ASL Environmental Sciences

Solutions Newsletter

Fall 2021

Fall 2021 ASL Newsletter. This issue:

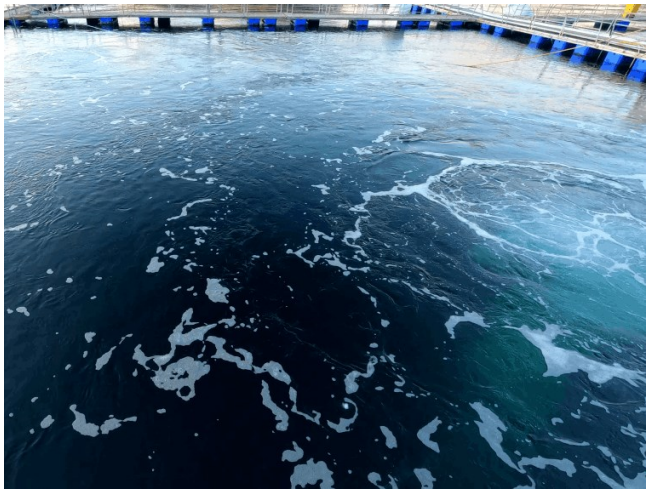
Canada's Ocean Supercluster Announces Real-time Bubble Diffuser Aeration Entrainment Monitor Project

On June 10, 2021, Canada's Ocean Supercluster announced four new projects with a total value of over $3.5 million, including the Real-time Bubble Diffuser Aeration Entrainment Monitor Project. This BC-led project will develop a real-time entrainment monitoring system for aquaculture fish farms in complex coastal ocean environments.

Bubble systems are used in finfish aquaculture net pens to mitigate the effects of harmful algae blooms (HAB), increase oxygen levels and lower surface water temperatures. This aeration monitor project will develop a real-time monitor balance system to mitigate these risks and ensure the effectiveness of bubble systems in aquaculture while reducing costs and emissions associated with fish-farming operations. The products and related services will allow customers to reduce overall greenhouse gas emissions and reduce the fish mortality from high surface temperature and harmful algal blooms.

The Real-time Bubble Diffuser Aeration Entrainment Monitor Project is led by ASL Environmental Sciences, who will develop services and products for the installation and maintenance of the monitoring systems, with partner MOWI Canada West, a potential customer of the system who will offer knowledge and experience using bubbler systems and provide input on needs and their ability to deploy this technology into existing operations.

With a total project value of nearly $500 thousand, the Ocean Supercluster will provide close to $325 thousand in funding, with the balance of funding coming from project partners.



ASL's real-time monitoring for bubble systems in aquaculture fish farms.

ASL Environmental Sciences

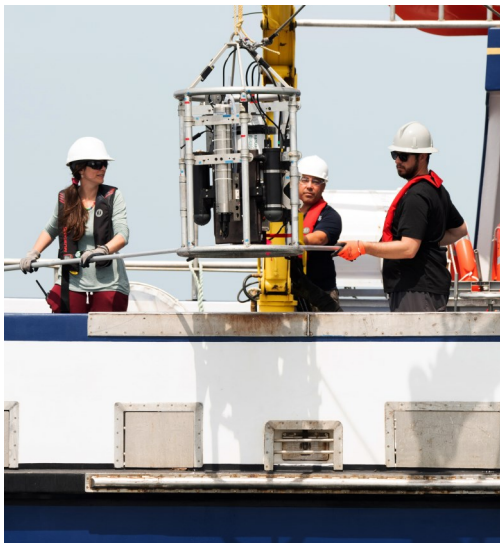
ASL Environmental Sciences Inc.
#1-6703 Rajpur Place, Victoria, BC, Canada V8M 1Z5
Phone: 1-250-656-0177 **Fax:** 1-250-656-2162 **Email:** asl@aslenv.com
www.aslenv.com

North Atlantic Right Whale Predator–Prey Relationship Study Using an Acoustic Zooplankton Fish Profiler

