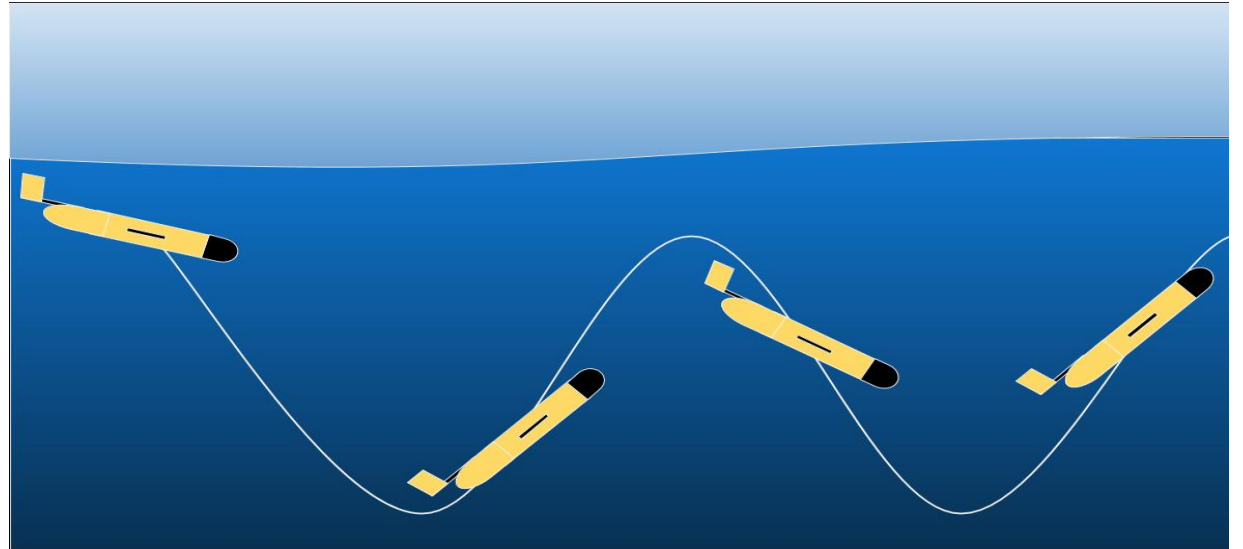


# Testing ocean gliders as a passive acoustic detection data collection tool

- Gliders are autonomous underwater vehicles
- Have no combustion engine, using electrical power from on-board batteries
- Quiet and unobtrusive survey tool
- Can survey for periods, at times, and in places that might be cost or weather restricted

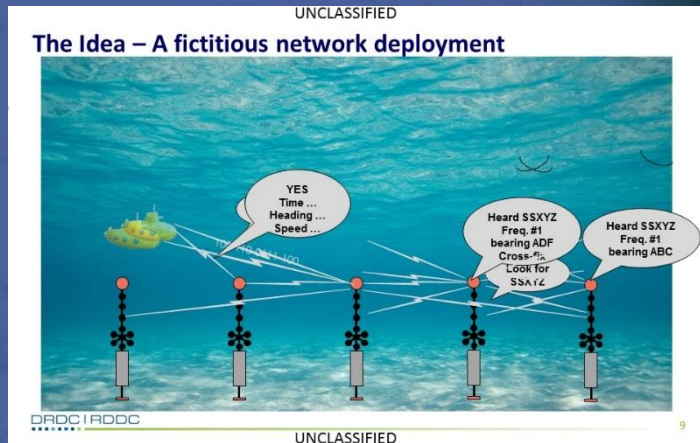
## GOAL

- Test the capacity of glider-mounted passive acoustic recording systems
- Test the capability of a real-time detection instrument developed by JASCO Applied Sciences
  - 21 on-board whale detection algorithms

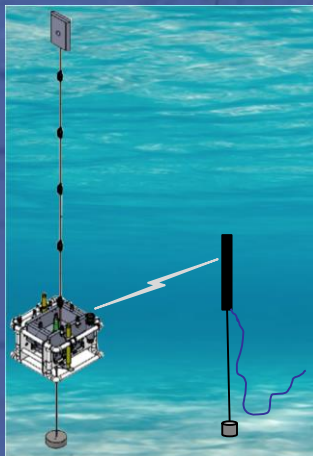




# Current and planned locations of acoustic nodes on Swiftsure Bank



cabled modem  
(no surface expression)



