BCSRIF - Bottlenecks to Survival

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Canada

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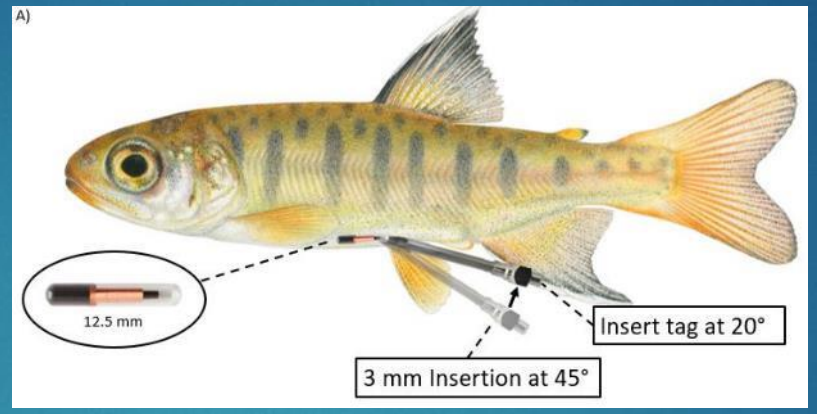
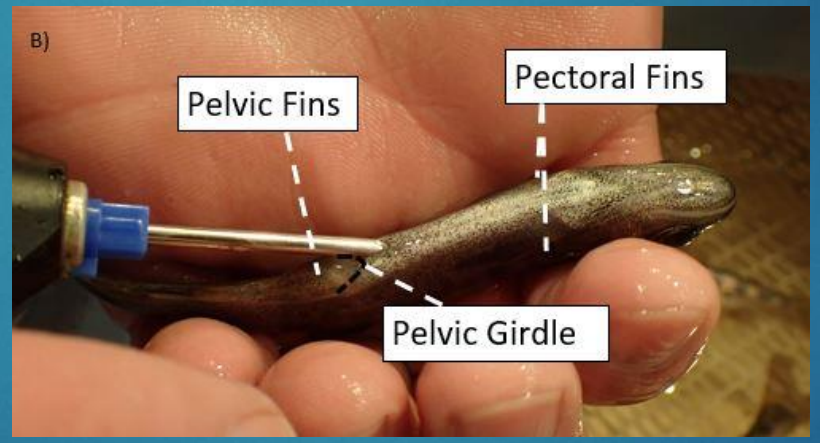
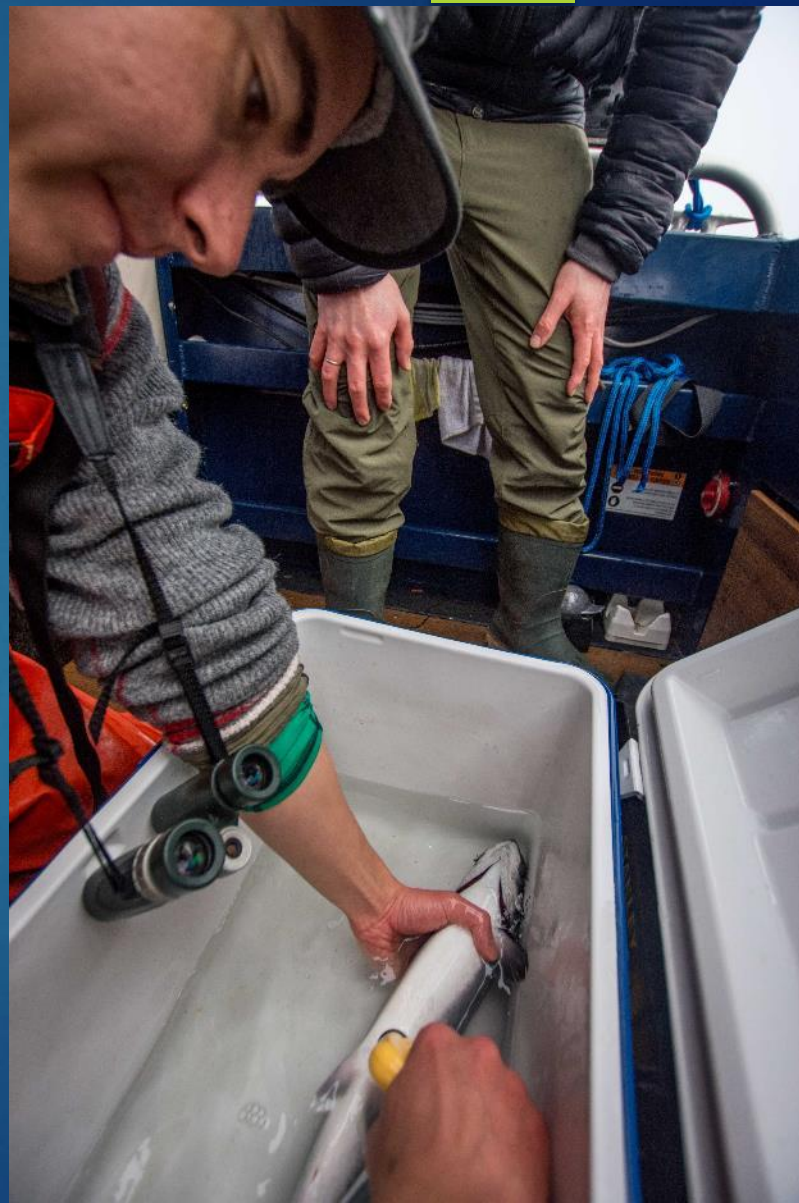
BCSRIF - Bottlenecks to Survival

- The Bottlenecks to Survival Program represents an **ambitious expansion** of **PIT tag infrastructure** and applications (Chinook, coho, and steelhead) within the **Canadian Salish Sea** (and to a lesser extent WCVI)
- The program is a **beginning** and aims to leave a lasting physical and methodological legacy
- Entering second phase of funding

- *Why PIT Tags?*
- PIT tags **do not** replace coded wire tags (CWTs)
- PIT tags offer:
  - Individual ID
  - (Effectively) limitless life
  - Non-lethal decoding (useful for mark release recapture)
  - Remote detection (in-river or fishway arrays)
- Repeated tagging of a cohort can allow determination of *stage-specific* survival







Five “Activities”

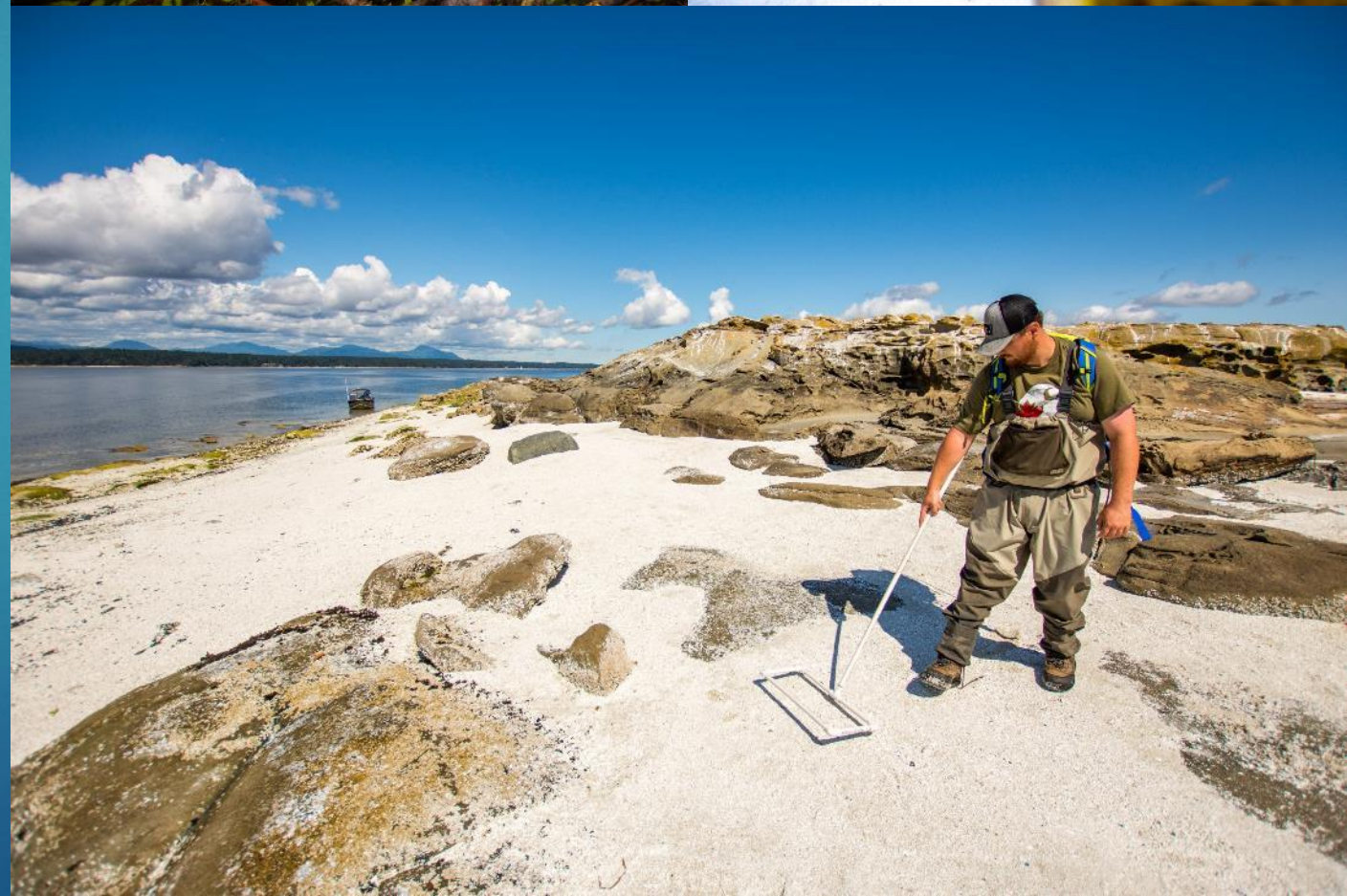
- Survival bottlenecks for hatchery-reared Chinook salmon and sympatric wild stocks
- Survival bottlenecks for hatchery-reared coho salmon and sympatric wild stocks
- Over winter trophic ecology, growth, and physiology of ECVI Chinook salmon (with UVic)
- Steelhead bottlenecks to survival and optimization of steelhead hatchery production (with Ministry of Forests)
- Enhanced fishery monitoring (with DFO Stock Assessment)