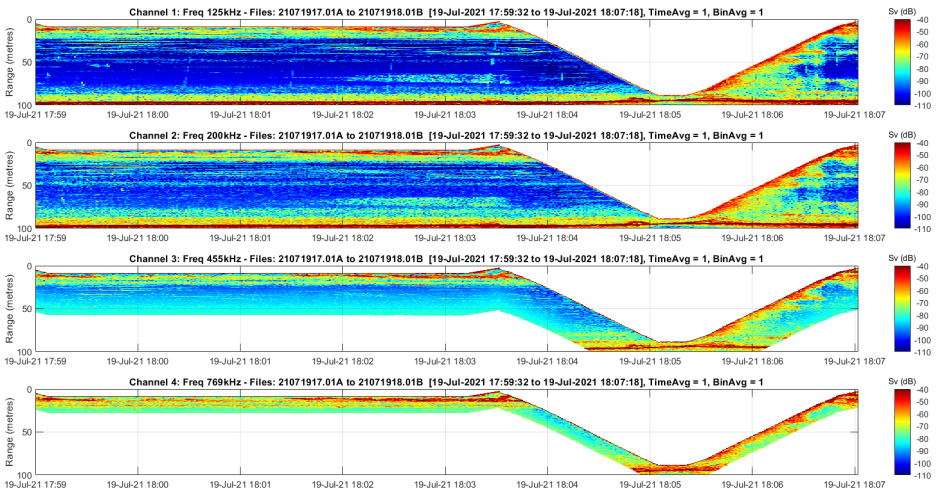
Once abundant throughout the North Atlantic, the North Atlantic right whale population has been reduced to fewer than 360 individuals and has been designated by the International Union for the Conservation of Nature as a critically endangered species. During the whaling era, these whales were exploited by the thousands for their plentiful oil and baleen. Now they face new challenges of ocean regime shifts linked to human-induced climate change. In the Gulf of Maine and the Scotian shelf regions, these regime shifts have resulted in less favourable foraging environments for the right whales.

To investigate the impact of these ocean regime shifts on the North Atlantic right whale, Kimberley Davies and her team from the University of New Brunswick along with collaborators that include the New England Aquarium, the Canadian Whale Institute, Dalhousie University and snow crab fishers in the Gulf of St Lawrence have been deploying ASL's Acoustic Zooplankton Fish Profiler (AZFP). The AZFP, along with other oceanographic instruments, are mounted to a cage which is lowered and raised to collect water column transects in two right whale habitats: the southern Gulf of St Lawrence, where right whales currently frequent, and the outer Bay of Fundy, where they used to be very abundant but have recently abandoned the area.

The AZFP is being used to quantify the distribution of right whale prey, namely the copepod *Calanus finmarchicus*. A key goal of this research is to try to understand what has changed in the oceanographic conditions in the Bay of Fundy that have caused the right whales to abandon this once-productive foraging ground. Also of interest is the characterization of the new habitat in the Gulf of St Lawrence where measurements are being made of diel variation in the distribution and abundance of right whale prey in the water column around foraging right whales.



Kimberley Davies, Captain Martin Noel and James Vlasic prepare instrument frame including AZFP for deployment. (Photo credit Nick Hawkins)



Four frequencies (125, 200, 455, 769 kHz) AZFP plots showing AZFP backscatter data. The AZFP is being used to detect diel variation in the distribution and abundance of right whale prey.

ASL Environmental Sciences Inc.
#1-6703 Rajpur Place, Victoria, BC, Canada V8M 1Z5
Phone: 1-250-656-0177 **Fax:** 1-250-656-2162 **Email:** asl@aslenv.com
www.aslenv.com

Acoustic Scintillation Flow Meter Installation Replaces Over-Velocity Detection System at BC Hydro's Wahleach Project

ASL AQFlow's Acoustic Scintillation Flow Meter (ASFM) has been installed at the BC Hydro's Wahleach project near Hope, BC, as a replacement to an existing Over-Velocity Detection System (OVDS). Hydroelectric operations use these detection systems in order to detect if the tunnel or penstock downstream of the intake has a leak or rupture. In such cases, intake gates are closed to prevent uncontrolled release of water that can be potentially dangerous for the public and may cause damage to properties and infrastructure.

