

Forage Fish: the importance of citizen science

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What is happening?

Forage fish, such as herring (*Clupea pallasii*) and eulachon (*Thaleichthys pacificus*), are important species in Átl'ka7tsem/Txwnéwu7ts/Howe Sound's ecosystem, providing food for many animals higher up the food chain. In recent years there has been an increased focus on improving our knowledge on the state of forage fish populations and on improving management practices for these species. Citizen science groups, non-profit organizations, and government bodies have all realized the key role that forage fish play in the ecosystem. As such, these organizations have allocated time and funds to increase research and restoration of these species and their habitats.



Herring eggs found in the west Átl'ka7tsem/Txwnéwu7ts/Howe Sound coastal area. (Credit: John Buchanan).

What is the current status?

Pacific Herring (*Clupea pallasii*)

Citizen scientist John Buchanan has been diligently observing and recording herring spawn in Átl'ka7tsem /Txwnéwu7ts/Howe Sound for the last nine years. Herring spawn surveys were conducted on four dates in both 2017 (January to March) and 2018 (February to April), and three dates in 2019 (January to May), covering an area from Kw'ech'ténm/McNab Creek to the south, continuing up the west coast of Átl'ka7tsem /Txwnéwu7ts/Howe Sound, to the Squamish Terminals (see Figure 1).¹ All surveys yielded sightings of herring spawn at various locations. The first spawn of the year is typically the smallest event. The fourth survey in 2018, undertaken on April 8, was particularly notable, being the densest spawning event observed during this survey in almost a decade.¹ Video footage also shows huge masses of herring spawn found at Foulger Creek on this date, just south of the Woodfibre site (see Resources).

Surveys conducted in 2019 showed similar observations to 2017 and 2018. The Foulger Creek area was densely spawned, while a small area of herring spawn was observed at Squamish terminals and other areas along the coast. New spawning was observed at Foulger Creek during two surveys (March and May), indicating two separate spawning events occurred. These surveys add to multiple years of data where a gap previously existed, giving important insight and helping establish trends of herring spawn activity along the west coast of Átl'ka7tsem /Txwnéwu7ts/Howe Sound inlet.

The harvest of herring roe is deeply seated in the history of the Skwxwú7mesh Úxwumixw/Squamish Nation. Herring roe is a central food in the traditional diet, and harvesting is a culturally significant practice.² However, over the past century, this practice has been discontinued because of the impacts of shoreline development and industrialization, as well as certain Canadian laws that forbid First Nation peoples from leaving reserves, thus prohibiting various cultural practices.² To help restore this tradition and pass the knowledge to younger generations, hemlock boughs were hung in the water in the vicinity of Nexen Beach in upper Átl'ka7tsem /Txwnéwu7ts/Howe Sound by members of the Skwxwú7mesh Úxwumixw/Squamish Nation, with advice and guidance from elders.² The boughs were found to be densely spawned when retrieved.²

Citizen science data on herring spawn collected over the last decade has been and continues to be invaluable, contributing to the overall picture of the health of the marine environment in Átl'ka7tsem /Txwnéwu7ts/Howe Sound. The return of herring to these waters has meant that traditional practices can once again be passed down to future generations and herring roe can be harvested.²

Based on modelling and monitoring data, herring spawn biomass in the Strait of Georgia stock region showed a strong increasing trend from 2010–2016. However, biomass has since shown a decreasing trend.^{3,4} This drop of more than 50% over four years