What will we do with stage-specific survival estimates:

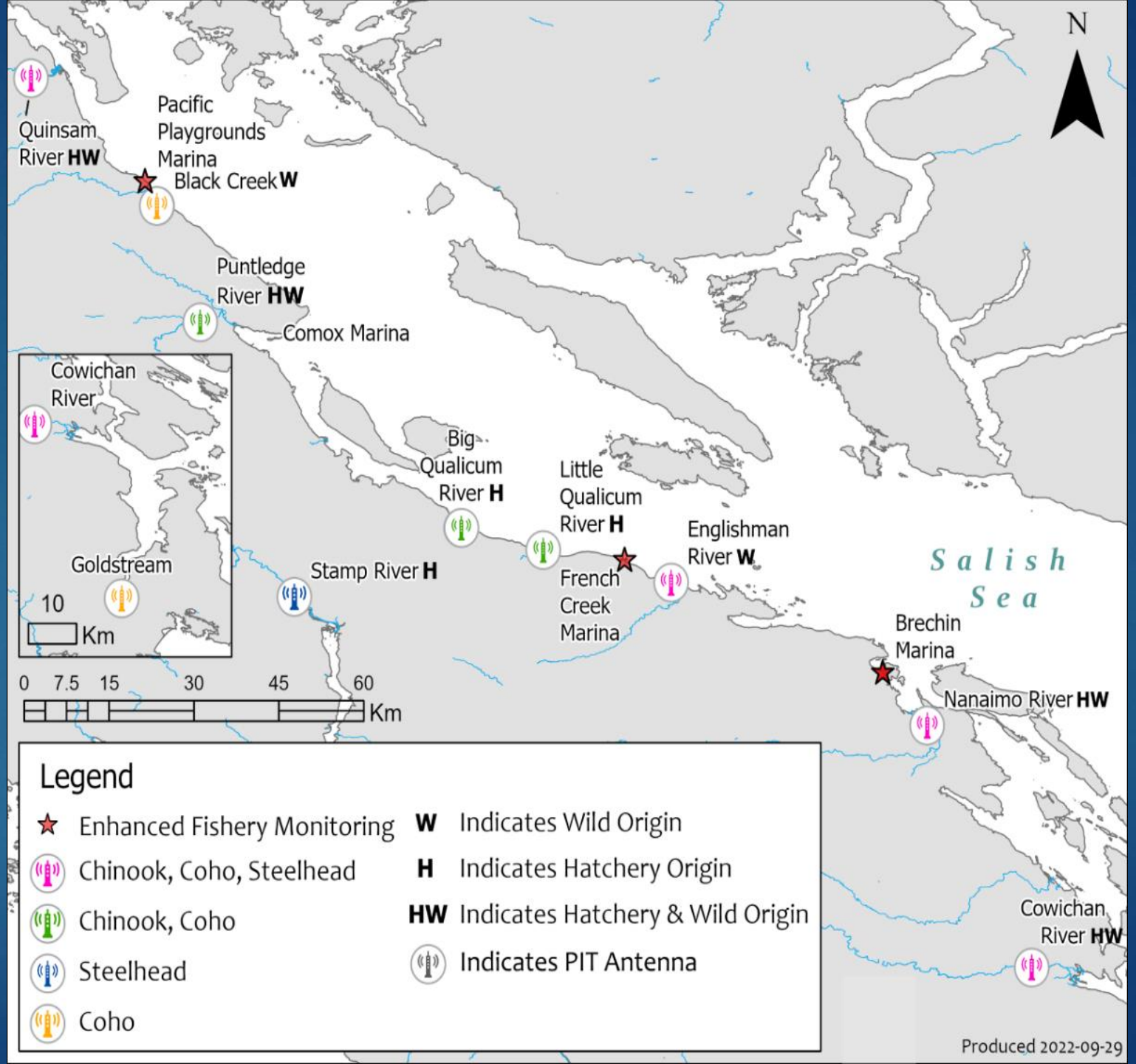
- Develop "Generalized" **stage-specific survival model** that can be used to test how changes to abundance or survival for different stages would impact adult abundance
- Compare **hatchery and wild survival** and investigate the specific stages driving any differences
- Investigate **freshwater survival** from release to ocean entry, a stage which is currently rolled into "survival to recruitment". Freshwater survival impacts may be more amenable to mitigation than marine impacts.
- Compare **stage-specific survivals in "Good"** years and/or stocks and/or origin groups (hatchery vs wild) to **"Bad"** years and/or stocks and/or origin groups (hatchery vs wild) to understand factors driving variability or trends in survival.

What else will PIT tag application and infrastructure allow us to do:

- Understand how **individual-level** factors (size, pathogen presence, condition) influence survival.
- Develop a mechanistic **understanding** of the results of **experimental release strategies** (i.e. if late releases, net pens, etc.. Increase overall survival how – at what stage – are they doing it)
- **Improve escapement estimates** (e.g. expansion of counts to account for passage after fence removal; calculation of rates of fish entering systems but not entering hatchery raceways)
- Develop studies of **terminal mortality rates**
- Develop **predation studies**
- **Refine fishery stock assessment** (e.g. investigate differential exploitation of hatchery and wild fish)



Activities 1 & 2 – Survival bottlenecks for hatchery-reared and naturally-produced Chinook and coho salmon


N
Quinsam River HW
Pacific Playgrounds Marina
Black Creek W
Puntledge River HW
Comox Marina
Cowichan River
Goldstream
10 Km
Big Qualicum River H
Little Qualicum River H
Stamp River H
French Creek Marina
Englishman River W
Salish Sea
Brechin Marina
Nanaimo River HW
Cowichan River HW
0 7.5 15 30 45 60 Km
Legend
Enhanced Fishery Monitoring
Chinook, Coho, Steelhead
Chinook, Coho
Steelhead
Coho
W Indicates Wild Origin
H Indicates Hatchery Origin
HW Indicates Hatchery & Wild Origin
Indicates PIT Antenna
Produced 2022-09-29

