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Book of Abstracts

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**Aquaculture for All!
Inclusive, Accessible, and Sustainable**

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AQUACULTURE ASSOCIATION OF CANADA **40** ASSOCIATION AQUACOLE DU CANADA
CELEBRATING 40 YEARS

**Delta Hotel & PEI Conference Centre
Charlottetown, Prince Edward Island**

The abstracts are listed in alphabetical order, by the presenter's last name. Abstracts have been formatted to fit the standardized template. Oral presentations are listed first with Poster presentations following, as noted in the header. Only abstracts presented at the conference are included; submitted abstracts that were not presented are excluded.

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ARNOLD, S.

KELP FARMING IN ATLANTIC CANADA: MARKET OPPORTUNITIES, GAPS, AND THE NEED TO 'RIGHT-SIZE' REGULATIONS

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The Ecology Action Centre's Kelp Kurious project is a support hub for the emerging farmed kelp sector in Atlantic Canada. A thriving kelp farming sector could help diversify coastal economies, improve regional food security, and offer business opportunities all along the value chain.

Shannon will present a market analysis published by the EAC and leaders in the food industry. The report highlights the potential for the region to secure substantial value from regenerative kelp farming and products within the next three to five years. Nova Scotia alone is positioned to realize \$38 million from farmed and processed kelp, a further \$20 million in related local economic activity and up to \$149 million in consumer and personal care products. The analysis also recommends a strategic roadmap for building this sector in a way that is sustainable and benefits as many communities as possible.

Unfortunately, currently onerous regulations mean small farmers are waiting years to get on the water. In order to realize the benefits of this low-impact sector of seafarming, regulations must be 'right-sized' to ensure marine ecosystems are protected while getting independent farmers on the water faster or the region risks being left behind by other jurisdictions.

maximum 2 lb size. 4. And high sensitivity to manipulations within their growth containers. We report here on our success in profitably culturing this species to sizes of 3 lb each, or more.

We have radically modified our cultural practices and equipment so that in raceways, ponds or tanks, from fry to fingerlings, growth rates are good and total mortalities are <0.5 % of total numbers. And, a radical modification of cultural practices to grow the fish from fingerlings to 3 - 4 lb slaughter weight limits total mortalities over the life cycle to 4 % or less.

The use of light in the second winter of culture forces vegetative growth and delays year 3 maturation to the 4th year of culture. As a result we harvest 3 - 4 lb Sockeye from November of the 3rd year of culture to June of the following year. Ca. 96 % survival from fry entry. Therapeutants, including antibiotics, are not used.

BACKMAN, S.

NINE YEARS OF SEAWEED FARMING: SUCCESSES, FAILURES, OPPORTUNITIES, AND ROADBLOCKS.

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Aquaculture, despite over a half century as a Canadian industry, has remained a significantly underutilized resource and opportunity to build food security in Canada. In contrast, Canada is a global leader in research and innovation utilized to grow the industry in other jurisdictions.

Magellan Aqua Farms Inc. began operations in 2004, experimenting with growing giant scallop, green sea urchin and blue mussel. We quickly settled on giant scallop as primary crop. We have never used, or applied, any chemical treatments in any of our operations, but instead relied on biomimicry techniques to control fouling and predation.

Changes in the marine environment saw a dramatic decline in spat recruitment and this led to our further dive into the principles of integrated multi-trophic aquaculture (IMTA). This culminated with a collaborative venture between Magellan Aqua Farms Inc. and Chopin Coastal Health Solutions Inc. in the formation of Turquoise Revolution Inc.

Seaweeds offer a unique opportunity to diversify aquaculture production, provide meaningful employment in coastal communities, and add to Canada's food security. The barriers to going from a niche artisanal farming operation to a coastal industry and economic engine are significant. They include regulatory barriers, supply chain entry nodes, market acceptance and access, financing, and scaling of operation.

BANSKOTA, A.

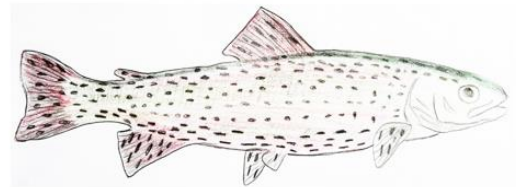
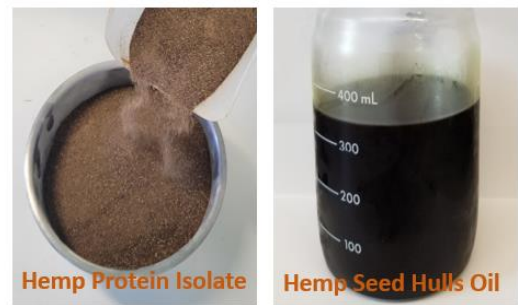
HEMP PROCESSING BY-PRODUCTS: A POTENTIAL SOURCE OF NEW AQUAFEED INGREDIENTS

Arjun Banskota, Sean Tibbetts, Alysso Jones, Joseph Hui, Roumiana Stefanova, Ian Burton, Joerg Behnke, Angelisa Osmond, Stefanie Colombo

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Aquaculture production activities occur in every province and territory of Canada, and in 2020 Aquaculture industry generated \$3.86 Billion in economic activity and employed 14,520 full time workers in Canada. The salmonid aquaculture industry has largely transitioned to using plant-based proteins and oils to reduce reliance on traditional marine ingredients (fish meals and oils), which have reached their limits. Exploring new ingredients for salmon and trout aquafeeds is crucial to meet the growing demand for farmed salmonid products. Hemp processing by-products show promise as potential aquafeed ingredients due to their good profiles of essential amino acids (EAAs) and polyunsaturated fatty acids (PUFAs) beneficial for fish growth and health. We have extracted kilogram-scale quantities of protein isolates (PIs) and oils from the hemp by-products, hemp cake and hemp seed hulls and evaluated their nutritional composition. High protein digestibility of >88% was observed for hemp PIs when evaluated using a two-phase *in vitro* gastric/pancreatic protein digestibility assay (IVGPD). Findings from both *in vitro* digestion assays and an *in vivo* feeding study with rainbow trout indicate that hemp processing by-products have potential as a novel aquafeed ingredient feedstocks, benefiting sustainable aquaculture practices.



BARDON-ALBARET, A.

PERFORMANCE EVALUATION OF DIPLOID AND TRIPLOID ARCTIC CHARR

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Valorēs implements a breeding program to enhance the performance of Arctic charr in commercial aquaculture, now advancing into its 10th generation of selection this fall. Diploid progeny face hurdles in attaining marketable size due to premature sexual maturity, impacting flesh quality and feed conversion. To counter this, Valorēs began producing triploid Arctic charr in 2016. Triploids, being sterile, channel energy away from gonad development into growth, offering advantages like reduced escapement risks and safeguarding intellectual property. Despite potential benefits, the financial viability of triploid production remains unexplored. This project is divided in two phases: separate rearing of diploids and triploids until market size, followed by performance assessment during harvest and processing. Metrics include survival rates, growth, feed conversion, maturation rate, and product quality (fillets yields, pigment, lipid and protein contents). Phase one aims to gather comprehensive data on survival, growth, and feed conversion across different ploidy levels over two years in commercial conditions. This project evaluates triploid fish performance under modern aquaculture conditions. Results will benefit stakeholders invested in Arctic charr aquaculture, ensuring the success and viability of Arctic charr breeding program and its industry.

BENFEY, T.J.

CAN THE HYPOXIA TOLERANCE OF TRIPLOID SALMONIDS BE IMPROVED?

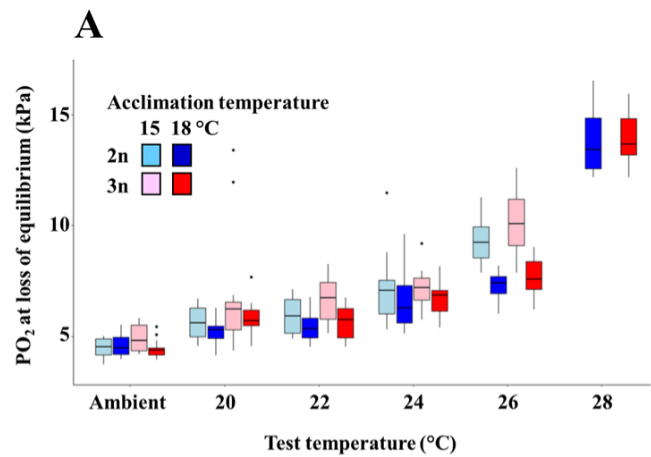
Tillmann J. Benfey, Rebecca R. Jensen, Sarah A. McGeachy, and Christopher A. Baker

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Triploids are sterile and therefore cannot reproduce if they escape from farms. While this has obvious management benefits, triploid fish are not used in aquaculture to any extent because they have reduced high-temperature and hypoxia tolerance. This presentation summarizes some of our on-going research on developing practical husbandry approaches to improve the hypoxia tolerance of triploid salmonids. These experiments use an acute hypoxia challenge with loss of equilibrium as the endpoint, and with brook charr (*Salvelinus fontinalis*) as a model salmonid species. Triploids (3n) are always compared to sibling diploids (2n) within an experiment.

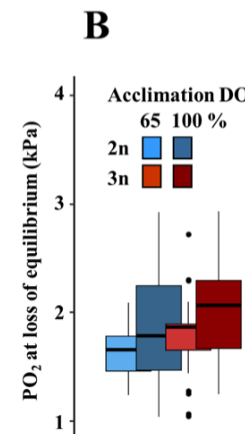
A: Acclimation to moderately elevated temperature (3°C above opt.) improves hypoxia tolerance in both ploidies; triploids are still inferior to diploids

Jensen, R.R. & T.J. Benfey. 2022. Acclimation to warmer temperature reversibly improves high-temperature hypoxia tolerance in both diploid and triploid brook charr, *Salvelinus fontinalis*. *Comp. Biochem. Physiol.* 264A: 111099.