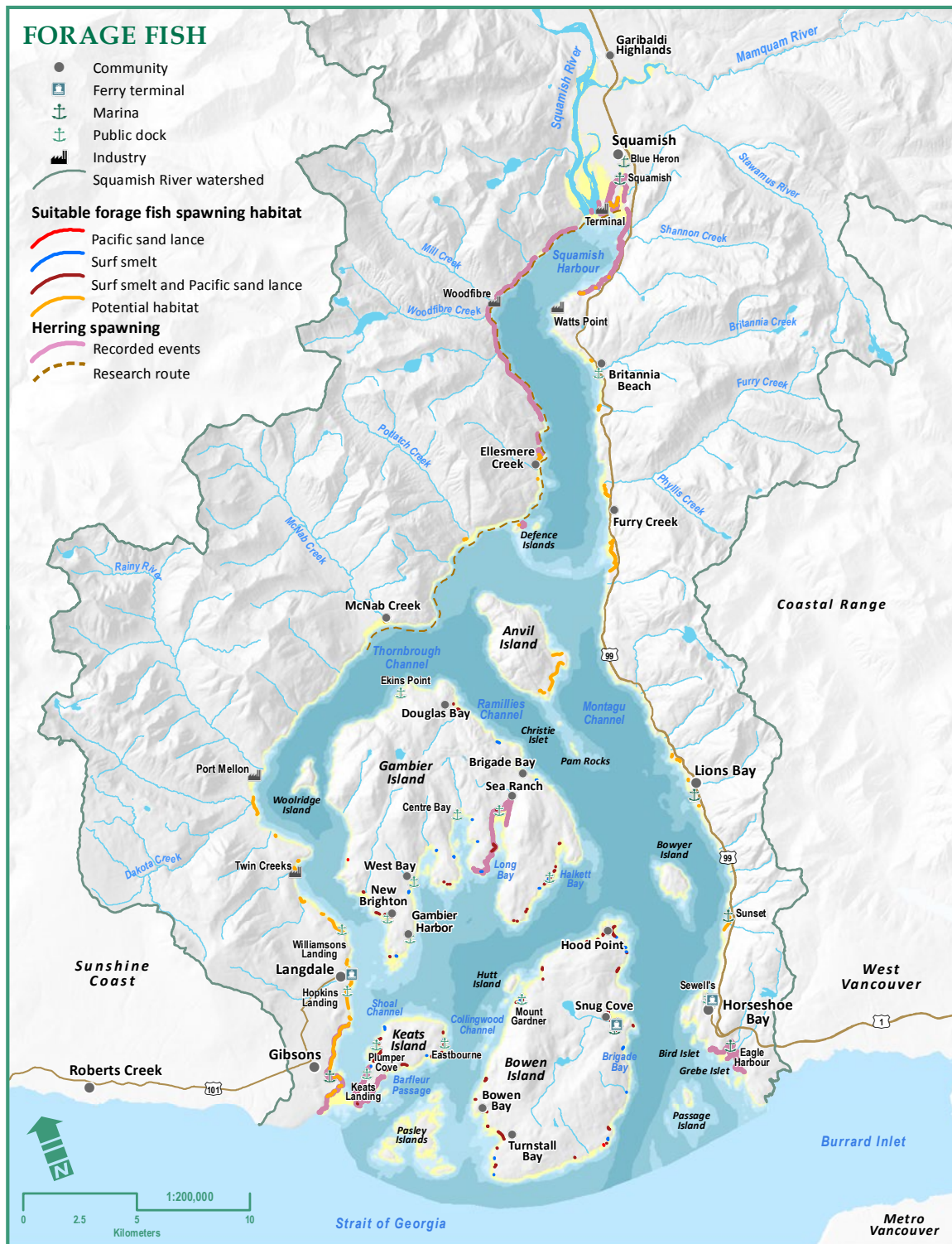


Figure 1. Forage fish spawning habitat and recorded herring spawning locations (data supplied by DFO, 1941–2002; citizen scientists on Bowen Island, 2015; Islands Trust, 2018; Friends of Forage Fish; and John Buchanan).¹⁰

highlights the need for careful conservation of this important forage fish. Monitoring and stock assessment are focussed on the aggregate migratory stock,ⁱ thus these trends are not specific to Átl'ka7tsem/Tx-

wnéwu7ts/Howe Sound. No data on herring spawn in Átl'ka7tsem/Txwnéwu7ts/Howe Sound has been available from DFO since the previous Ocean Watch Howe Sound (OWHS) 2017 edition.



Herring spawn on hemlock boughs. (Credit: John Buchanan).

Eulachon (*Thaleichthys pacificus*)

Since 2004 concerns surrounding eulachon stocks resulted in long-term harvest closures of eulachon for both commercial and recreational purposes.⁵ In B.C., three distinct populations of eulachon have been assessed under the *Species at Risk Act* (SARA): two are “Endangered”ⁱⁱ (Fraser River and Central Pacific Coast

populations) and one is of “Special concern”ⁱⁱⁱ (Nass/Skeena Rivers population).⁶ The Squamish River is listed as a probable eulachon spawning river, under the Central Pacific Coast population grouping.⁶ There is no current information on eulachon in Átl'ka7tsem/Txwnéwu7ts/Howe Sound.

i) Aggregate migratory stock – summed index stocks for the Strait of Georgia region.

ii) Endangered – species facing imminent extirpation or extinction.

iii) Special concern – species which may become threatened or endangered because of a combination of biological characteristics and identified threats.