PIT Array Network Expansion
Fishway / Hatcheries

Hatchery Tagging

Early Marine Tagging

Freshwater Survival Estimates

In-river Tagging

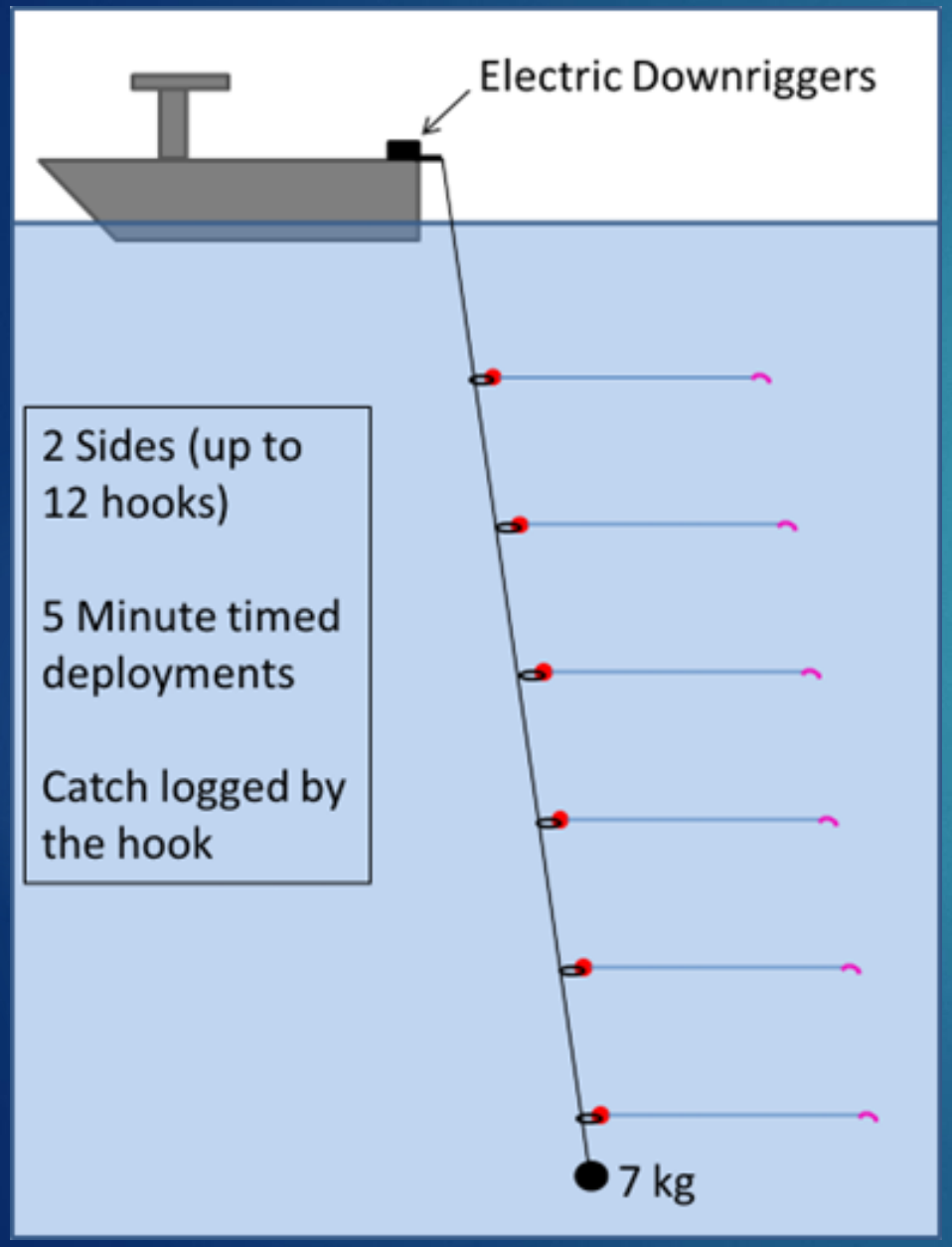
Fall / Early Winter Marine Tagging

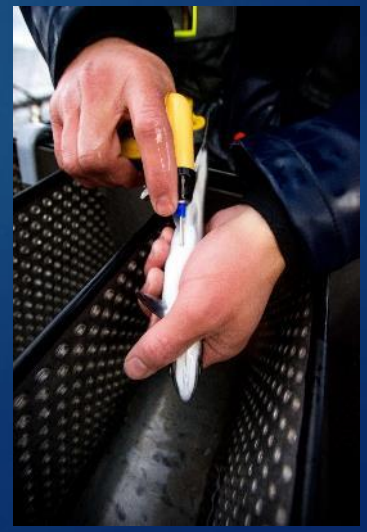
Winter / Spring Marine Tagging

Summer Adult Tagging

Detection at Return

Marine tagging (microtrolling)





Microtrolling

https://www.youtube.com/watch?v=ETfma2rYxic

Bottlenecks Program To Date

Hatchery PIT-Tagging

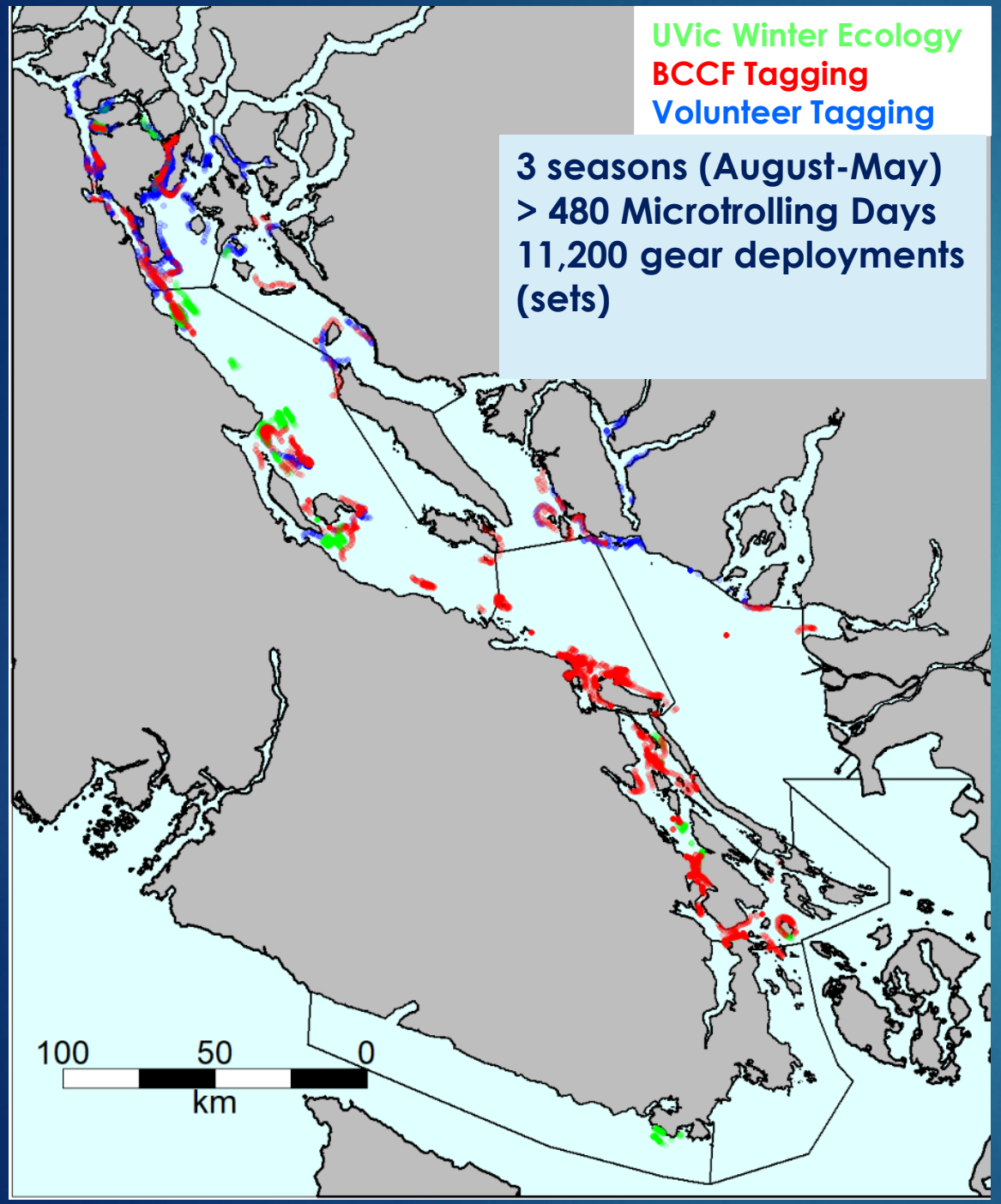
Watersheds	Species	2020_2021 Totals	2021_2022 Total	2022_2023 Total
Cowichan, Nanaimo, Little Qualicum, Big Qualicum, Puntledge, Quinsam	Chinook (fall)	31,640	33,994	30,000
Nanaimo	Chinook (summer)	5,000	5,000	5,000
Toquaht (Thornton Creek)	Chinook (fall)	5,000	0	0
Nanaimo, Big Qualicum, Puntledge, Quinsam	Coho (smolts)	20,000	20,000	7,000
Quinsam (4 Study)	Coho (smolts)	N/A	N/A	8,000
Millstone, Millstream, Goldstream	Coho (smolts)	N/A	11,500	13,000
Stamp/Somass (Robertson Creek)	Steelhead	5,000	5,000	5,000
Total		**65,000**	**76,500**	**68,000**

Bottlenecks Program To Date

Estuary/River PIT-Tagging

Watersheds	Species	2020_2021 Total	2021_2022 Total	2022_2023
Cowichan, Nanaimo, Puntledge	Chinook	10,101	10,361	10,814
Black Creek, Cowichan, Englishman, Nanaimo, Puntledge	Coho	18,220	13,272	7,720
Cowichan, Quinsam, Englishman	Steelhead	943	328	233
Total		**29,264**	**23,961**	**16,857**

Marine tagging (microtrolling)



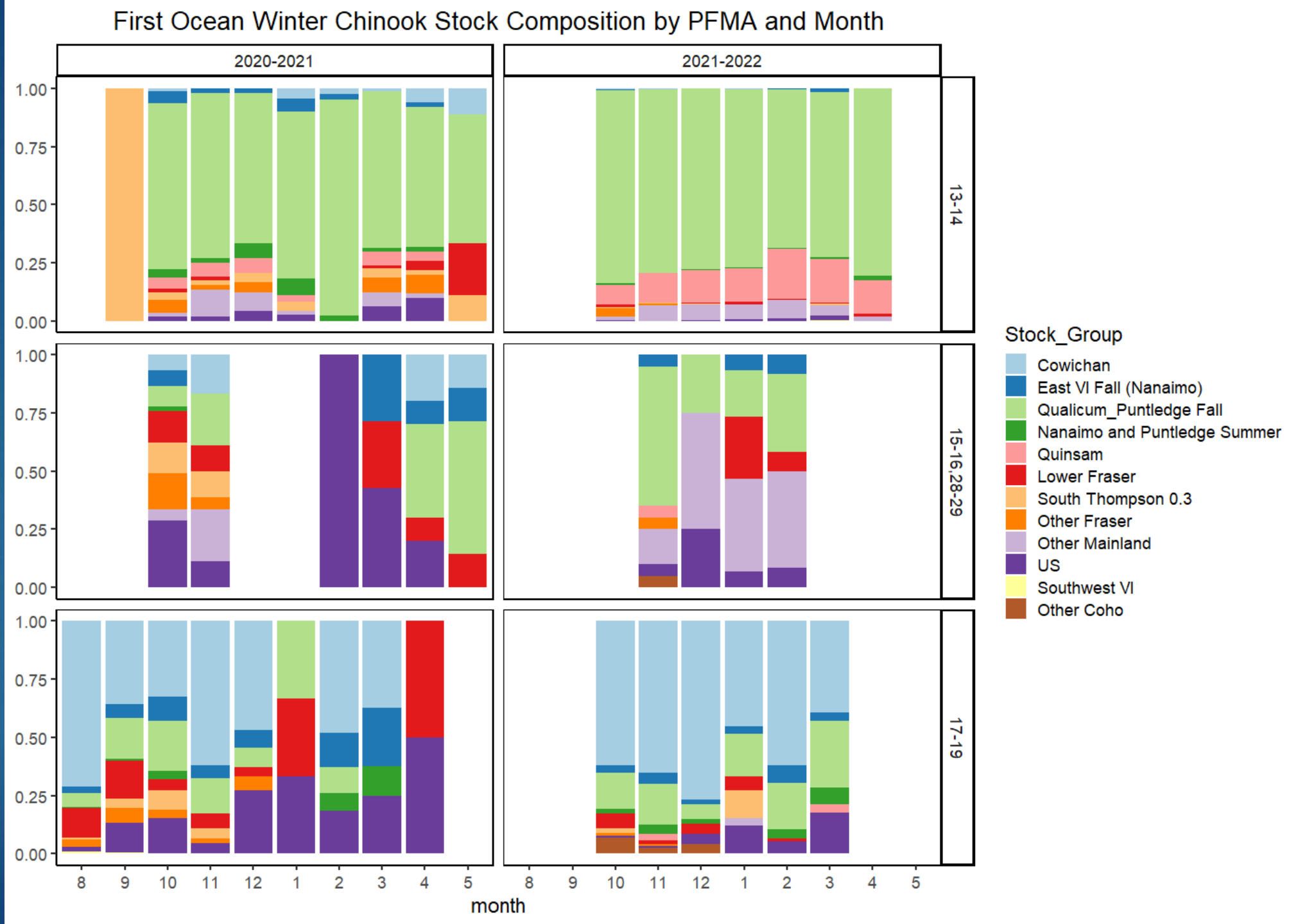
Map of Microtrolling Genetic Stock Composition

