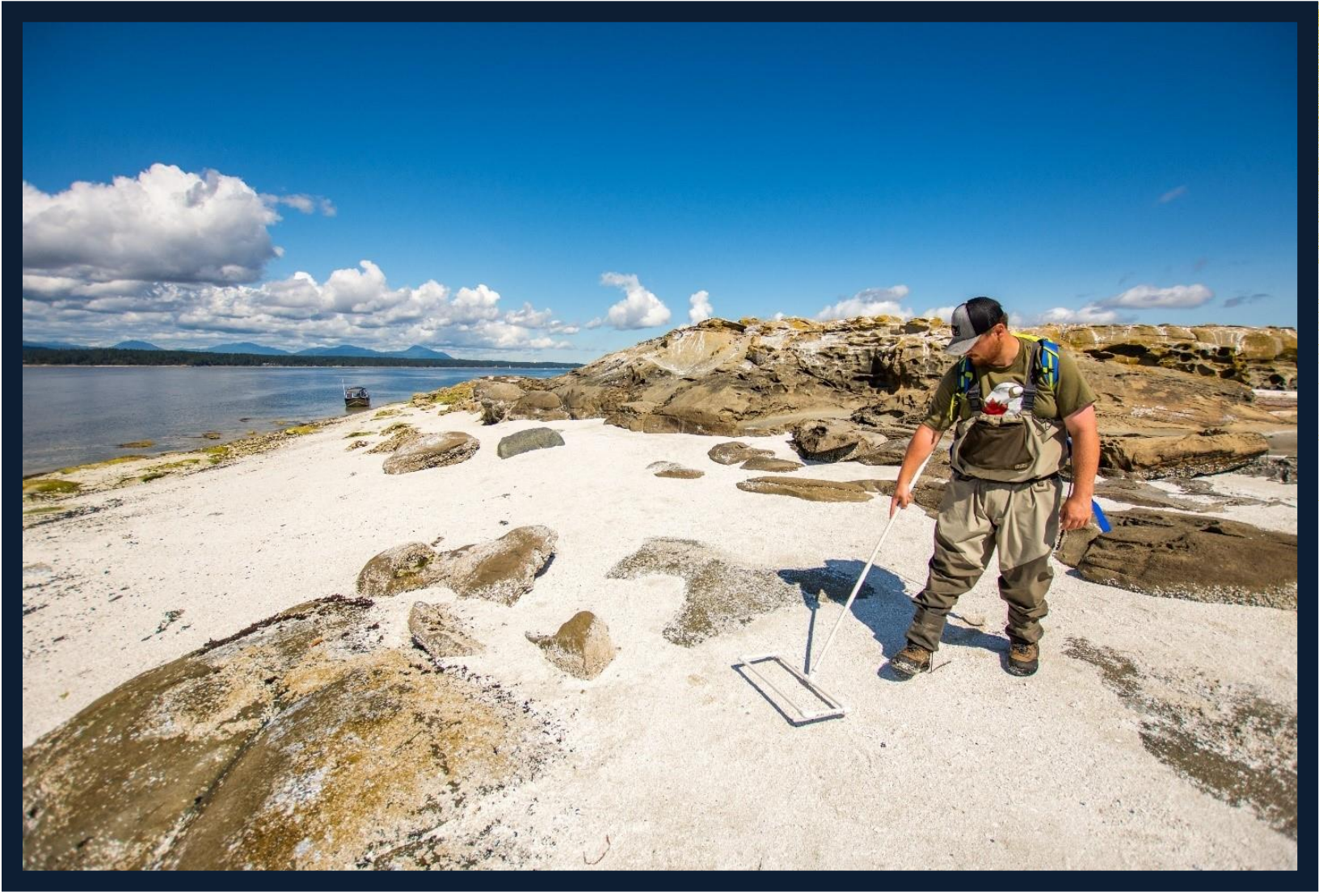

BOTTLENECKS TO SURVIVAL
INNOVATIVE PINNIPED PREDATION MONITORING PILOT STUDIES

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PACIFIC SALMON FOUNDATION

BRITISH COLUMBIA CONSERVATION FOUNDATION

Photo credit: Danny Swainson

EXECUTIVE SUMMARY

Through funding from the BC Salmon Restoration and Innovation Fund (BCSRIF), the Pacific Salmon Foundation (PSF) and British Columbia Conservation Foundation (BCCF) have initiated an innovative program using passive integrated transponder (PIT) tags to study the survival of Chinook and coho salmon, and steelhead around Vancouver Island. This project, titled "*The Determination of Bottlenecks Limiting Wild and Enhanced Juvenile Salmon and Steelhead Production in BC*" (hereafter the *Bottlenecks Program*), has created a comprehensive network of PIT tagging and detection across 11 watersheds on east coast Vancouver Island (ECVI).

The *Bottlenecks Program* has deployed over 250,000 PIT tags across 11 ECVI and two West Coast Vancouver Island systems, focusing on outmigrating Chinook and coho smolts. Detectable by PIT antennas, these tags provide critical data on fish movements and predation. This program has enabled tracking live fish and those consumed by predators, offering valuable insights into these species' marine survival challenges.

