Átl'ka7tsem / Howe Sound

# Slhawt' / Herring Spawn Survey Report

Winter & Spring 2024

## Full Report

(Click here for the Executive Summary)

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Tem Lhawt': the time of herring and herring spawns in Skwxwú7mesh territory

Photo: E. Jackson

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A project of MakeWay

## Published on
November 22, 2024

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## Acknowledgements
The Searching for Slhawt' / Herring Spawn Survey Program takes place on the unceded territory of the Skwxwú7mesh Úxwumixw (Squamish Nation). This program is carried out in partnership between the Átl'ka7tsem / Howe Sound Marine Stewardship Initiative (MSI) and Squamish Nation Ta na wa Yúus ta Stitúyntsam' (Rights and Title Department).

Our hands are raised in gratitude to everyone involved in this program; it is truly a community effort. This work would not be possible without the energy, time, and passion that everyone brings forth to caring for these waters and the creatures that inhabit them. Special thanks to the Squamish Nation Archaeological, Cultural, and Environmental (ACE) Technicians and supporting staff, volunteer surveyors, contractors, local knowledge holders, MSI staff, and generous support from our partners and sponsors.

More information and the Executive Summary version of this report are available here: www.howesoundguide.ca/search-for-slhawt-herring

Data is publicly available in the Marine Reference Guide, an online interactive map, at www.howesoundguide.ca/map.

# Table of Contents

# 1. Preface

This program takes place on the unceded territory of the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation). Sḵwx̱wú7mesh territory spans from the village of X̱wáýx̱way in the south, to Ch'ḵw'elhp (Gibsons) in the west, up into the Tsewilx' (Tantalus Mountain Range). The territory expands north to Sḵwiḵw (Whistler), east to the drainage of the Pitt River, and south again toward Indian Arm and the villages of the North Shore, Eslhan and Xwmélts'stn.

Átl'ḵa7tsem is one of three Sḵwx̱wú7mesh place names for the deep glacial fjord also known today as Howe Sound (Figure 1); Átl'ḵa7tsem roughly translates to 'paddling out of the fjord toward the Salish Sea'. Large rivers such as the Squamish, Ch'iyáḵmesh (Cheakamus), Mámx̱wem (Mamquam), Cheekeye, and Sawa7elt (Stawamus) all flow past Squamish, into the estuary, and out into the Sound. On the west side of Átl'ḵa7tsem, past towering granite cliffs that lean into the ocean, is the old village of Swiyát, also known today as the Woodfibre LNG site, where three notable creeks flow straight into Átl'ḵa7tsem.

Slhawt' (Pacific herring, *Clupea pallasii*) play a vital role in this complex marine ecosystem, providing an essential link between lower and upper trophic levels of the food web. Traditionally, herring have represented the first flush of protein to return to Átl'ḵa7tsem after a long winter. During this period, known to the Squamish Nation as Tem Lhawt' (Time of the Herring), the shoreline springs to life as the entire food chain, including birds, salmon, seals, whales, bears, and humans, share in the celebration.

This report documents the results of the 2024 Search for Slhawt' / Herring Spawn Survey Program, which took place between the dates of February 7 and May 7, 2024. This is the fourth annual survey effort, and all survey data from 2021-2024 is publicly available in the Marine Reference Guide, at www.howesoundguide.ca/map.

Figure 1: An aerial view of Átl'ḵa7tsem (Howe Sound), taken from the northern end and facing south.

# 2. Background

## 2.1 Slhawt' (Pacific herring, *Clupea pallasii*)

Pacific herring, known as slhawt' in the Sḵwx̱wú7mesh sníchim (Squamish language), are schooling forage fish that are integral to the Pacific marine food web. Herring are a keystone species; they represent the primary food source for coho salmon, chinook salmon, and harbor seals, and are an important component of the diets of other marine animals such as orcas, humpback whales, sea lions, and many species of shorebirds (Moss, 2016, Pearsall et al., 2021). As such, changes in herring populations have direct and significant impacts on the local ecosystem.

On the Pacific coast of Canada, the herring spawn season occurs annually in early spring. Adult herring migrate from the deeper waters of their summer feeding areas into brackish estuaries and shorelines to spawn. The female herring deposit their eggs along the shoreline of intertidal and subtidal zones. The eggs adhere to hard surfaces such as seagrasses, kelp, rockweed, boulders, wood, and other available substrate. Male herring fertilize the eggs, often turning the water milky-green in colour with their milt. Once the spawning event is complete, the adults return to their summer feeding areas. Adult herring will spawn on average 5 - 7 times in their lifetime.

The ch'em'esh (herring eggs) are typically laid in abundance, multiple layers thick, and many animals feed upon them while they develop. After about 10-14 days, the eggs hatch. Larval herring, once hatched, will stay near their spawning grounds for the first 2-3 months as they mature into juvenile herring. Juveniles remain in shallow bays and inlets during the summer of their first year feeding on larval crustaceans and mollusks before migrating to deeper waters in the fall, where they remain for 2-3 years before returning to shallow waters to spawn.

Figure 2: Pacific herring (left) and herring spawn on rockweed (right).

## 2.2 Átl'ka7tsem / Howe Sound

In Átl'ka7tsem, herring were once abundant and acted as an important food source for people and animals in the region. The Squamish Nation have been stewards of these lands and waters for thousands of years, harvesting slhawt' and their ch'em'esh annually. However, a history of industrial activity within the past century has impacted the health and biodiversity of Átl'ka7tsem, including herring populations.

The most notable of industrial impacts on Átl'ka7tsem's marine environment come from mining, a chemical manufacturing facility, and pulp mill operations during the twentieth century. Britannia Mine, once Canada's largest copper mine, operated in Britannia Beach for 70 years. The water discharged from the mine when active and the subsequent runoff that continued to leak into the environment after the mine closed in 1974 was highly acidic due to Acid Rock Drainage (ARD), a chemical reaction between oxygen and the minerals present in the mine water. The ARD caused toxic runoff to enter Átl'ka7tsem and decimated marine life around Britannia for decades before remediation efforts were implemented in 2006 (Alava, 2017). A FMC chlor-alkali plant (the production of caustic soda) opened in 1965 near the mouth of the Squamish River and was shut down just five years later in 1970 due to excessive mercury discharge into Átl'ka7tsem. The Woodfibre Pulp Mill, operational from 1912 to 2006, released many chemicals and pollutants into Átl'ka7tsem through the discharge of effluents from the paper making process (Pokhrel & Viraraghavan, 2004). The Port Mellon Pulp Mill, known today as Howe Sound Pulp and Paper, opened in 1909 and continues to operate today under much stricter emission standards.

The commercial herring fishery also had a devastating impact on the herring populations throughout the Salish Sea (Thornton & Moss, 2021). From the 19-20th century, the commercial herring fishery grew into a major export and great numbers of herring were processed for oil and fish meal. These commercial catch rates became unsustainable and by the 1960's herring stocks collapsed in the Salish Sea, resulting in fisheries closures. In some areas of the Salish Sea herring fisheries have reopened, but they remain closed in Átl'ka7tsem to-date.

Recovery efforts in Átl'ka7tsem began in 1988 with improvements to industrial operations following the implementation of the Fisheries Act in 1985. Remediation efforts for the mercury pollution were initiated in the 1990's and the Province of British Columbia implemented efforts to remediate Britannia Mine effluent in 2006. Many local organizations and individual advocates have brought attention to the ecological, cultural, and economical value in restoring and protecting marine health in the region. The Squamish Streamkeepers have made considerable efforts to improve and restore herring spawn habitat in both Átl'ka7tsem and Burrard Inlet. Their methods included wrapping toxic creosote pilings to protect spawning habitat and providing mesh net panels as alternative substrate.

There has been a noticeable recovery of marine life over the past decade in Átl'ka7tsem and more broadly in the Salish Sea, in part due to these efforts, along with the myriad other regional marine restoration, conservation, and stewardship activities. The herring returned, bringing with

them the salmon, and, more recently, whales have been spotted in an abundance not witnessed in decades. In 2021, Átl'ka7tsem was designated a UNESCO Biosphere Region, bringing attention to the recovering biodiversity and cultural richness of the area.

Squamish People have a strong oral history that accounts for herring presence and abundance through time in Átl'ka7tsem. Squamish People have relied on herring as a subsistence food since time immemorial. For example, herring bones were found in six of eight archaeological dig sites within Átl'ka7tsem dating back at least 2000 years (and 3000 years in other parts of the territory) (Archaeology of Squamish Territory, 1998). Herring density in Átl'ka7tsem was high enough that a lhét'emten (herring rake) was used to harvest the fish. Given the strong relationship between herring and Squamish People, Squamish Nation has a continued interest in tracking the health of herring and herring spawn in the territory.