https://psfsogdc.maps.arcgis.com/apps/dashboards/dfd60eff62714806b731d3bfe7e98066

Northern Strait of Georgia

Sunshine Coast and Lower Mainland

Southern Gulf Islands



Northern Strait of Georgia

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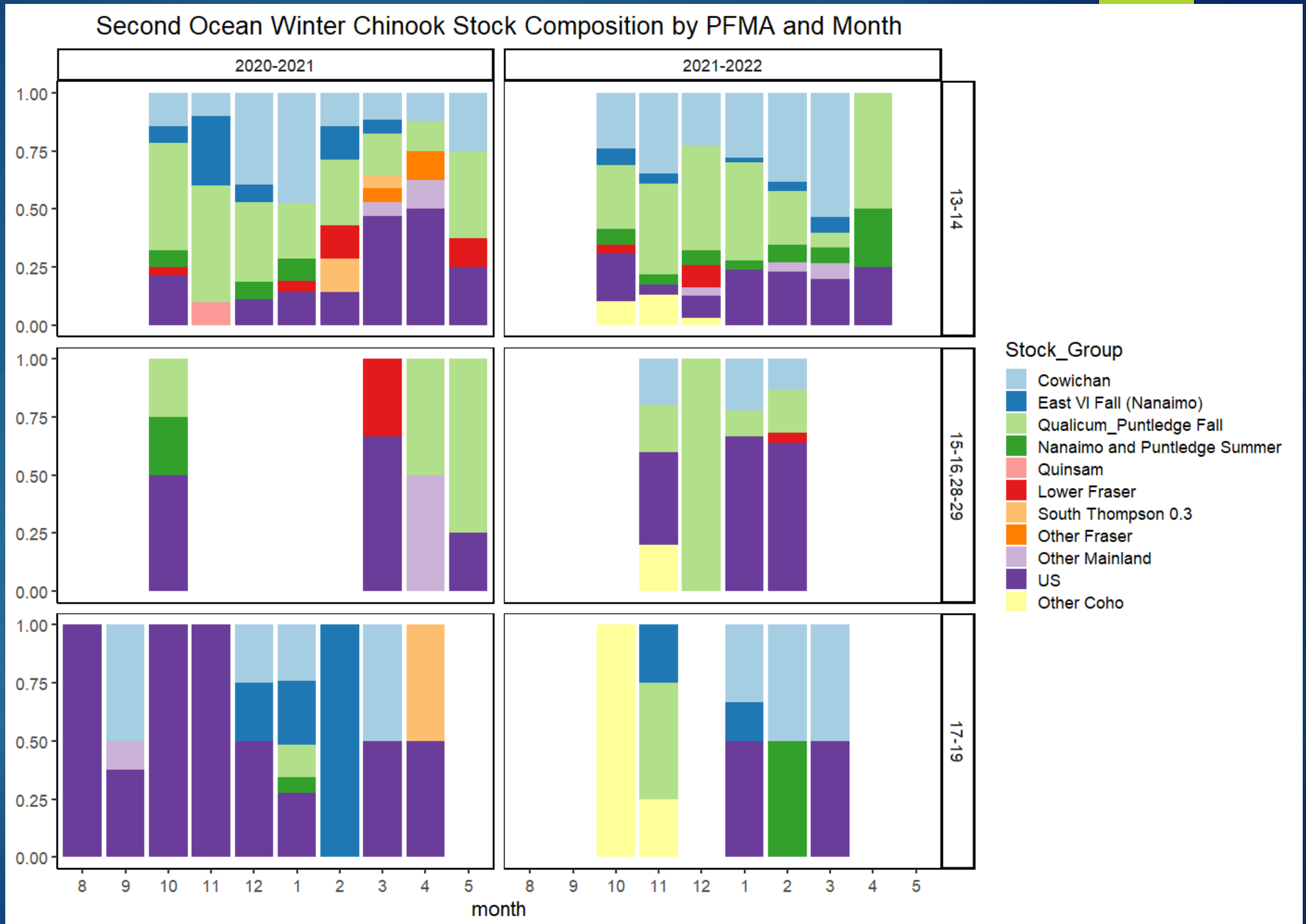
Southern Gulf Islands



Bottlenecks Program To Date

Microtrolling PIT-Tagging

Tagged (% Target Stocks)

	Chinook		Coho
Year	First Ocean Winter	Second Ocean Winter	First Ocean Winter
2020-2021	1,849 (65%)	205 (68%)	654(19%)
2021-2022	2,977 (77%)	244 (60%)	143 (NA)
2022-2023	2,347 (?)	129(?)	13 (NA)
Totals	**7,173**	**578**	**801**

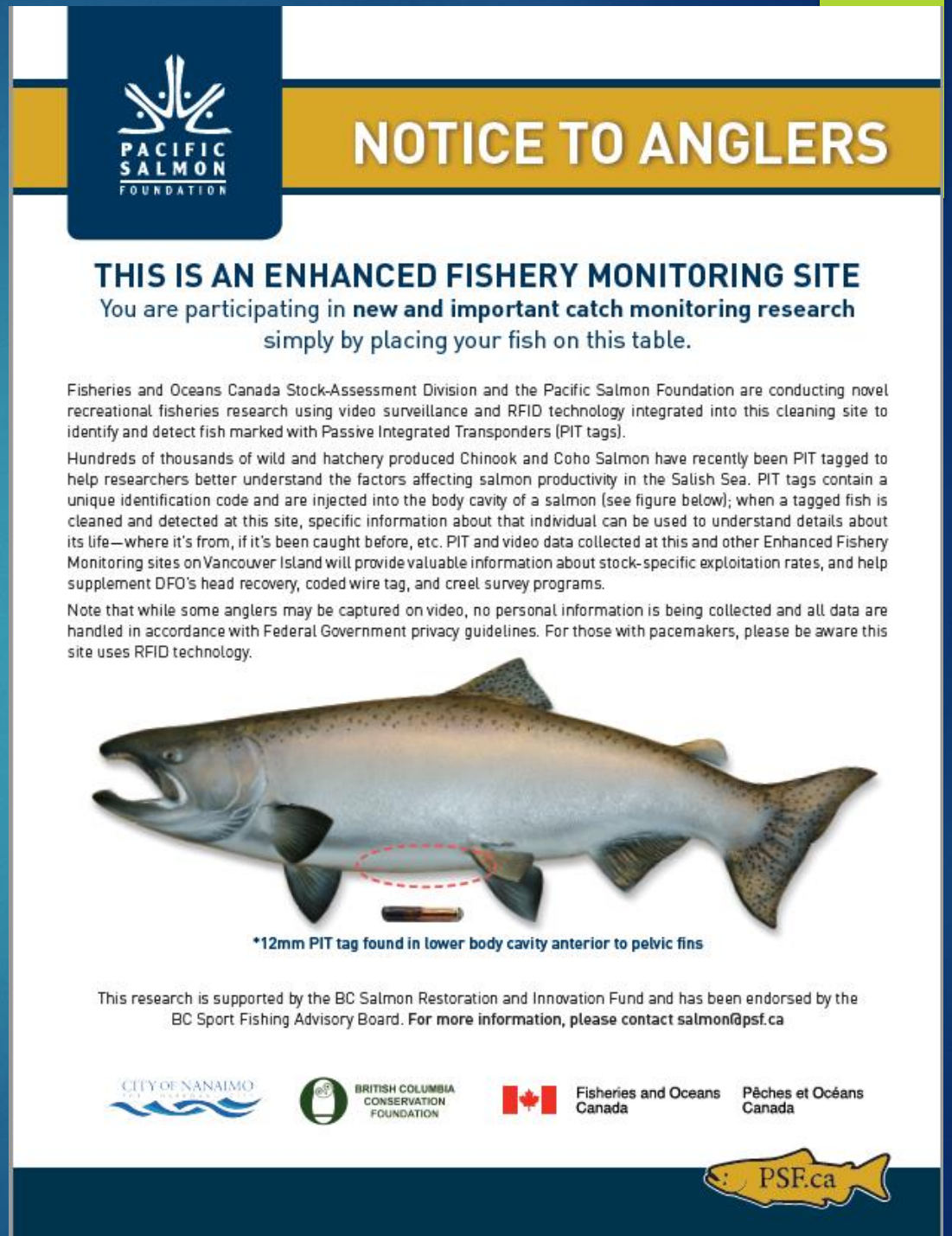
Note: Genetics were not analyzed for Coho after 2020-21, no Coho tagging in 2022-2023

Activity 5: Enhanced Fishery Monitoring

Main Objectives

1) Monitor recreational fishery harvest for PIT tags to identify fish that survived to contribute to a fishery

2) Modernization of recreational catch monitoring through video surveillance



PACIFIC SALMON FOUNDATION

NOTICE TO ANGLERS

THIS IS AN ENHANCED FISHERY MONITORING SITE

You are participating in **new and important catch monitoring research** simply by placing your fish on this table.