The program recovered 44 PIT tags from known harbour seal haulouts on ECVI, indicating predation events, with 33 tags linked to the *Bottlenecks Program*. Mobile scanning efforts proved effective across 10 of 14 sites, although identifying specific predators remains challenging due to the diverse array of marine animals utilizing haulout areas. Despite extensive microtrolling efforts, predated tag detection rates were low, possibly due to environmental factors affecting tag deposition and retention on the haulout and predator behaviour.

The program's extension until March 2026 aims to deploy additional PIT tags, enhancing marine haulout detection rates. The Miami Islet antenna pilot demonstrated the feasibility of in-situ antennas for detecting predation events and identifying predators. Real-time data collection emerged as a critical need, potentially improving response times and reducing site visits.

The study underscores the potential of PIT tags to provide spatiotemporal data on predation events and suggests that expanding the network of mobile scanning and haulout monitoring antennas could offer broader ecological insights. This innovative approach may inform future conservation strategies and fishing efforts, contributing to understanding predator-prey interactions and informing questions on the survival rates of salmon.

Citation:

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INTRODUCTION

Through funding from the BC Salmon Restoration and Innovation Fund (BCSRIF), the Pacific Salmon Foundation (PSF) and British Columbia Conservation Foundation (BCCF) have developed an innovative program utilizing passive integrated transponder (PIT) tags and a comprehensive system of arrays around Vancouver Island to provide insights into stage-specific survival of Chinook (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and steelhead (*O. mykiss). The Determination of Bottlenecks Limiting Wild and Enhanced Juvenile Salmon and Steelhead Production in BC using PIT tags and Spatially Comprehensive Arrays* (hereafter the *Bottlenecks Program*), has established a network of partners to develop and implement PIT tag application and detection programs across 13 watersheds along the east coast of Vancouver Island (ECVI).

The *Bottlenecks Program* has deployed over 250,000 FDX-B 12 mm PIT tags across the 11 systems along the east coast of Vancouver Island and two west coast systems. PIT tags allow for the fates of individual fish to be captured. They are not battery-powered; the tags remain dormant until they encounter an electromagnetic field generated by PIT antennas. Therefore, they have a long lifespan and can remain functional throughout the salmon's life unless damaged (Babey et al., 2020). This unique functionality has been instrumental in the success of the *Bottlenecks Program*, enabling the detection of both live fish crossing antennas and those that have been predated. Tagging occurs during all life stages of Chinook, coho and steelhead in the Salish Sea, focusing on freshwater outmigration and the first year at sea. The highest number of tags deployed in outmigrating Chinook and coho are in the hatchery, river and estuary environments during spring smolt outmigration.

In addition to providing valuable insights into the survival of an individual fish, PIT tags can also tell us about the ultimate fates of the fish. Some are consumed by predators or caught in fisheries, and the subsequent detection of the tag at a haulout or nest, for example, can tell us about predation rates. Predators transport PIT tags to various locations, such as haulout or nesting areas, where the consumed tags remain detectable until broken or moved by weather events (Atkinson, 2018; Sherker et al., 2021). This feature facilitates data collection related to the spatiotemporal movements of juvenile salmon in marine environments and their interactions with predators.

Purpose

Given the extensive deployment of PIT tags into East Coast Vancouver Island (ECVI) salmon and prior research demonstrating the recovery of tags post-predation, this study aimed to enhance understanding of the spatiotemporal effects of predation. Researchers designed a multi-faceted pilot study, building on methods used in the *Salish Sea Marine Survival Project*, to achieve the following objectives:

1. Detect tags residing on pinniped haulouts using manual scanning.
2. Develop in-situ PIT tag monitoring sites on pinniped haulouts.

3. Estimate predation rates on tagged salmon by Pacific harbour seals (*Phoca vitulina*).

This report highlights the investigative efforts of the *Bottlenecks Program*, focusing on the recapture of PIT tags consumed and expelled at harbour seal haulouts using both mobile scanning and installed antenna infrastructure.

METHODS

Study Area

The *Bottlenecks Program* study area is the Salish Sea ecoregion, an inland sea encompassing Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia. Juvenile salmon and trout are tagged across 13 river systems (Figure 1). Haulout scanning locations were focused in areas between Cowichan Bay and Nanaimo due to the large numbers of PIT tags being deployed in the Cowichan, Nanaimo and Puntledge river, coupled with winter microtrolling key locations for catching young of the year Chinook (Figure 2).