Western scientific methods of monitoring herring in Átl'ka7tsem have been carried out by federal, academic, and community science efforts since the 1960s. Fisheries and Oceans Canada (DFO) conducted studies on herring spawn sites and density in Átl'ka7tsem from 1966 to 2001 for stock assessment purposes. Since then, herring spawn presence has been studied in parts of Átl'ka7tsem, for example through John Buchanan's community science surveys starting in 2010 through to 2019. Academic and conservation groups have also conducted a handful of studies on herring in the region within the past decade. The Squamish Streamkeepers led considerable efforts to protect and restore herring spawn habitat in both Squamish and Vancouver.

From 2021 to 2024, herring spawn monitoring has been conducted collaboratively by the Átl'ka7tsem / Howe Sound Marine Stewardship Initiative (MSI) and the Squamish Nation Ta na wa Yúus ta Stitúyntsam' (Rights and Title Department).

## 2.3 Searching for Slhawt' / Herring Program Development

### 2019

- Kiyowil (Elder Bob Baker) and other Skwxwú7mesh Elders asked that the students of Aya7ayulh Chet (Cultural Journeys) program at St'a7mes School hatch a plan to bring the community back into relation with the herring of Átl'ka7tsem.
- For the first time in many generations, the community gathered to celebrate the return of the herring, known as Tem Lhawt' in the Skwxwú7mesh sníchim (language).
- Students hung cedar and hemlock boughs in the intertidal zone off a beach near St'a7mes Village, and within a week the herring had returned to spawn. Watch a video about the 2019 harvesting of Ch'em'esh from Matthews West.
- Local community scientist John Buchanan began passing on knowledge about the herring spawn to MSI staff and Squamish Nation youth.

### 2020

- The Searching for Slhawt' / Herring Spawn Survey team was formed.

- John Buchanan formally passed on responsibilities of monitoring herring spawn, and the new team began mapping and sharing the story of herring in Átl'ka7tsem.

## 2021

- The Searching for Slhawt' team took to the water by boat and snorkel to understand where and when the herring were spawning in northern Átl'ka7tsem.
- Students of Aya7ayulh Chet studied the moon and tides to predict the arrival of the herring in Skwxwú7mesh territory. Following the students' recommendations, the community gathered on the beach to welcome the herring through ceremony.
- Results and maps from the program were shared in a blog post about the 2021 herring spawn season.

## 2022

- The survey team expanded to cover a larger region of northern Átl'ka7tsem, and documented herring spawns using a standardized protocol.
- 20 volunteers supported spawn surveys in the Squamish Estuary.
- Herring spawn was documented from January 18 to April 16, 2022.
- 2022 was the first year that a formal report was created to share survey findings.

## 2023

- The Searching for Slhawt' team grew with Matty Moore from the Squamish Nation Rights and Title Department and Addison Farr of Seadog Expeditions.
- 25 volunteers supported spawn surveys in the Squamish Estuary.
- Herring spawn was documented from February 26 to April 7, 2023.
- A full 2023 Search for Slhawt' report was released with more details.

## 2024

- The survey team included Matty Moore as the lead snorkel surveyor from the Squamish Nation Rights and Title Department. Along with his support, two other Squamish Nation surveyors were trained this year; Aaron Skye and Nick Baker.
- The MSI boat crew included Matthew Van Oostdam, Addison Farr, and at times Kieran Brownie, other guests, or volunteers.
- Virginie Chalifoux, PhD student from UBC's Aquaculture and Climate Change Lab, spent a day on the boat to investigate impacts of climate change on herring egg development.
- Over 35 volunteers helped us regularly survey the Squamish Estuary for spawn.
- Herring spawn was documented from February 16 to April 26, 2024.
- With the Skwxwú7mesh community, we celebrated Tem Lhawt' with the annual Welcoming of the Herring event. Ch'em'esh (herring eggs) on cedar and hemlock boughs were harvested from Foulger Creek bay.
- Of note was a new spawn area documented near the area known as Txwn7us (Two Islands), just south of Darrel Bay. As in previous years, extensive spawn was documented throughout the Squamish Estuary and near Foulger Creek / Woodfibre Creek.

- A series of 4 short films about the Search for Slhawt' / Herring Program were created; filmed by Kieran Brownie and funded by the British Columbia Salmon Restoration and Innovation Fund (BCSRIF), via the Pacific Salmon Foundation (PSF).
- Full results, details, photos, and maps from 2024 are in Section 4. Results.

# 3. Survey methods

The Searching for Slhawt' / Herring Spawn Survey Program has been collaboratively developed between the Átl'ka7tsem / Howe Sound Marine Stewardship Initiative (MSI) and the Squamish Nation Ta na wa Yúus ta Stitúyntsam' (Rights and Title Department).

This program builds upon work and knowledge from Squamish Nation, Kiyowil (Elder Bob Baker), Squamish Streamkeepers, community scientists such as John Buchanan, St'a7mes School of School District 48, Fisheries & Oceans Canada (DFO), and others who cared for these waters before us. Methodologies and survey sites were developed in consultation with insights and guidance from these key partners and advisors.

The surveys are conducted under a Section 52 Scientific License from DFO.

## 3.1 Survey objectives

The Searching for Slhawt' / Herring Spawn Survey Program aims to:

1. Map, monitor, and document Pacific herring (*Clupea pallasii*) spawn in northern Átl'ka7tsem from late winter to spring, on an annual basis.
2. Establish and maintain an adaptive program structure that is sustainable, shares capacity within the community, and contributes to the understanding that herring are a keystone species.
3. Collect data that will be useful and credible for informing decision-making processes in the region.

In collecting this information annually we aim to establish a long-term dataset that tracks the status and trends of herring spawn distribution, abundance, and timing in northern Átl'ka7tsem. These data will be useful for future studies of herring in the region and provide a baseline to understand ecosystem responses to human impacts (e.g., development, resource extraction, and climate change).

Data is uploaded to MSI's Marine Reference Guide, a publicly accessible, online, interactive map that informs regional decision-making and marine spatial planning. Sharing the data within this map helps to close the loop between knowledge and action; it ensures monitoring data can directly inform regional education and decision-making processes, such as the Squamish Nation referrals review process which evaluates proposed projects within the territory.

## 3.2 Data collection

Herring spawn is deposited by the fish onto myriad surfaces, such as wood, rock, kelp, eelgrass, rockweed, sedges, grasses, and rushes. Along the British Columbia coast, herring spawn is typically found between about 1.5m above 0-tide level and 18m below 0-tide level, with activity peaking in late March to early April (Outram & Humphreys, 1974). The eggs are deposited when the water covers the shoreline. Eggs hatch out in about 10-14 days, depending on water temperatures (faster development occurs with warmer temperatures), leaving egg casings behind. As such, there is approximately a 2 week window to record a spawn event after it occurs.

Surveyors collect the following information:

1. Location and timing of herring spawn.
2. Temperature of water (in degrees Celsius).

Other observations include notes about spawn density, wildlife present, and spawn substrate.

In 2024, we used ArcGIS Survey123 as our data collection tool (Figure 3). All surveyors filled out a Survey123 form each time they conducted a survey, whether they found spawn or not. When spawn was found more details were entered in the form, including spawn location (as a line on a map, indicating the start and end of spawn along a shoreline), notes on density, additions observations such as spawn substrate and wildlife, and photos. If spawn was found in multiple locations, the form was filled out again for each location.

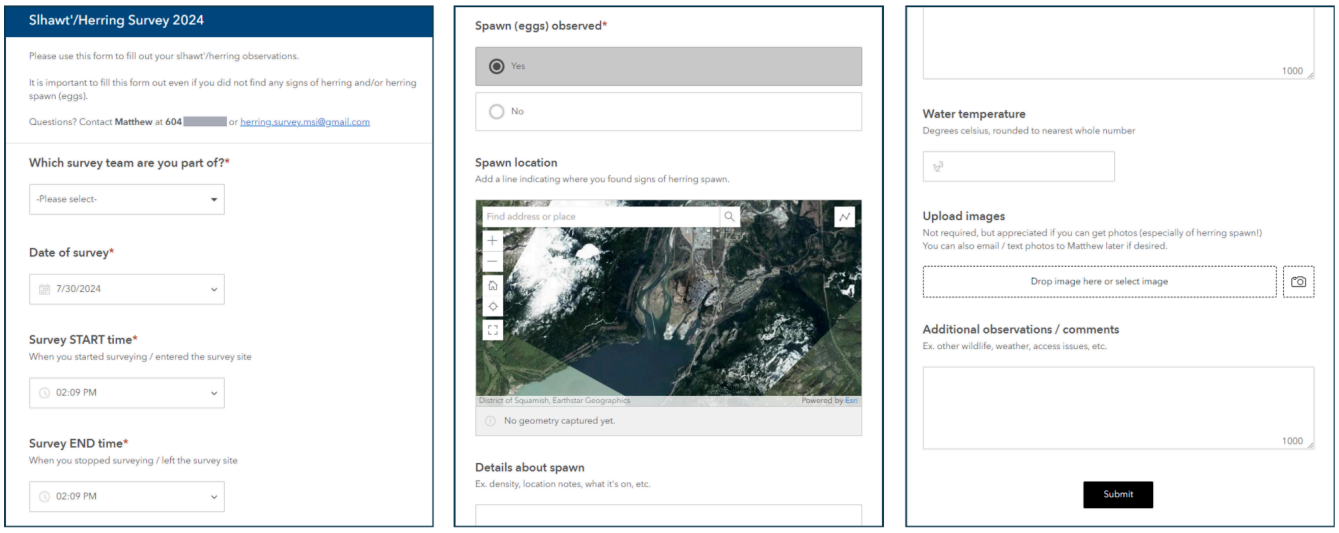


Figure 3: The Survey123 form used by surveyors. Note - these images do not show all questions; additional questions appeared conditionally, based on the initial response. Questions not shown include: name of the surveyor and site name.