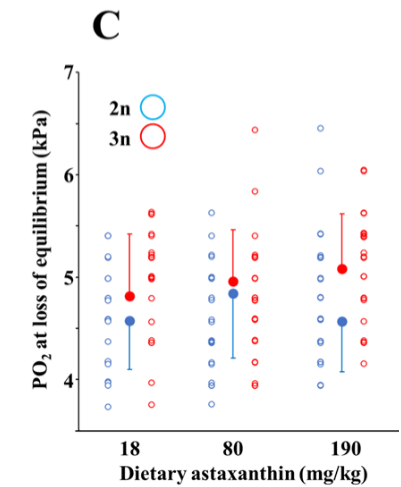
B: Acclimation to moderate hypoxia improves hypoxia tolerance in both ploidies; triploids are still inferior to diploids

McGeachy, S.A., 2022. Hypoxia tolerance of triploid brook charr, *Salvelinus fontinalis*. MSc thesis; manuscript in preparation.



C: Antioxidant supplementation does not improve hypoxia tolerance; triploids are still inferior to diploids

Baker, C.A., 2023. The effect of dietary supplementation of astaxanthin on acute hypoxia and thermal tolerance in triploid and diploid brook charr, *Salvelinus fontinalis*. MSc thesis; manuscript in preparation.



We are also investigating whether high-temperature and hypoxia tolerance of triploids can be improved through selection within family-based breeding programs that include sibling diploids and triploids within each family.

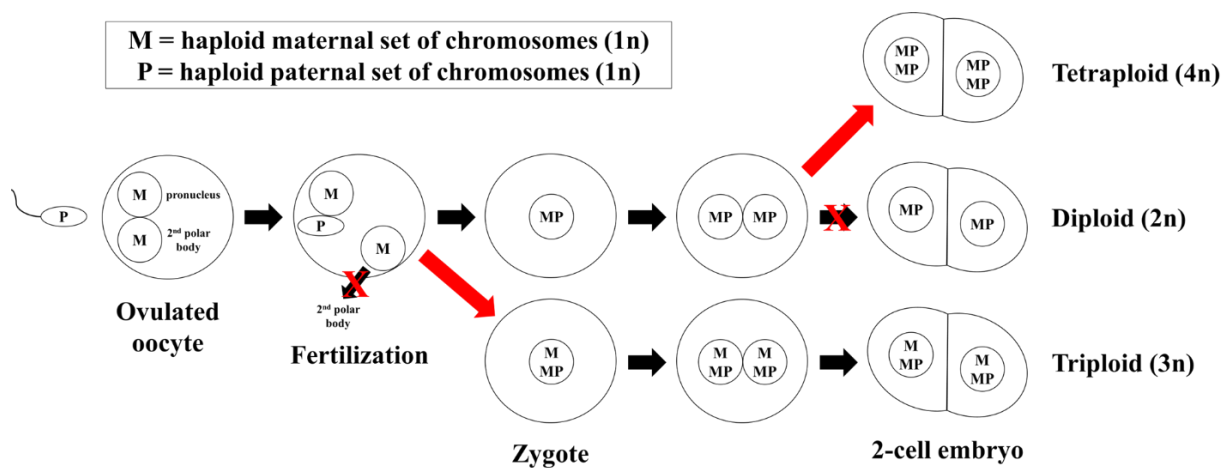
BENFEY, T.J.

AN INTRODUCTION TO TRIPLOIDS FOR THE NON-SPECIALIST

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The ‘blueprint of life’ is encoded by DNA. Most of the DNA that makes up an animal’s genome is contained within chromosomes that are located within the nucleus of every cell. Although chromosome number varies among species, they are typically found in pairs (‘homologues’), with one homologue of each pair inherited from each parent. Such animals are therefore referred to as ‘diploid’ because each nucleus contains two complete sets of homologous chromosomes, one from the mother and one from the father. Adding a third set makes the animal ‘triploid’ and generally results in sterility. Whether produced through triploidy or some other means, such sterile animals have clear advantages for aquaculture whenever reproduction affects valuable production traits (e.g., growth, appearance, meat quality, or immunocompetence) or poses risks to the environment (e.g., escapees interbreeding with wild stocks or establishing feral populations). Triploidy has been assessed for practical application in many aquaculture species, including fish, bivalve molluscs, and shrimp, but there are few examples of successful adoption for commercial production. The goal of this presentation is to set the stage for a special session on Triploids in Aquaculture by introducing the non-specialist to what triploids are and how they are produced, and by summarizing some of their pros and cons for aquaculture. Subsequent presentations in this session will then provide in-depth information on the production and use of triploid fish and bivalves in both research and industry settings.



BLANCHET, A.

EFFECT OF CARGO SHIP NOISE ON THE SHELL STRUCTURE OF BLUE MUSSELS POST LARVAE *MYTILUS EDULIS*

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It has been shown by many studies that cargo ship noise influences recruitment of bivalves' young stages such as the blue mussel. In the present work, we studied the effect of noise on the structure of the shell itself. We began the experiment by exposing pediveliger mussel larvae to cargo ship noise for 3 weeks in larvosonic mesocosms, a specialized tool for controlled sound exposure on invertebrate larvae. We used either control (123 dB), low (132 dB), medium (138 dB) or high (150 dB) sound treatment. Pediveligers were then placed in epoxy resin deposited on a microscope slide to be examined with Raman spectrometry.

The result of this analysis shows that the shell is slightly affected as the calcium carbonate's structure did not significantly differ between control and other noise treatments. The main difference was observed for shell's pigments for which significant wavenumber shift occurred between low noise and control treatments. As such difference could be explained by a greater amount of empty space in the shell structure, we plan to test this hypothesis by studying the shell structure by electron microscopy.

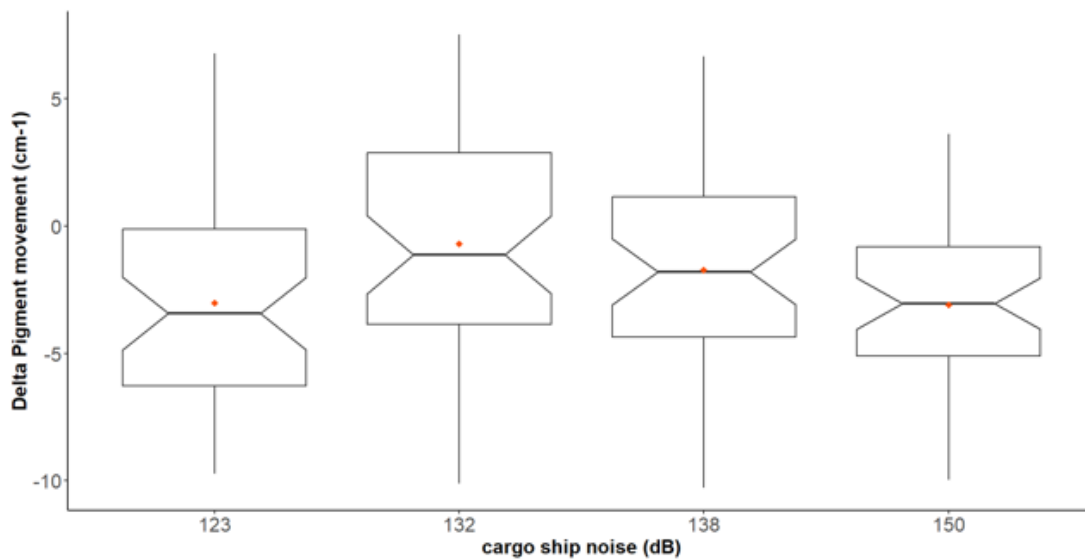


Figure 1: Boxplot graph of pigment position movement between calcite and aragonite (delta = aragonite- calcite). The red dot represents the mean pigment position movement.

BOOMAN, M.

PIVOTAL STUDY TO DETERMINE THE BIOEQUIVALENCE OF PAQ FLOR® (FLORFENICOL PREMIX) TO THE REFERENCE LABELED PRODUCT (FLORFENICOL PREMIX) WHEN ADMINISTERED IN MEDICATED FEED TO ATLANTIC SALMON *Salmo salar* L.

Marije Booman, James A. Harris, Steven V. Radecki, Richard G. Endris, Kevin Bynum, Sean Parker, Benny Shapira.

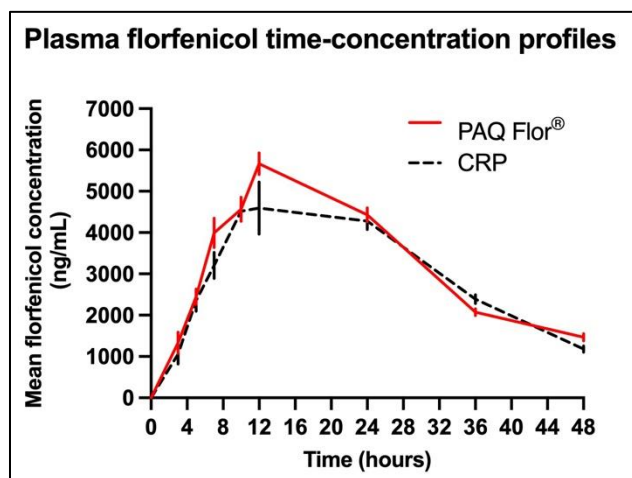
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Florfenicol is a broad-spectrum antibiotic, approved in Canada to treat furunculosis in Atlantic salmon. Phibro Animal Health Corporation has developed a generic product of a 50% florfenicol medicated premix, PAQ Flor®. This study was performed to confirm bioequivalence between the generic PAQ Flor® and the pioneer product (Canadian Reference Product or CRP), to fulfill a requirement for approval from the Veterinary Drugs Directorate for use of PAQ Flor® in Canada.

This study followed a blinded, single dose, single period, sequential study design and comprised two treatment groups of Atlantic salmon, administered either PAQ Flor® (test) or CRP (reference), at a label dose of 10 mg florfenicol/kg body weight, in medicated feed via oral gavage. Blood samples were collected at periodic intervals between 3 and 48 hours after dosing and were analyzed for plasma florfenicol content.

Comparison of the pharmacokinetic profiles of both products showed that for both primary outcome variables AUC_{last} and C_{max} , the 90% confidence intervals of the test to reference ratios were contained within the required range of 0.8-1.25.