The ASFM uses ultrasonic pulses across an intake to analyze variations in turbulence to measure flow. These data are used to produce real-time current velocities and discharge volumes. At the Wahleach site, two independent 4-path ASFM instruments—acoustic beams consisting of transmitter (Tx) and receiver (Rx) pairs—were mounted to a removable frame that was lowered into an intake slot (Figure 1). This installation did not require dewatering of the tunnel and provides a non-intrusive method to measure water flow passing through the intake. Maintenance and trouble-shooting of the ASFM system can be conveniently performed from the intake floor. The previous OVDS was based on measurements of differential pressure using Pitot tubes that had become unreliable. It caused false gate trips in the past resulting in rapid dewatering of the tunnel which is very harmful for the stability of the tunnel. ASFM data were analyzed for repeated measurements at ten steady flow conditions (Figure 2). The average standard deviation for these tests was less than 1% for each of the 4-path ASFMs. A bias adjustment value has been used to reduce the discharge by approximately 5.5% to match with turbine test data collected in 2002. These test results comply with BC Hydro's requirements for an accurate monitoring of over-velocity.

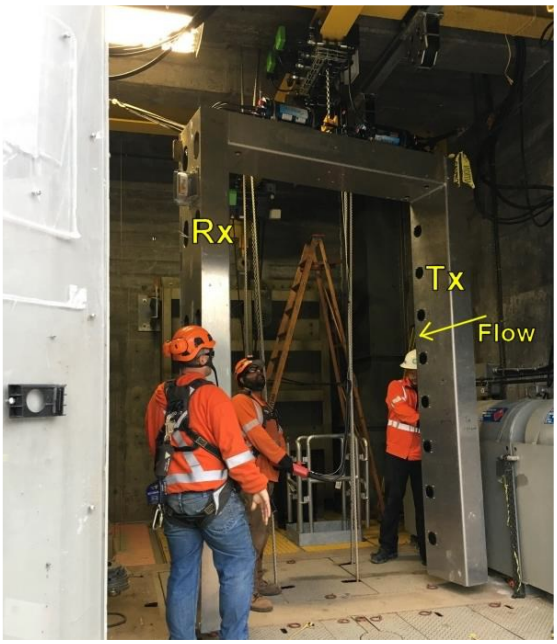


Figure 1. Removable ASFM support frame being installed at the intake maintenance gate slot. The direction of flow and the location of the transmitter (Tx) and the receiver (Rx) transducers are indicated.

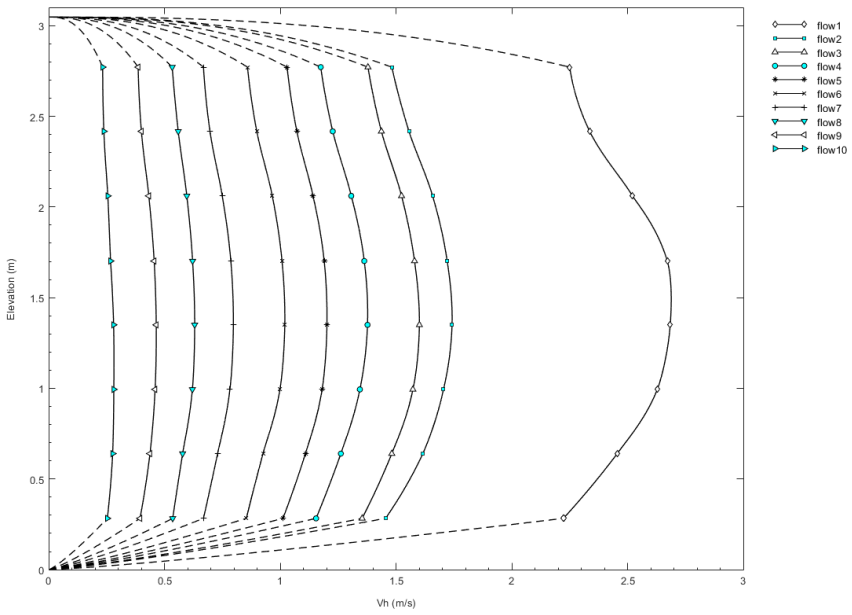


Figure 2. Curves display the horizontal component of velocity from all eight ASFM transducer paths for ten flow conditions.