The Search for Slhawt' / Herring Spawn Survey Program is divided into two sub-sections:

a. Land-based surveys throughout Skwelwil'em (the Squamish Estuary)
   Our land-based survey team takes advantage of the time period when the tide is low enough that they can walk or paddle (kayak, canoe, or stand up paddle board "SUP") around shores of the estuary and visually see spawn above the waterline (Figure 4).

The land-based team is predominantly volunteers; in 2024 we had 35 volunteer surveyors participate in weekly monitoring of their assigned site. There were 3 - 4 volunteers assigned to each estuary site, and they checked their site approximately once per week from February 7 to May 1, 2024.

See the 2024 Searching for Slhawt' Volunteer Manual for more details.



Figure 4: Land-based surveyors inspect substrate for signs of herring spawn in the Squamish Estuary.

### b. Boat-based snorkel surveys along shorelines of northern Átl'ka7tsem

The boat-based survey team is more flexible with the tide heights within which they can survey. The shorelines that the boat-based team visits are not accessible by foot. In 2023 and 2024, MSI contracted Addison Farr of Seadog Expeditions to provide boat services to access these more remote sites.

During boat-based surveys, a snorkeler swims along the shoreline looking closely at suitable spawning substrate for signs of eggs (Figure 5). Depending on conditions, the snorkel surveyor will swim between 100 m to 1 km per site. They then return to the boat and swim at another site. If conditions allow, the boat can also approach the shoreline to allow for substrate inspection in key locations while the surveyor is sitting on the boat. Boat-based sites were checked 1 - 2 times per week in 2024.

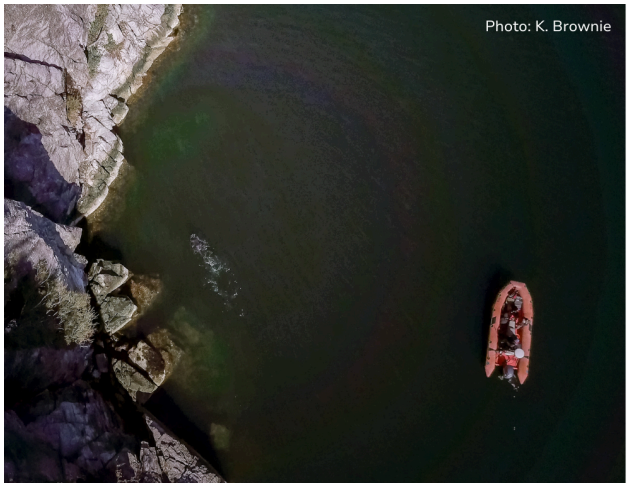



Figure 5: Boat-based surveys occur at sites in the northern end of Átl'ka7tsem.

When spawn is found by either team, the location (GPS coordinates), date/time, and other details are recorded in Survey123 (Figure 3). Significant efforts have been made each year to document surveys and spawn events in photo and video when possible.

Before monitoring begins for the season, all surveyors receive training on conducting herring spawn surveys, including accurate egg identification, data collection, site-specific orientations, safety guidelines, and habitat protection protocols. Community consultation on survey methodologies and sites is conducted on a yearly basis during a volunteer information session hosted by MSI in January. Survey results are presented at the end of the survey season during a community event in late May.

We acknowledge that these methodologies likely underestimate the true quantity of spawn in Átl'ka7tsem, as our boat-based team does not dive deep below the surface. Water clarity varies in each survey site and throughout the winter and spring. Sometimes the snorkel surveyors can see spawn several meters below them in the water, and sometimes they need to swim with their hands in front of them for visual reference in murky waters. Due to capacity constraints, our program only focuses surveys on the northern end of Átl'ka7tsem. Though we occasionally receive community reports of herring and/or spawn in other parts of Átl'ka7tsem, our team is only able to consistently survey within the pre-determined survey sites, detailed below.

## 3.3 Sites

Surveys were conducted at 16 sites in 2024 (Figure 6). These sites were selected in 2021 based on Skwxwú7mesh Traditional Ecological Knowledge, past findings by community scientist John Buchannan, studies and restoration work done by Squamish Streamkeepers, and community observations.

Small adjustments to survey areas were made in 2024 based on shoreline health, development, accessibility, and results from the previous three years of herring surveys.

The 7 land-based survey sites throughout the Squamish Estuary were monitored from February 7 to May 1, in 2024 (Figure 7). The 9 boat-based survey sites throughout northern Átl'ka7tsem were monitored from February 7 to May 9, in 2024 (Figures 8 - 9).

| Site name | Team |
|---|---|
| 1. Skwelwil'em Central Estuary | Land-based surveyors |
| 2. Estuary Trail | Land-based surveyors |
| 3. Terminals West Side | Land-based surveyors |
| 4. Cattermole Slough | Land-based surveyors |
| 5. a+b Mamquam Blind Channel | Land-based surveyors and boat-based surveyors |
| 6. a+b West Estuary | Land-based surveyors and boat-based surveyors |
| 7. a. Terminals South | Boat-based surveyors |

| | |
|---|---|
| 7. b. Oceanfront | Land-based surveyors and boat-based surveyors |
| 8. Shannon Falls | Boat-based surveyors |
| 9. Darrell Bay | Boat-based surveyors |
| 10. Gonzales Creek | Boat-based surveyors |
| 11. Txwn7us (Two Islands) | Boat-based surveyors |
| 12. West Walls | Boat-based surveyors |
| 13. Tantalus Landing | Boat-based surveyors |
| 14. Swiyat (Woodfibre) | Boat-based surveyors |
| 15. Woodfibre Creek | Boat-based surveyors |
| 16. Foulger Creek | Boat-based surveyors |

Figure 6: Table of survey site names and the team responsible for checking them.