In conclusion, this study demonstrated bioequivalence of the generic product PAQ Flor® to the CRP in Atlantic salmon, and PAQ Flor® was approved for use in Canada.



BRACELAND, M.

**A MAKING BIOCHEMISTRY CLINICAL: APPLICATION OF SERUM
BIOCHEMISTRY IN AQUACULTURE**

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Serum biochemistry is a key tool in the understanding of human and animal health. However, its implementation in fish and shellfish aquaculture has been restricted to specific cases and scientific studies. This is due to several factors, including variable pre-analytical and analytical methodologies leading to high intra and inter assay variability making clinical reference ranges difficult to implement, and a lack of validation of biomarkers. This presentation will evaluate best practices in pre-analytical and analytical phases and demonstrate the effects these have on reliability of results. For example, the effects of storage temperature, hemolysis, and chemistries will be discussed. The benefits of the implementation of this approach will also be illustrated through specific case studies from Canada and international aquaculture.

BRIDIER, G.

OVERWINTERING SURVIVAL IN JUVENILE OYSTERS: UNDERSTANDING THE ROLE OF ENERGETIC PHYSIOLOGY FOR *Crassostrea virginica* SEED

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The American oyster *Crassostrea virginica* is an economically important species, providing several million dollars to fishery and aquaculture economies every year. However, little information is available on the energetic physiology of oyster seeds during the winter period, even though this life stage represents a crucial stage determining the production of adult oysters and the economic performance of hatcheries. For two consecutive years, we monitored the energy reserves and fatty acid dynamics of *Crassostrea virginica* seeds from the fall acclimation period to the end of winter dormancy (September – May, Fig. 1). Four size classes (3, 4, 6 and 25 mm) were reared both in the hatchery under ambient conditions and in the field (control group). Results show that, in contrast to adults, oyster seeds continue to accumulate energy throughout the winter. Energy levels were also higher in 25 mm seeds, suggesting greater resistance of larger size classes to the harsh winter conditions. This study will also provide oyster producers with new knowledge to predict the overwintering success of juvenile oysters and maximize their winter survival by improving their diet in the hatchery before releasing them into the wild.

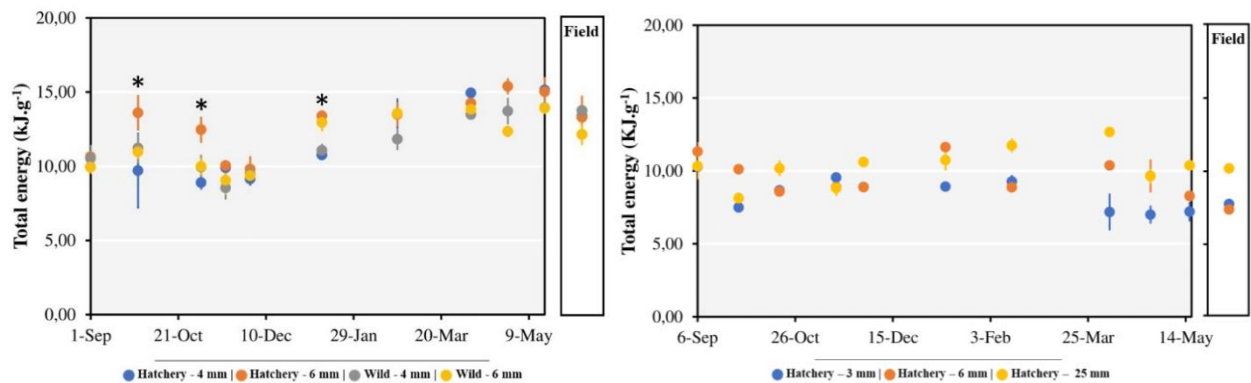


Fig. 1: Total energy content of 4- and 6-mm juvenile oysters from hatchery- (H4 and H6, respectively) and wild-origin (W4 and W6, respectively) sampled between September 2021 and May 2022 (A). Total energy content of 3-, 6- and 25-mm juvenile oysters sampled between September 2022 and May 2023 (B).

BRUCE, T.

ASSESSMENT OF COINFECTION WITH *Flavobacterium covae* AND CHANNEL CATFISH VIRUS IN FINGERLING CHANNEL CATFISH *Ictalurus punctatus*

Timothy Bruce, Amber Johnston, Allison Wise, Courtney Harrison, Brent Vuglar, Jason Abernathy, Benjamin Beck, Benjamin LaFrentz

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In U.S. channel catfish (*Ictalurus punctatus*) production, bacterial pathogens are primarily responsible for disease within production ponds. Channel catfish virus (CCV) has also played a role in production mortality and mainly impacts fry and fingerling production. In a pond-rearing environment, pathogen coinfections may increase the severity of the constituent pathogens and elevate mortality, thus potentiating economic losses for U.S. producers. A recent study assessed and characterized the effects of bacterial and viral coinfection in juvenile channel catfish. Single immersion infections of *F. covae* (ALG-00-530) and CCV (2013-CCV-DRB), alongside a mixed coinfecting treatment group, were incorporated into the experimental design.

The single virulent *F. covae* infection resulted in a total cumulative percent mortality (CPM) of $21.3 \pm 6.7\%$, while the CCV-only group was $77.0 \pm 9.2\%$. A coinfection (half-dose combination) of each pathogen demonstrated pronounced mortality ($100.0 \pm 0.0\%$) over 13 days following the initial challenge.

Trial results indicate changes in catfish mortality levels and trends from simultaneous exposure to multiple pathogens (Figure 1). Reducing disease outbreaks in catfish farming is critical to enhancing production yields and quality products, and comprehending infection dynamics of pathogens coinfections will provide more insight into targeted control measures for catfish health.

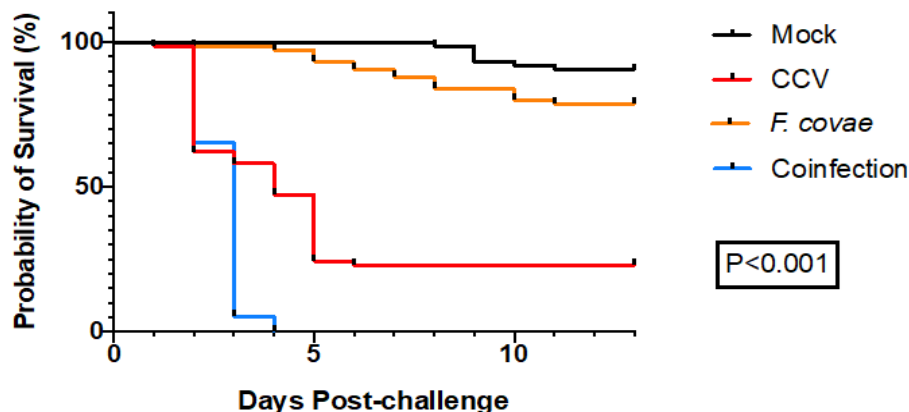


Figure 1. Kaplan-Meier survival curve of mortality from the coinfection trial

BURR, G.S.

CHARACTERIZING GENETIC X ENVIRONMENT INTERACTIONS OF ATLANTIC SALMON SELECTED FOR GROWTH IN NETPENS THROUGH EVALUATIONS IN RECIRCULATING AQUACULTURE SYSTEMS

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Growth performance of fish in any production system is affected by environment and genetics. The St. John River (SJR) strain has been selected for growth in net pens at the National Cold Water Marine Aquaculture Center (NCWMAC) for five generations while the Gaspé strain was previously selected for growth in recirculating aquaculture system (RAS) for two generations. It was previously shown the Gaspé strain outperformed the SJR strain in a RAS. With RAS Atlantic salmon facilities coming to the U.S., we wanted to know if our selected SJR strain would perform as well or better than the Gaspé strain. Staff at the NCWMAC shipped approximately 1,000 eyed eggs (2,000 eggs total) from both strains to the Conservation Fund's Freshwater Institute in Shepherdstown, WV and an additional 2,000 eggs to the Northern Aquaculture Demonstration Facility in Bayfield, WI. Eyed eggs were also maintained and grown at the NCWMAC. All studies were conducted in a RAS. Once the fish reached ~50 g/fish, they were pit tagged, weighed, and combined into 3 replicate tanks per treatment at each location until they reached approximately 4 kg/fish.

Results from the Freshwater Institute showed the SJR strain weighed 4.6 kg/fish while the Gaspé strain weighed 3.6 kg/fish at harvest. Similarly, at the Northern Aquaculture Demonstration Facility, the SJR strain weighed 4.8 kg/fish while the Gaspé strain weighed 2.6 kg/fish. SJR strain fish at the NCWMAC weighed 2.7 kg/fish while the Gaspé strain fish weighed 1.8 kg/fish at the most recent weighing. A complete profile of growth, fillet characteristics, mortality, and maturity will be presented. The results of the study clearly show the growth superiority of the SJR strain when compared to the Gaspé strain in a RAS.

BYRRO GAUTHIER, N.

UNVEILING THE IMPACT OF ANTHROPOGENIC NOISE ON BIVALVE EARLY RECRUITMENT IN TWO DISTINCT SITES

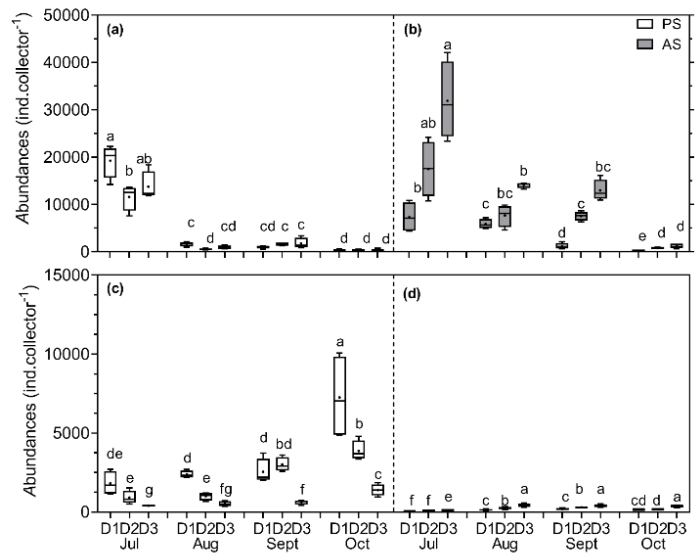
Nathália Byrro Gauthier, Thomas Uboldi, Frédéric Olivier, Réjean Tremblay, Laurent Chauvaud, Delphine Mathias, Pascal Lazure, Tarik Meziane, Gesche Winkler.

