ASL Environmental Sciences

Solutions Newsletter

Fall 2020

Fall 2020 ASL Newsletter. This issue:

ASL Announces Dannielle Eager as the 2020 Acoustic Zooplankton Fish Profiler (AZFP) Award Contest Winner

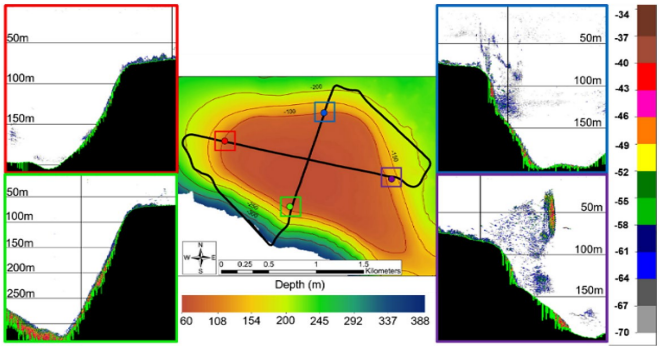
ASL Environmental Sciences is pleased to announce Dannielle Eager as the winner of the fifth annual Acoustic Zooplankton Fish Profiler (AZFP) early career scientist award contest. Dannielle is presently studying at the University of Plymouth at Devon, UK at a postgraduate level in the school of Biological and Marine Science.

Dannielle's research will focus on the influence of dynamic seamount oceanography on pelagic biota in the tropical Indian Ocean, with support from the Garfield Weston Foundation, Bertarelli Foundation and the University of the Highlands and Islands.

Dannielle Eager

In contrast to surrounding waters, seamounts support high biodiversity and high predator –prey interactions which are driven by oceanographic processes. These energetic processes, which have recently been identified as turbulent internal waves, aggregate zooplankton over seamount summits, sustaining an abundant schooling fish community which is preyed on by sharks. While oceanographic measurements enable the identification of the prevailing oceanographic regime, the AZFP will provide the critical "missing link" whereby we could relate the incidence of internal waves to the schooling of fish and their predation through single target detections.

The awarded AZFP (38/125/200/455 kHz) will be incorporated into an intensive fine scale multi-disciplinary survey being carried out over a four-week period in March 2021 at a seamount where large aggregations of biota have previously been identified. A full complement of moored and vessel-mounted instruments such as ADCPs, thermistor strings and fisheries echosounders will be used to define the fine-scale energetic oceanographic and biological processes with coincident *in situ* plankton sampling and towed cameras for fish and shark validation. The ultimate aim of the project is to link the oceanographic processes to the aggregation of zooplankton, fish schooling and predatory behaviour of sharks with the AZFP as it measures the high spatial and temporal resolution of acoustic backscatter throughout the water column.



The spatial distribution of biota over Sandes seamount from a research cruise in November 2019 showing multibeam bathymetry (centre) with the ES70 transect and 38 kHz ES70 mean volume backscattering strength (dB re 1 m^{-1}) echograms of biota over the northwest (red), southwest (green), northeast (blue) and southeast (purple) flanks.

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

Hydro-acoustic Studies of Eulachon Fish Distribution Related to Roberts Bank Terminal 2 Project

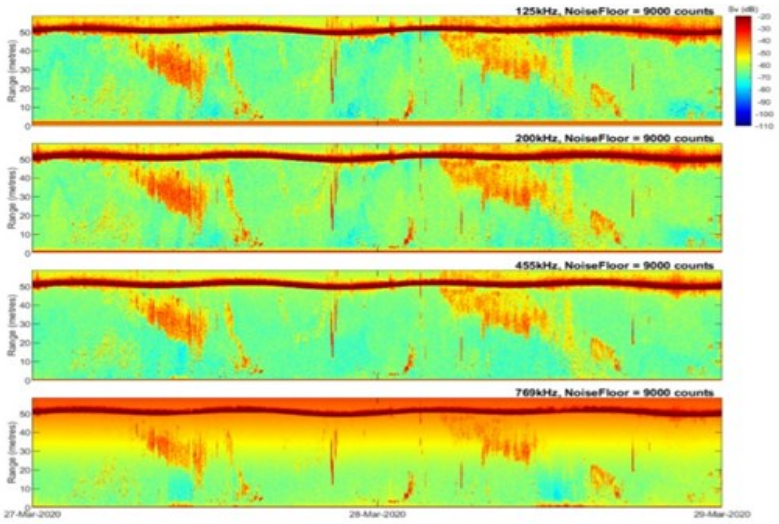
ASL Environmental Sciences (ASL) was chosen by Hemmera Envirochem Inc. and the Vancouver Fraser Port Authority (port authority) to perform a hydroacoustic study of eulachon fish (*Thaleichthys pacificus*) distribution in the vicinity of Deltaport Terminals off the mouth of the Fraser River, BC. To support the development of the Dredging and Sediment Discharge Plan that will form part of the Construction Environmental Management Plan of the Roberts Bank Terminal 2 Project (project), the port authority has committed to developing eulachon-specific mitigation that will be used during dredging activities. A pilot study was developed to examine the efficacy of hydroacoustic techniques in detecting adult eulachon.