ASL Environmental Sciences Inc.
#1-6703 Rajpur Place, Victoria, BC, Canada V8M 1Z5
Phone: 1-250-656-0177 Fax: 1-250-656-2162 Email: asl@aslenv.com
www.aslenv.com

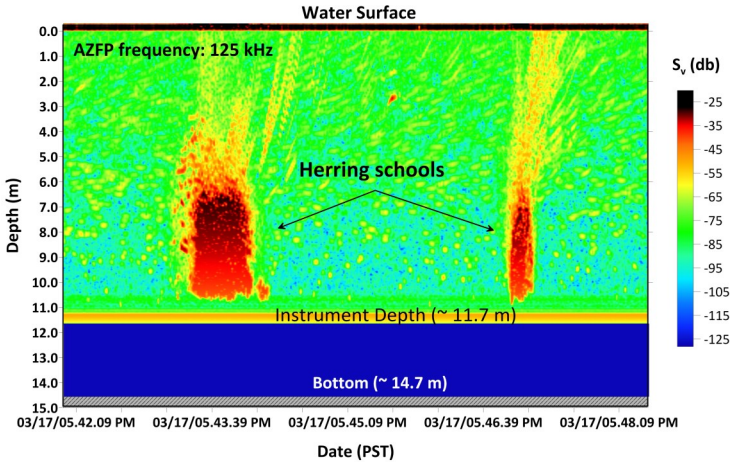
The Salish Sea Community Guardians Invites Community Collaboration to Enhance the Salish Seas Herring Spawning Recovery

Pacific herring (*Clupea pallasi*) play a vital role in the food web of B.C. Canada coastal waters. They are a significant food source for Chinook and Coho salmon, lingcod and a host of marine birds and mammals. Through these marine predator–prey relationships and their seasonal life cycles, the Pacific herring have far-reaching influence on terrestrial birds and mammals as well. This is most evident during the salmon spawning cycle as salmon, which feed on herring, travel up rivers and transfer their nutrients to the forests and the many bird and mammal inhabitants. In the Salish Sea, herring are of great cultural significance as a fishery and respected as a critical element that supports all species in the marine environment.

In recognition of the importance of the Pacific herring, the Salish Sea Community Guardians, an organization dedicated to all aspects of stewardship for Salish Seas First Nations, have created a cross-cultural action plan. This action plan would provide First Nations traditional herring spawning habitat recovery and protection in key herring spawning areas in waters around southern Vancouver Island. Part of this action plan involves the construction of two types of habitat curtains suspended below floating docks and log booms. These curtains, made from either synthetic materials or hemlock and cedar branches, provide ideal spawning sites for the depositing of herring eggs.

ASL Environmental Sciences Inc., in collaboration with the Salish Sea Community Guardians, deployed an Acoustic Zooplankton Fish Profiler (AZFP) on March 17, 2021. This multi-frequency echosounder was placed in a traditional herring spawning location in Saanichton Bay near Victoria, B.C. The deployment was for approximately one month and coincided with the seasonal herring spawn. Its purpose was to detect herring populations. Data collected from the AZFP deployment will fulfill one of the key initiatives to monitor the herring spawn in these created habitats and will be complemented by surface surveys carried out using the Department of Fisheries and Oceans protocols. The instrument was successfully recovered on April 14, 2021 and preliminary analysis show encouraging signs of herring schools within the area.

Drone photo showing ASL's AZFP mooring just prior to its deployment. (Photo credit, Geoff Mullins, GKM Research)



Echogram plot of AZFP data showing herring schools adjacent to the installed habitat curtains. (March 17, 2021).