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Anthropogenic noises (i.e., vessel and pile driving noises) have been acknowledged to accelerate the settlement and metamorphosis of bivalves, which are major processes influencing the recruitment, in controlled conditions. Recently, studies have highlighted that some bivalves are more susceptible to noise, while others are more tolerant. Despite this, there is still a lack of research exploring the impact of distances from these noises on bivalve recruitment, as well as establishing an exposure criterion to prevent changes in recruitment.

For that, a comparative monitoring was conducted at two sites differing in noise pollution level - pristine and anthropized. We tested whether distances (from 25 to 890 m) from anthropogenic noise could affect the recruitment of *Hiatella arctica*, and Mytilidae using artificial collectors moored on transects. Overall, environmental conditions (except sound levels) were homogeneous through the transects. At the pristine site, vessel noise reached 132-135 dB $1\mu Pa^2.s$, while at the anthropized site (a mix of pile-driving and vessel noise exceeding $> 140 dB 1\mu Pa^2.s$), a higher level of sound.

Distinct patterns in recruitment responses to anthropogenic noise were observed among species, varying by site depending on the level of sound exposure. This is the first field study controlling anthropogenic noise emission showing evidence of shifts on bivalve population. We suggest that threshold noise level for bivalves should be below 140 dB re $1\mu Pa^2.s$ to avoid alterations in recruitment.



CAO, T.

EFFECT OF IRON LEVEL ON GENE EXPRESSION AND PROTEOME OF *Moritella viscosa*, IMPLICATIONS FOR PATHOGENESIS

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Iron is an essential element for life and play a pivotal role in bacterial pathogens. It is required for the respiratory chain and as-cofactor. Bacterial pathogens can sequester iron from the host protein, and outside of the host, like in marine environments, bacteria have to scavenge for iron sources. *Moritella viscosa* is a marine psychrophilic Gram-negative pathogen that causes winter ulcerative disease in several fish species. However, iron overload is toxic for the cells causing dysregulated oxidative response. Here, we describe for the first time the *M. viscosa* iron uptake mechanism and the regulatory network in response to iron-limited conditions. Outer membrane protein (OMPs) profiles of *M. viscosa* grown under iron-rich and iron-limited conditions revealed specific proteins related to external iron transport. Transcriptome analyses of bacteria grown under iron-limited showed differential expression in 995 genes, including those related to virulent genes such as adhesins, invasins, and iron homeostasis. Genes coding for outer membrane adhesin-like proteins, cold-active serine alkaline proteases, hemolysins, the hemin transport system, ferrous iron, TonB-dependent siderophore receptors, hydroxamate siderophore transporters and uncharacterized protein were significantly upregulated in abundance under iron limitation, along with genes related to oxidative stress. These findings provide a comprehensive analysis of the protein and transcriptional response of *M. viscosa*, enhancing our understanding of the gene regulatory network of this pathogen and revealing target genes that can aid in the development of effective therapeutic strategies against this important fish pathogen.

CHOPIN, T.

TWENTY-FOUR YEARS OF SEAWEED FARMING THROUGH THE DEVELOPMENT OF INTEGRATED MULTI-TROPHIC AQUACULTURE (IMTA)

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The Western world is finally understanding that marine macroalgae have many nutritional, health, environmental, economic and societal benefits, along with ecosystem services to offer, and cultivating them should be a good idea. This is one of the reasons for their sudden popularity. We must, however, discern social media hype from useful information, practices and action, if we want to convert this seaweed moment into a long-term seaweed momentum.

Over the last 2-3 decades, marine Integrated Multi-Trophic Aquaculture (IMTA) has been an important vehicle for raising the profile of seaweeds and their aquaculture in the western world (dominated by animal aquaculture), as its key inorganic extractive component is seaweeds.

Diversification is imperative for the aquaculture sector in Canada if it wants to develop harmoniously and responsibly with a greater societal acceptance that would allow expansion.

Current barriers to the development of seaweed aquaculture and IMTA are regulatory impediments and the acceptance of economic demonstrations, which, paradoxically, have already been made.

We need to make the Blue Economy greener, to enter the era of the Turquoise Economy, by adopting a circular economy approach through the development of IMTA systems, in which nutrients of fed aquaculture are co-products, not wastes, for additional crops provided by extractive aquaculture. Bioremediation/restoration must be envisioned through integrated coastal area management (ICAM) and not restricted to being within the limit of a fish (salmon) site.

COLLINS, B.

THE ECONOMICS OF SEAWEED FARMING IN NORTH AMERICA

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Seaweed cultivation is not new to North America. Farms have been deployed on the East and West Coasts for four decades. Seaweed-derived products as inputs for crops and animals are also decades old and have well-established markets. These markets have almost exclusively been serviced with wild-harvested seaweed. Over the past decade, there has been a push towards regenerative agriculture and aquaculture, putting cultivated seaweed in the spotlight as a target for innovation and investment. This opportunity was the impetus for the creation of Cascadia Seaweed Corp. in 2019.

Since operating its first farms in partnership with the Uchucklesaht Tribe Government, Cascadia Seaweed has grown its farming operations to include eight farms in six territories along the coast of British Columbia. In 2023 Cascadia grew 300 tonnes of seaweed from 100 km of production line.

This presentation will discuss Cascadia’s five years of experience along the value chain, from licensing and seed production to getting products into customers' hands. Particular emphasis will be placed on the cost of growing raw biomass and getting it to the processing facility. Gaps in the value chain, thoughts on future innovation and trends observed in agricultural markets will be discussed.



COLOMBO, S.

ASSESSING CONSUMER IMPLICATIONS OF REDUCED SALMON SUPPLY AND ENVIRONMENTAL IMPACT IN NORTH AMERICA

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This study investigates the impact of the Canadian government’s decision to reduce the supply of farm-raised salmon in British Columbia (BC) on domestic prices, the level of imports, and the environment. By drawing upon data from diverse sources, this study used the SARIMAX model to forecast future trends in salmon prices up to 2026. The forecasted results reveal that retail salmon prices will exhibit greater unpredictability and a predicted price increase of over CAD 30 per kilogram by 2026. In addition, increased consumption of imported salmon due to BC farm closure is expected to contribute to heightened carbon emissions and result in job losses within rural and Indigenous communities. In short, BC salmon farm closure carries profound consequences for both the environment and market dynamics.

Date	Forecasted Price	Date	Forecasted Price	Date	Forecasted Price
24 January	29.06	25 January	29.65	26 January	30.23
24 February	28.67	25 February	29.25	26 February	29.84
24 March	29.12	25 March	29.71	26 March	30.29
24 April	28.6	25 April	29.18	26 April	29.77
24 May	29.76	25 May	30.34	26 May	30.92
24 June	29.43	25 June	30.01	26 June	30.59
24 July	28.79	25 July	29.37	26 July	29.96
24 August	27.86	25 August	28.44	26 August	29.02
24 September	28.5	25 September	29.08	26 September	29.66
24 October	27.05	25 October	27.64	26 October	28.22
24 November	28.41	25 November	28.99	26 November	29.58
24 December	27.23	25 December	27.82	26 December	28.4

Figure 1. Forecasting salmon prices per kilogram from January 2024 to December 2026.

COLOMBO, S.

STRATEGIES TO SUPPLY SUFFICIENT LEVELS OF n-3 LC-PUFA TO ATLANTIC SALMON THROUGH THE DIET AND DE NOVO BIOSYNTHESIS THROUGH SELECTIVE BREEDING AND SALMON STRAIN ENHANCEMENT

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The aquaculture industry is a substantial user of wild-sourced fish oil to supply omega-3 (n-3) long-chain polyunsaturated fatty acids (LC-PUFAs) in feeds, which are required by many economically important species, particularly Atlantic salmon (*Salmo salar* L.). One potential strategy to meet the physiological requirement for n-3 LC-PUFA is to improve its biosynthesis rather than through dietary inclusion. The objective of this work is to develop strategies to ensure sufficient levels of n-3 LC-PUFA to Atlantic salmon by *de novo* biosynthesis through selective breeding and salmon strain enhancement. Two studies were conducted to investigate genetic influence on n-3 LC-PUFA synthesis and storage: (1) to determine if landlock salmon have a better capacity to synthesize and store n-3 LC-PUFA in comparison to the commercial strain, and (2) to determine phenotypic variability in n-3 LC-PUFA tissue content within a commercial population. The results showed that diet and genetics are interacting factors that determine LC-PUFA storage in tissues. Overall, these studies suggest there is a genetic basis behind the potential for selected salmon (either by strain or within a commercial population) to use fish oil-free diets more efficiently than SJR salmon, with regards to FA metabolism.

COLOMBO, S.

CONSUMER PERCEPTIONS OF THE CANADIAN SALMON SECTOR AND THEIR ASSOCIATIONS WITH BEHAVIORS: A PERSPECTIVE FROM INDIGENOUS RIGHTS

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Previous studies on consumer perceptions and behaviors of salmon have often neglected Indigenous rights within the Canadian salmon sector. This study addresses this gap by integrating Indigenous rights into the current analysis, alongside considerations of sustainability practices, socio-economic impacts, and consumer motivations. Our research objectives aim to fit three consumer perceptions—environmental sustainability, economic considerations, and Indigenous rights—and to evaluate their associations, alongside perception of a price increase, socio-demographics, and consumer motivation factors, with purchasing behaviors related to Canadian salmon products. Data was collected from a nationwide online survey and used the Graded Response Model and Cumulative Link Models. Our findings demonstrate how consumer profiles are associated with these four perceptions and their underlying determinants. Specifically, economic considerations, price increase, and origin importance demonstrate positive associations with the selection of fresh salmon and the purchase of Canadian-sourced salmon. There was also a positive correlation with the purchase of Canadian farm salmon over imports. The results of this study underscore the importance of implementing regulatory frameworks that promote sustainability, raise consumer awareness, protect Indigenous rights, ensure transparency in supply chains, and address socio-economic disparities. Efforts to support Indigenous communities and promote fair trade practices can contribute to social equity and environmental stewardship.