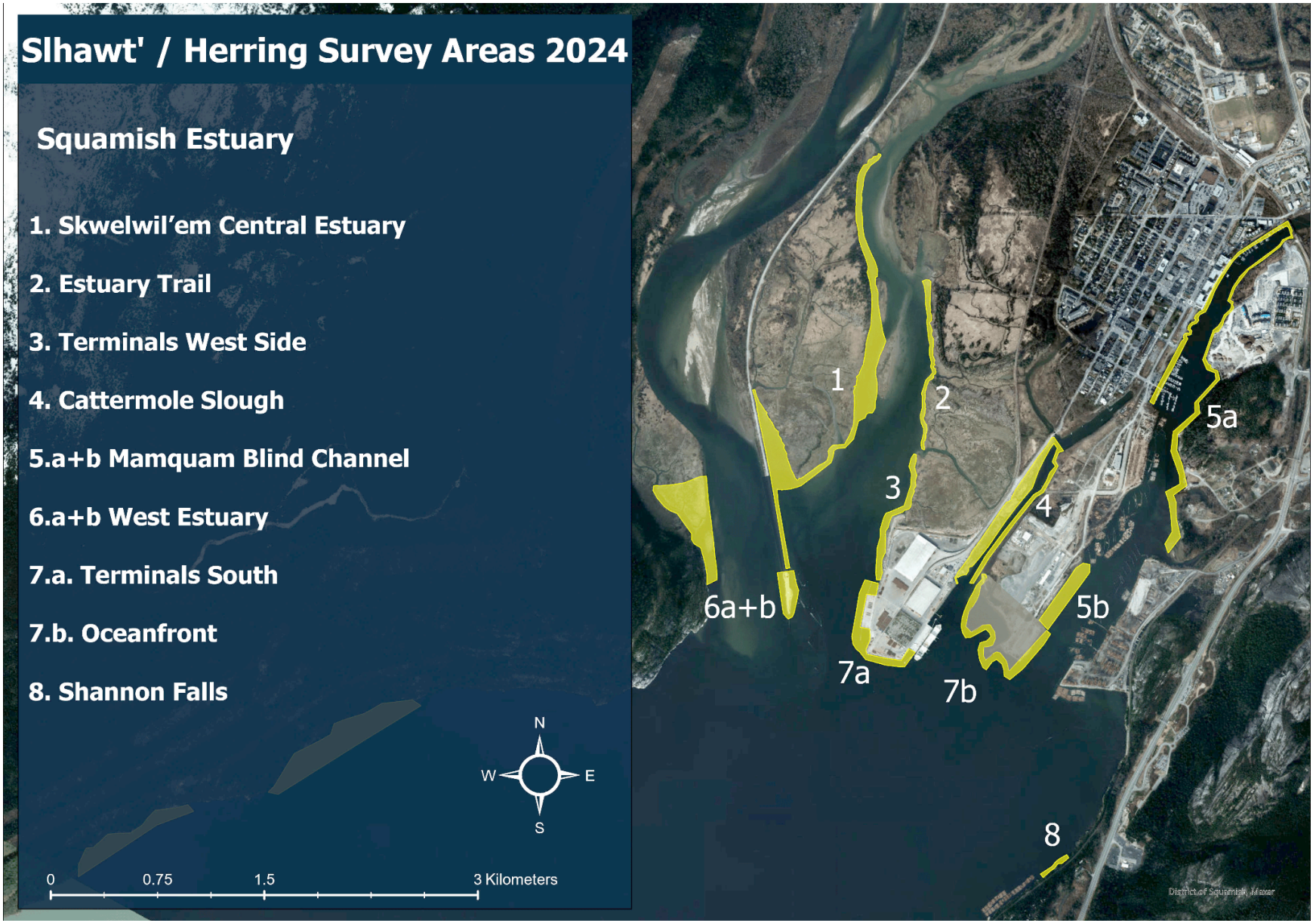


Figure 7: Map of 2024 Squamish Estuary herring spawn survey sites. View these survey areas on the Marine Reference Guide (online map).

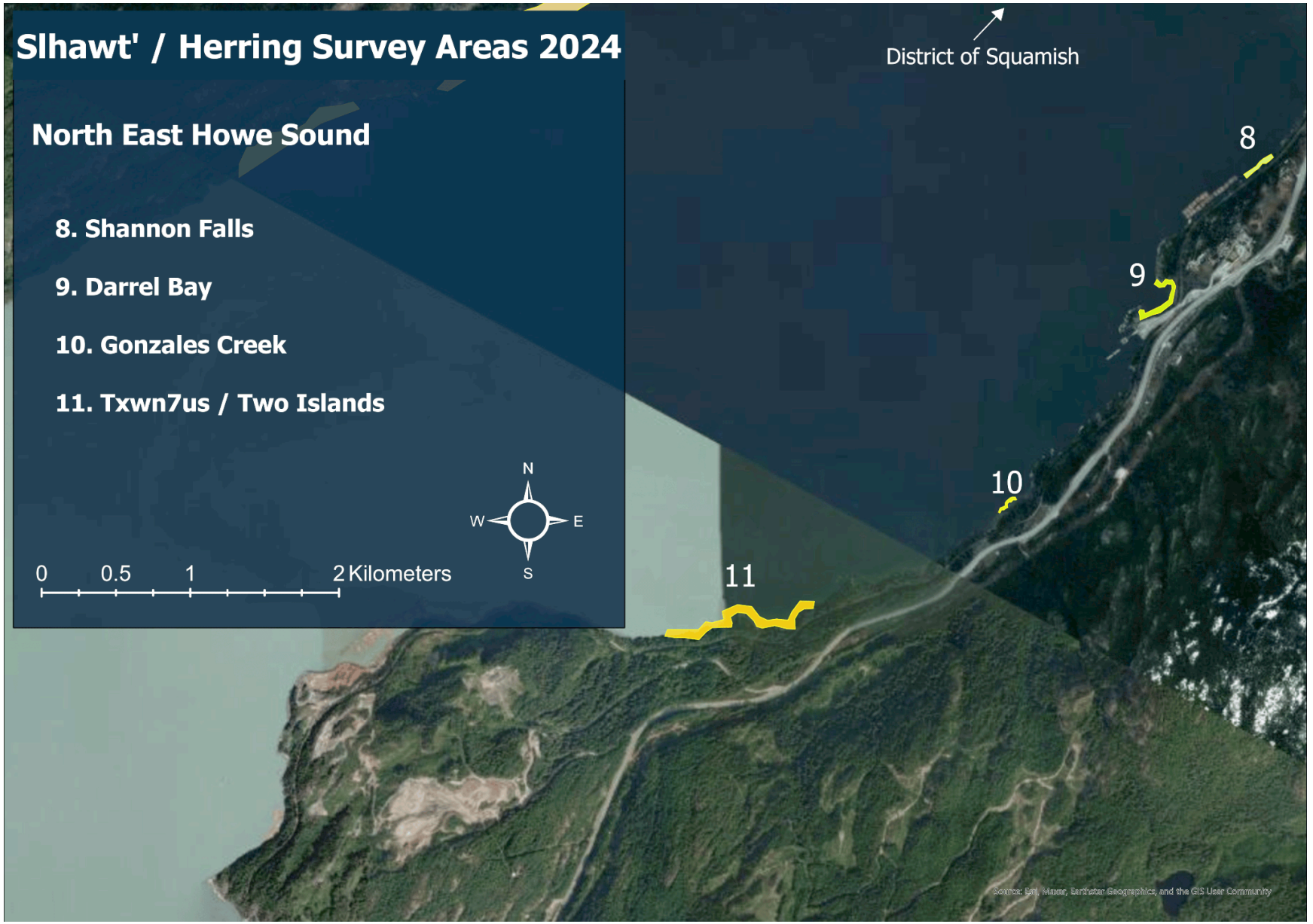


Figure 8: Map of 2024 North East Átl'ka7tsem herring spawn survey sites. View these survey areas on the Marine Reference Guide (online map).

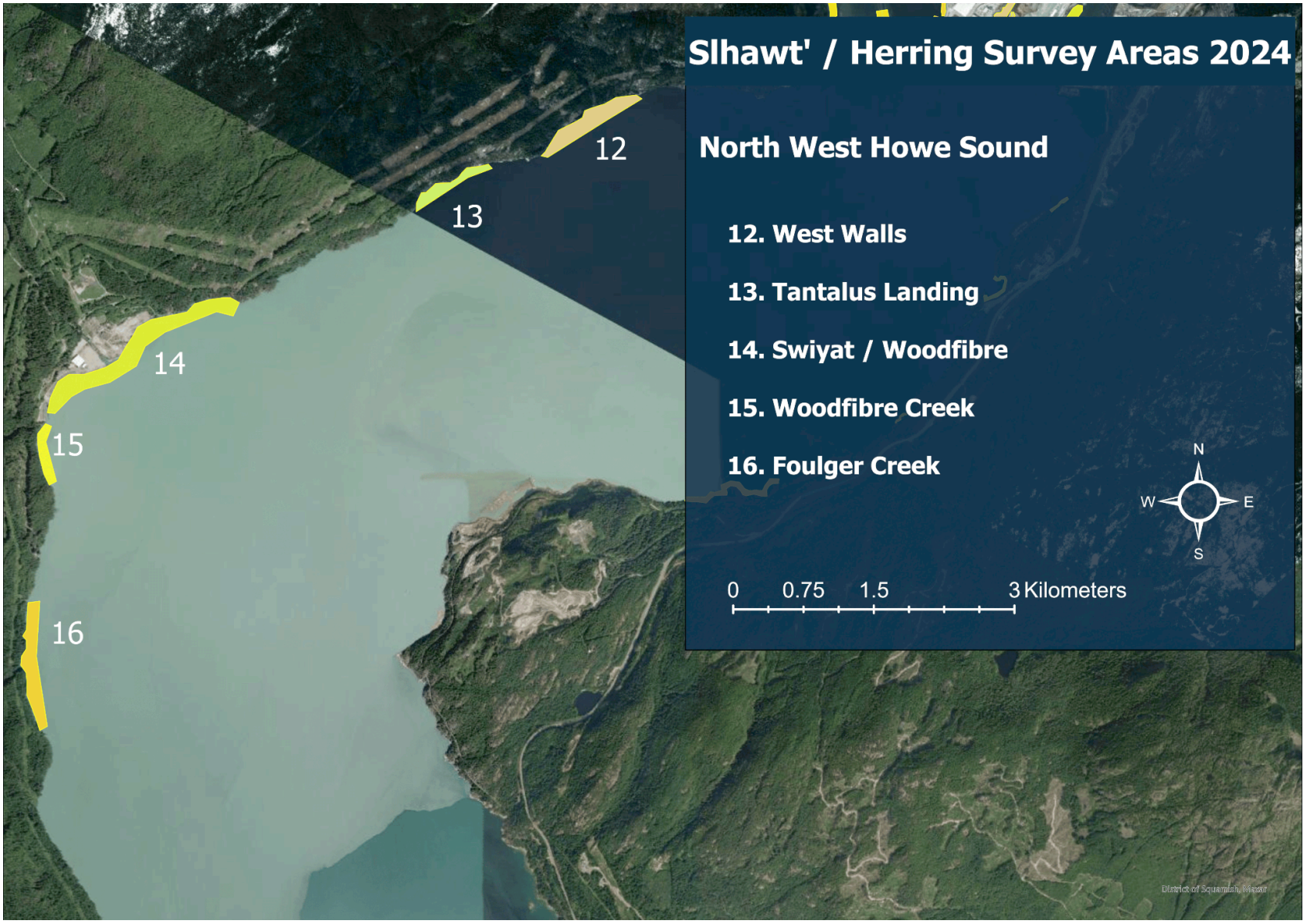


Figure 9: Map of 2024 North West Átl'ka7tsem herring spawn survey sites. View these survey areas on the Marine Reference Guide (online map).