Northern Anchovy (*Engraulis mordax*)

After excitement over anchovy sightings hit the news in 2015 and 2016^{7,8} there remains little to no data on anchovy numbers returning to Átl'ka7tsem/Txwnéwu7ts/Howe Sound. Anecdotal evidence of schooling anchovy in Átl'ka7tsem/Txwnéwu7ts/Howe Sound was recorded on video in two instances in 2017, in May and September (see Resources). In Janu-

ary and October 2018, conservationist Bob Turner of Nexwlélexwem/Bowen Island, spotted large schools of anchovy accompanied by a raft of hungry predators (see Resources). After a decade of no sightings (OWHS 2017), there is a clear need for more studies into the numbers and movements of this important species.

Pacific sand lance (*Ammodytes hexapterus*) and surf smelt (*Hypomesus pretiosus*)

These species are important forage for predators such as seabirds, other fish, and marine mammals. As both species are beach spawners, they are especially sensitive to coastal development, shoreline modification and other anthropogenic foreshore disturbances.⁹ Various groups (i.e., the Islands Trust Conservancy, Bowen Island Conservancy, the David Suzuki Foundation, the Pacific Salmon Foundation, and the B.C. Shore Spawners Alliance) are conducting ongoing re-

search to learn more about critical beach spawning habitat and ways to improve management practices for Pacific sand lance and surf smelt. For example, the Islands Trust Conservancy is conducting forage fish spawning habitat assessments on various islands throughout the Strait of Georgia, while the B.C. Shore Spawners Alliance is working to protect critical beach spawning habitats and document spawning beaches.

What are the potential impacts of climate change on forage fish?

The use of hard armouring (e.g., seawalls and riprap) to combat sea level rise is a primary threat to the survival of forage fish due to resulting [coastal squeeze](#), i.e., loss of intertidal habitat necessary for spawning (see [Shoreline erosion and sea level rise](#), OWHS 2020).

In recent years, elevated ocean temperatures have been linked to the higher abundance of Northern anchovy in the Salish Sea;¹¹ however, this positive correlation is

likely to exist only up to a certain temperature threshold. Changes in sea surface temperature and ocean acidification may potentially impact egg and/or larval survival and could result in changes in the timing of spawning. This, in turn, would have roll-on effects on species relying on forage fish as prey.¹¹ Climate change could also affect the timing, amount and types of prey available to forage fish.

What has been done since 2017?

The table below reports on progress made on recommended actions from the previous 2017 article, where identified. Many of these require ongoing action.

2017 ACTION	ACTION TAKEN
INDIVIDUAL AND ORGANIZATION ACTIONS	
<p>Support research, monitoring and protection of forage fish habitats and water quality.</p>	<ul style="list-style-type: none"> • BC Shore Spawners Alliance held a workshop in June 2018 showing volunteers how to identify and map forage fish spawning sites (run by Ramona de Graaf). • Islands Trust Conservancy undertook Forage Fish Habitat Assessments for Bowen, Gambier and Keats Islands in 2014, and have continued with other Gulf Islands (most recently in 2019 on North Pender, James and Sidney Islands). • Sea to Sky Cultural Journeys program teaching school kids about harvesting herring roe. John Buchanan has continued to keep records of herring spawn activities throughout the west coast of the Sound.
GOVERNMENT ACTIONS AND POLICY	
<p>Prioritize and fund research, monitoring and protection of forage fish habitats.</p>	<ul style="list-style-type: none"> • The Coastal Restoration Fund, an Oceans Protection Plan initiative, was announced in May 2017. In May 2018, the fund awarded two grants to groups operating in Átl'ka7tsem/Txwnéwu7ts/Howe Sound. <ul style="list-style-type: none"> • \$1.3 million over five years, awarded to the Sea Change Marine Conservation Society (in partnership with the Canadian Coast Guard and DFO). The grant was awarded to assist in the restoration of eelgrass and estuarine habitat for Pacific salmon and forage fish in four areas, one being Átl'ka7tsem/Txwnéwu7ts/Howe Sound (alongside the Gulf Islands, Burrard Inlet and Sechelt).¹² • \$1.5 million over five years, awarded to the Squamish River Watershed Society (in partnership with Canadian Coast Guard & DFO). The project aims to restore coastal habitats by “re-establishing freshwater connection to the estuary” supporting salmon recovery and improving water quality and habitat for other fish and wildlife.¹³ See Salmon article, OWHS 2020 for more info. • A national program (Strategic Program for Ecosystem-based Research and Advice) has been developed by DFO in order to help identify ecosystem-based approaches to management strategies. This approach will assist in considering impacts of climate change and will hopefully bring a better understanding of the collective role that forage fish have in the ecosystem, leading to more appropriate management decisions/strategies. • Bill C-68, an amendment to the <i>Fisheries Act</i>, came into effect August 28, 2019. The provision allows for extra protections and considerations to be made with respect to fish stocks, fish habitat and conservation of marine biodiversity, among other things.¹⁴ • Green Shores for Coastal Development – Credits and ratings voluntary program for minimizing environmental impact of waterfront development. This program was awarded funding in Jan/Feb 2019 from Natural Resources Canada as part of the Federal Climate Change Adaptation Program.¹⁵ The shoreline is key spawning habitat for many forage fish, and soft-shore development options can help reduce egg mortality.¹⁶