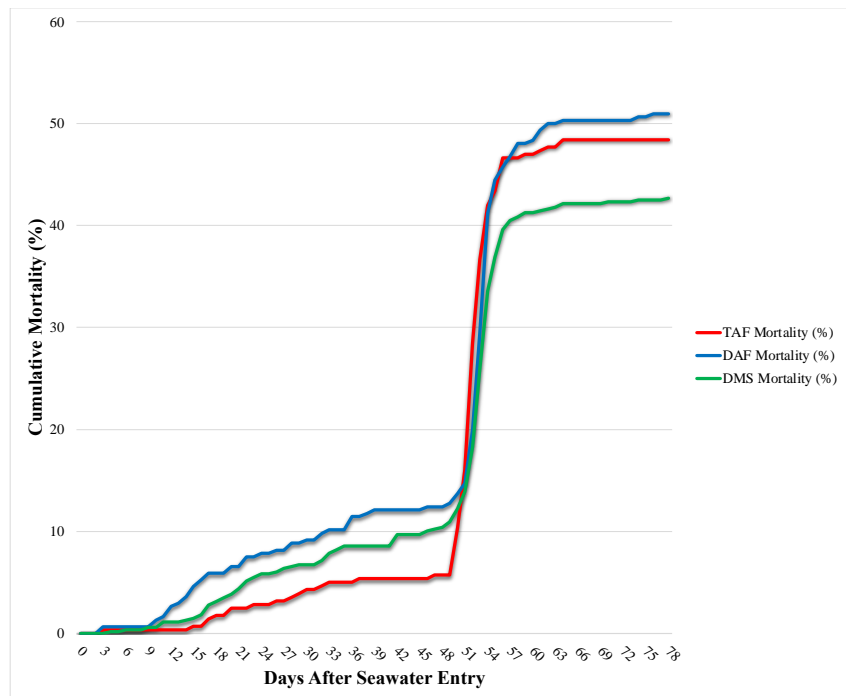
CONCANNON, A.V.

GROWTH AND SURVIVAL OF MIXED-SEX DIPLOID AND ALL-FEMALE DIPLOID AND TRIPLOID RAINBOW TROUT (*Oncorhynchus mykiss*) IN VARIABLE-TEMPERATURE SEAWATER

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This study is examining the effects of family, sex ratio, and ploidy on tolerance of rainbow trout to full strength seawater at variable temperature. Triploidy, characterized by three complete chromosome sets, renders fish sterile and offers advantages in net-pen production, but triploids often have lower thermal tolerance than diploids. Conducted at the Huntsman Marine Science Centre (Saint Andrews, NB), this experiment used similarly sized fish from 48 mixed-sex diploid families, 15 all-female diploid families, and 12 all-female triploid families, with each fish individually PIT-tagged for tracking purposes.



After a two-month freshwater acclimation period, fish were transitioned to seawater at ambient temperature (13 ± 1 °C). Temperature was then gradually increased to 21°C at one degree per day, decreased and held at 18°C for 10 days, and finally decreased at one degree per day back to ambient temperature (7 ± 1 °C). Growth was assessed at three time points: PIT-tagging, 30 days after seawater entry, and at mortality or the end of the experiment. The experimental findings revealed low levels of fish mortality after seawater entry. Mortality increased as temperature increased (see figure). Statistical analysis of growth rates and survival or mortality by ploidy and family will be discussed. This experiment seeks to evaluate the performance of sterile triploids under variable temperature conditions that may occur within marine net-pens, while also considering the potential to breed for improved performance based on family-level variations in response.

CORDERO, R.

COMPARATIVE ANALYSIS OF ZOOPLANKTON SIZE FRACTION DISTRIBUTIONS AMONG VARIOUS SHELLFISH AQUACULTURE EMBAYMENTS IN ATLANTIC AND PACIFIC CANADIAN COASTAL REGIONS

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Shellfish aquaculture contributes significantly to global food security and Canada's economy, yet it brings potential environmental challenges, particularly concerning habitat alteration. These issues highlight the necessity for sustainable practices in shellfish farming globally. In this context, zooplankton plays a dual role: as potential food for shellfish and indicator of community structure and functioning, making their study pivotal for the industry's sustainability. The Aquaculture Monitoring Program (AMP), directed by the Department of Fisheries and Oceans (DFO), aims to monitor environmental impacts by tracking changes in zooplankton community structure. This research focuses on analyzing variations in zooplankton size across different sampling events across multiple bays in Canada, examining the effects of day of sampling, location within the bay, and tidal influences. Initial results have shown size fraction variation related to the day of sampling and location within the bay, but less so with tidal changes. While conclusive patterns have not yet emerged across multiple bays, these observations establish a foundation for detecting nuanced, long-term environmental consequences. The implementation of AMP highlights the critical need for ongoing, detailed monitoring to identify and mitigate impacts on coastal habitats, ensuring the longevity and ecological responsibility of the shellfish aquaculture industry.

CORNISH, L.

INTERNATIONAL COLLABORATIONS IN THE SEAWEED INDUSTRY

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Cultivation of a select, yet relatively small group of seaweeds has been a major activity specific to East Asia for centuries. Applications primarily comprised food and medicinal usage, and feed or feed components.

By the mid-1800's the commercial value of red seaweed hydrocolloids was recognized in Europe. When Japanese agar, important for bacteriological and food applications became unavailable in 1941, global efforts to find and cultivate carrageenophytes began. Domestication of seaweeds that produced commercial quantities of the requisite phycocolloid, with the appropriate physical and chemical properties was required because wild harvesting activities threatened to drastically deplete natural sources.

Two such initiatives were championed by one of the world's leading carrageenan manufacturers at the time, Marine Colloids Inc., and by the 1970's, carrageenan-bearing seaweeds were domesticated and in mass production in Atlantic Canada, and also in S.E. Asia, both of which became very successful farming businesses.

Disruptive technologies (i.e., tropical phyconomy) eventually interfered however, and new insights and collaborations became necessary to further develop and propel the global seaweed industry forward in each of these distinctly different locations. This review highlights some of those activities, particularly in S.E. Asia.

CUNNINGHAM, J.

EXPLORING LARVAL SETTLEMENT OF THE EASTERN OYSTER *Crassostrea virginica* IN ATLANTIC CANADA

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An ongoing issue for the Nova Scotia oyster aquaculture industry is the lack of reliable seed sources, which primarily relies on collecting wild seed. This research aims to help farmers and managers optimize spat collection and plan for future scenarios by understanding and predicting the timing of settlement of the eastern oyster *Crassostrea virginica* in response to environmental drivers. The Growing Degree Day (GDD) framework is used to leverage the dominant effect of temperature on larval development and predict the timing of settlement. The model is calibrated with existing literature data and validated with field data collected from June to September 2022 across four estuaries in Nova Scotia. The validated GDD model could be implemented as a tool for farmers where the only input is temperature. Coupling the GDD model with temperature predictions from a regional climate model enables settlement predictions for three distinct timeframes: Past (1991-1995, Present (2021-2025), and Future (2051-2055). Findings suggest that rising ocean temperatures may lead to habitat expansion and earlier settlement for *C. virginica* in Atlantic Canada, however, varying changes in food resources could pose challenges for predicting settlement. Outcomes from this research reaffirm our understanding of major biological drivers such as temperature and highlight avenues for further investigation to understand challenges associated with food availability.

DITLECADET, D.

SUSCEPTIBILITY OF LUMPFISH (*Cyclopterus lumpus*) TO THE INFECTIOUS SALMON ANAEMIA VIRUS (ISAV)

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The use of lumpfish as a biological control agent of sea lice has rapidly increased in the Atlantic salmon industry, jumping from 1.7 to more than 54 million individuals in Norway between 2008 and 2017. They are currently used in some marine farms in Atlantic Canada, where they cohabitate with Atlantic salmon in cages, feeding on the parasites. The potential escape of lumpfish from sea cages is raising some concerns, notably regarding their potential role as pathogens carriers; their welfare is also a concern, as they are known to be susceptible to some pathogens found in salmon aquaculture.

The objectives of this work was to determine if lumpfish are susceptible to the infectious salmon anaemia virus (ISAV), a pathogen present in Atlantic Canada that causes a disease reportable to the world organization for animal health (WOAH), and if lumpfish could be potential transmission vectors. Results support that lumpfish are not susceptible to ISAV and are unlikely transmission vectors.

DIXON, B.

DEVELOPING QUANTITATIVE ELISAS FOR ASSESSING PROTEIN-LEVEL CHANGES OF SALMONID CYTOKINES FOR FISH HEALTH STUDIES.

Rodríguez-Ramos, Tania; Abram, Quinn H.; Rodríguez Cornejo, Tania; Heath, George; Rivera, Laura; McKenzie, Emily.; Frenette, Aaron P.; Benito-Wong, Valentina; Supinski, Rochelle; Gamperl, A. Kurt; Dixon, Brian.

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Climate change-related challenges and disease outbreaks threaten the sustainability of aquaculture in Canada. Developing quantitative protein-level assays for relevant stress and immune biomarkers is critical for assessing salmonid immune responses. We have developed antibodies and quantitative sandwich enzyme-linked immunosorbent assay (ELISA) for candidate stress and immune proteins with a focus in cytokines, signalling molecules that initiate and regulate immune responses. Recombinant proteins targets were produced in an Escherichia coli expression system using expression plasmids. Recombinant proteins were purified via immobilized metal affinity chromatography (IMAC), and further purified via size exclusion chromatography to generate mono-disperse protein samples free of contaminating bacterial proteins. Chickens and rabbits were immunized with these purified proteins to generate marker-specific polyclonal antibodies. We have validated and tested assays against Interleukin 2, Interleukin 1 β , Interferon I and Interferon γ , among others, in cell lines and fish tissues after infection and temperature challenges. There was not always a correlation between increases in gene expression and increases in protein levels. These assays will be of use to researchers, those developing vaccines or therapeutics and even fish health managers at production facilities in discovering how immune system proteins and cells are functioning in order to improve fish health and prevent economically costly losses.