Existing acoustic  
mooring

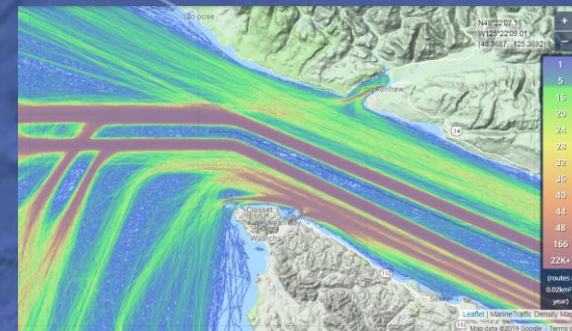


Modem Link

Possible Node locations

Cable

Carmanah Lightstation



Google



# OPP-MEQ Noise Baseline

Svein Vagle, Caitlin O'Neill and Peter van Buren  
Ocean Sciences Division, IOS



Government  
of Canada

Gouvernement  
du Canada

Canada

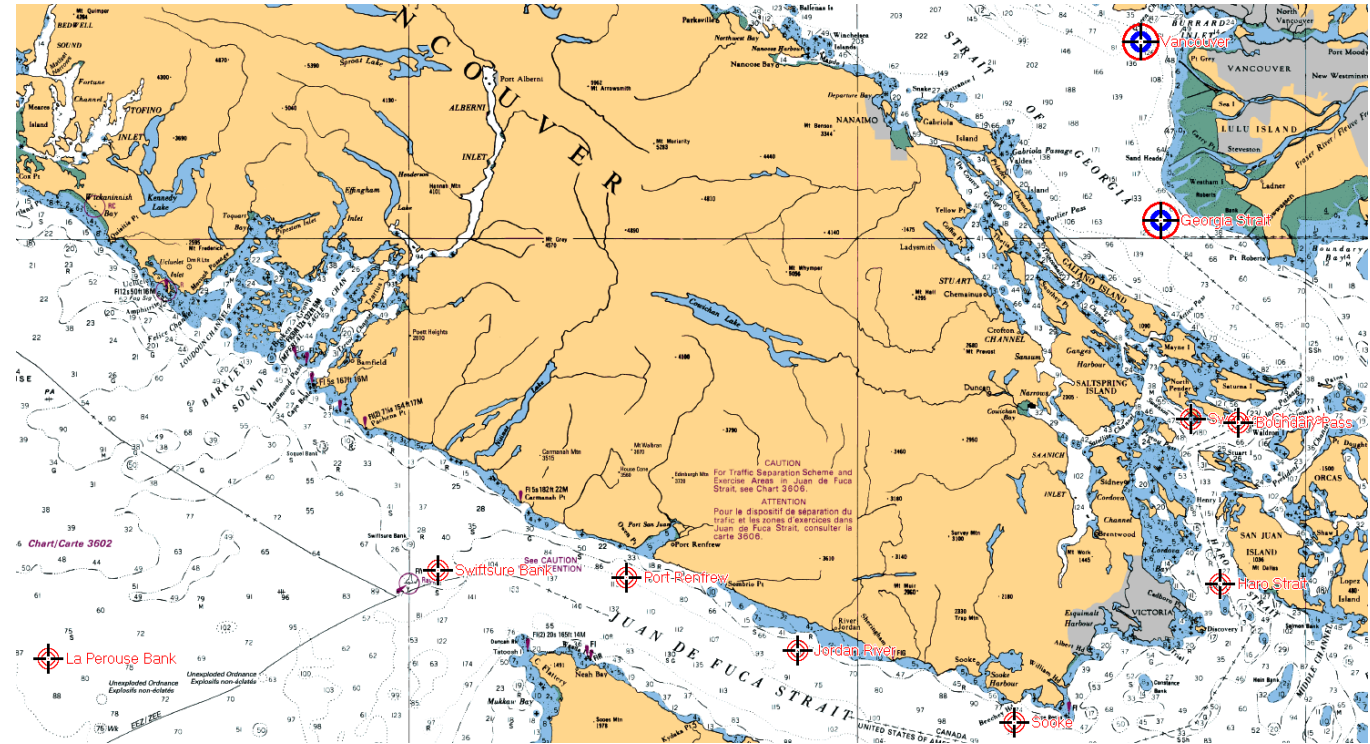


# Goals and Objectives

Reduce the impact of day-to-day vessel traffic on the acoustic environment for marine mammals

- Collecting continuous ambient noise recordings in 6 SRKW habitat areas since February 2018. (Moorings serviced every 3-4 months, CCGS Vector)
- Participated in Lateral displacement trials in Juan de Fuca, 2018 & 2019.
- Equipment for two additional moorings in Strait of Georgia will be in place June 2020 (TMX Recommendations 5/6)
- Set up calibration facility at IOS for annual calibrations of DFO hydrophone systems.
- Measurements of SRKW and NRKW echolocation clicks source levels (with UVic researchers).

Map of project area showing sound recorders at La Perouse and Swiftsure Banks and Juan de Fuca, Haro Strait and Boundary Pass. (Two new recorders in Strait of Georgia in early June 2020)





# 2019 Results

- Soundscapes vary significantly from habitat to habitat depending on sound sources and geography. Relevant to choice of mitigation approaches.
- Soundscapes highly dependent on changes in water masses (sound speed characteristics) on tidal timescales. Relevant to evaluation of impact of mitigation approaches.
- Lateral displacement (2018 study) of deep-sea vessels in Juan de Fuca **not** effective as approach to reduce noise in critical habitats. Displacement of tugs and other near-shore vessel traffic **is** effective mitigation.



# Plans for 2020

- Analyze 2 years of underwater noise data in SRKW critical habitat to generate pre-TMX baselines and baseline metrics.
- Analyze impact of 2019 lateral displacement trial on noise in Juan de Fuca.
- Expand array of hydrophone stations to include Georgia Strait (TMX Recommendations 5/6 funding)
- Set up a vessel noise model for the Salish Sea (based on existing model for Gulf of St. Lawrence). Validate model using baseline observations and model the effect of additional TMX vessels and TC mitigation approaches.



# OPP-MEQ SRKW Impacts

Sheila J Thornton, Christine Konrad, Katy  
Gavrilchuk, Charley Cragg

Pacific Science Enterprise Centre, West Vancouver



Government  
of Canada

Gouvernement  
du Canada

Canada

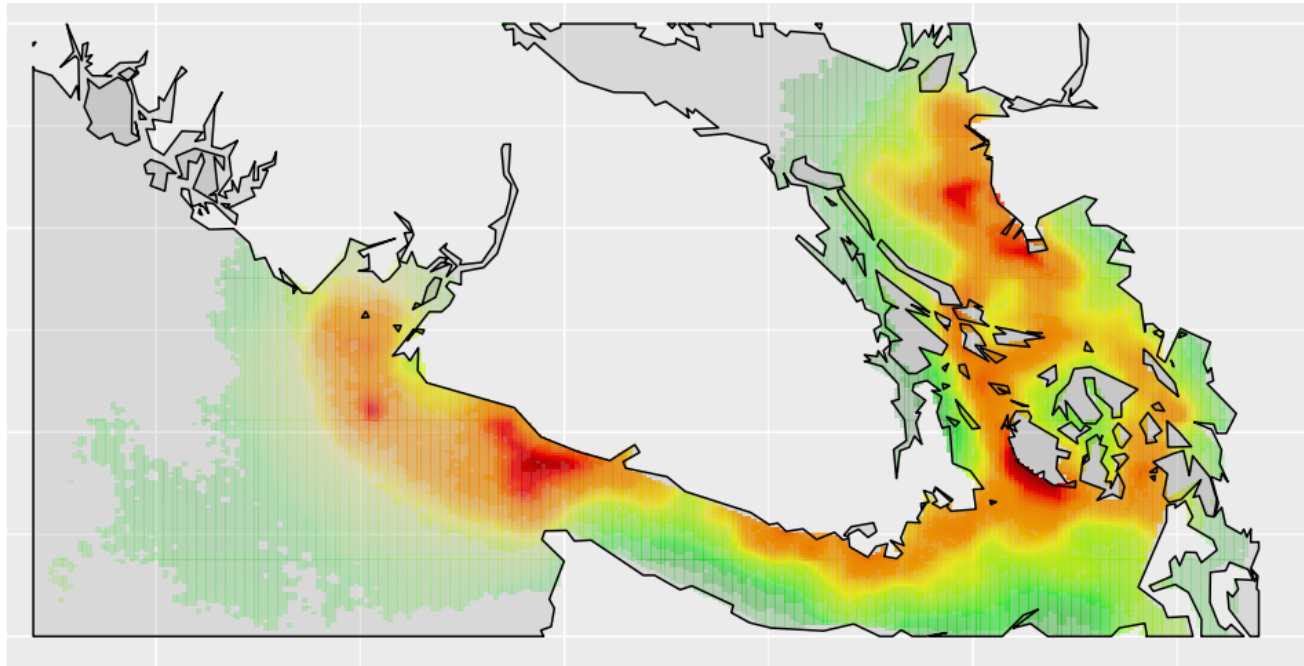


# Goals and Objectives

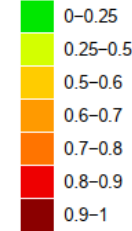
- Identify SRKW habitat and fine scale habitat use in the Salish Sea; provide best available information to management
- Evaluate diving behaviour and catch per unit effort data of NRKW and compare to NOAA data for SRKW to refine threats to SRKW survival and recovery
- Better understand impacts to RKW through stress hormone analysis, foraging behaviour and prey analysis