What can you do?

A detailed overview of recommended actions relating to climate change is included in *The path to zero carbon municipalities* (OWHS 2020). In some cases, no progress was identified on previous recommended actions; these remain listed below. Additional actions marked as **NEW** also follow.



Individual and Organization Actions:

- **NEW** Be aware of beaches near you that are used as spawning beaches by forage fish. Take care not to disturb these areas.



Government Actions and Policy:

- Monitor and enforce the legislation (B.C. Land Act) that prohibits changes below the high tide line without lease or license of occupation.
- **NEW** Increase funding in support of monitoring forage fish numbers and distribution in Átl'ka7tsem /Txwnéwu7ts/Howe Sound.



Kelp greenling forage fish. (Credit: Eli Wolpin)

Methods

Since 2010, citizen scientist John Buchanan of the Squamish Environment Society (SES) has conducted annual herring spawn surveys in late winter and early spring along the west coast of Átl'ka7tsem/Txwnéwu7ts/Howe Sound. In 2018-2019, herring spawn surveys were conducted by boat on four dates in 2018 (February to April), and three in 2019 (January to May). The surveys commenced in the south

around Kw'ech'ténm/McNab Creek and finished in upper Átl'ka7tsem/Txwnéwu7ts/Howe Sound around the Squamish Ferry Terminal, or Stawamus Creek, in the north. John conducts surveys of the rocky shores and seaweed beds, documenting his findings with photographs, videos and coordinates on maps, taking note of any significant findings or other observations of note.

Resources

This list is not intended to be exhaustive. Omission of a resource does not preclude it from having value.

John Buchanan Resources

January 2017. Herring Report #1

<https://www.youtube.com/watch?v=ZmYVsJMRuVQ>

February 2017. Herring Report #2

<https://www.youtube.com/watch?v=Jt1emUPgE98>

March 2017. Herring Report #3

<https://www.youtube.com/watch?v=hMThXebOpzE>

March 2017. Follow-up to Report #3

<https://www.youtube.com/watch?v=wWM21LT7xZg>

April 2018. Herring spawn report #4

www.youtube.com/watch?v=tABHmo0CDQk

Accessed October 17, 2019.

Ramona de Graaf, June 2016. BC Shore Spawners

Alliance work <https://youtu.be/H-8F67Acxlc>.

Accessed September 24, 2019.

Reeltime M, 2017. Massive school of anchovies in

Howe Sound, May 2017 <https://youtu.be/xgNKco-h1-s>. Accessed October 17, 2019

Taylor, A 2017. Howe Sound Anchovy, October 2017

<https://youtu.be/qQ9-yv1F28g>. Accessed October 17, 2019

Coastal Squeeze

<https://oceanwatch.ca/howesound/wp-content/uploads/sites/2/2016/11/diagram-coastal-squeeze-BRANDED.png>

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- 11 Duguid, W. D. P. *et al.* Historical fluctuations and recent observations of Northern Anchovy *Engraulis mordax* in the Salish Sea. *Deep. Res. Part II Top. Stud. Oceanogr.* 159, 22–41 (2019).
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ADDITIONAL INFORMATION

Buchanan, J., 2019. Email communication with Howe Sound Biosphere Region Initiative Society, Squamish Environment Society on behalf of John Buchanan, July 18, 2019.