# 4. Results

In 2024, weekly land and boat based surveys began in early February. Evidence of new herring spawn was found starting on February 16 through to April 26. Surveys concluded for both teams in early May 2024.

Spawning activity occurred throughout many of the survey sites in 2024. Results below are shared in chronological order, with accompanying details and photos in sub-sections 4.2 and 4.3. Maps show spawn locations; data can also be viewed on the Marine Reference Guide.

Comparison of results from 2021 - 2024 are in Section 5.

## 4.1 All spawn events of 2024

The table below (Figure 10) shows the date, location and lunar stage when spawn events were documented. It is important to note that this survey program reports on documented herring spawns and the dates below do not necessarily represent the exact date that spawn was deposited by the fish. Rather, they show the date that spawn was found. Due to the frequency that sites are surveyed, it's likely that spawn was found within a couple of days of being deposited.

The lunar stage has been noted below as there is a relationship between the tide cycles (which are driven by the lunar stage) and forage fish spawning activity (Hay & Kronlund, 1987). For example, we have noted in previous years that the Foulger Creek spawn occurs each year around the same lunar stage, making it predictable within an approximate time period.

| Date | Site / location | Lunar Stage |
|---|---|---|
| February 16 | 7.a. Terminals South | First Quarter moon |
| March 9-12 | 1. Central Estuary<br>2. Estuary Trail<br>3. Terminals West Side<br>4. Cattermole Slough<br>5.b. Mamquam Blind Channel<br>6.b. West Estuary<br>7.a. Terminals South<br>7.b. Oceanfront | New Moon |
| March 16 | 11. Txwn7us (Two Islands) | Waxing Crescent |
| April 13 | 16. Foulger Creek and north | Waxing Crescent |
| April 19 | 3. Terminals West Side | Waxing Gibbous |
| April 26 | 3. Terminals West Side<br>15. Woodfibre Creek and south | Waning Gibbous |

Figure 10: Table of documented spawn events from the 2024 winter / spring herring spawn survey season.

## 4.2 Herring spawns within land-based survey sites

The land-based sites throughout Skwelwil'em (the Squamish Estuary) were monitored weekly by volunteers, MSI staff, and Squamish Nation Rights and Title Archaeological, Cultural, and Environmental (ACE) Technicians. Most sites are accessible by walking, though some require paddling (kayak, canoe, SUP).

The first spawn of the season was documented along the south shore of the Squamish Terminals on February 16, 2024 (Figure 11). The eggs were found on rockweed and rock. This spawn was mostly one layer dense, with some patches of higher density.

Figure 11: Herring spawn found on rockweed and rock along the Squamish Terminals shoreline, February 16, 2024.

The second, and much larger, spawn event occurred from March 9-12. Spawn was found across almost the entire Squamish Estuary (Figures 12-15); on many grassy banks in the Central Estuary, along the rocks and rushes / sedges left at the deconstructed Spit Road and remaining island, down both sides of the Cattermole Slough, along south-western banks of the Mamquam Blind Channel, on new rip rap (rocks) at the Oceanfront development, and again along the Squamish Terminals south shoreline. Many seabirds were observed feeding on the eggs during this spawn event.

Figure 12: Spawn found on rushes (left) and creosote-covered wood (right) along the Mamquam Blind Channel, March 10, 2024.

During this March 9-12 event, spawn was documented on almost every hard surface available up to the high tide line, including rockweed, grasses, rushes, sedges, rocks, and wood (natural and creosote-covered structures).


Figure 13: Spawn found on rushes along the Mamquam Blind Channel, March 10, 2024.

In several locations the spawn was multiple layers thick, with the highest density spawn being in the grasses, rushes, and sedges along both sides of the Cattermole Slough, all the way up to the high tide line (Figure 14).


Figure 14: Spawn found on rushes along the Cattermole Slough (left) and rocks at the Oceanfront park (right), March 9, 2024.

Notably, spawn was documented along the recently deconstructed Spit Road / training dyke at the mouth of the Squamish River, where bare rocks and some grasses remain, only visible to land-based surveyors at low tides (Figure 15).

Figure 15: Spawn found on rushes and rocks along the recently deconstructed Spit / training dyke, March 21, 2024.

All spawn event locations and dates are shown on the map in Figure 17. We have indicated that an area in Site 3 had 'suspected' spawn; this shoreline was not extensively surveyed due to lack of accessibility, however we suspect that there was spawn deposited here during the March 9-12 event, as spawn was documented on neighboring shorelines with the same substrate.

Over the remainder of the survey season, a series of smaller spawn events were documented in the Squamish Estuary sites (Figure 16). On April 19, a volunteer surveyor found a few meters of new spawn in the Terminals West Side site. On April 26, the boat-based team found more spawn in the same area. It is unclear as to whether the spawn found in these two different surveys was deposited at the same time, or if they were separate small events.


Figure 16: Spawn found on rockweed north west of Squamish Terminals on April 19 (left) and April 26 (right), 2024.

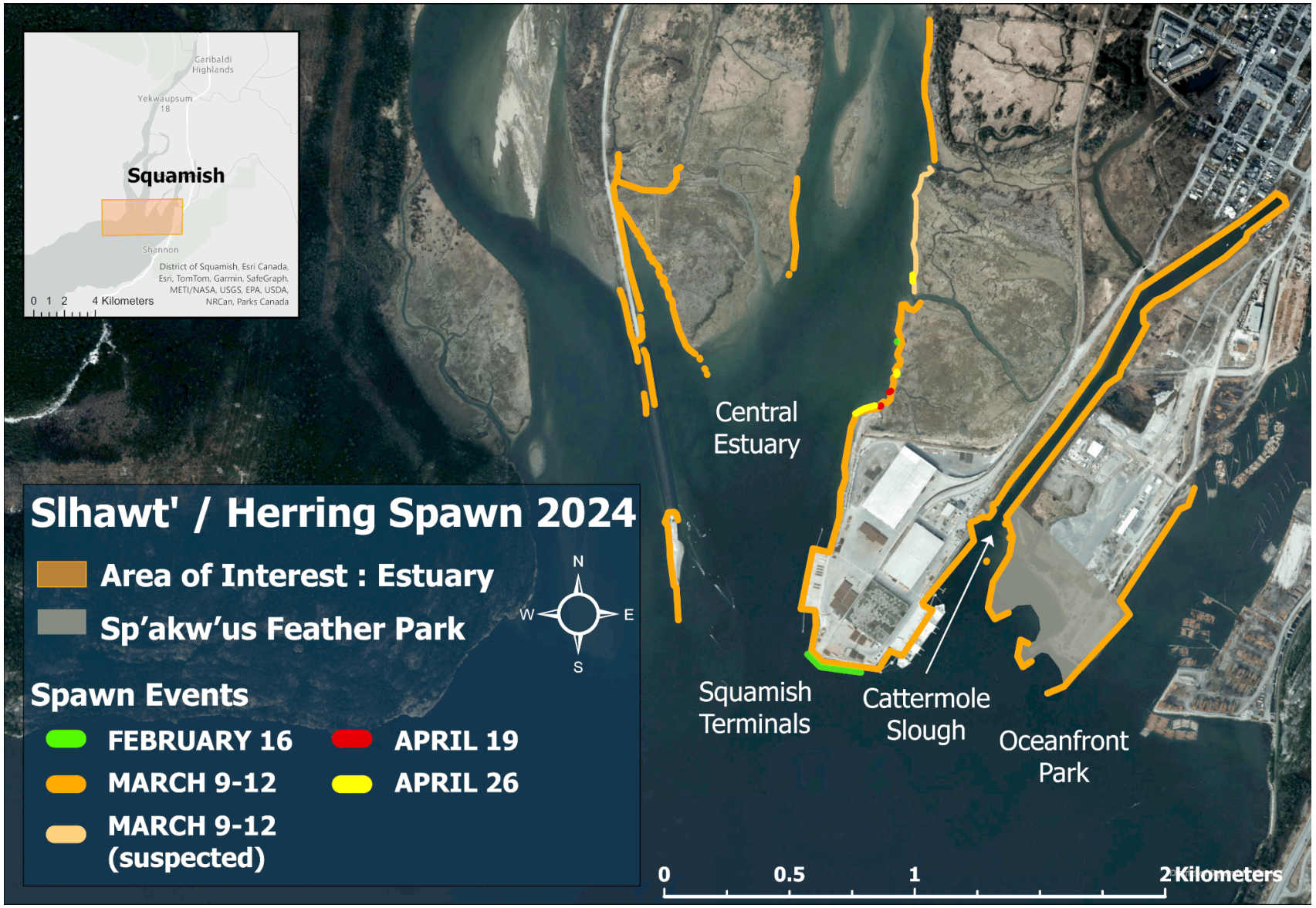


Figure 17: Map of 2024 herring spawn documented within the Squamish Estuary. Data can also be viewed on the Marine Reference Guide (online map).