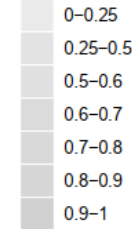
# 2019 Outcomes – Habitat maps



Percentage



Confidence



Effort correction analysis complete

Currently working on publication  
detailing annual SRKW habitat  
May to October

Maps will provide monthly habitat  
use from May to October by pod

Publication of biological  
significance planned for late  
spring/early summer of 2020



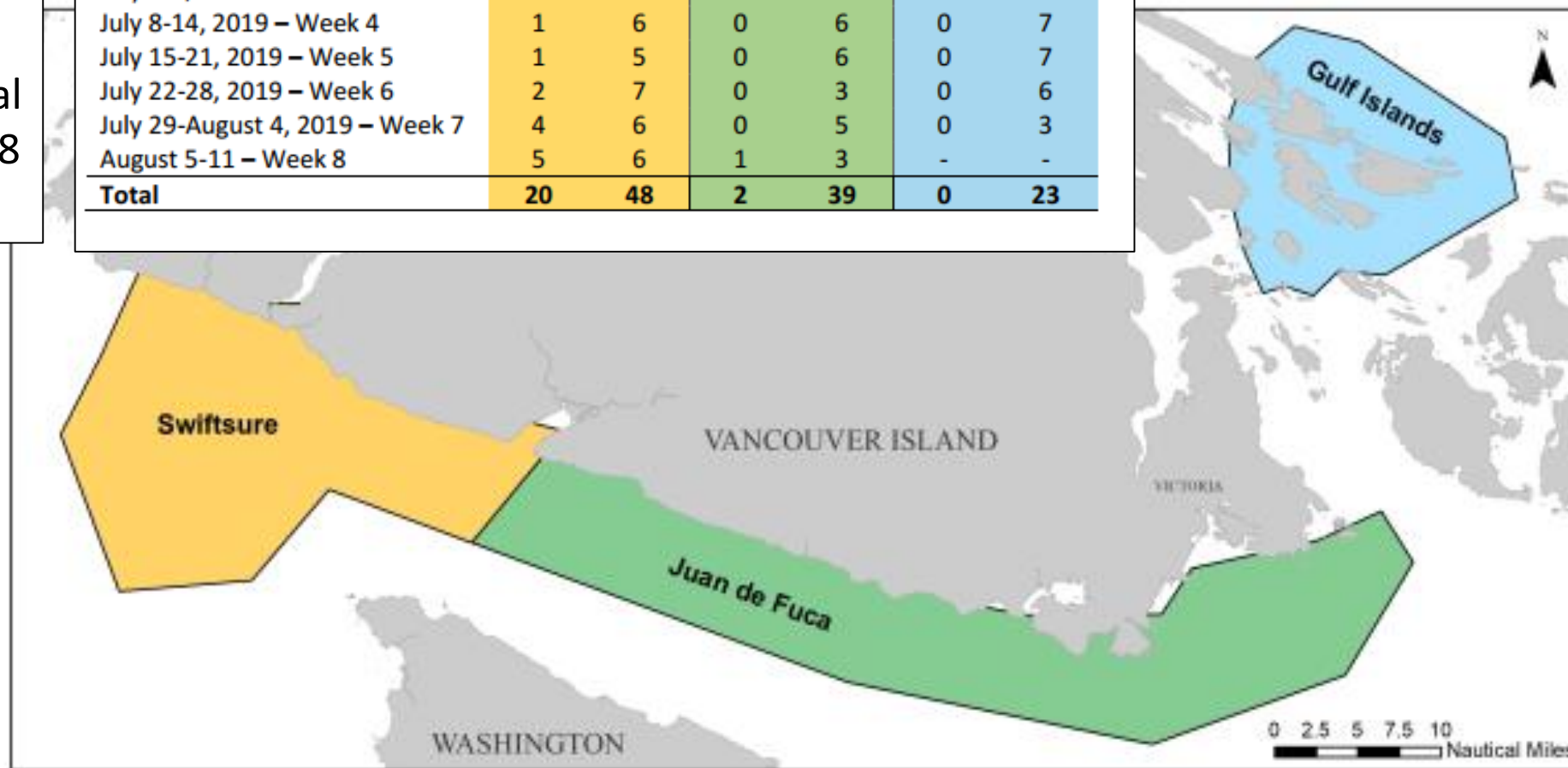
# 2019 Outcomes - Habitat Use

## OUTCOME - 2019

87 days on the water

- 32 SRKW days
- 13 focal follows/16.2 hrs of data
- 18 group behavioural surveys/64.8 hrs/398 scans

Dates	Swiftsure		Juan de Fuca		Gulf Islands	
	Whale days	Vessel days	Whale days	Vessel days	Whale days	Vessel days
June 17-23, 2019 – Week 1	0	5	0	4	-	-
June 24-30, 2019 – Week 2	3	7	0	7	-	-
July 1-7, 2019 – Week 3	4	6	1	5	-	-
July 8-14, 2019 – Week 4	1	6	0	6	0	7
July 15-21, 2019 – Week 5	1	5	0	6	0	7
July 22-28, 2019 – Week 6	2	7	0	3	0	6
July 29-August 4, 2019 – Week 7	4	6	0	5	0	3
August 5-11 – Week 8	5	6	1	3	-	-
<b>Total</b>	<b>20</b>	<b>48</b>	<b>2</b>	<b>39</b>	<b>0</b>	<b>23</b>