Fisheries and Oceans Canada Stock-Assessment Division and the Pacific Salmon Foundation are conducting novel recreational fisheries research using video surveillance and RFID technology integrated into this cleaning site to identify and detect fish marked with Passive Integrated Transponders (PIT tags).

Hundreds of thousands of wild and hatchery produced Chinook and Coho Salmon have recently been PIT tagged to help researchers better understand the factors affecting salmon productivity in the Salish Sea. PIT tags contain a unique identification code and are injected into the body cavity of a salmon (see figure below); when a tagged fish is cleaned and detected at this site, specific information about that individual can be used to understand details about its life—where it's from, if it's been caught before, etc. PIT and video data collected at this and other Enhanced Fishery Monitoring sites on Vancouver Island will provide valuable information about stock-specific exploitation rates, and help supplement DFO's head recovery, coded wire tag, and creel survey programs.

Note that while some anglers may be captured on video, no personal information is being collected and all data are handled in accordance with Federal Government privacy guidelines. For those with pacemakers, please be aware this site uses RFID technology.

*12mm PIT tag found in lower body cavity anterior to pelvic fins

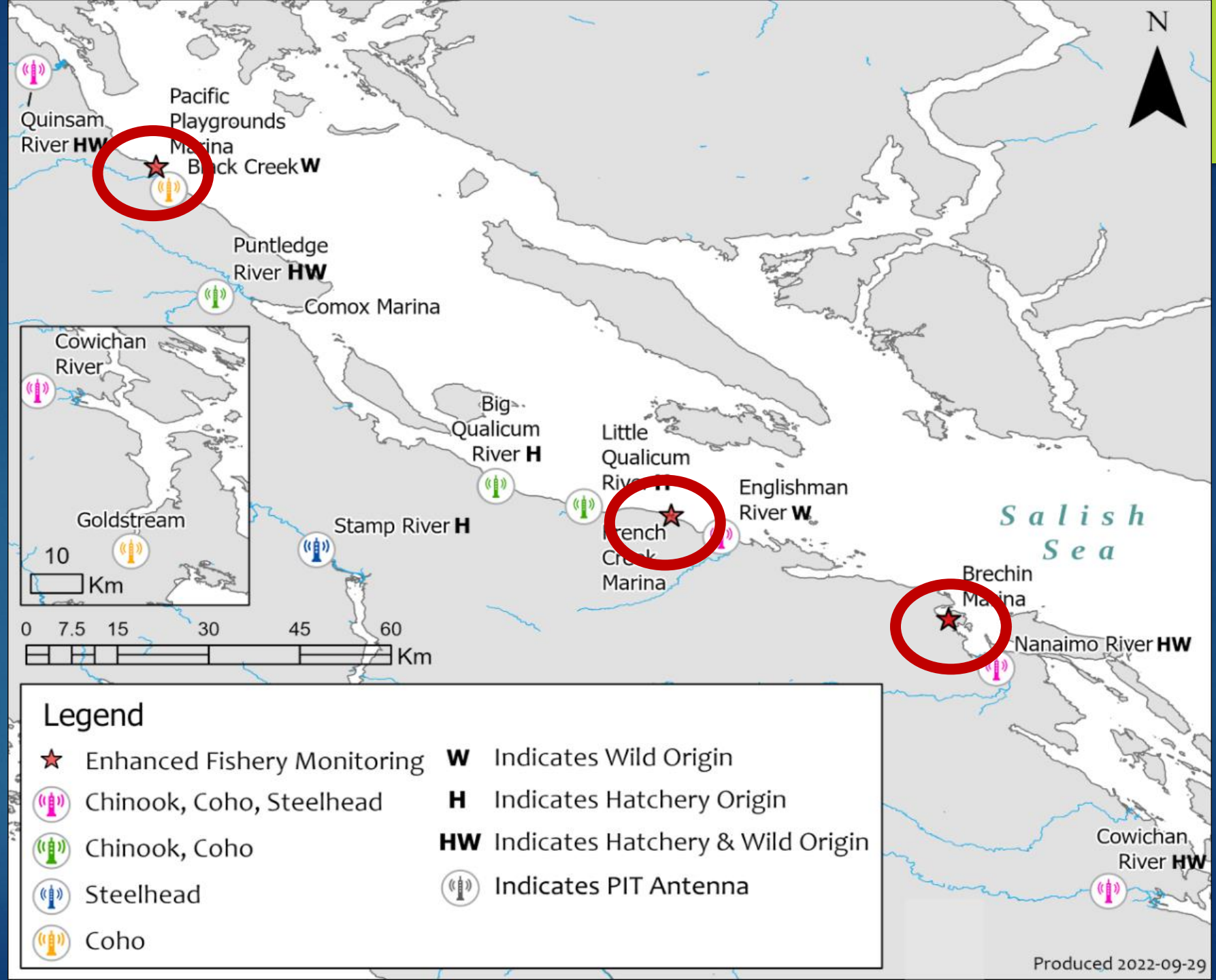
This research is supported by the BC Salmon Restoration and Innovation Fund and has been endorsed by the BC Sport Fishing Advisory Board. **For more information, please contact salmon@psf.ca**