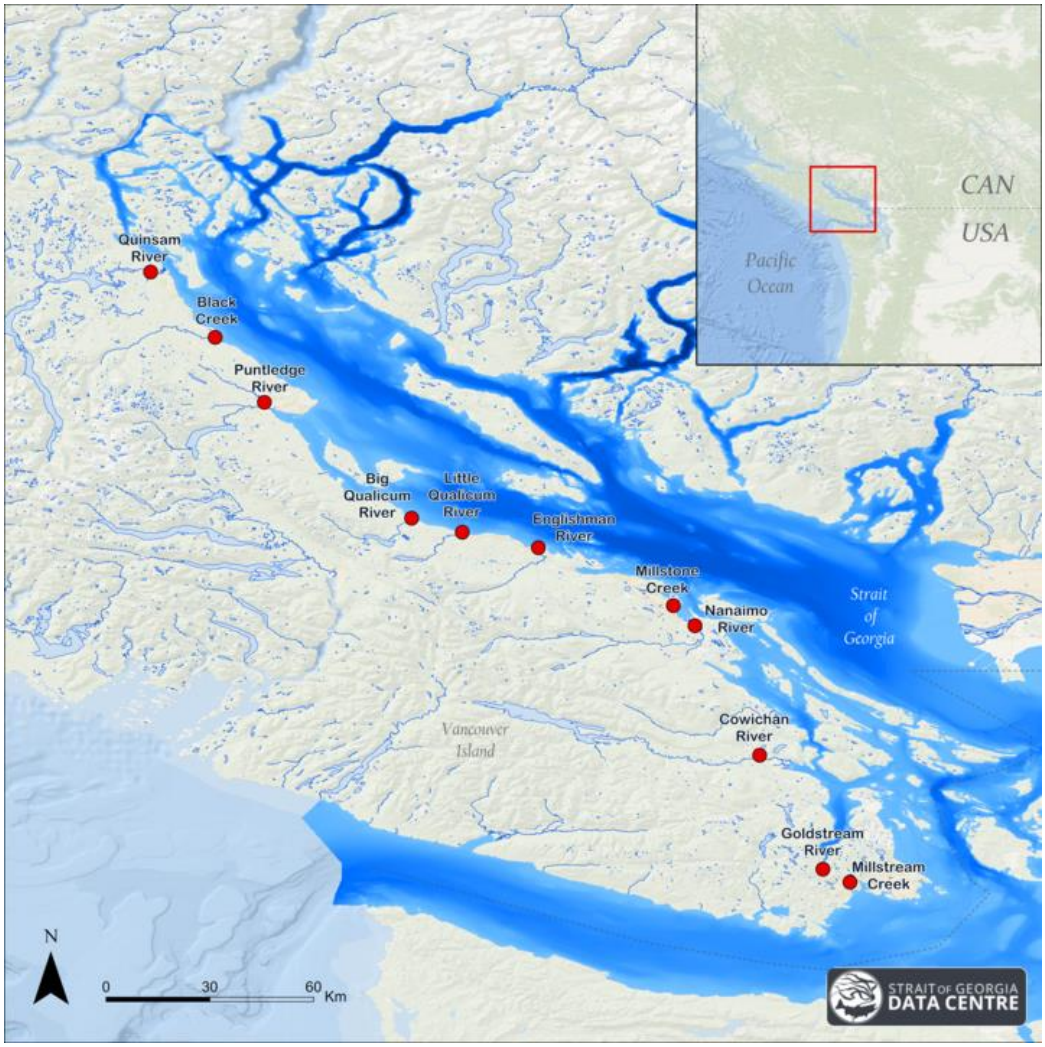

Figure 1. Map of Vancouver Island depicting all rivers with fixed antenna infrastructure installed as of 2024. The map was created by Strait of Georgia Data Centre, 2024.