# 2019 Outcomes – DTAG study

## NRKW DTAG Fieldwork Summary 2018 & 2019

**229 h/43 d** of effort

**23** unique NRKW individuals tagged

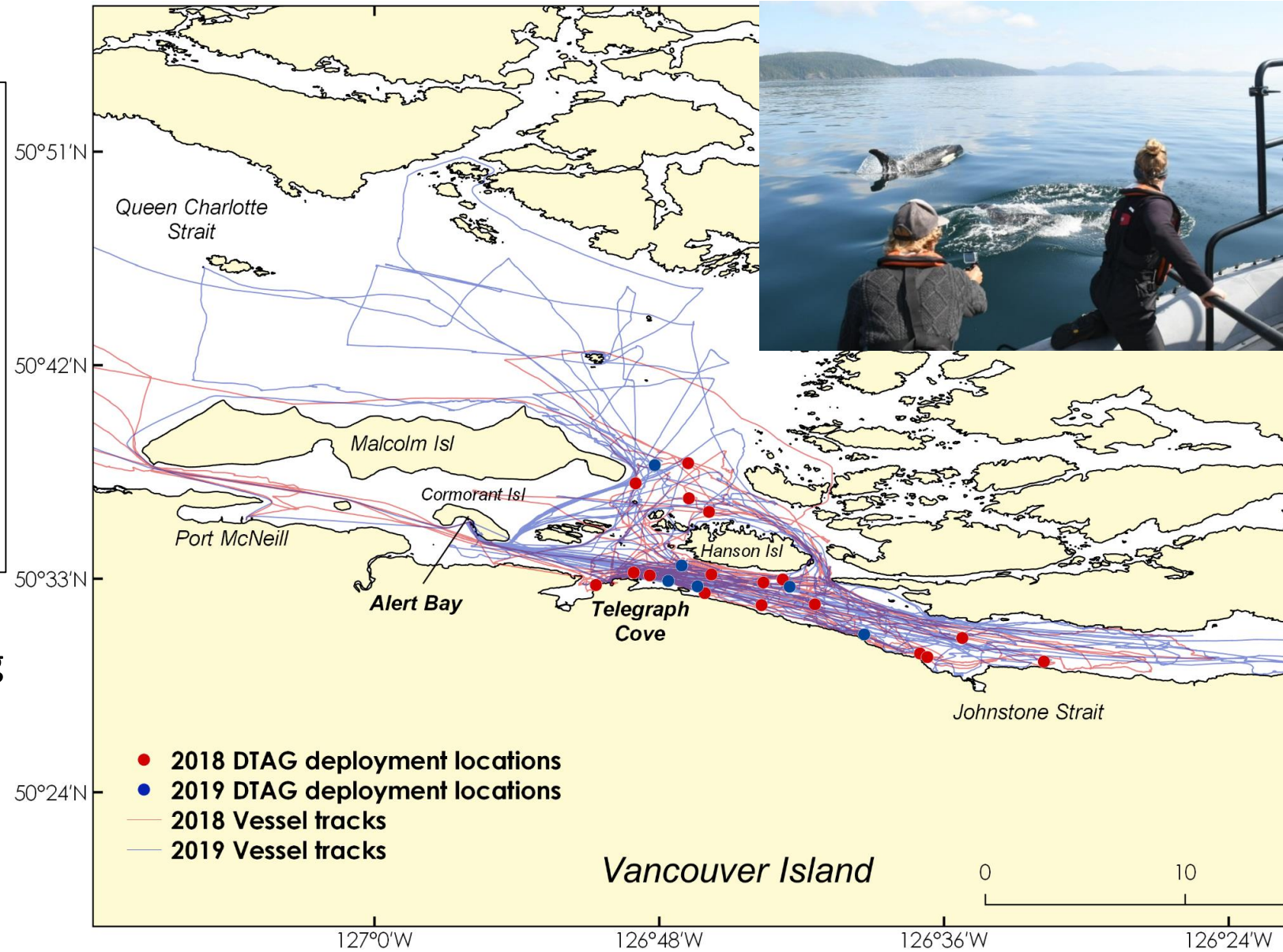
**10** females, **10** males, **3** TBD

Collected **61 h** of **night** time data (n=12)

**55 h** of **day** time data (n=22)

Data analysis to follow

**PURPOSE:** Develop a better understanding of foraging behaviour in Resident Killer Whale habitat; evaluate the behaviour in the context of acoustic environment; evaluate foraging behaviour at night.





# Fecal Collection and Analysis

## Year 2 of fecal collection – NRKW/SRKW comparative analyses

- Samples are currently being aliquoted and distributed
- Prey identification/genetic analysis (PBS)
- Metabolomics panel (MEQ/Contaminants/Hormones)
- Hormone analysis (UBC MSc student/DFO)
- Contaminants - five aliquots
- Gut Microbiome (NOAA collaboration)
- Stable isotopes (TBD)
- Parasitology (TBD)





# Future Plans

- JDF Year 3 – base out of Port Renfrew – two vessels
- DTAG Year 3 – shift to central coast/Bella Bella (low vessel traffic)
- Fecal Year 3 – continued effort both SRKW and NRKW
- Robson Bight – deploy recorders for acoustic reserve data
- Breath and blow program – initiation
- Begin data analysis for Oceans/SARA RSIA
- Begin to shift overall focus toward data and sample analysis



# Contaminants of SRKW and their prey

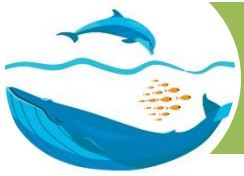
Dr. Tanya Brown and Katerina Colbourne  
Ocean Science Division – Pacific Science Enterprise Centre