CITY OF NANAIMO

BRITISH COLUMBIA CONSERVATION FOUNDATION

Fisheries and Oceans Canada | Pêches et Océans Canada

PSF.ca


N
Quinsam River HW
Pacific Playgrounds Marina
Black Creek W
Puntledge River HW
Comox Marina
Cowichan River
Goldstream
10 Km
Big Qualicum River H
Little Qualicum River H
Stamp River H
Englishman River W
French Creek Marina
Salish Sea
Brechin Marina
Nanaimo River HW
Cowichan River HW
0 7.5 15 30 45 60 Km
Legend
Enhanced Fishery Monitoring
Chinook, Coho, Steelhead
Chinook, Coho
Steelhead
Coho
W Indicates Wild Origin
H Indicates Hatchery Origin
HW Indicates Hatchery & Wild Origin
Indicates PIT Antenna
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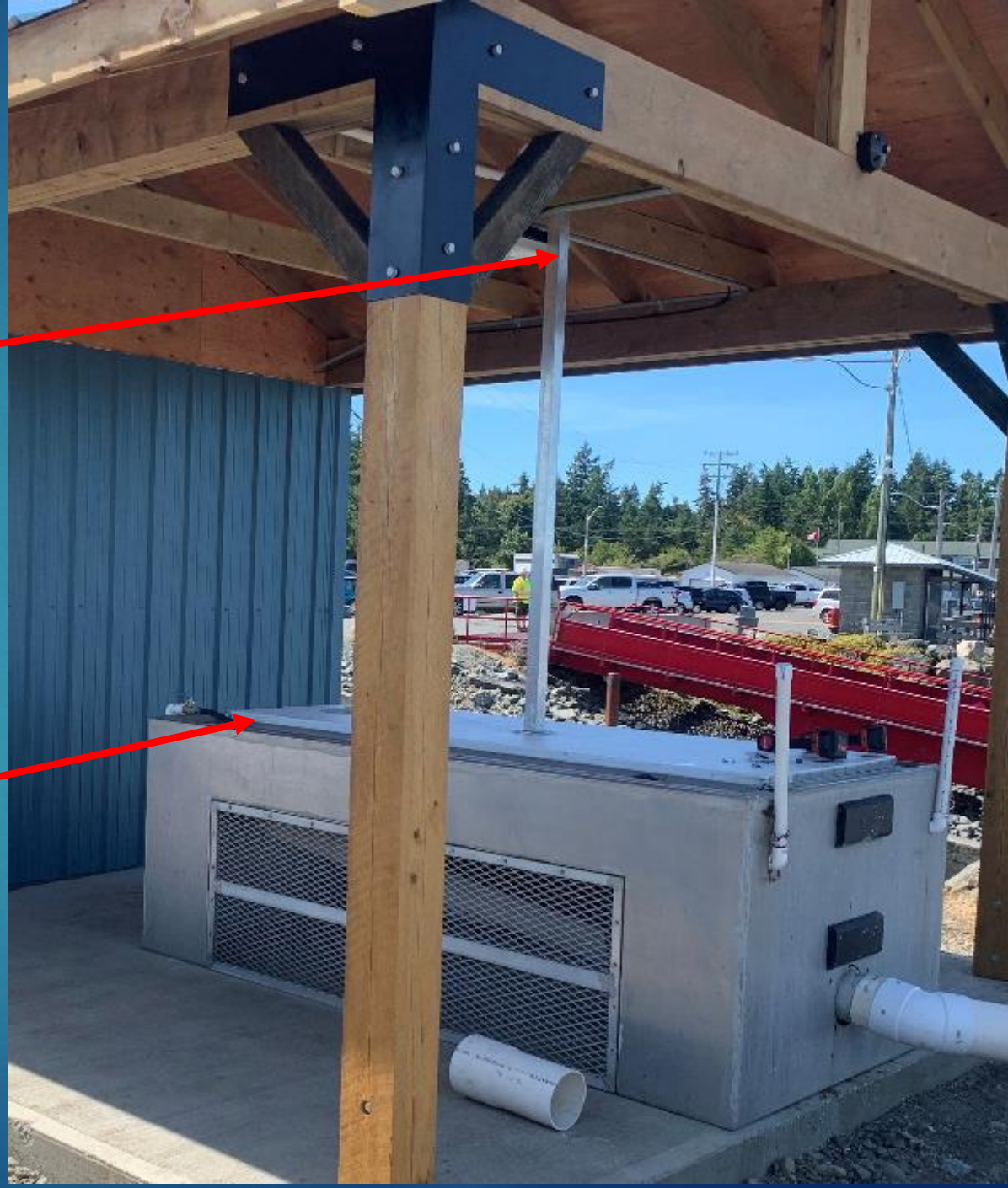
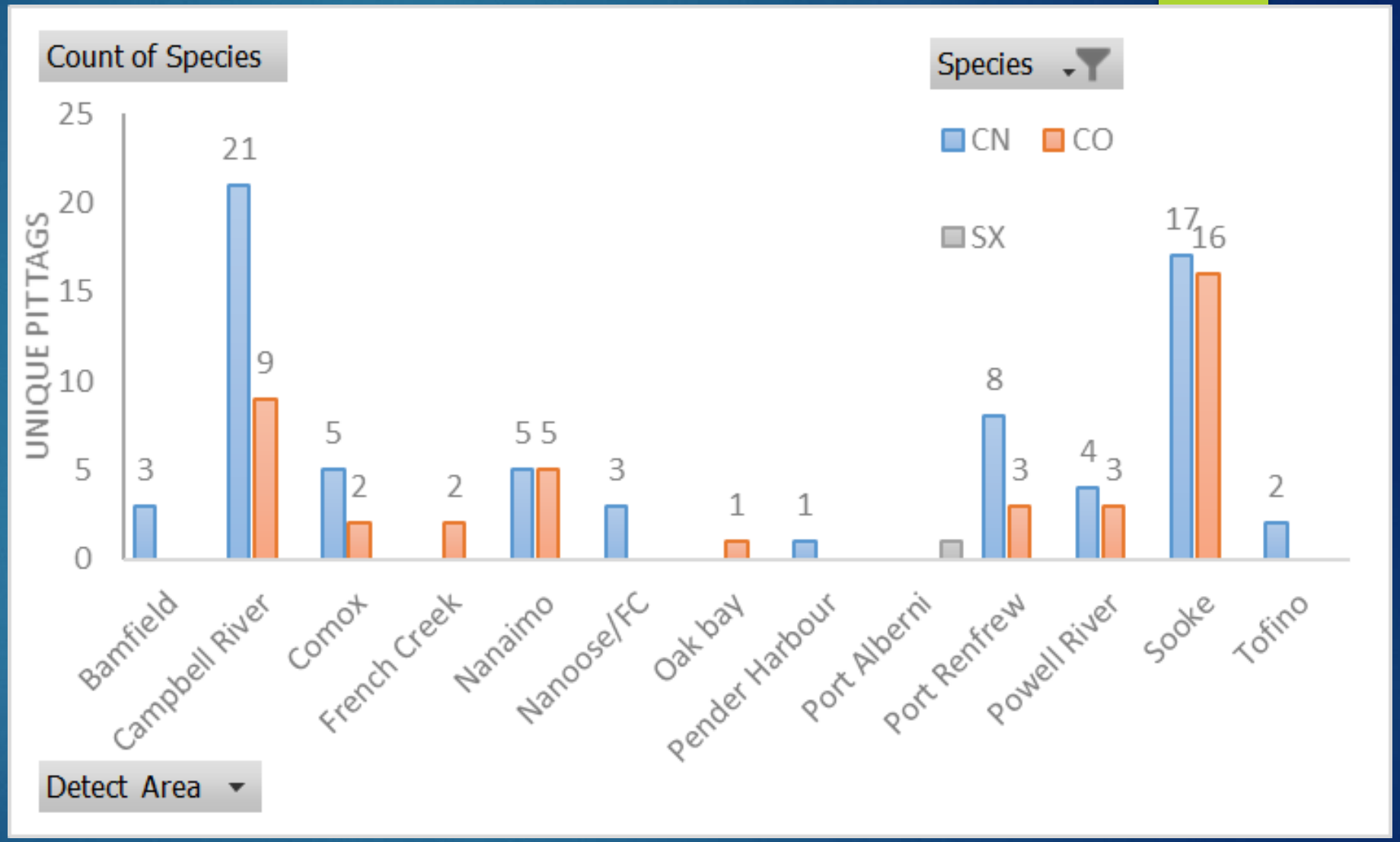
Integrated PIT Antennas