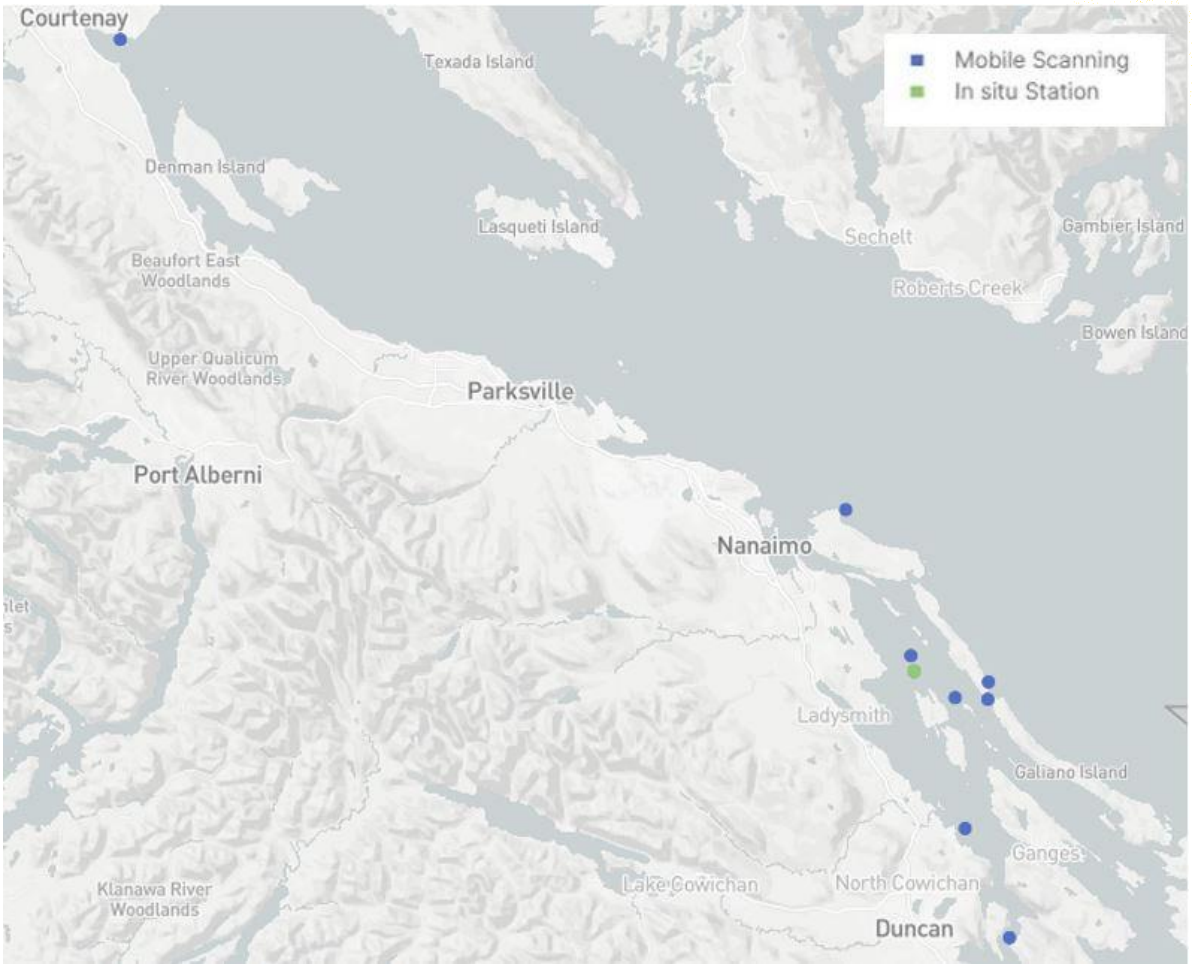

Figure 2. Map displaying locations of detected PIT tags during mobile scanning activities (blue) and the location of the in-situ predator monitoring station. Map developed using the Bottlenecks Data System (White-Gluz 2024).

PIT Tag Detection

Two methods were developed to detect PIT tags on seal haulouts: mobile scanning and fixed PIT antennas with trail cameras. Information on haulout locations were gathered from local and indigenous knowledge and the most recent harbour seal surveys completed by DFO (Government of Canada, 2019).

Mobile Scanning

Mobile scanning was done using two different types of mobile antennas. The first was a Biomark HPR Plus Handheld PIT tag Reader with the BP Plus Portable Antenna attachment. The second antenna was a custom-made mobile antenna constructed of 1.27 cm PVC pipe and Cat5e 350 MHz 24 AWG Ethernet Network cable, incorporating a Biomark IS1001 reader board. Both antennas have a similar read range of 12 to 18 inches, depending on the location and substrate.

Mobile scans began with an area survey, where a boat would slowly approach a known haulout site from a distance to determine if any marine mammals were present. Once it was known that no marine mammals would be disturbed, scanners would visually survey the haulout area and parse it into a grid with each section being scanned by at least two scanners to develop a detection efficiency estimate. If only one scanner was present, the scanner would complete two full sweeps of the haulout area.

Haulout scans corresponded to low tides to maximize the survey haulout area. The grid scans began closest to the water, moving farther away if the low tide was rising and farthest from the water to the closest if the tide was falling. This allowed for the lowest areas of the haulouts to be scanned during each site visit. Additionally, the type of substrate present at each haulout was recorded for each survey. This was done to compare the longevity rates of tags at different haul outs to inform a tag depletion estimate.

In-situ Antenna on Miami Islet

Miami Islet is a documented harbour seal haulout (Government of Canada, 2019) located north of Thetis Island, between Yellow Point on Vancouver Island and Valdes Island. This location was chosen with three key factors in mind. First, the topography of the Miami Islet provides a large area for seals to haulout and a large enough gradient from the high-water mark to the highest area, where a box to house monitoring equipment could be safely stored. Second, the last harbour seal haulout count had many seals utilizing this area (Government of Canada, 2019). Lastly, the *Bottlenecks Program* microtrolls and tags first ocean-year Chinook in this area during winter, therefore we would expect to find evidence of local predation events on PIT tagged salmon.

The antenna placed on Miami Islet was a 6 m HDPE Biomark antenna with a sub-node controlled by a Data-Over-Power Reader Board (IS1001). Four batteries were situated on the site with a 300-watt 60-cell solar panel. The antenna was anchored into the ground with cinderblocks and aircraft cable. Two trail cameras (Cabela's Outfitter Gen 4 48MP Black IR Trail Camera) were installed to monitor the antenna. One camera was programmed for motion detection, and the other was programmed to take photos every 60 minutes. The antenna and game camera times were synced to the field laptop to compare photos and PIT tag detections accurately.

This portion of the study piloted innovative methods for the real-time detection of tags within harbour seals. This approach aimed to provide detailed spatiotemporal data on predation events and perhaps collect enough data to develop predation estimates on tagged salmon.