Government  
of Canada

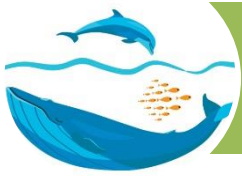
Gouvernement  
du Canada

Canada

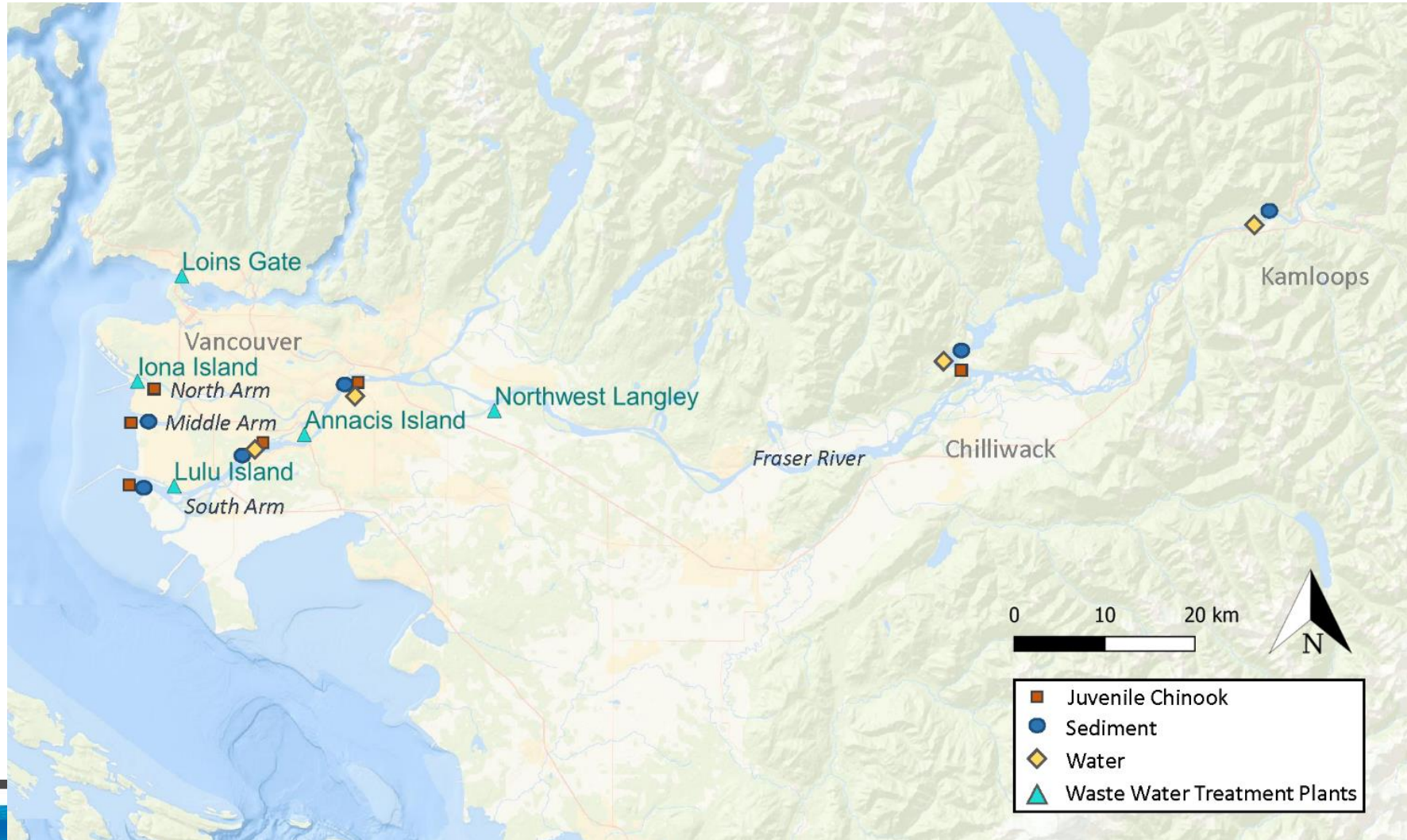


# SRKW Contaminants Project Summary

Studies	Description	Sampling
SRKW food web and habitat	Characterizing & ranking contaminants of concern	<ul style="list-style-type: none"><li>- Over 2,000 SRKW prey collected, stock ID currently being done for Chinook;</li><li>- 23 sediment sites, contaminant analysis underway.</li></ul>
SRKW health effects	Assessing health related impacts	<ul style="list-style-type: none"><li>- 37 fecal samples collected for metabolite and contaminant analysis.</li></ul>
Chinook salmon habitat and health effects	<ul style="list-style-type: none"><li>- Characterizing contaminants of concern;</li><li>- Assessing impacts</li></ul>	<ul style="list-style-type: none"><li>- 66 liver samples for health effects analysis;</li><li>- 14 juvenile chinook for contaminant analysis (underway)</li></ul>
Mercury (other metals) in SRKWs	<ul style="list-style-type: none"><li>- Metal trends in killer whales over a 40 year period</li></ul>	<ul style="list-style-type: none"><li>- 688 killer whale skin samples for contaminant analysis.</li></ul>



# Juvenile chinook salmon and habitat (sediment, water, and WWTP) sampling locations



## Thank you

Pacheedaht First Nation –  
Helen Jones, Tammi Peter  
Tsawwassen First Nation –  
Krystal Lockert  
Raincoast Conservation  
Foundation – Misty  
MacDuffee, Dave Scott  
Ocean Wise – Marie Noel,  
Peter Ross, Kelsey Delisle,  
Anna Posacka  
Simon Fraser University,  
Vicki Marlatt  
ECCC – Roanna Leung,  
Cecilia Wong, Christopher  
Marshall

# Chinook Salmon—Killer Whale Interactions

Cameron Freshwater and Jackie King  
Ecosystem Science Division – Pacific Biological Station