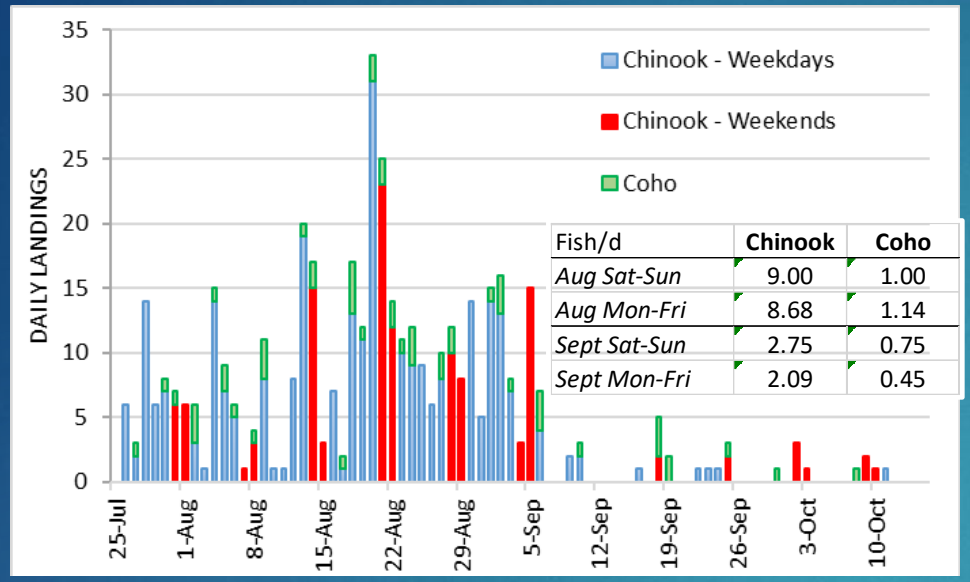
Integrated Head Depots

Integrated Cameras

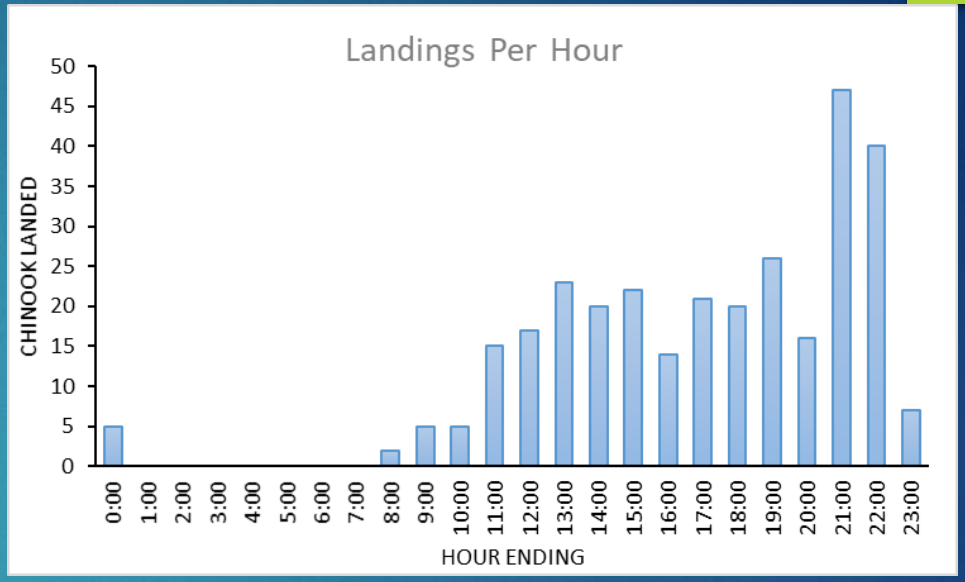
Landing Site PIT Detections n =111

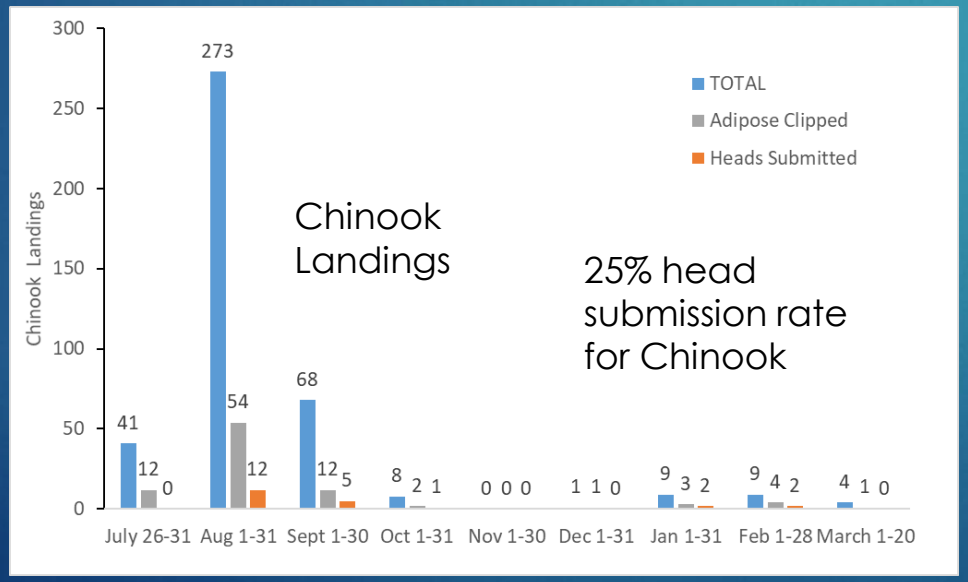


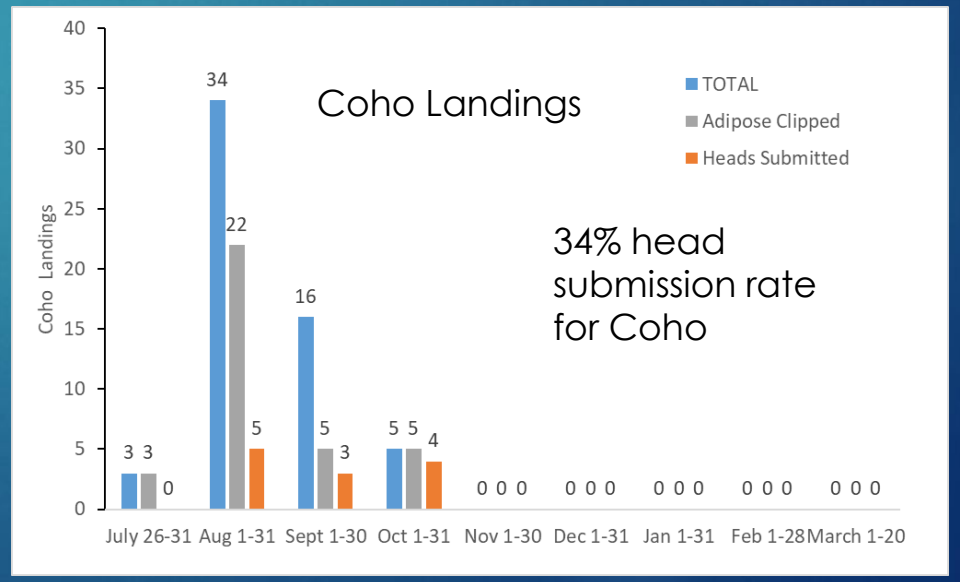
Continuous Data - Landings



Fish/d	Chinook	Coho
Aug Sat-Sun	9.00	1.00
Aug Mon-Fri	8.68	1.14
Sept Sat-Sun	2.75	0.75
Sept Mon-Fri	2.09	0.45