ASL proposed using the Acoustic Zooplankton Fish Profiler (AZFP), a calibrated multi-frequency echosounder, to measure distribution of the eulachon, particularly during the spring period when they are believed to migrate past Roberts Bank and up the Fraser River to spawn. The AZFP is a four-frequency acoustic profiler that can be deployed for months, continuously measuring day and night, or can be used in real-time transect mode. In the spring of 2020, three AZFPs were moored off Deltaport for six weeks, covering the peak April migration period. The acoustic profile data covered the water column down to 150 m depth, at one shallow site and one deep site. The eulachon are known to occur near-bottom, but during migration may be present at shallower depths.

Eulachon can be differentiated from other fish species using multiple frequency acoustics (Gauthier and Horne, 2004) and estimates of aggregated abundance can be made (J. Horne 2020, pers. comm.). The figure below shows the typical acoustic signature of individual and aggregated fish schools.

This pilot study will allow the port authority to evaluate the effectiveness of monitoring eulachon distribution using multi-frequency echosounders. If the pilot study is successful, the port authority will consider how best to utilize the technology as eulachon-specific mitigation as part of the Dredging and Sediment Discharge Plan.

ASL's James Bartlett examining data.



Four frequency AZFP data showing fish.

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Beaufort Regional Strategic Environmental Assessment

Banks Island, NWT.

ASL Environmental Sciences is pleased to announce the public release of the Beaufort Regional Strategic Environmental Assessment (BRSEA) Final Report, the completion of a comprehensive five-year project covering the Inuvialuit Settlement Region, situated in the Western Canadian Arctic. The objectives of BRSEA were to provide strategic direction and integrated analysis of environmental and community-based parameters that would be directly and indirectly affected by future offshore oil and gas development activities in the Beaufort Sea. BRSEA was a collaborative effort involving numerous northern indigenous communities and governmental organizations such as The Inuvialuit Regional Corporation, Inuvialuit Game Council and Crown Indigenous Relations and Northern Affairs Canada.

ASL Environmental Sciences was sub-contracted by Kavik-Stantec (project-lead) to provide disciplinary leadership and scientific expertise to BRSEA in applying oceanography, Arctic sea ice, weather and climate, coastal dynamics, and seafloor geology understanding to the assessment. Unprecedented changes are occurring within each of these disciplines, associated with climate change. Regional climate change assessments were conducted for a 30-year period (2020–2050) and used to assess the potential impacts of resource development scenarios on the environment and traditional activities, accounting for a changing climate. ASL's contributions in oceanography were lead by Mr. Keath Borg. Contributions to sea ice and coastal dynamics were co-led by Dr. Matthew Asplin and Mr. David Fissel. Seafloor dynamics and permafrost was assessed by Mr. David Fissel, with external contributions from Dr. Gwyn Lintern.

Through our contributions, ASL is supporting decision-making on possible future resource development and management, environmental conservation programs, subsistence activities and other complementary commercial activities in the region. The assessment report will inform the upcoming review of the moratorium on oil and gas activities in Canada's Arctic offshore waters, announced in the United States–Canada Joint Arctic Leaders' Statement in December 2016.

We would like to express our appreciation to northern indigenous residents who contributed to workshops, shared their knowledge, participated in projects, led research and attended meetings over the past five years. We would also like to acknowledge the BRSEA Advisory Committee as well as many other partners and collaborators who contributed to the overall BRSEA program.

More information on this project can be found here https://rsea.inuvialuit.com/

or contact Matthew Asplin (masplin@aslenv.com)

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ASL Partners with the University of Victoria to Develop Smart Tools for Analyzing Ocean Acoustics Data

September 2020 marks the end of the first 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.