The antenna for Miami Islet was installed on July 5, 2022, and data was recorded until November 9, 2022, which was the last time the site was visited and downloaded. Unfortunately, the antenna was destroyed before the data was downloaded again on November 29 during a winter storm. Therefore, the data presented herein is limited to the four-month window in which the antenna was operational.

RESULTS

Mobile Scanning

Thirteen known harbour seal haulouts were scanned on 14 different occasions. Of those 14 sites, 10 had 29 unique tags detected between them (Table 1; Figure 3). Of these 29 tags, 27 were linked to the *Bottlenecks Program* or partnered project tags. Two were not able to be linked to a known fish. Haulout names are from the DFO surveys completed in 2019 (Government of Canada, 2019).

Table 1. Summary of tags detected during mobile scanning events at harbour seal haulouts.

DATE	LOCATION	HAUL OUT NAME	TAGS FOUND
2021-06-29	West Protection Island	H0452	0
2021-07-23	Miami Islet	H0027	7
2021-07-23	Danger Reef	H0028	1
2021-07-23	Rose Islets	H0047	1
2021-08-05	Burial Islet	H0499	1
2021-08-05	Sansum Point	H1522	0
2021-08-05	Crofton Reef	H0592	4
2021-08-09	Union Point	H1474	0
2021-08-09	South Union Point	H0414	0
2022-07-05	Miami Islet	H0027	2
2022-07-19	South Shah Point Reef	H0590	4
2022-07-19	Black Rock	H1460	1
2022-10-05	Southeast Orlebar Point Rock	H0055	4
2023-03-01	Comox Harbour Seal Haulout	H0104	4

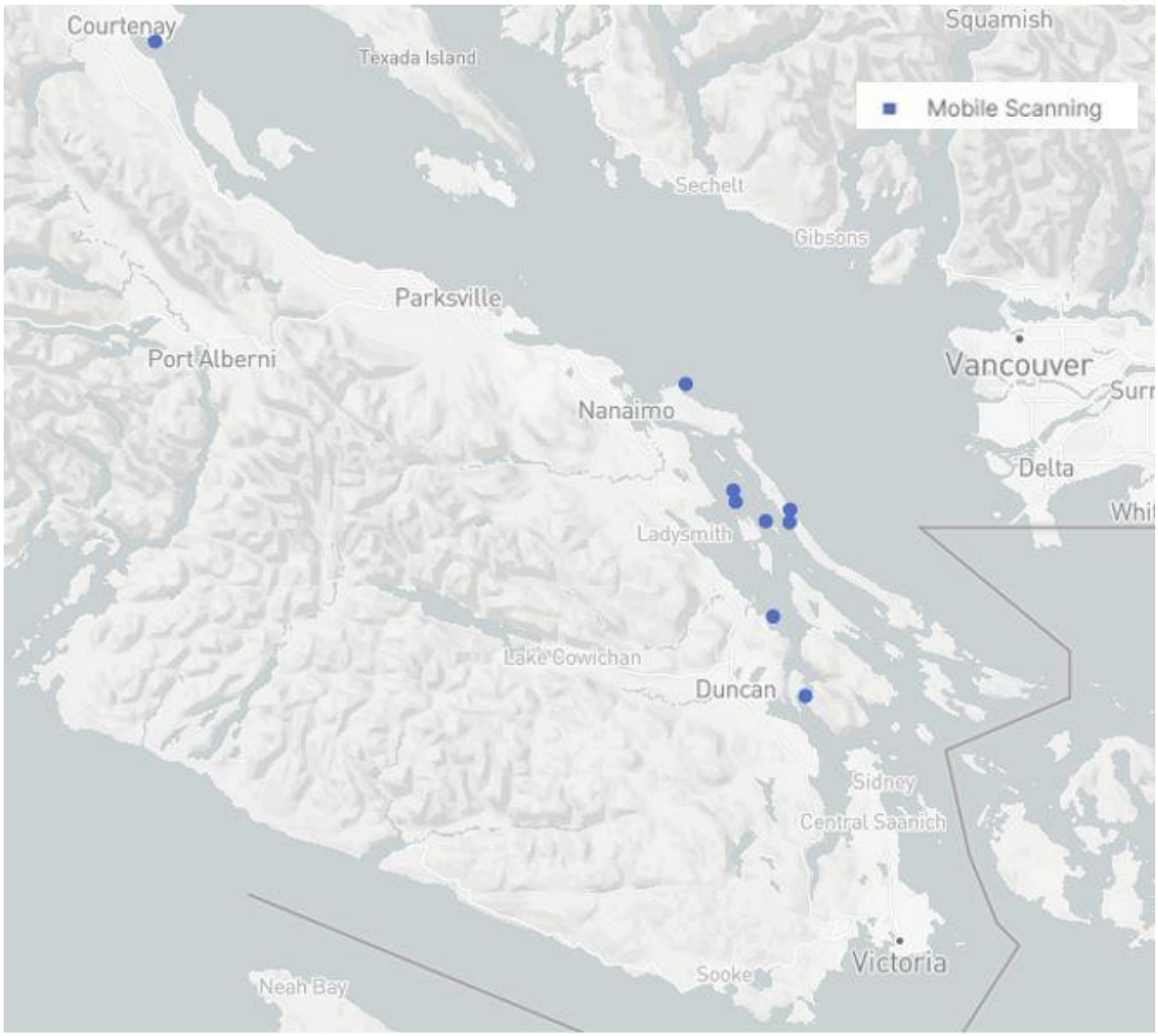

Figure 3. Map displaying locations of detected PIT tags during mobile scanning activities, 2024. Map developed using the Bottlenecks Data System (White-Gluz 2024)