## 4.3 Herring spawns within boat-based survey sites

In 2024, the boat-based sites were monitored weekly by MSI staff and Squamish Nation Rights and Title ACE Technicians. The team surveyed these sites by snorkeling and shoreline spot-checks during low tides when it was possible to approach the shore by boat. Marine biologists from Keystone Environmental were conducting SCUBA surveys within the WFLNG site area every two weeks, and shared their results with our team when they found herring and/or spawn.

The first documented spawn in this region was near an area known as Txwn7us (Two Islands), which is just south of Darrel Bay, on March 16 (Figure 18). This is not a site that our team checks weekly; this spawn was reported by a community member and subsequently confirmed by our team. Our survey program has never documented spawn along this eastern shoreline, although previous to our work it was known that herring have spawned in that area.

Figure 18: Spawn found on rockweed at Txwn7us, March 21, 2024.

On April 13, the survey team documented an extensive spawn event along the shoreline surrounding Foulger Creek (Figures 19-20). This spawn event around Foulger Creek has been observed annually around the same lunar cycle (first quarter moon) for several years. It has been one of the most consistent, high density spawn events year over year and typically extends along several kilometers of shoreline. See section 5.3 for further details on the impending industrial impacts for this shoreline.

Herring eggs develop over 10-14 days depending on a variety of environmental factors, including water temperature. When the entirety of the spawn event along the Foulger Creek shoreline was surveyed this year, it was noted that eggs varied in developmental stages (Figure 21). We believe that spawning in this area would have taken place over several days to account for this variety in developmental stage.


Figure 19: Spawn on rockweed and rocks around Foulger Creek, April 13, 2024.


Figure 20: Spawn found on rockweed north east of Foulger Creek, April 26, 2024.


Figure 21: Close-up of herring eggs with eyes developing.

Days prior to this spawn event, Squamish Nation People set cedar and hemlock boughs in the bay at the mouth of Foulger Creek. When the herring arrived shortly thereafter, they deposited several layers of ch'em'esh (herring eggs) onto the boughs (Figure 22). See section 4.4 for more details and photos of the harvest.

Figure 22: Ch'em'esh (herring eggs) are harvested by Squamish Nation People in Foulger Creek bay.

Our team returned to the Foulger Creek area on April 26, 2024, and were fortunate to observe several humpback whales swimming back and forth along the shoreline between Woodfibre Creek and Foulger Creek (Figure 23). The whales appeared to be feeding. Many shorebirds were also observed in the area.

Figure 23: Abundant wildlife was observed around Foulger Creek and Woodfibre Creek after the April 13 spawn event, including humpback whales (left) and shorebirds (right).

The last spawn event documented in 2024 was found on April 26, just north of Foulger Creek and within the Woodfibre LNG site boundaries. It was first found by SCUBA diving marine biologists working for Keystone Environmental, as part of the Woodfibre LNG project and its related environmental monitoring.

Notably, the spawn that the Keystone team documented was not only on rockweed, but also on sugar kelp. This is the first time during our survey program history that herring spawn has been recorded on this kelp species. Unfortunately the MSI does not have permission to share the photos of the spawn on kelp in this report.


Figure 24: Map of all 2024 herring spawn documented within the boat-based survey area. Data can also be viewed on the Marine Reference Guide (online map).

## 4.4 Community engagement with slawt' (herring) and ch'em'esh (herring eggs)

In 2024 the MSI continued its commitment to working alongside St'a7mes School and Squamish Nation Education Department (Squamish Valley) to celebrate and welcome the herring back to Atl'ka7tsem.

Herring and ch'em'esh (herring eggs) have historically been an important food source for First Nations along the Pacific coast. However, in the 1960s, herring populations declined significantly due to commercial overfishing. In Atl'ka7tsem, herring and their spawning sites were further impacted by industrial activities that polluted the waters and degraded shoreline habitat.

In 2019, for the first time in almost 100 years, Skwxwú7mesh (Squamish Nation People) harvested herring eggs from their territory. Annual herring welcome ceremonies and efforts to harvest herring eggs have continued since 2019 (Figures 25-30).



Figure 25: The annual Herring Welcome Ceremony at Totem Hall on the St'a7mes Reserve, March 14, 2024.

Working in a collaborative way and with the guidance from Squamish cultural workers, we gathered at Totem Hall on the St'a7mes Reserve on March 14, 2024. Youth from St'a7mes School and Xwemélch'stn Etsimxwawtxw (Capilano Little Ones School) danced and sang songs to invite the herring back to these shores. Elders and community joined as well, and everyone tied together hemlock boughs and rock weights so that we could place them in the water, inviting the herring to come and lay their eggs on the branches.


Figure 26: Cedar boughs are weighed down with rocks (right) and placed in the water (left) during the Herring Welcome Ceremony, March 14, 2024.

During the week prior to this event, Matthew Van Oostdam, Jonny Williams, Welwaltenaat Myia Antone, and Addison Farr joined the Squamish Nation Culture and Language team on the water. Stories were shared about how hemlock and cedar boughs have been anchored into bays along the western shoreline of Atl'ka7tsem to harvest small amounts of herring eggs.


Figure 27: Cedar and hemlock trees were placed in Foulger Creek and collected later for a traditional harvest of ch'em'esh (herring eggs), April 16, 2024.

This year, at Foulger Creek, herring spawned on the hemlock and cedar boughs that had been anchored in the water. Within 24 hours of the deposition, we documented the spawn event and a small amount was harvested and distributed to elders and families that wanted to taste the herring eggs. It is a great honor to take part in this work and we take the responsibility of passing on this knowledge and these gifts very seriously.

Figure 28: Ch'em'esh (herring eggs) on cedar boughs placed near Fouler Creek, April 14, 2024.


Figure 29: Preparing to set cedar and hemlock boughs in the water. Photo by C. Cheverie.

Figure 30: Cedar and hemlock boughs are loaded onto the boat. Photo by C. Cheverie.

In 2024, MSI worked with program partners to create a series of 4 short films to share about the Search for Slhawt' / Herring Program and Squamish connections to these magnificent little fish (Figure 31). The films were created by Kieran Brownie and funded by the British Columbia Salmon Restoration and Innovation Fund (BCSRIF), via the Pacific Salmon Foundation (PSF). We invite you to watch the full versions of the four short films here: www.howesoundguide.ca/slhawt-herring-films

Figure 31: Stills from the four short films created to share about the Search for Slhawt' / Herring Program and connections to herring.

# 5. Comparing 2021, 2022, 2023, and 2024

2024 was the fourth year that MSI conducted herring spawn surveys; MSI began survey efforts in 2021. Change over time can be observed by looking at the maps depicting spatial distribution of spawning activities from 2021-2024 (Figure 32, or on the Marine Reference Guide). These maps show that certain areas in northern Átl'ka7tsem have been used by spawning herring repeatedly over the past four years, while other sites have been visited by the spawning fish only during some years. This dataset is based on a limited time period with varied methods and survey effort over the years, and should not be used as a basis for larger time scale assumptions or patterns. This work highlights the need for more consistent long term monitoring that identifies the intertidal zones that are potential and repeated sites for herring spawning activity.

The following section provides a detailed discussion of three key spawning sites that were used by herring during the 2024 season: Central Estuary, Foulger Creek, and Txwn7us (Two Islands).

## 5.1 Central Estuary

Since 2021, many of the intertidal zones in the Central Estuary have been used by spawning herring (Figure 32). The results from 2021 - 2024 show annual consistent use of many shorelines throughout the estuary. Notably, herring are even spawning in areas where the shoreline has been modified in recent years, such as on the deconstructed Spit Road (removed in spring 2023) and new rip rap at the Oceanfront park (placed within the past 2-3 years).