ASL Environmental Sciences Inc.
#1-6703 Rajpur Place, Victoria, BC, Canada V8M 1Z5
Phone: 1-250-656-0177 **Fax:** 1-250-656-2162 **Email:** asl@aslenv.com
www.aslenv.com

ASL Collaborates with the University of Victoria to Develop Rapid Processing of Large Echogram Datasets

September 2021 marks the end of the second year of ASL's collaboration with the University of Victoria through the Mitacs Accelerate Internship Program. Mitacs is a not-for-profit group that fosters industrial–academic partnerships. ASL has partnered with Professor Stan E. Dosso and M.Sc. student Alex Slonimer to fund a research study in ocean acoustics. This graduate research is focused on multi-frequency echosounders—specifically, data collected with ASL's Acoustic Zooplankton and Fish Profilers (AZFPs) that are used to measure the presence and abundance of fish and plankton. The goal of this industry-academic partnership was to develop new tools for the processing and classification of echogram data.

The results of this partnership have been the development of software and tools for the analysis of multi frequency acoustic echogram data. These new capabilities include extraction to a convenient format and a viewer application to quickly and efficiently review the data. For preprocessing the data, tools have been developed for noise removal, calculation of mean volume backscatter (MVBS), and surface detection. For manual review and categorization, an interactive tool has been developed that can pre-classify the echograms using an unsupervised clustering algorithm and enable manual classification into more detailed classes.

The output of this classification may be fed directly into further processing for echo-integration and calculation of nautical area scattering coefficient (NASC) for biomass estimates. Alternatively, this data may be used to train convolutional neural networks (CNNs) to automate the classification of echograms. The CNN's learned latent features of the classes, which may represent such characteristics as the positionality in the water column, fish school density, fish school size, multi-frequency relative frequency response and others.

Through the Mitacs partnership, a CNN was developed that, in addition to the echogram data, was also trained with ancillary information including depth and solar angle. The classification of the data into different classes at a pixel level was achieved with this CNN. Rather than aiming to classify regions containing fish schools, this was able to classify individual pixels of the echogram. In addition to school detection, this method of classification has enabled accurately identify of near surface bubble noise and biology that is distributed in layers through the water column such as zooplankton. A metric for assessing the quality of output from a CNN is the F_1-score, which is the harmonic mean of precision and recall. It is defined as

$$F_1 \text{ - score} = \frac{2}{precision^{-1}+recall^{-1}} = \frac{2TP}{2TP+FP+FN},$$

where TP, FP, and FN are the number of classified echogram pixels that are true positives, false positives, and false negatives, respectively. The best performing CNN classified herring, juvenile salmon, and bubble classes with F_1 - scores of 93.0%, 87.3%, and 86.5%, respectively. This significantly outperforms a traditional rule-based benchmark approach, which only achieved F_1-scores of 78.3%, 68.7%, and 55.2% for the respective classes of herring, juvenile salmon, and bubbles.