Of the 27 linked tags, 21 were from Chinook, four from coho, and one was from a coastal cutthroat trout (*O. clarkii clarkii*). The oldest tag recovered was from a Chinook tagged in the Cowichan River on May 11, 2015, and was recovered on Miami Islet on July 22, 2021. All associated fish bio-data are presented in Appendix A.

The substrate type was recorded at each haulout surveyed. However, with the relatively low number of tags found, insufficient data was available to determine which substrate type was best for retaining tags. Interestingly, tags were found above and below the high water mark on haulouts. In some cases, tags were found in higher areas where it was more likely that an avian predator had consumed the tagged fish. While we cannot assume that harbour seals consumed all recovered tags,

we can confidently say that all recovered tags found on the haulouts were tagged fish that were predated.

In-situ Pinniped Monitoring Station on Miami Islet

During its operational period, the antenna had a total of 19,438 detections. Of those, 10 unique tags were recorded on the antenna, with six originating from the *Bottlenecks Program* or partnered programs. The other four unique tags were from unknown sources and are considered "orphan" tags.

The motion-triggered trail camera was the only camera functioning properly when the antenna was operational. Three of the ten unique tags were linked to a positive image showing a seal over the antenna while the detections were being recorded (Figure 4; Table 2).

Of the recovered tags we can trace, five were of hatchery origin and were tagged at the Nanaimo River Hatchery, and one was of wild origin, tagged in the Cowichan River (Table 2).

Figure 4. Miami Islet haulout antenna with positive detection of harbour seal and a tag detection (September 22, 2022, at 12:49 PM).

Table 2. Summary of linked tag detections at Miami haulout antenna

WATERSHED	SPECIES	COHORT	STOCK	OUTMIGRATION YEAR	TAG ID	RELEASED	FORK LENGTH (MM) AT TAGGING	ORIGIN	DATE/ TIME DETECTED	CONFIRMED WITH IMAGE
Nanaimo	ck	fall-run	Nanaimo	2022	989.001042 002795	2022-05-10		hatchery	2022-08-17 16:14	Y
Nanaimo	ck	fall-run	Nanaimo	2022	989.001042 002373	2022-05-10		hatchery	2022-08-24 13:48	
Nanaimo	ck	summer-run	Nanaimo	2021	989.0010393 98482	2021-04-23		hatchery	2022-09-22 12:50	Y
Cowichan	ck	fall-run	Cowichan	2022	989.0010419 19671	2022-06-07	71	wild	2022-09-24 6:33	
Nanaimo	ck	fall-run	Nanaimo	2022	989.001042 002084	2022-05-10		hatchery	2022-10-02 0:02	
Nanaimo	ck	summer-run	Nanaimo	2022	989.0010419 93660	2022-05-10		hatchery	2022-10-10 21:09	Y

DISCUSSION

The *Bottlenecks Program* aimed to leverage the extensive PIT tagging network established along ECVI to understand the spatiotemporal effects of predation on salmonids. This objective focused on detecting PIT tags from known harbour seal haulouts on ECVI. Through the combined efforts of mobile scanning and the in-situ monitoring station, we confirmed predation events on salmonids tagged as part of the *Bottlenecks Program*.

The mobile scanning efforts proved effective, with 10 of the 14 sites yielding at least one detected PIT tag. However, several questions arose from the process. For instance, it was not possible to determine which predator consumed the tagged fish. While harbour seals are suspected to be one of the primary predators, other marine animals such as sea birds, sea lions, and piscivorous fish are also possible predators. Therefore, while mortality due to predation can be confirmed, the predator's identity remains uncertain. In addition, the lifetime of a PIT tag on a haul out once it has been deposited is unknown and likely depends on the substrate and environmental conditions. PIT tags deposited onto a bare rock surface are more likely to get washed away from wave action than those in loose cobbles or gravel. Furthermore, the frequency with which scans should be conducted to maximize the likelihood of detecting the most tags needs to be reviewed; increased scanning effort is likely required moving forward.

Despite extensive PIT tagging through microtrolling efforts between the Nanaimo and Cowichan Bay areas, detecting tagged fish from local microtrolling was lower than expected on our haulout scans. Notably, during microtrolling from August to October of 2022, over 1,584 tags were deployed within 20 km of Miami Islet, but only one of those PIT tags was detected on the haulout. Several factors might explain this low detection rate, including tidal influences washing tags away, predators depositing tags in deeper waters, or predators focusing on different fish sizes or age classes.