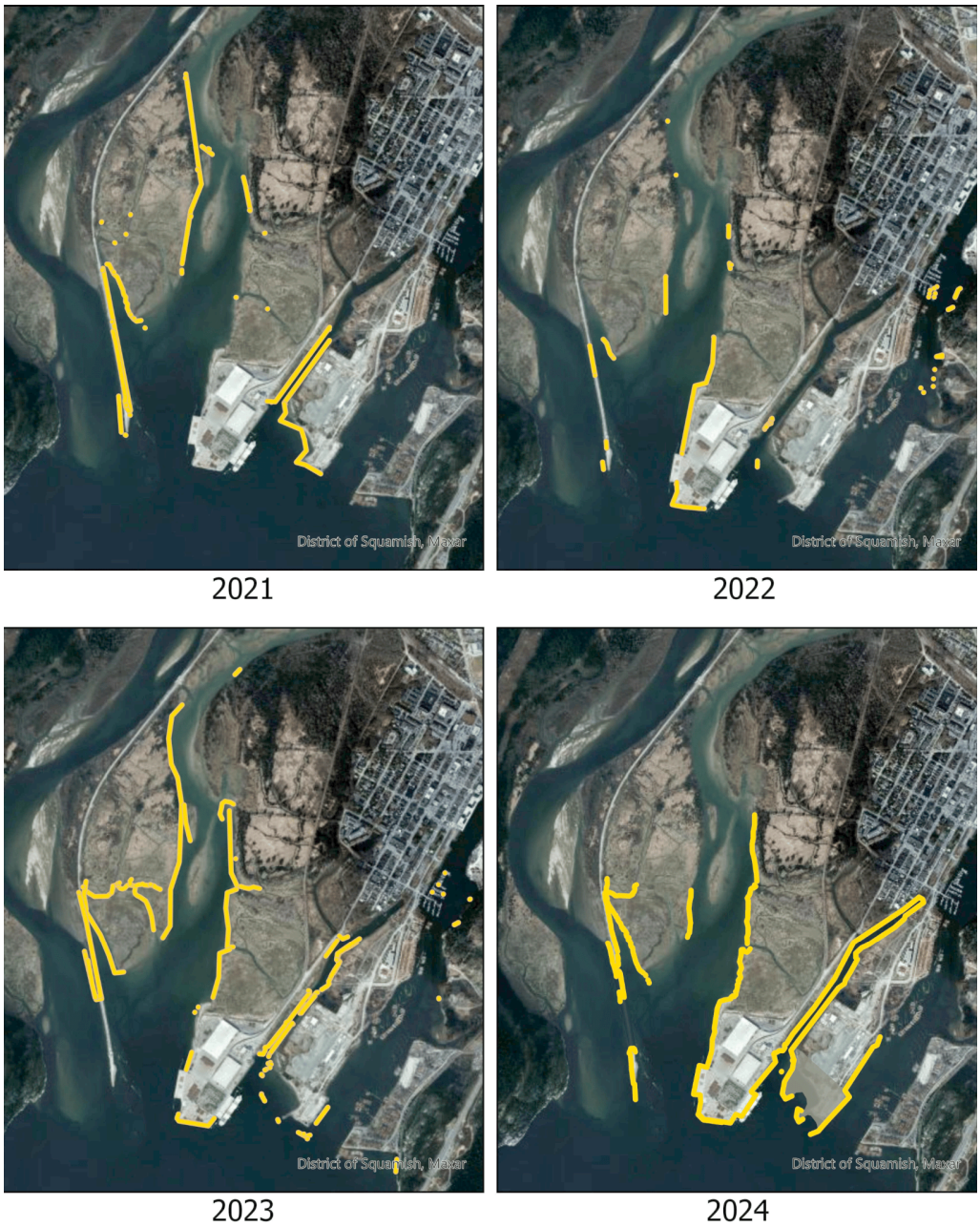


Figure 32: Documented herring spawn across the Squamish Estuary from 2021-2024. Data can also be viewed on the Marine Reference Guide (online map).

In 2024 the major Squamish Estuary spawn event took place over March 9-12th and was one of the largest spawn events documented during MSI's 4 years of survey efforts based on surface area covered in eggs. The spawn covered approximately 8 km of shoreline, including grassy banks in the Central Estuary, along the rocks and grasses left at the deconstructed Spit Road and remaining island, down east and west sides of the Cattermole Slough, along south-western banks of the Mamquam Blind Channel, on new rip rap (rocks) at the Oceanfront development, and along the Squamish Terminals south shoreline.

Most of the spawn in the Central Estuary was found on intertidal grasses, as well as some rock, wood debris / structures, and rockweed. Though considerable work has been done by Squamish Streamkeepers and others to remove or cover much of the creosote-treated wood in the Estuary, there remain several pilings and shoreline structures that herring spawn on each year of our surveys (Figure 33). The herring seek out the clean smooth surface to lay their eggs on, however, creosote is toxic and leads to embryo death or severe deformities (Vines et al., 2000).


Figure 33: Herring spawn deposited onto creosote-covered wood in the Mamquam Blind Channel, March 10, 2024. These herring embryos will not likely survive, as creosote is toxic.

## 5.2 Txwn7us (Two Islands)

On March 16, 2024 spawn was reported by a community member at a location known as Txwn7us (Two Islands), which is just south of Darrel Bay (Figure 34). This location is on the eastern side of Átl'ka7tsem, and this is the first time our survey team has recorded herring spawn in that area.

Community knowledge and surveys by John Buchanan indicate that the shoreline from Shannon Falls to Watts Point had been historically documented to have herring spawn. From 2021 to 2023, the MSI boat-based team and volunteers checked the eastern shoreline occasionally, but did not document any spawn. Our team will continue to check this area in future years.

The spawn found in 2024 at Txwn7us varied in density and was scattered along a shoreline with gaps of up to 30 m between spawn locations. The eggs had been deposited on rock and rockweed. Sea lions were observed in the area hunting bait fish on the same day that spawn was identified.


Figure 34: Spawn found at Txwn7us (Two Islands), March 22, 2024.

## 5.3 Foulger Creek - Notable changes on the horizon

In 2021, 2022, 2023, and 2024, extensive herring spawn has been documented by our team along the shoreline from Woodfibre Creek to Foulger Creek (Figure 35). John Buchanan had also documented consistent spawn events in this area during his surveys. The most notable spawn event for our team occurred in 2023, when eggs were documented along 5.5 km of shoreline from Woodfibre Creek almost to Zorro Bay. During 2023, our team was fortunate enough to witness herring actively spawning, with their milt turning the waters milky green in colour.

Figure 35: Spawn found along the Foulger Creek shoreline from 2021 (left), 2022 (middle), and 2023 (right).

On April 13, 2024, spawn was documented along approximately 2.5 km of shoreline near Foulger Creek and Woodfibre Creek (Figure 36). Egg density was relatively high with multiple layers of eggs being prevalent.



Figure 36: Foulger Creek bay, April 13, 2024. J. Buchanan filming larvae movement inside eggs.

A notable change coming to this shoreline is the threat of log booming. Two tenures are currently approved (expiring in 2026) for forestry companies to store logs along the shoreline near Foulger Creek. When the tenures were first proposed over 10 years ago, local groups expressed their concern about the potential impacts on herring spawn and habitat: www.ccbowen.ca/logdump.

Despite concerns, the tenures were approved. They have not been active in recent years, however recent work on the nearby forestry road indicates they may soon host logs (Figure 37). This is extremely concerning as log booms can destroy herring spawning habitat and other marine life in the intertidal zone. It cannot be stated more clearly that this shoreline from Woodfibre Creek to Foulger Creek is important herring spawn habitat - this shoreline consistently has the highest density of herring spawn documented within our study region.

The scale and timing of the log booming operations are unclear to MSI at this time, however, access road construction has begun and the tenure area may soon host logs. Disturbance of habitat along this shoreline may significantly impact the 2025 spawning season. This area is also one of the few locations where Squamish Nation People have been able to successfully harvest herring roe on cedar and hemlock branches within the past century (Figure 38). These cultural practices and harvesting of a traditional food has only just recently restarted and the potential industrial practice puts that resurgence at great risk.

View the log tenure area and herring spawn data on the Marine Reference Guide.


Figure 37: ACE Technician Matty Moore snorkels the shoreline near a newly constructed road near log booming tenure (left), and records herring spawn on rockweed on that shoreline (right), May 3, 2024.

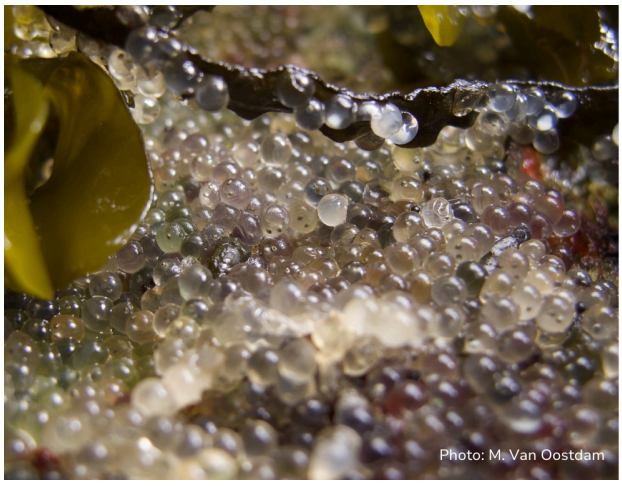


Figure 37: Dense spawn is found between Foulger Creek and Woodfibre Creek, on rock, wood, rockweed, sugar kelp, and hemlock / cedar boughs, April 13, 2024.

# 6. Acknowledgements

## 6.1 Volunteer engagement

Our hands are raised in gratitude to all the volunteer herring spawn surveyors. Many of our volunteers returned to the program after participating in previous years.