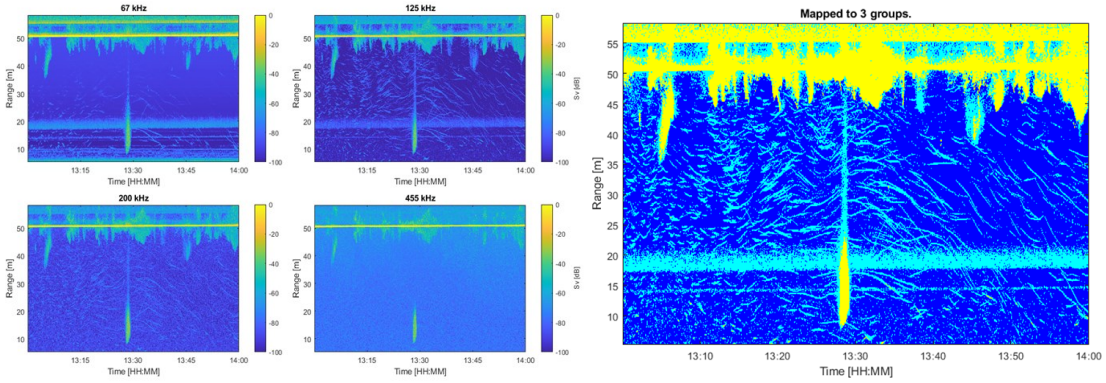
These instruments are used on cabled networks, autonomous moorings, and ocean gliders.

Presently, analysis of this type of data is expensive, time consuming, and prone to analyst bias. The analysis also requires an advanced understanding of ocean acoustics. The purpose of this research is to automate the analysis using deep neural networks that are informed by scattering acoustics, biological behaviour and environmental context. This builds on previous work conducted by ASL with Professor Alexandra Branzan Albu for identifying herring schools within echograms. Rather than placing bounding boxes around fish schools, this new study aims to perform pixel-wise classification of fish schools and plankton.

In addition to training neural networks on real data, this project will develop representative synthetic echograms for the scattering species in the water column. The same acoustic scattering models used to develop the simulated data will be used in the forward models for conducting acoustic inversion to derive species abundance and biomass information.

For this research, ASL is providing funding, computers with proprietary oceanographic data processing tools, and decades-long expertise in oceanography, engineering, manufacturing, and underwater acoustics.

This work will further automate AZFP data processing workflows while leveraging state of the art statistical modeling and machine learning methods. A major emphasis of the work will be to develop algorithms and tools that generate timely and repeatable results without requiring extensive interaction with an expert user. This will reduce the total effort spent on data analysis, allowing ever increasing data volumes to be processed in a timely and cost-effective manner, supporting, for example, fish stock monitoring and biomass estimation. In addition, the automation will allow near-real time processing that will greatly enhance our capability for monitoring time critical phenomenon such as availability of food sources for marine mammals, or surveys of fish and sediment disposition near dredging operations.



Four frequency echograms (left) with pixel-wise classification (right).

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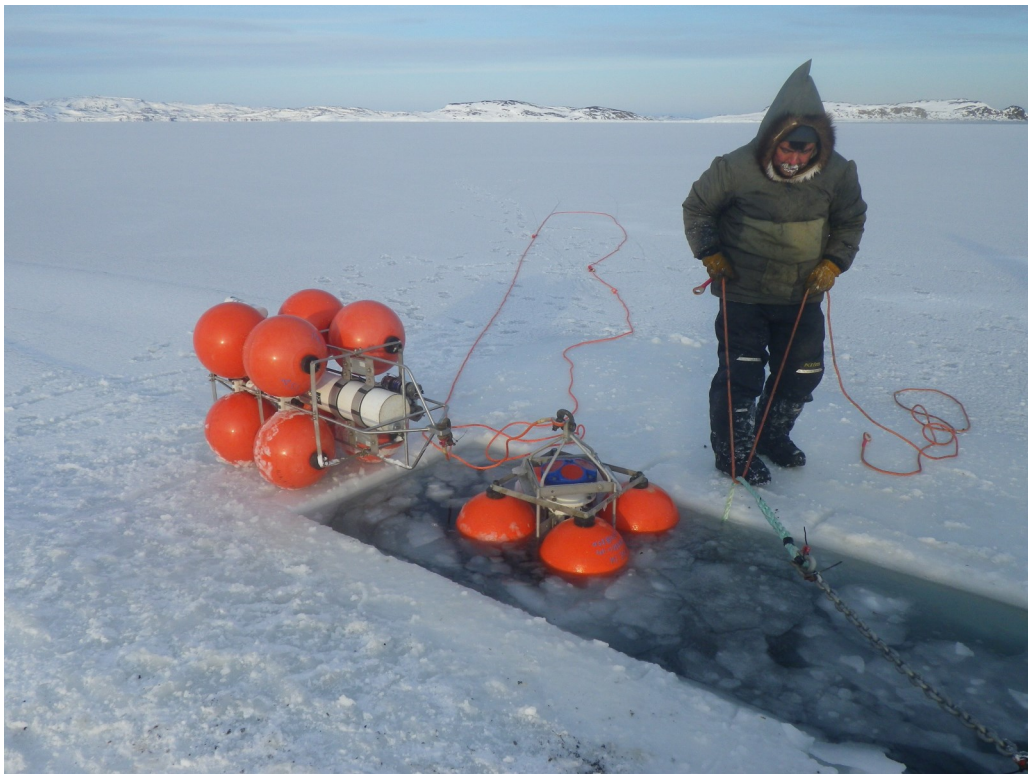
Oceanographic Data Collection for Labrador Marine Research and Monitoring