DIXON, B.

IMMUNOMODULATORY AND ANTIBACTERIAL EFFECTS OF PACAP IN WHITE SHRIMP AND FISHES

Jesús Luis Betancourt, Tania Rodríguez-Ramos, Laura Rivera, James Campbell, Lowia Al-Hussinee, Tania Rodríguez-Cornejo, Daniel Eduardo Coronado-Molina, Janet Velázquez-Pérez, Yamila Carpio, Mario Pablo Estrada, Jorge Hernández-López, Laida Ramos, Eyesun Fajei, Shawna Semple, Mark Fast, Brian Dixon

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Pituitary adenylate cyclase-activating polypeptide (PACAP) is a highly conserved multifunctional neuropeptide belonging to the secretin/glucagon/vasoactive intestinal peptide superfamily. In recent years, the role of PACAP in immunoregulation has been partially elucidated in mammals and teleost fishes demonstrating that PACAP modulates both innate and acquired immune systems. Given this background, in this study, we evaluated the immunostimulant and antibacterial properties of PACAP-38 and PACAP-modified sequence(s) in fish cell lines, salmon and shrimp *L. vannamei* during infection or exposure to various bacterial pathogens. Toxicity of PACAP, direct antimicrobial activity and receptor binding was assessed. Immunological status was assessed by measuring immunological indicators, immune protein levels by ELISA and immune genes by RT-qPCR. Results showed that PACAP improves immune parameters prior to infection and fish survival after infection, with effects depending on the modification of the peptide sequence. Overall, our findings provide critical insight regarding the role of PACAP in aquaculture immunology and its potential use as an alternative to antibiotics in aquaculture.

DORAFSHAN, S.

HAEMATOLOGICAL INDICES IN DIPLOID AND TRIPLOID HYBRIDS BETWEEN FEMALE RAINBOW TROUT *Oncorhynchus mykiss* AND MALE CASPIAN TROUT *Salmo trutta caspius*

Salar Dorafshan, Mohammad Reza Kalbassi, Mohammad Pourkazemi and Bagher Mojazi Amiri

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Salmonid hybridization has been extensively studied for various purposes. However, due to genomic incompatibility, diploid hybrids often experience high mortality rates. In contrast, triploid salmonid hybrids often exhibit better viability, growth, and survival rates. The Caspian trout, *Salmo trutta caspius*, attains the largest size among all brown trout subspecies and predominantly inhabits the Caspian Sea, particularly Iranian waters.

For hybrid production, eggs freshly stripped from five female rainbow trout were mixed with fresh semen from five male Caspian trout and activated. Triploidy was induced in half of the egg batch through a 10-minute heat shock at 28°C, beginning 10 minutes post-fertilization. Subsequently, the eggs were maintained at 9-10°C until reaching the fry stage. The ploidy status was confirmed through blood smears and flow cytometry.

Haematological characteristics, including red blood cell (RBC) linear dimensions, surface area, and volume, RBC and white blood cell (WBC) counts, haematocrit (Hct), hemoglobin (Hb) levels, and RBC abnormalities, were measured in 10 diploid and 15 triploid hybrids.

All morphometric indices were significantly larger in the RBCs of triploid hybrids compared to diploids. Triploid hybrids also

had lower RBC count, Hct, and Hb levels, and higher WBC counts, than diploids (Table 1), and also exhibited increased erythrocytic abnormalities, such as pinched cells, compared to diploids (Fig. 1).

Table 1. Haematological parameters in diploid and triploid hybrids between female rainbow trout and male Caspian trout (mean \pm standard deviation).

Parameters	Diploid Hybrids	Triploid Hybrids
RBC (cell/mm ³)	901666 \pm 8000 ^a	676428 \pm 44000 ^b
WBC (cell/mm ³)	5250 \pm 112 ^a	7750 \pm 764 ^b
Hct (%)	38.11 \pm 0.52 ^a	32.65 \pm 1.83 ^b
Hb (g/dL)	8.45 \pm 0.07 ^a	6.93 \pm 0.41 ^b

Significant differences between two groups (*t*-test, *p*<0.05).

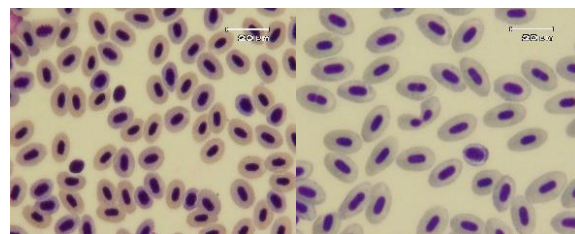


Fig. 1. Blood smears of the diploid (left) and triploid (right) hybrids between female rainbow trout and male Caspian trout. Note the larger size and presence of abnormalities in triploid hybrids.

All the assessed haematological indices were influenced by ploidy level. Therefore, it is expected that optimal culture conditions will differ between diploid and triploid hybrids, potentially affecting the aquaculture potential of these fish.

DUCHESNE, E.

METABOLOMIC RESPONSE OF TRIPLOID *Mytilus edulis* FAMILIES TO HEATWAVES

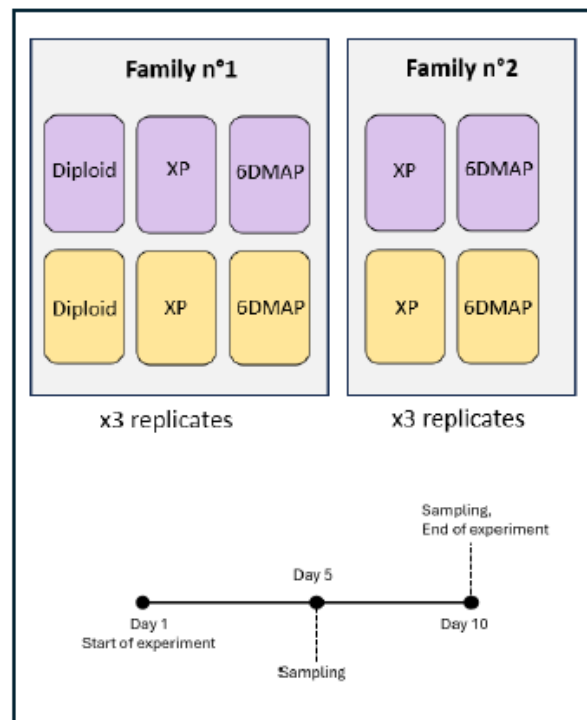
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The aquaculture industry is increasingly exploring triploid mussels (*Mytilus edulis*) due to their potential for enhanced growth efficiency. Triploidy disrupts gonadal development, potentially redirecting energy towards somatic growth. However, triploid tolerance to environmental stressors, like heatwaves, remains unclear. Understanding their response to such events is crucial as heatwaves are becoming longer and more frequent with climate change. This study compares the metabolomic response of diploid and triploid *Mytilus edulis* families to heatwave conditions.

Different mussel families were produced using two triploidy induction methods (chemical: 6DMAP or pressure shock: XP) alongside diploid controls. Individuals were exposed to two temperature scenarios reflecting control and heatwave conditions experienced at Prince Edward Island mussel farms. Liquid chromatography-tandem mass spectrometry (LC-MS/MS) is being used to analyze metabolite profiles related to mortality and oxygen consumption rates determined in each group of mussels.

These data will be integrated with transcriptomic analyses from a separate project to identify genes associated with thermal tolerance and elucidate the metabolic pathways involved in the response.



DUGLAS, S.

COMPARISON OF EARLY INFECTION AND EARLY IMMUNE RESPONSE OF ATLANTIC SALMON PRIMARY MACROPHAGES AGAINST *Vibrio Anguillarum* O1 & O2 SEROVARS.

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Vibrio anguillarum is one of the well-known marine pathogens in aquaculture and causes vibriosis in various fish and invertebrate species. The early cellular infection process and its host immune response remain unclear. This study performed an infection assay and RNA sequencing analysis to identify relevant genes in Atlantic salmon primary macrophages in response to early *V. anguillarum* serovar O1 and O2 infection. Samples were taken after 1 h post-infection (hpi) and 2 hpi, mimicking early cellular infection.

Gene ontology (GO) analysis enriched pathways related to Toll-like receptor signaling and RIG-I-like receptor signaling at 1 hpi and Cytosolic DNA-sensing and C-type lectin receptor signaling were enriched at 2 hpi with serovar O1. In contrast, cells infected with O2 server Biosynthesis of unsaturated fatty acids, Fatty acid elongation, IL-17 signaling were enriched at 1 hpi, and at 2 hpi Toll-like receptor signaling was additionally enriched compare with O1. *V. anguillarum* is an extracellular pathogen. *V. anguillarum* O1 and O2 elicit distinct cellular immune responses, indicating differing mechanisms of interaction with macrophages, perhaps driven by the lipolysaccharide O-antigens.