The extension of the *Bottlenecks Program* until March 2026 will see hundreds of thousands of additional PIT tags deployed, increasing the likelihood of tag detections at marine haulouts. Mobile haulout scanning will continue and expand to the Discovery Islands area through a partnership with A'Tlegay Fisheries Society, and will see increased efforts; however, the current uncertainties with the data collected (probability of detection, inferring predator, and logistics) must be addressed. The Miami Islet antenna pilot program demonstrated that in-situ antennas could effectively detect tags and identify predators in the marine environment.

The Miami Islet antenna pilot program operated for 127 days and, through the combination of camera traps and PIT antenna infrastructure, directly linked a PIT tagged fish's mortality to predation. The high number of detections of a small number of unique tags is directly related to the duration of time the tag spent within the PIT antenna electromagnetic field. As seals move on and off the haulout, multiple detections of the same tags increase the confidence in attributing these detections to salmon predated by seals. In-situ antennas showed promise for understanding harbour

seal predation on PIT tagged salmon. Photo validation confirmed that tags from salmon were detected in harbour seals as they moved over the antenna. However, the possibility remains that the seal could have consumed another predator who predated upon the tagged individual.

Real-time data collection was not possible during the pilot study; however, we will explore this moving forward for the in-situ monitoring. On Miami Islet, we were unaware that the antenna had been destroyed in November until the next site visit in mid-December. Additionally, a tag stuck on the antenna was recorded 13,071 times between October 10 and October 20, potentially reducing the read range and "colliding" with other tags that may have crossed the antenna simultaneously, possibly leading to missed tags. Real-time data access would allow immediate remediation of these issues and reduce the required site visit frequency.

The potential for PIT tags being used to track migration is limited compared to the fine-scale spatial data that can be acquired through acoustic or satellite tags. However, with thousands of PIT tags entering the Salish Sea every year and their lower cost relative to other electronic tagging methods, leveraging the number of PIT tags now in circulation in the Salish Sea could lend itself to studies of movement patterns. Given the foraging range of harbour seals, typically 10-20 km of their haulout (Department of Fisheries and Oceans – Pacific, 2010), and the rapid digestion rates observed in studies (Markussen, 1993), the likelihood is that tags detected on haulouts will be from salmon consumed within this >20 km vicinity of a given haulout. From this, we can gain new insights into the distribution of stocks within the Salish Sea.

In conclusion, the Bottlenecks to Survival Program has demonstrated the potential of PIT tags to provide valuable spatiotemporal data on predation events affecting salmon. The continued development of in-situ monitoring sites and a coordinated increase in mobile haulout scanning could yield more accurate predation rates, informing the overall survival models currently being developed. The program can significantly enhance our understanding of predator-prey interactions by expanding on current efforts, incorporating real-time data collection, and increasing the number of haulout monitoring sites, which will inform more effective conservation strategies for salmonids in the Salish Sea.

REFERENCES

Atkinson, J., and Damborg, J. (2018). Marking juvenile Cowichan River Chinook with PIT tags to support in-river predation and marine survival investigations. Prepared for the Salish Sea Marine Survival Project. P8.

Babey, C.N., Gantner, N., Williamson, C.J., Spendlow, I.E., and Shrimpton, J.M. (2020). Evidence of predation of juvenile white sturgeon (*Acipenser transmontanus*) by North American river otter (*Lontra canadensis*) in the Nechako River, British Columbia, Canada. J. Appl. Ichthyol. 36(6): 780–784. doi:10.1111/jai.14114.

Department of Fisheries and Oceans Canada (DFO) – Pacific Region. (2010). Population assessment Pacific harbour seal (*Phoca Vitulina Richards*). https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/338997.pdf

Government of Canada. (2019). Harbour seal *(Phoca vitulina*) counts and haulout locations along BC coast - Harbour seal counts and haulout locations https://open.canada.ca/data/en/dataset/be5a4ba8-79dd-4787-bf8a-0d460d25954c

Markussen, N. H. (1993). Transit time of Digesta in captive Harbour Seals (*Phoca vitulina*). Canadian Journal of Zoology, 71(5), 1071–1073. https://doi.org/10.1139/z93-144

Sherker, Z.T., Pellett, K., Atkinson, J., Damborg, J., and Trites, A.W. (2021). Pacific great blue herons (Ardea herodias fannini) consume thousands of juvenile salmon (*Oncorhynchus* spp.). Can. J. Zool. 99(5): 349–361. doi:10.1139/cjz-2020-0189.

Vollset, K.W., Lennox, R.J., Thorstad, E.B., Auer, S., Bär, K., Larsen, M.H., Mahlum, S., Näslund, J., Stryhn, H. & Dohoo, I. (2020). Systematic review and meta-analysis of PIT tagging effects on mortality and growth of juvenile salmonids. *Reviews in Fish Biology and Fisheries, 30*, 553-568. https://doi.org/10.1007/s11160-020-09611-1.

White-Gluz. B. (2024). Bottlenecks to Survival Database Report. Prepared for the Department of Fisheries and Oceans Canada (BC Salmon Restoration Innovation Fund). P 12.

APPENDIX A

Biological Data Associated with Salmon Detected on Mobile Haulout Scans.