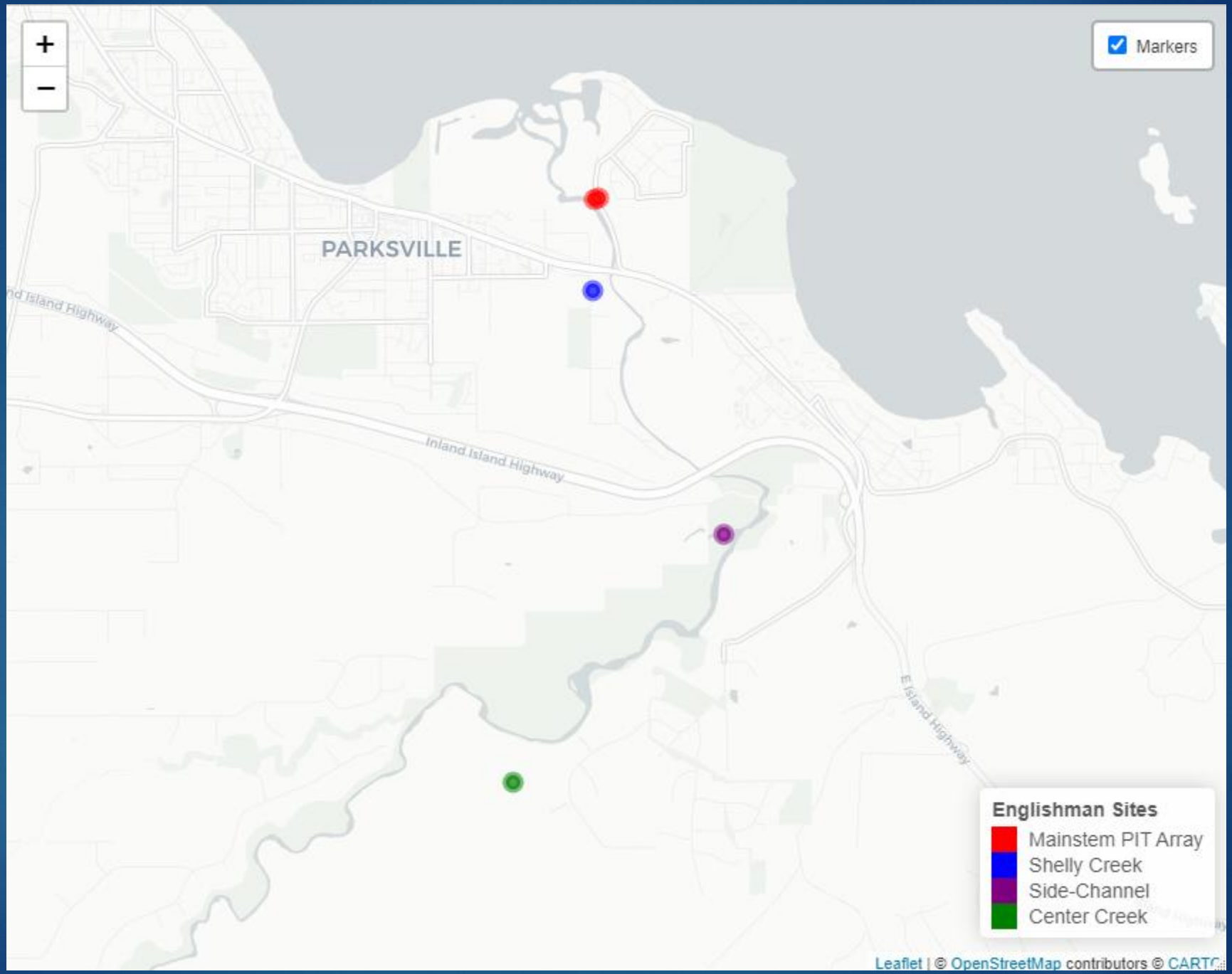






Englishman River

- Assess Marine Survival Rates of Coho Between Two Locations
  - Tag a subset of outmigrants throughout the outmigration
    - Shelly Creek (in Partnership with MVIHES)
    - Center Creek (in Partnership with Snaw-Naw-As)
  - DFO RRU asked us to assess the Side-Channel (2021)
    - Side-Channel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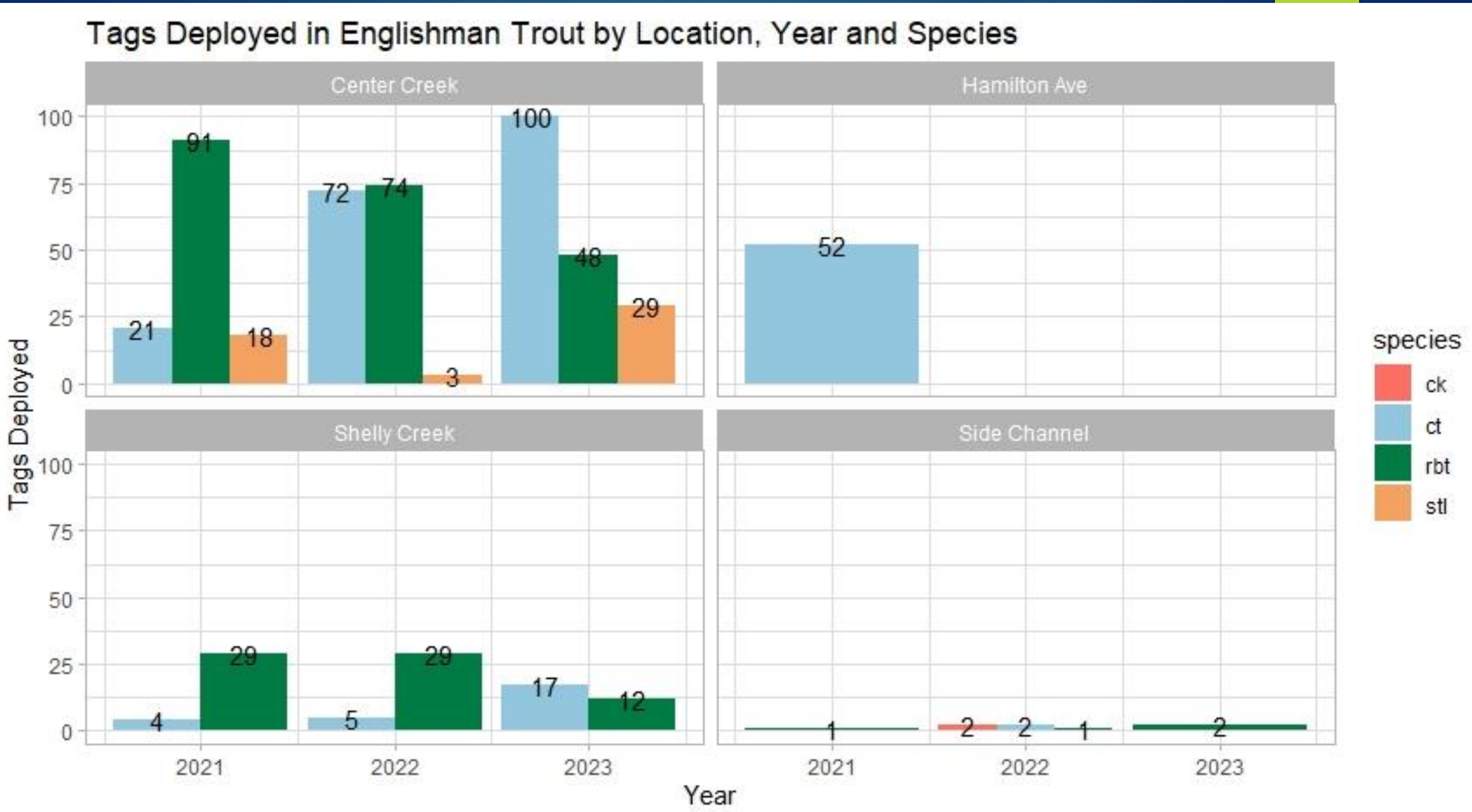
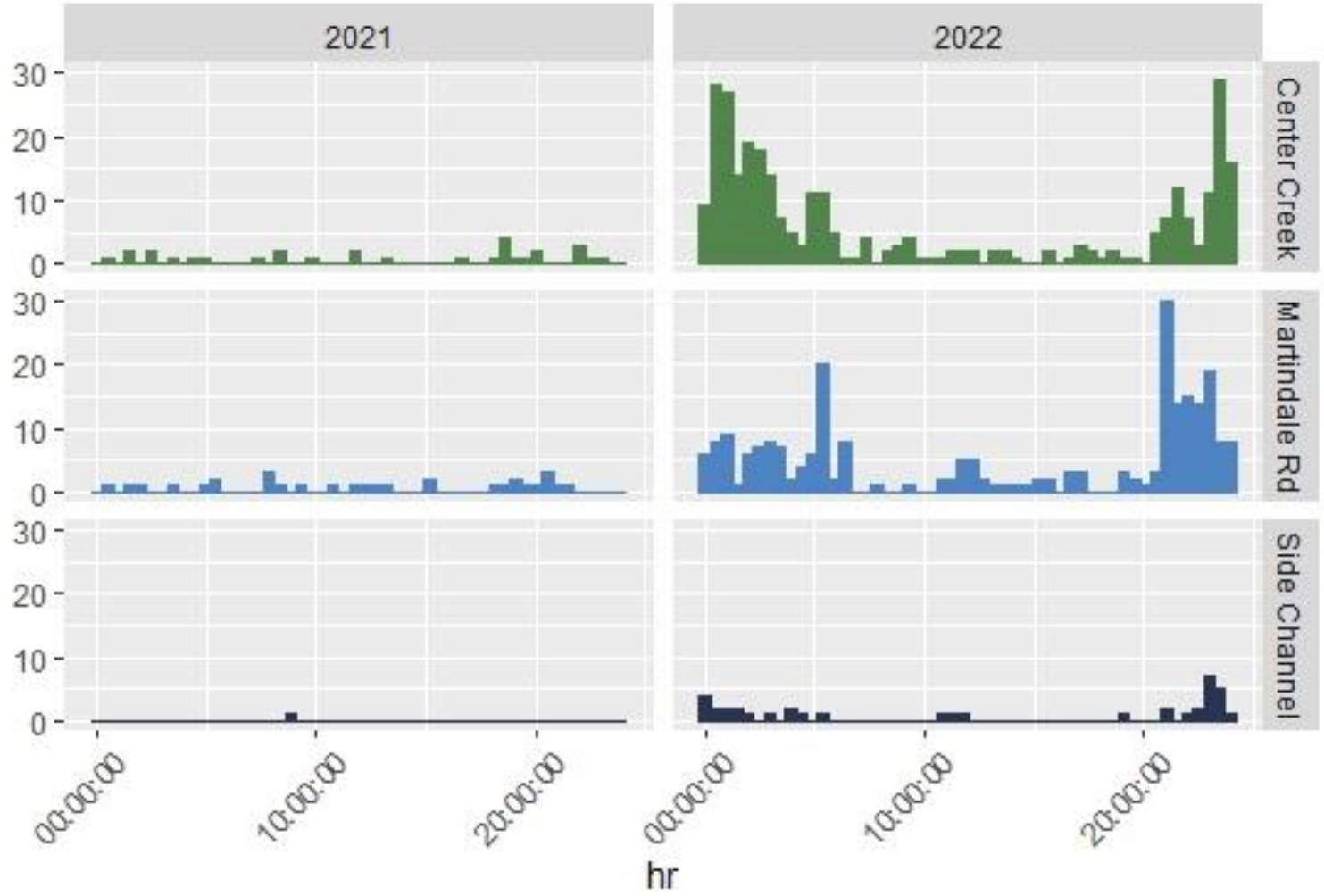
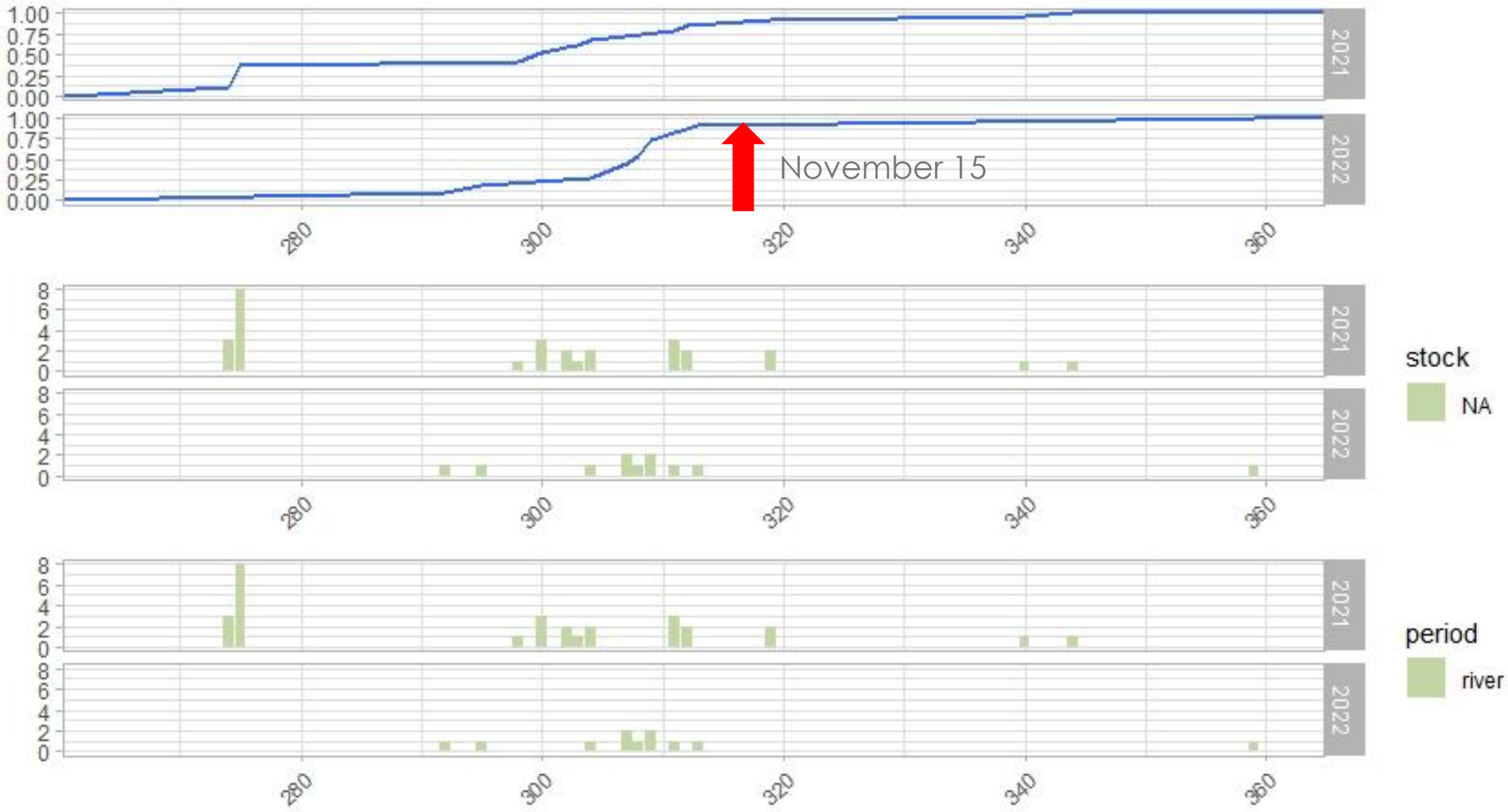
−
Markers
PARKSVILLE
Inland Island Highway
Englishman Sites
Mainstem PIT Array
Shelly Creek
Side-Channel
Center Creek
Leaflet | © OpenStreetMap contributors © CARTO


Tags Deployed in Englishman Trout by Location, Year and Species
Center Creek
Hamilton Ave
Shelly Creek
Side Channel
Tags Deployed
Year
2021
2022
2023
0
25
50
75
100
21
91
18
72
74
3
100
48
29
52
4
29
5
29
17
12
1
2
2
1
2
species
ck
ct
rbt
stl

Coho


2021
2022
Center Creek
Martindale Rd
Side Channel
30
20
10
0
00:00:00
10:00:00
20:00:00
hr
site
Center Creek
Martindale Rd
Side Channel

Adult Returns



Englishman River 2022 Coho Adult Return Stock Structure