Government  
of Canada

Gouvernement  
du Canada

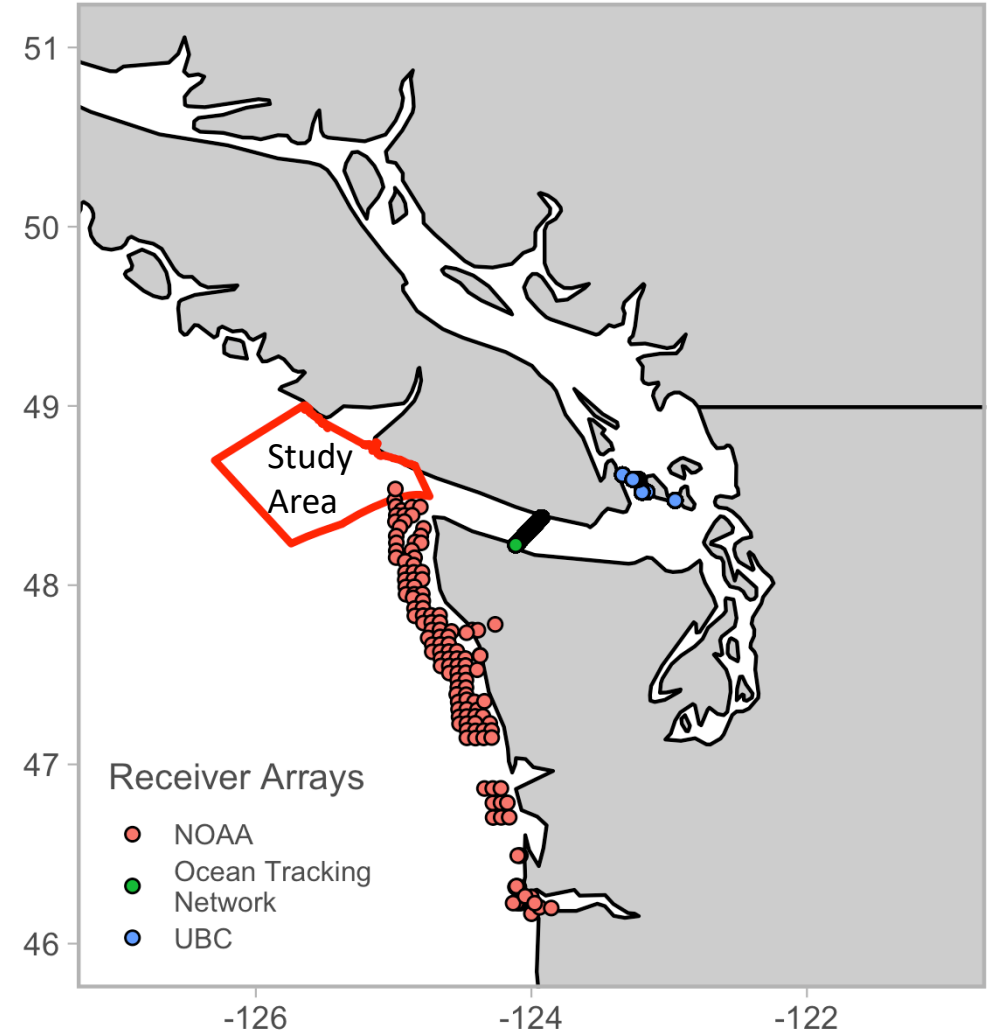
Canada



# Objectives and Activities

Estimate prey availability in resident killer whale amended critical habitat

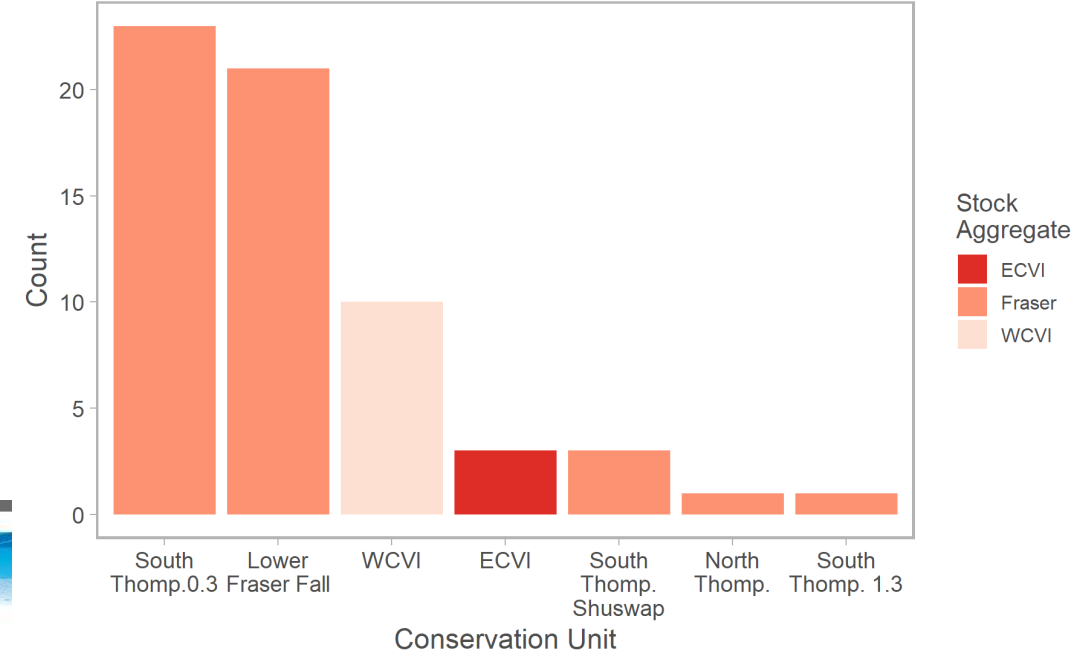
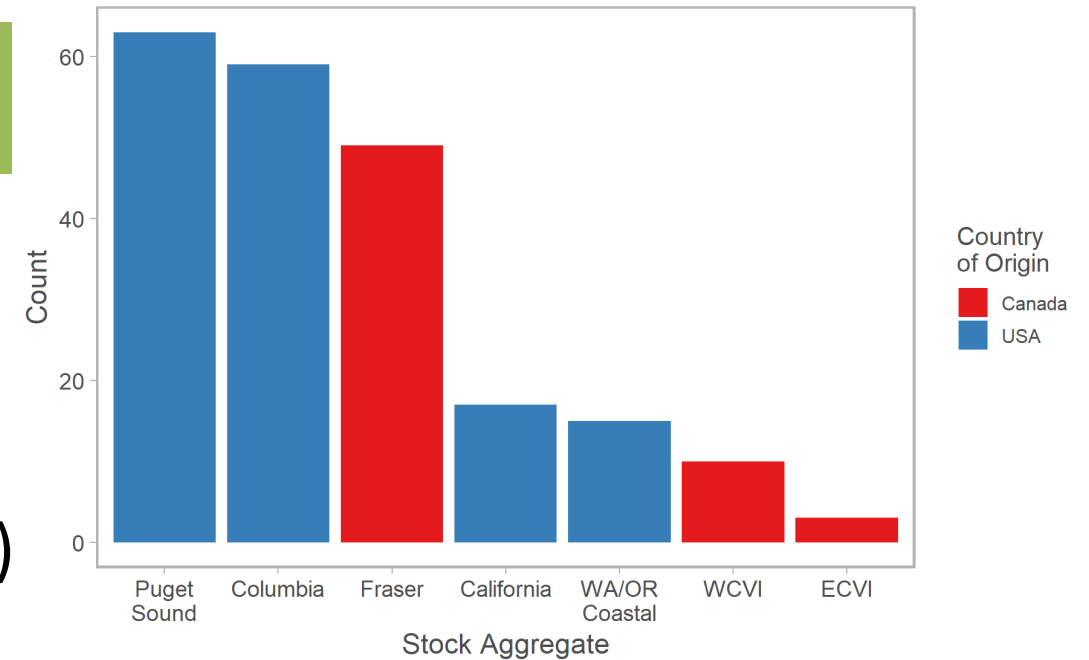
1. Tag returning adult Chinook salmon to quantify stock-specific residence times in habitat and estimate survival
2. Utilize existing commercial troll catch and genetics data to develop robust model of stock-specific abundance