In a collaborative effort with the Nunatsiavut Government and Dalhousie University to measure ice, water current and other physical and biological properties of the marine environment, ASL Environmental Sciences contributed a prototype Log Ice Profiling Sonar (LogIPS), and on February 15th 2020, the sonar was deployed on a taut-line mooring in the waters off Nain, Nunatsiavut, Labrador. The mooring also contained an acoustic doppler current profiler (ADCP) as well as data loggers for chlorophyll, turbidity, temperature–salinity and dissolved oxygen. The mooring was deployed through a hole cut in the sea ice, with an open-water recovery planned for later this year.

The deployment was part of a project run by the Nunatsiavut Government to collect information about the sea ice environment on the Labrador coast using a variety of data sources and multimedia communication tools. The project aims to map ice hazards and monitor climate-related patterns and changes in the sea ice environment to provide information to Labrador Inuit that can inform travel on the sea ice. Paul McCarney, research manager with the Nunatsiavut Government, coordinated the work, with additional expertise provided by Eric Oliver, an assistant professor of physical oceanography at Dalhousie University. This work is in collaboration with Adrienne Tivy at the Canadian Ice Service and Clark Richards at Bedford Institute of Oceanography. The work relied heavily on the local knowledge expertise and efforts of Joey Angnatok, Mentor–Harvester and field researcher with the Nunatsiavut Government, pictured below.



Joey Angnatok preparing ADCP and IPS mooring cages for deployment through the ice.
(Photo credit: James Bartlett)

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Development of the Queen Charlotte Strait Ocean Model

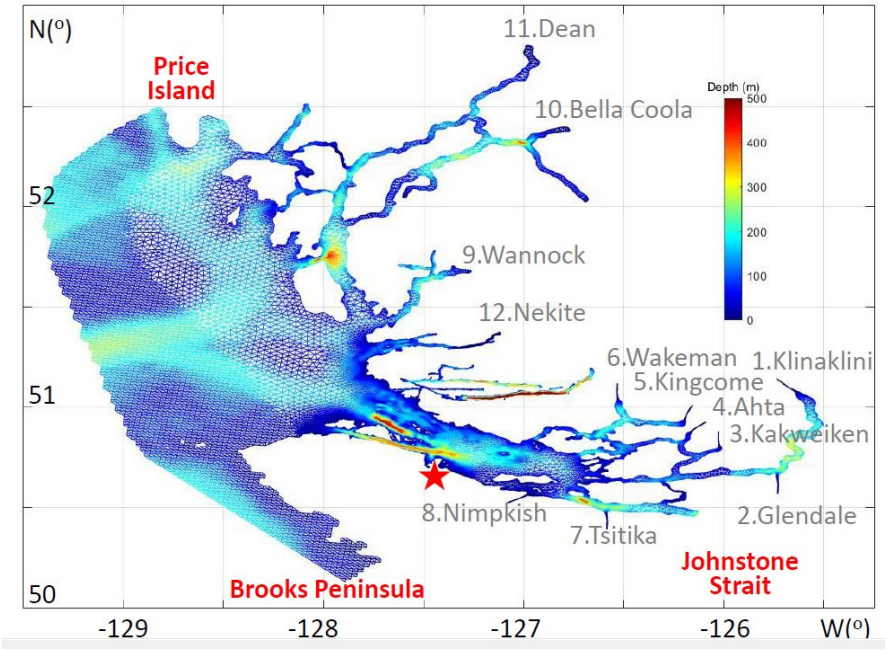
BC's marine coastal ecosystems are among the most productive and diverse communities in the world (Poore, G.C.B., and G.D.F. Wilson. 1993). Numerical modeling of such areas gives insights into the complex nature of these successful regimes. High-resolution hydrodynamic models of the coastal ocean can be used to assist the aquaculture industry and its regulators in different ways; for instance, they can provide information to select optimal locations for farms and to assess their particle/pathogen dispersal to the environment as well as farm-to-farm interactions.