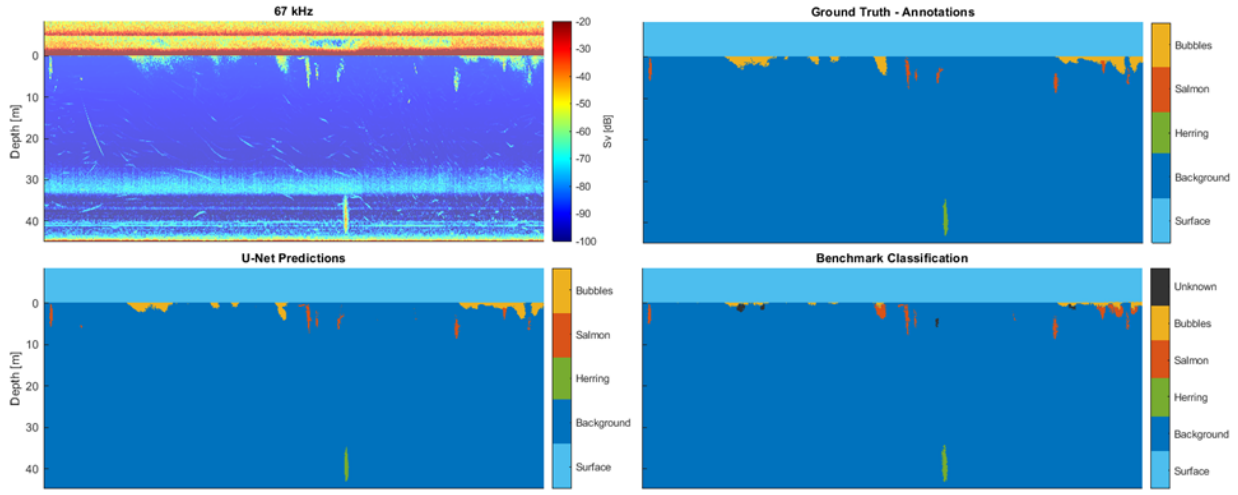
Continued on next page

ASL Environmental Sciences Inc.
#1-6703 Rajpur Place, Victoria, BC, Canada V8M 1Z5
Phone: 1-250-656-0177 Fax: 1-250-656-2162 Email: asl@aslenv.com
www.aslenv.com

ASL Collaborates with the University of Victoria to Develop Rapid Processing of Large Echogram Datasets

continued

This method of automation is a first step to rapid processing of large echogram data sets and will enable in-house processing with a short turn-around time from data intake to results. For more information and to discuss your AZFP data processing needs, you can reach out to Alex Slonimer via email at aslonimer@aslenv.com.

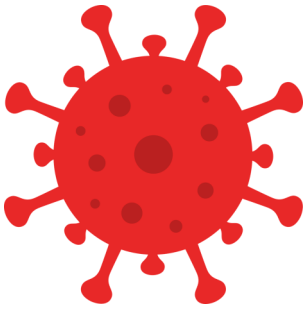


One hour of echogram data from Oksillo Channel, BC, at 11 am, July 4, 2015, for one frequency (out of four) of AZFP echogram data (top left), and corresponding ground truth from manual annotations (top right). Below are automated classifications, using a CNN (bottom left), and rule -based approach (bottom right).

Field Work During Covid

Travel restrictions associated with Covid have somewhat limited our ability to do field work for our clients, particularly internationally. In some cases we have compensated by sending ready-to-deploy moorings to the client on site, and have helped them remotely with the equipment set up and deployment. Our guys miss out on a field trip, but the equipment gets deployed. Let us know if that might work for your project.

Contact Rick at rbirch@aslenv.com



ASL Environmental Sciences Inc.
#1-6703 Rajpur Place, Victoria, BC, Canada V8M 1Z5
Phone: 1-250-656-0177 **Fax:** 1-250-656-2162 **Email:** asl@aslenv.com
www.aslenv.com

ASL's Fourth Annual Beach Cleanup at Mount Douglas Park, Victoria, BC

Several ASL employees and their family members spent Saturday July 24, 2021, at Mount Douglas Beach leaving the beach better than before as about 5 kg of debris was taken away. This was the first time for one of our employees. He enjoyed himself so much that we're now planning another beach cleanup this fall. These beach cleanups are important as it has been shown that most floating plastic in the oceans eventually ends up on beaches (see https://www.hakaimagazine.com/features/scooping-plastic-out-of-the-ocean-is-a-losing-game/).

Conferences

Upcoming Conferences

Association of British Columbia Marine Industries (ABCMI 2021)
November 2–4, 2021
Vancouver, BC

Oceans Sciences Meeting (OSM 2021)
February 27–March 4, 2022
Honolulu, Hi, USA

Oceanology International (OI 2021)
March 15–17, 2022
London, UK

Recent Past Conferences

Canadian Meteorological and Oceanographic Society (CMOS)
May 31–June 11, 2021
Virtual Conference

Acoustical Society of America
June 7–11, 2021
Virtual Conference

Port and Engineering under Arctic Conditions (POAC 2021)
June 14–18, 2021
Virtual Conference

ASLO 2021 Aquatic Sciences Meeting
June 22–27, 2021
Virtual Conference