# 2019 Stock Composition

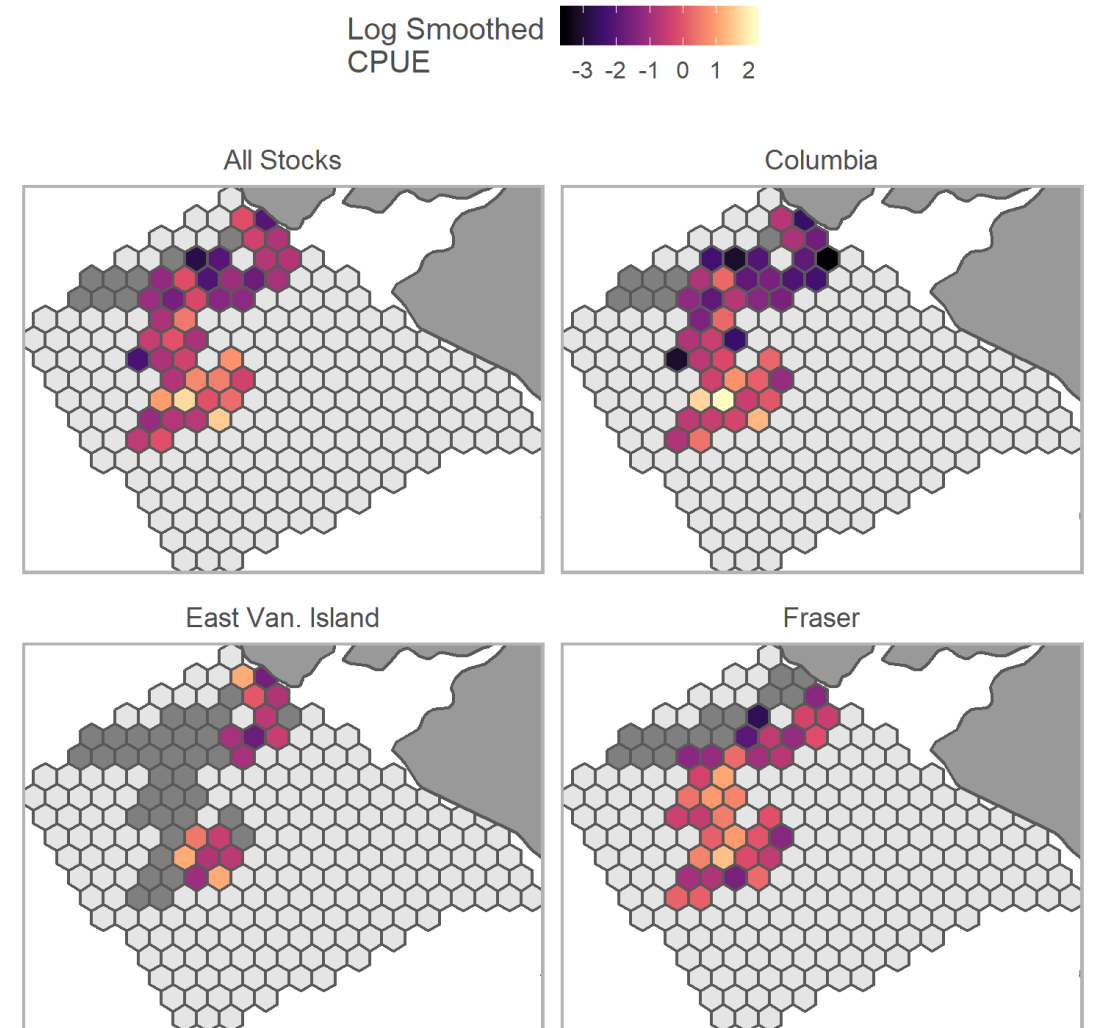
- 293 adult Chinook landed, biosampled, and released in good condition
- Puget Sound, Columbia River and Fraser River stocks dominated catches (**top right**)
- Canadian-origin fish (**bottom right**) came predominantly from South Thompson 0.3 and Lower Fraser River Fall CUs
- Caveat: uncertainty in stock composition due to small sample size and may be biased by sampling relatively late in the year





# 2019 Stock Distribution

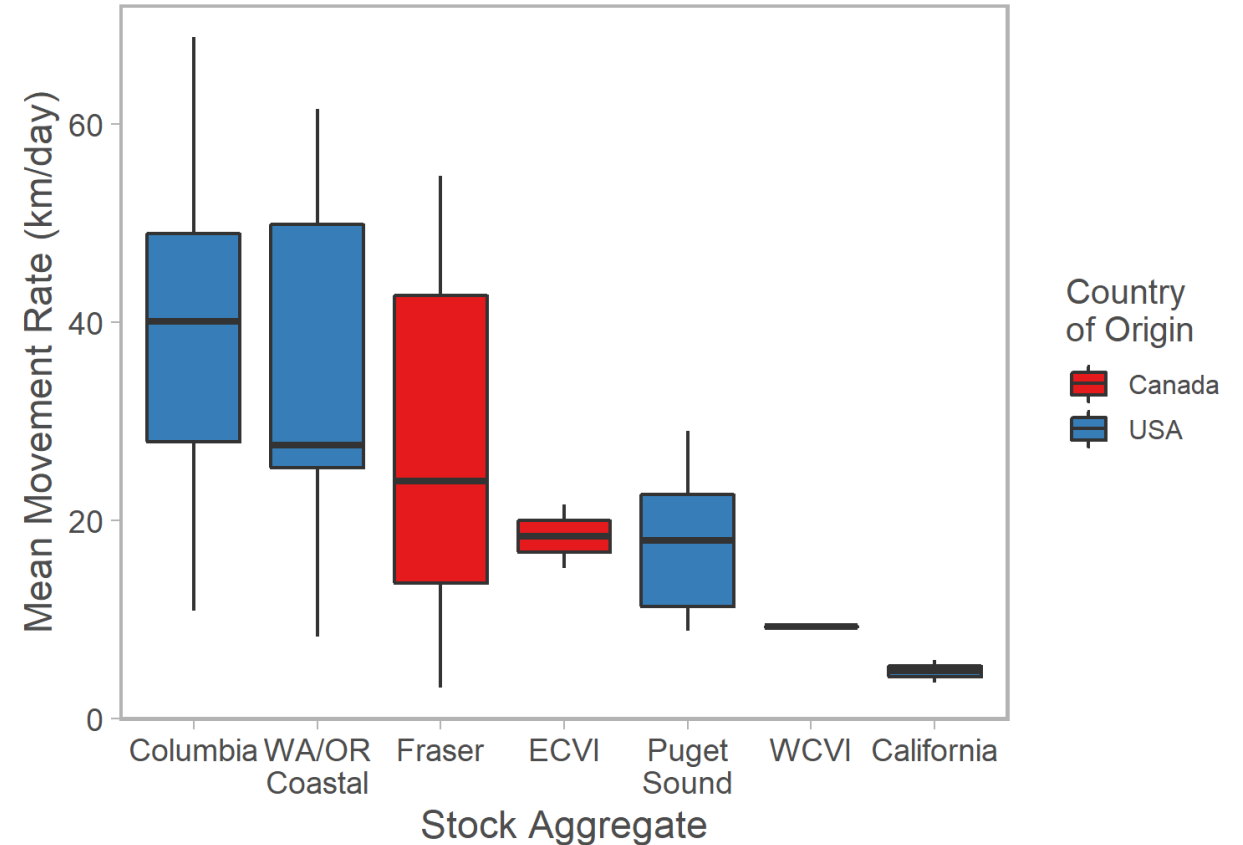
- Variability among stock aggregates in distribution within killer whale critical habitat
- Columbia River concentrated offshore, ECVI patchily distributed, and Fraser River relatively homogeneous
- Caveat: sample sizes still relatively small and only a fraction of habitat surveyed to date