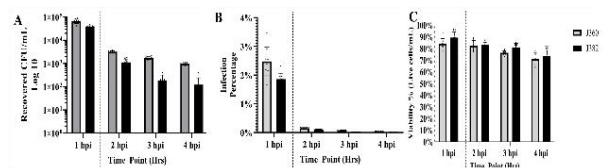


Fig 1. (A) Recovered Colony Forming Units, (B) Infection Percentage of Macrophage, (C) Cell Viability percentage of Macrophage cell infection of O1 & O2 at 15°C at 1 hpi and 2 hpi

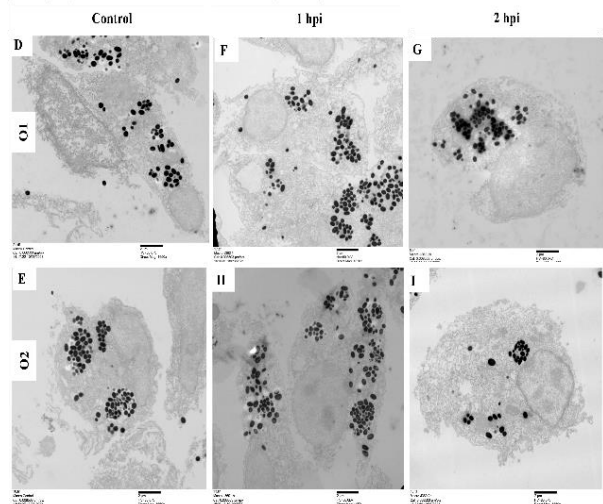


Fig 2. TEM imaging of (D) Macrophage Cell Non-Infected; (E) Macrophage Cell Non-Infected Treated with Gentamycin; (F) infection of O1 at 1 hpi; (G) infection of O1 at 2 hpi; (H) infection of O2 at 1 hpi; (I) infection of O2 at 2 hpi; at 15°C at the Magnification of 1,650X

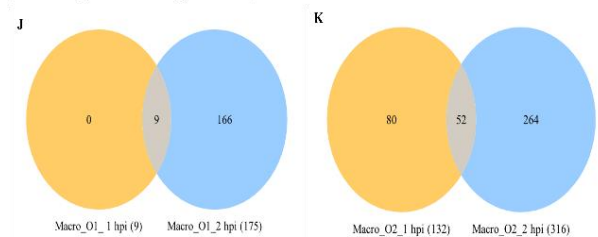


Fig 3. Comparison of DEGs of Atlantic salmon primary macrophages cells infected with *V. anguillarum*. (J) DEGs of primary macrophages infected with *V. anguillarum* O1 at 1 and 2 hpi; (K) DEGs of primary macrophages infected with *V. anguillarum* O2 at 1 and 2 hpi at 15°C.

DUNLOP, M.J.

TOWARDS THE UTILIZATION OF INVASIVE TUNICATES AS A RESOURCE

Matthew J. Dunlop, Ian Lucas

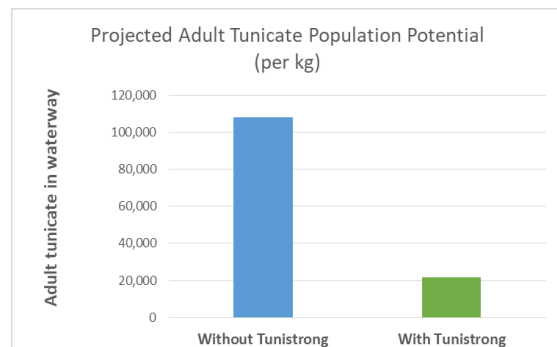
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Tunistrong Technologies is a forward thinking Prince Edward Island (PEI) based sustainable biotechnology company dedicated to the valorization of Tunicates, an invasive marine animal which causes significant challenges for aquaculture on PEI and around the globe. The challenges Tunicates create in PEI are immense, worsening as the climate warms, and leading to increased costs and decreased productivity for many members of our aquaculture community. One of the hardest hit areas is the blue mussel industry, which is a major source of employment for Islanders and a significant part of the islands blue economy.



Tunicates are poised to overwhelm mitigation and containment procedures designed to limit their spread and lessen negative impacts associated with tunicates, necessitating a new approach to safeguard local aquaculture and 80% of Canadas blue mussel industry from this invasive species.

Tunistrong is paving the way for this new approach, by developing a scalable biorefinery which utilizes tunicates as an input and outputs various unique value added products. By turning waste into a resource Tunistrong is laying groundwork for new aquaculture industry while directly addressing the challenges invasive tunicates cause to our aquaculture industries.



ESLAMLOO, K.

CHALLENGES POSED BY *Vibrio parahaemolyticus* TO CANADIAN OYSTER AQUACULTURE

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A major challenge affecting oyster aquaculture in Atlantic Canada is *Vibrio parahaemolyticus* (Vp). This bacterium is prevalently found in marine environments and may cause food poisoning in humans through raw consumption of Vp-containing seafood, such as raw oysters. In recent years, the oyster aquaculture sector has experienced significant losses due to increased incidents of ‘regulatory non-compliance’, for Vp levels in accordance with Health Canada regulations. Vp load in coastal waters and consequently, oyster samples, are predicted to increase over the next decades, due to increasing ocean temperatures. We conducted a preliminary survey to evaluate Vp impacts on oyster production and develop mitigatory strategies to minimize industry impacts. There are various culture- and molecular-based methods developed for Vp detection and enumeration. However, more rapid, and precise analytical approaches can improve Vp quantification performance to better support consumer safety. Given that only a small subset of Vp strains are pathogenic to humans and their prevalence is temperature-dependent, implementing extensive monitoring programs on the prevalence of different Vp strains associated with environmental factors may help mitigate Vp-driven risks. Further, development of temperature models for coastlines along the Canadian Atlantic Ocean could facilitate more effective management of Vp for oyster aquaculture in the coming year

FARQUHARSON, S.

GENDER-BASED OPPORTUNITIES AND CHALLENGES IN SALMONID FARMING IN ATLANTIC CANADA

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In October 2022, ACFFA released: Gender-Based Opportunities and Challenges in Salmonid Farming in Atlantic Canada, the first study of its kind to look at gender equity throughout Atlantic Canada’s salmon farming value chain.

The report focuses on assessing gender-based employment issues within the salmonid farming and related industries in Atlantic Canada and BC, based mainly on Census data and Statistics Canada labour force datasets, as well as direct input from companies across the salmonid farming value chain in Atlantic Canada. The report includes comparisons to other regions and industries where possible. Key measures examined include gender balance in employment, pay equity, as well as equity in advancement and training opportunities.

	NL		NS		NB		Atlantic Canada		BC		Canada		
	2011	2016	2011	2016	2011	2016	2011	2016	2011	2016	2011	2016	
Farmed Salmonid Production	Female	98	79	31	70	177	260	305	409	384	351	882	992
	Male	270	238	227	201	554	589	1,052	1,027	1,114	1,254	2,586	2,900
	Total	368	317	258	271	731	849	1,357	1,436	1,499	1,604	3,468	3,892
	Gender ratio	0.36	0.37	0.13	0.35	0.32	0.44	0.29	0.41	0.34	0.28	0.34	0.34
Processing	Female	133	223	25	39	375	626	533	888	402	441	1,193	1,544
	Male	172	273	46	71	359	365	577	708	521	527	1,458	1,972
	Total	305	496	71	110	734	991	1,110	1,597	923	968	2,650	3,515
	Gender ratio	0.77	0.82	0.55	0.56	1.05	1.72	0.92	1.25	0.77	0.84	0.82	0.78
Total Production and Processing	Female	230	302	56	109	552	886	838	1,297	786	792	2,074	2,535
	Male	443	511	273	271	913	954	1,628	1,736	1,636	1,780	4,044	4,872
	Total	673	813	328	381	1,465	1,840	2,467	3,033	2,422	2,572	6,118	7,407
	Gender ratio	0.52	0.59	0.20	0.40	0.60	0.93	0.51	0.75	0.48	0.44	0.51	0.52

Source: Statistics Canada, 2016 Census of Population, Catalogue no. 98-400-X2016290 and 2011 Census of Population, Catalogue no. 99-012-

Numbers in Nova Scotia and New Brunswick show some improvement in that more females entered the industry between 2011 and 2016. In New Brunswick in 2011, the gender employment ratio was 0.32. In New Brunswick in 2016

Table 4: Average Incomes and Gender Pay Ratios (2016)

	Atlantic Canada			BC			Canada		
	Males	Females	Gender Ratio	Males	Females	Gender Ratio	Males	Females	Gender Ratio
Farmed Salmonid Value Chain									
Salmonid farming*	\$42,473	\$33,552	0.79	\$51,965	\$38,559	0.74	\$44,048	\$33,019	0.75
Processing	\$31,307	\$17,300	0.55	\$39,975	\$27,778	0.69	\$31,289	\$18,931	0.61
Feed	\$40,156	\$35,617	0.89	\$50,874	\$36,184	0.71	\$59,362	\$40,527	0.68
Transportation and storage	\$51,859	\$37,888	0.73	\$59,159	\$43,765	0.74	\$52,531	\$42,146	0.80
Professional services	\$44,037	\$31,949	0.73	\$47,987	\$31,244	0.65	\$50,506	\$34,195	0.68

FILGUEIRA, R.

ADVANCING KNOWLEDGE ON FACTORS AFFECTING SOCIETALLY-ENDORSED SUSTAINABLE AQUACULTURE

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Despite its role as a key socio-economic driver, aquaculture can be a controversial topic with public opposition and conflicts challenging the sustainability of the sector. From a societal perspective, the seemingly intractable challenge centres around gaining acceptance of aquaculture as a complementary valued activity along with other more established uses of the coastal and marine environment. As a result, a deeper understanding of public perceptions and multi-scalar factors influencing opinions becomes critical for developing sustainable and socially acceptable aquaculture. In this presentation, we discuss the findings from a seven-year research project (www.coastalfutures.ca) focused on gaining a better understanding of societal needs for the sector in a manner that potentially contributes to global opportunities for aquaculture to be realized. Organized around five sub-modules, we focus our interdisciplinary expertise on acquiring knowledge on perceptions of social licence and how these may be influenced by occupational health and safety, aquaculture-community dynamics, socio-ecological finfish carrying capacity and the role of communities in marine spatial planning. Our path-breaking approach to aquaculture development – which requires both scientific excellence and social responsibility – highlight a range of factors and linkages that need to be integrated if companies, regulators, communities and other stakeholders are to better understand how societally-endorsed sustainable aquaculture may be achieved.