Volunteers gathered in late January 2024 at St'a7mes School to participate in a general training session. They listened to Matthew Van Oostdam and Squamish Nation survey team leader Jonny Williams speak about the importance that this data set serves to Squamish Nation in asserting their rights on their territory and rebuilding a personal relationship with the herring. Volunteer surveyors signed up for survey sites and in the following weeks attended training sessions in all sorts of weather conditions (Figures 39-40).

Figure 39: Volunteers walk the shoreline searching for herring spawn between February and May.


Figure 40: Volunteers paddle to access herring spawn locations that aren't possible for them to walk to.

Volunteers in 2024 included: Feet Banks, Sanjay Carter-Rau, Diana Gawol, Sean Sweeney, Davina Dube, Jess Herman, Patrick MacNamera, Lesley Douglas, Brendan MacDonald, Tyler Hart, Eden Imbeau, Sarah McJannet, Tina Currie, Mike Turley, Sarah Keller, Kate Brandon, Erin Woodley, Justine Payne, Aida Goma Petit, Paul Filippelli, Meryn Corkery, Sophie Vanderbanck, Andrew Leyland, Kevin Murphy, Raegan Mallinson, Alex Harris, Erik Jackson, Savannah Zumach, Jordan Akers, August Aylesworth, Ali Mackeller, Fil, Ron, Ian Lowe, and others.

In late May 2024, MSI hosted the Herring Happenings 2024 event at Brackendale Art Gallery to share the preliminary results from the season's surveys with volunteers, contractors, and community members (Figure 41). The event also featured stories and ongoing research about herring in Átl'ka7tsem, and two new short films about herring. We were honoured to host close to 100 people at this event, which showcases the growing interest and support from our community.



Figure 41: Matthew Van Oostdam shares 2024 survey results and films at our end-of-season event.

The new children's book 'Tem Lhawt' (Time of the Herring), written by Welwaltenaat Myia Antone and Matthew Van Oostdam, and illustrated by Latashkinem, was available for sale (Figure 42). The proceeds of the book sales are put towards the book production costs. More information about this event can be found on our website at Herring Happenings of 2024.



Figure 42: The new Tem Lhawt' (Time of the Herring) book available for sale at the Herring Happenings of 2024 event.

## 6.2 Surveys logged and estimated hours

There were approximately 35 surveyors that contributed to the project in 2024. In Survey123, our data collection tool, there were 142 herring spawn surveys logged. The time to complete a single survey can be between 2-6 hours, depending on location and site size. If an average survey is 4 hours, this would mean that an estimated 568 hours were spent searching for herring spawn in 2024.

We are immensely proud of this impactful work and look forward to working with many of these dedicated volunteers and community members again in future years.

## 6.3 The 2024 boat-based survey and support team

The 2024 boat-based survey team (Figure 43) included: Matthew Van Oostdam, Jonny Williams, Matty Moore, Aaron Skye, Nick Baker, Kieran Brownie, Addison Farr, Ellika Cairns, John Buchanan, and Harriet the Herring. Thank you to those who supported surveys and reporting efforts: Rachel Munger, Charlene Williams, Gwyn Taylor, Nikita Wallia, Fiona Beaty, and others.

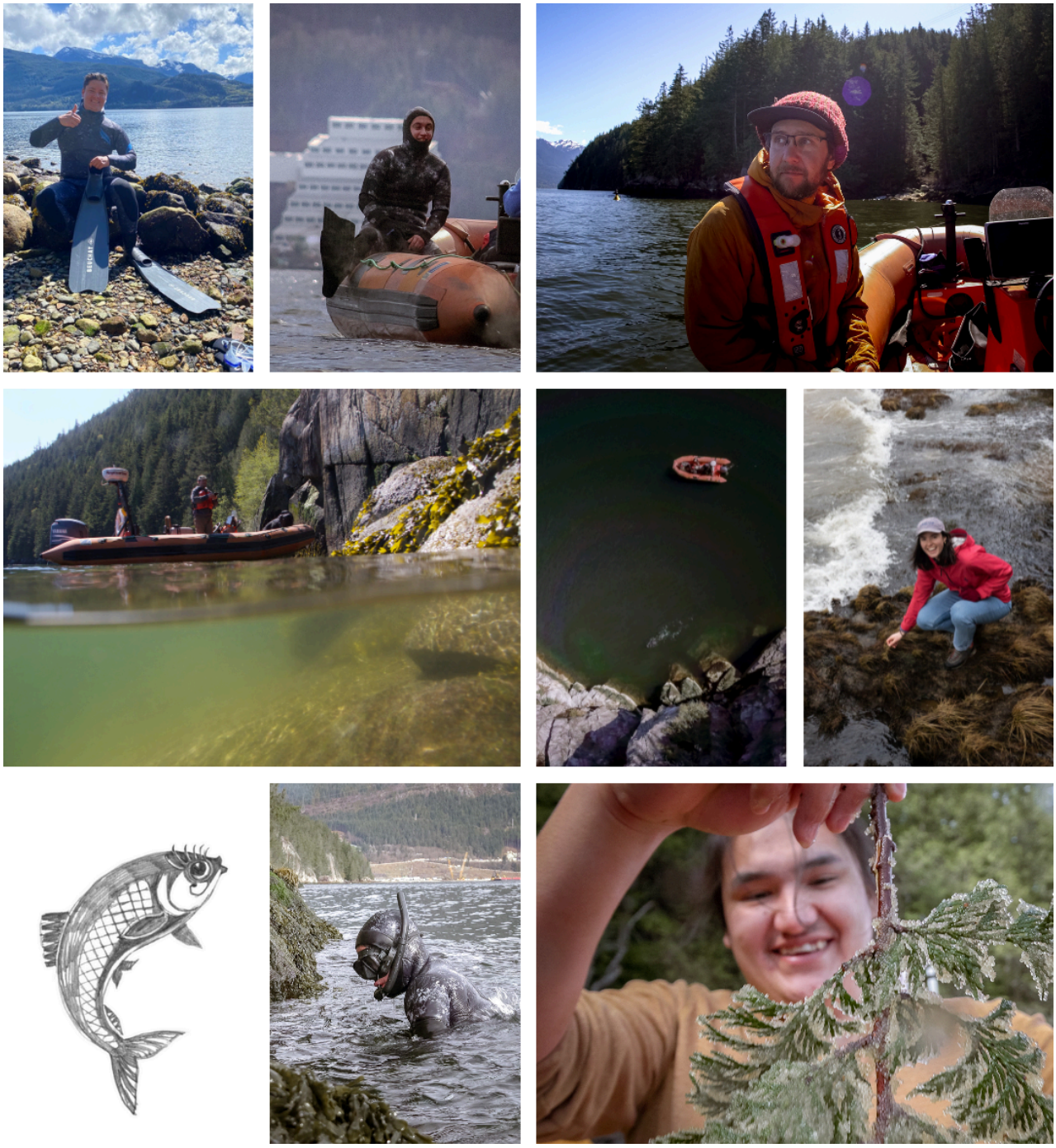

Figure 43: Members of the 2024 MSI boat-based survey team.

## 6.4 Sponsors and supporters

This work would not be possible without the generous support from our partners and contributions from our sponsors. We would like to extend our thanks to:

- Squamish Nation
- Sitka Foundation
- David Suzuki Foundation
- GFL Environmental Inc.
- Pacific Salmon Foundation
- Squamish Community Foundation
- BC Conservation & Biodiversity Awards
- BC Fish & Wildlife Compensation Program
- MakeWay Charitable Society
- Squamish Streamkeepers
- RUX
- Immenso Diving Equipment
- Dive Sports Canada
- Patagonia Vancouver
- Brackendale Art Gallery
- Squamish Terminals
- District of Squamish and other local governments
- St'a7mes School of School District 48
- Squamish Yacht Club
- Squamish Harbour Authority
- Howe Sound Biosphere Region Initiative Society

There are more contributing community members than we can feasibly list in this report. Whether support was offered through donations, advice, organizational support, or otherwise; we thank you immensely for your efforts.

# 7. Learn more

Find more information about herring and the Searching for Slhawt' Program at the links below:

Searching for Slhawt' / Herring Program page

2021 Searching for Slhawt' / Herring Program Summary

2022 Searching for Slhawt' / Herring  Program Report

2023 Searching for Slhawt' / Herring Program Report

2024 Searching for Slhawt' / Herring Program Report - Executive Summary

Series of four short films:

- Search for Slhawt' / Herring Spawn in Átl'ka7tsem / Howe Sound
- Connections to Slhawt' / Herring: Interview with Charlene Williams
- Connections to Slhawt' / Herring: Interview with Matthew Van Oostdam
- Connections to Slhawt' / Herring: Interview with Matty Moore

Video about the 2019 harvesting of Ch'em'esh

Searching for Slhawt' in the news

2021-2024 Herring spawn survey results (data) on the Marine Reference Guide (map)

Summary of John Buchanan's 2010-2015 community science herring spawn surveys

Impacts of log booms on marine ecosystems

Questions, feedback, and requests for more information are welcomed to be submitted to:

Ellika Cairns, MSI Project Director
marinestewardshipinitiative@gmail.com

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