# 2019 Stock-specific Migration Patterns

- 99 individuals fitted with acoustic tags with 76% detected on NOAA, OTN, and UBC receiver arrays
  - Provide data on migration rates, depth distribution, and survival
- Differences among stocks in migration rates, which suggests certain stocks reside in killer whale critical habitat longer than others
- Caveat: currently sample sizes relatively small but will increase as surveys continue





# Plans for 2020

- Tagging study
  - Continue to develop DFO, NOAA and UBC collaborations to leverage available data
    - E.g. incorporate killer whale data from DFO hydrophones when analyzing Chinook behavior
  - Increase sample size to better survey all stocks
    - Deploy 100-150 tags over longer time period (May-Sep.)
  - Increase precision of movement/survival estimates
    - Deploy DFO receiver arrays on La Perouse and Swiftsure Banks
- Stock-specific abundance study
  - Finish stock-composition model, allowing proportional abundance of different stocks to be predicted in any given month
  - Expand model to include recreational catch and genetics data (WCVI and Salish Sea)
  - Collaborate with DFO and NOAA staff to develop coast-wide spatio-temporal distribution model

# Cetacean Research Program:

## La Perouse acoustic analysis to support SRKW Critical Habitat identification

Thomas Doniol-Valcroze, James Pilkington  
Pacific Biological Station



Government  
of Canada

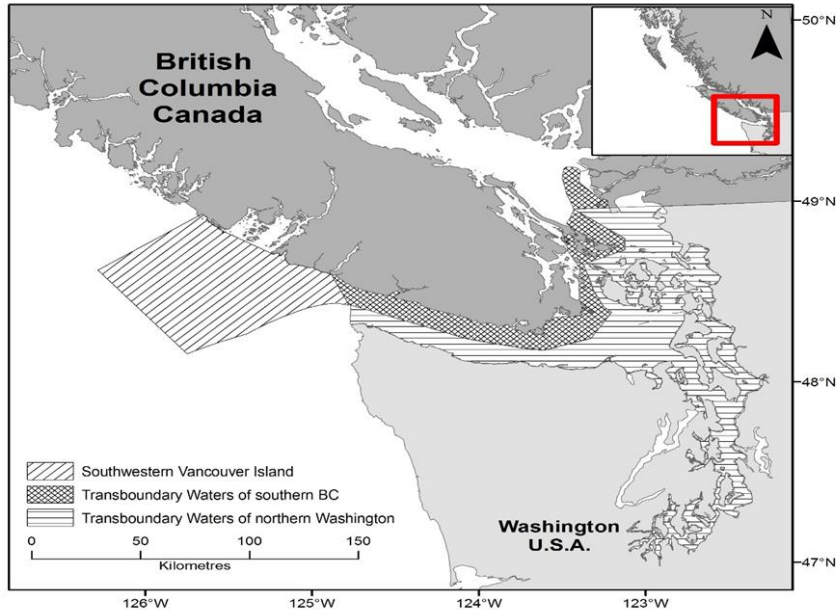
Gouvernement  
du Canada

Canada

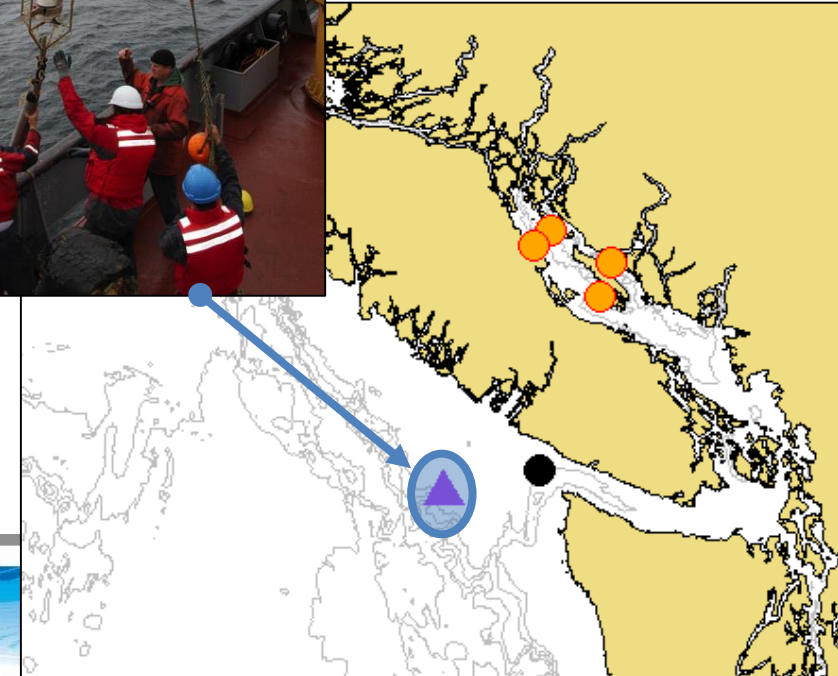


# Activities and Results

Map of project area: SRKW Critical Habitat



Two years of acoustic data (2017-18) from La Perouse Bank are being analyzed to refine our knowledge of habitat use



Analysis and results will be presented at the National Marine Mammal Peer-Review Committee in February 2020  
→ Publication of CSAS research document and Science Advisory Report