SITE NAME	DFO HAUL-OUT NAME	TAGGING DATE	DATE RELEASED	DATE/ TIME DETECTED	STOCK	SPECIES	OUT-MIGRATION YEAR	ORIGIN	COHORT	FORK LENGTH AT TAGGING	LATITUDE	LONGITUDE
Black Rock	H1460	2021-06-03	2021-06-03	2022-07-19 14:53	Cowichan	ck	2021	wild	fall-run	68	49.0094	-123.595400
Burial Islet	H0499	2019-06-10	2019-06-10	2021-08-05 9:03	Cowichan	ck	2019	wild	fall-run	82	48.7694	-123.562
Comox Harbour	H0104	2021-06-16	2021-06-16	2023-03-01 0:00	Puntledge	ct	2021	wild	unknown	227	49.667901	-124.924227
Comox Harbour	H0104	2021-04-21	2021-05-28	2023-03-01 0:00	Puntledge	ck	2021	hatchery	fall-run		49.667901	-124.924227
Comox Harbour	H0104	2021-06-23	2021-06-23	2023-03-01 0:00	Puntledge	ck	2021	unknown	unknown	67	49.667901	-124.924227
Comox Harbour	H0104	2021-12-02	2021-05-19	2023-03-01 0:00	Puntledge	co	2022	hatchery	smolt		49.667901	-124.924227
Crofton Reef	H0592	2020-08-17	2020-08-17	2021-08-05 11:03	Cowichan	ck	2020	wild	fall-run	174	48.8795	-123.6299
Crofton Reef	H0592	2017-05-24	2017-05-24	2021-08-05 11:05	Cowichan	ck	2017	hatchery	fall-run	75	48.8795	-123.6299
Crofton Reef	H0592	2016-06-14	2016-06-14	2021-08-05 11:11	Cowichan	ck	2016	wild	fall-run	99	48.8795	-123.6299
Crofton Reef	H0592	2016-08-30	2016-08-30	2021-08-05 11:05	Cowichan	ck	2016	wild	fall-run	163	48.8795	-123.6299

Danger Reef	H0028	2021-04-22	2021-05-19	2021-07-22 12:29	Nanaimo	ck	2021	hatchery	fall-run		49.0532	-123.7131
Miami Islet	H0027	2016-06-03	2016-06-03	2021-07-22 10:40	Cowichan	ck	2016	wild	fall-run	76	49.0375	-123.708300
Miami Islet	H0027	2015-05-11	2015-05-11	2021-07-22 11:23	Cowichan	ck	2015	unknown	fall-run	69	49.0375	-123.708300
Miami Islet	H0027	2019-06-21	2019-06-21	2021-07-22 10:36	Cowichan	ck	2019	wild	fall-run	74	49.0375	-123.708300
Miami Islet	H0027	2019-05-31	2019-05-31	2021-07-22 10:53	Cowichan	ck	2019	wild	fall-run	66	49.0375	-123.708300
Miami Islet	H0027	2018-05-24	2018-05-24	2021-07-22 10:40	Cowichan	ck	2018	hatchery	fall-run	86	49.0375	-123.708300
Miami Islet	H0027	2016-05-29	2016-05-29	2021-07-22 10:37	Cowichan	ck	2016	hatchery	fall-run	82	49.0375	-123.708300
Miami Islet	H0027	2022-01-18	2022-05-19	2022-06-22 9:08	Robertson Creek	stl	2022	hatchery	river release		49.0375	-123.708300
Miami Islet	H0027	2021-05-10	2021-05-10	2022-07-05 12:21	Englishman	co	2021	wild	smolt	83	49.0375	-123.708300
Miami Islet	H0027	2019-05-23	2019-05-23	2022-07-05 13:03	Cowichan	ck	2019	hatchery	fall-run	89	49.0375	-123.708300
Rose Islets	H0047	2021-05-05	2021-05-05	2021-07-22 13:45	Cowichan	ck	2021	hatchery	fall-run		49.0111	-123.645300
South Shah Point Reef	H0590	2021-05-18	2021-05-18	2022-07-19 13:19	Cowichan	ck	2021	wild	fall-run	67	49.0268	-123.594300
South Shah Point Reef	H0590	2021-05-11	2021-05-11	2022-07-19 13:38	Cowichan	co	2021	wild	smolt	110	49.0268	-123.594300

South Shah Point Reef	H0590	2019-05-23	2019-05-23	2022-07-19 13:40	Cowichan	ck	2019	hatchery	fall-run	76	49.0268	-123.594300
South East Orlebar Point Rock	H0055	2021-04-22	2021-05-19	2022-10-05 9:07	Nanaimo	ck	2021	hatchery	fall-run		49.1996	-123.8129
South East Orlebar Point Rock	H0055	2021-03-17	2021-05-13	2022-10-05 10:21	Nanaimo	co	2021	hatchery	smolt		49.1996	-123.8129
South East Orlebar Point Rock	H0055	2021-05-05	2021-05-05	2022-10-05 9:07	Cowichan	ck	2021	hatchery	fall-run		49.1996	-123.8129

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