As part of a Program for Aquaculture Regulatory Research (PARR) project at DFO, ASL is developing a high-resolution model for Queen Charlotte Strait, BC. Working with DFO scientists, a new mesh model was developed for the Queen Charlotte Strait area.

The model is an application of the unstructured grid, Finite-Volume, primitive equation Community Ocean Model (FVCOM). Currently, the horizontal resolution of the model grid ranges from 50 m at the Port Hardy region to 2000 m at the open ocean (Queen Charlotte Sound and northwest shelf of Vancouver Island). At the open ocean boundary, the model is one-way nested within the operational largescale Coastal Ice Ocean Prediction System for the West coast (CIOPS-W). The latter is developed by the Canadian Operational Network of Coupled Environmental PredicTion Systems (CONCEPTS), with 1/36̊ horizontal resolution (~2.0 to 2.5km). At the surface, the FVCOM model is forced by the operational High-Resolution Deterministic Prediction System (HRDPS) from Environment and Climate Change Canada (ECCC), which provides surface winds and heat flux with a 2.5 km spatial resolution. Benefitting from the operational ocean prediction system (CIOPS), and using the atmospheric predictions (HRDPS), this coastal ocean model would have the capacity to be operational and provide high-resolution coastal ocean nowcasts and forecasts up to 48 hours over the Queen Charlotte Strait area.

Output from this model were compared to observations of water level, ADCP current meter data, and sea temperature/salinity profiles, with favorable results showing the model demonstrates a reasonable skill level.

FVCOM model showing finite grid of the Queen Charlotte Strait.



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ASL Career Opportunity

Masters Student Position: Fishery Acoustics Specialist

Memorial University of St. John's Newfoundland, in collaboration with ASL Environmental Sciences, has an opening for a graduate level student interested in the biological, oceanographic or acoustics disciplines. This position will focus on the development of software models to predict sonar system performance and to explore new processing techniques. In addition to the modeling of sonar performance and processing techniques, this position will also have a field work component. ASL Environmental Sciences, based in Victoria, British Columbia, has more than 40 years of experience in acoustics, oceanography, ice research, remote sensing and operational services. We provide scientific consulting and instruments to Canadian and international clients from industry, government and academic sectors. For a list of responsibilities and qualifications for this position, please see our careers page (https://aslenv.com/careers.html) or click here for posting. This graduate position is fully funded.

New Equipment Purchases

ASL has recently added several acoustic noise recorders to the lease pool: three RTSYS RSEA 320's, and two Turbulent Research Porpoise units.

The RESEA 320's are rated to 1000 m depth with a single synchronized hydrophone input of 24 bit acquisition and selectable sampling rates up to 1000 kHz. They include pressure and temperature sensors, 512 GB microSD card plus 4 TB hard drive.

The hydrophones are GeoSpectrum M36-V35-900 hydrophones.

The Turbulent Research Porpoise units are rated to 2000 m, come with an M36-900 external hydrophone, and have 128 GB of internal memory (expandable to 2TB).

RTSYS underwater acoustic recorders.

ASL Carries Out Field Work Remotely

As ASL continues to adapt to life with COVID, a number of field projects around the world have been put on hold due to global travel restrictions. In some cases, where timing of the data is critical, projects could not be delayed. In collaboration with our clients and stakeholders, we have been able to find creative solutions to ensure that project timelines remain on track. Here are a few of the ways we have been able to assist our clients remotely:

- Preassembly of moorings that are delivered configured and ready to put in the water by a ship's crew
- Providing detailed procedures and "coaching" to client personnel to carry out the work independently
- Remote/virtual desktop connection through a client's computer to communicate with instrumentation for testing, configuration or data recovery
- Using Teams or Zoom meetings to have a visual presence of the room and oversee operation from afar
- Through ASL's large inventory of oceanographic equipment, it is possible in most cases to provide a second set of instrumentation that is preconfigured and can be swapped in for the equipment being recovered. This allows for minimal downtime and can reduce the need for servicing equipment in the field.

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