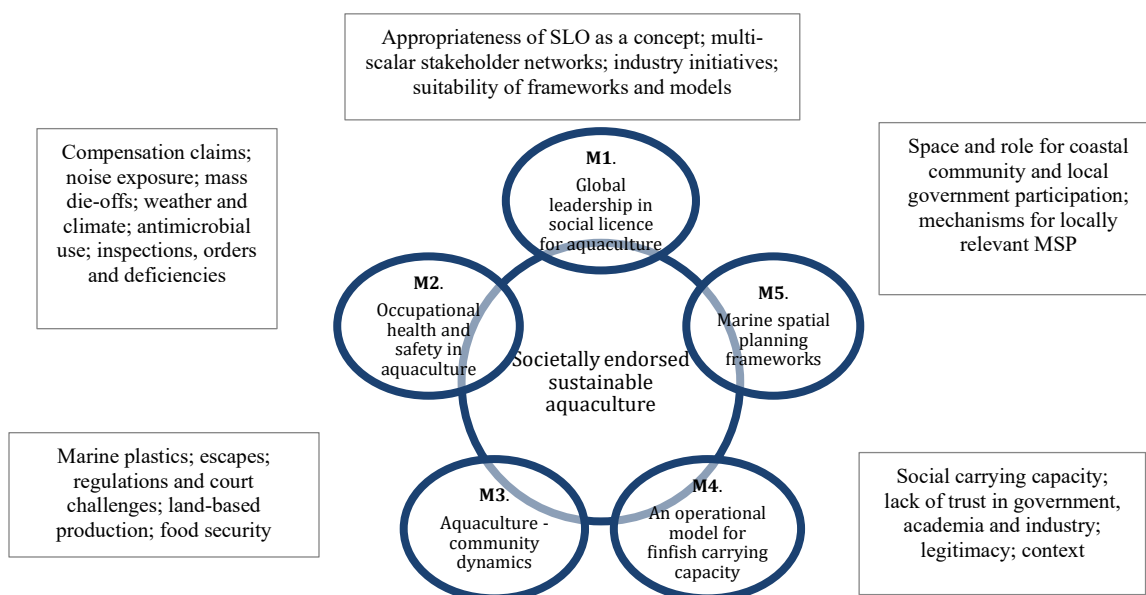


Figure 1: A societally-endorsed sustainable aquaculture research framework

FOWLIE, W.

AN INTRODUCTION TO THE WE'KOQMA'Q FIRST NATION TROUT FARM

Wayne Fowlie

We'koqma'q First Nation (the "Band" or "We'koqma'q") is a small and thriving Mi'kmaw community of approximately 1,100 Members based in Whycocomagh, Nova Scotia. The community has a state-of-the art school and health center, as well as private businesses that cater to Cape Breton Island tourists and residents, creating a vibrant cultural environment. The Band's focus is on driving revenues for the purpose of investing into the Community's social programming. Along with We'koqma'q's ventures noted, they are also continuing to expand and grow their commercial aquaculture operations – WFN Fish Farm Limited Partnership.

In 2016 the Band invested in a trout farm and by 2017 produced approximately 80,000 trout of 2 Kg size. In 2018, the Band purchased a trout hatchery (Big Falls Trout Hatchery) located in Wolfville and had made the necessary investment in an existing building in Aberdeen to repurpose it into a processing facility. By 2019 and after further upgrades to the processing facility and the hiring of a full time sales / marketing expert, the company had become fully vertically integrated and was producing and, selling direct to market, approximately 500,000 fish annually.

FRASER, T.

THE GROWTH AND PHYSIOLOGY OF TRIPLOID POST-SMOLTS REARED FOR 140 DAYS IN ONE OF EIGHT TEMPERATURES RANGING FROM 3.0 TO 20.5°C

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Triploid Atlantic salmon are sterile, which can be beneficial for aquaculture. However, they have different environmental optima to regular diploid salmon. To assess this, 260g diploid and triploid post-smolts were reared on constant light and one of eight temperatures, ranging from 3.0 to 20.5°C in 2.5°C increments, for 140 days. We assessed growth, sexual maturation, cataracts, and blood and plasma parameters associated with osmoregulation and metabolic traits. Triploids had more cataracts than diploids, with those at 20.5°C being terminated early due to their severity. No triploid females showed signs of ovarian development, but male and female diploids, and triploid males, showed a positive increase in the prevalence of gonad development (puberty) with temperature (Figure 1). In both ploidy, growth over the entire trial period was greatest at 10.5°C, where immature fish reached an average weight of 1.2kg. There was no ploidy effect on growth at any temperature in immature fish. Blood and plasma variables were influenced by temperature and ploidy. Most notably, ploidy effects on haematocrit, haemoglobin, and lactate suggested minor alterations in metabolic traits.

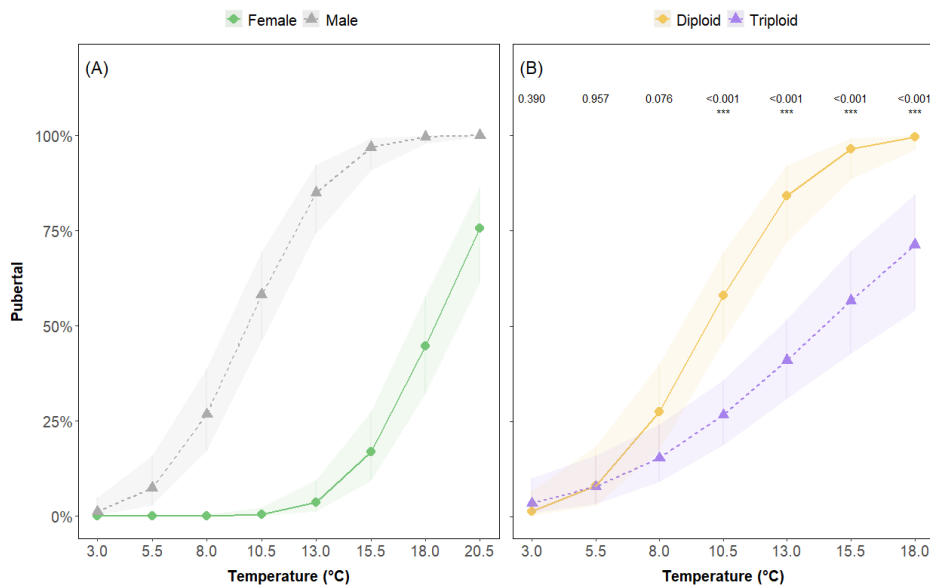


Figure 1. Pubertal prevalence in (A) diploids and (B) males in relation to temperature. The values in (B) are p-values comparing ploidy effects within temperature.

FRASER, T.

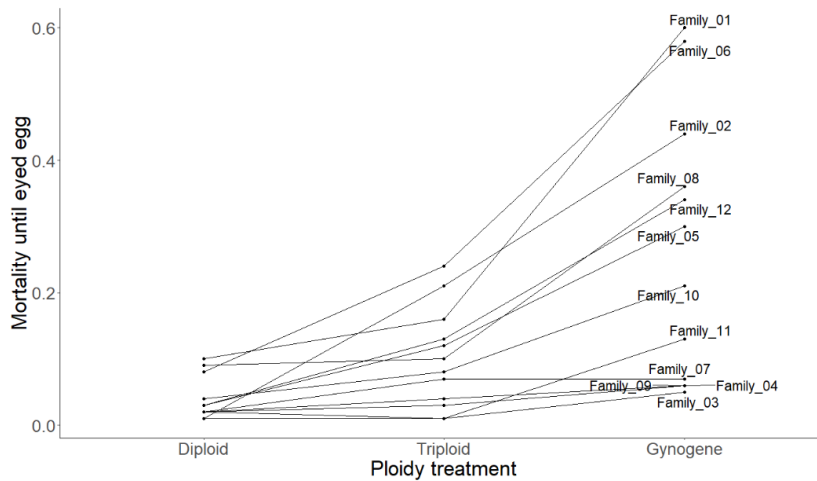
THE INFLUENCE OF INBREEDING AND ABERRANT INHERITANCE ON WELFARE IN TRIPLOID ATLANTIC SALMON *Salmo salar*

Thomas Fraser, Aurélien N. Delaval, Kevin A. Glover, Monica F. Solberg, Per Gunnar Fjelldal, Tom J. Hansen, Francois Besnier, Lars H. Stien, Florence Phocas, Edwige Quillet, Alison C. Harvey

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Triploid Atlantic salmon are the most cost-effective and consumer-accepted way of producing sterile salmon to limit genetic interactions with wild salmon. However, the industry has been faced with performance and welfare issues. Triploid-specific production protocols can mitigate some of

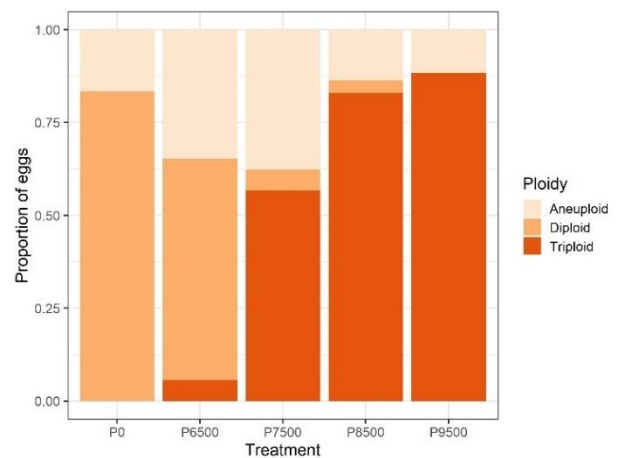


the challenges, but there are still knowledge gaps.

Triploids have two copies of maternal DNA, and we hypothesise that an inbreeding effect from the double genetic load from the dam may contribute to the poorer welfare and performance observed in triploids. To investigate this, we followed growth, survival (left figure), and welfare of 12 half-sib families of triploids, diploids and gynogenetic

(containing only maternal DNA) salmon through a full production cycle. The results will be linked to the maternal genetic variation to investigate the merit of establishing triploid-specific breeding lines. Another possibility is that failure in the pressure shock treatment may lead to unwanted errors in the chromosomes (right figure) causing poor welfare and performance. To pursue this, salmon eggs were subjected different hydrostatic pressures and followed through a full production cycle. Diploids served as controls. Parent to offspring inheritance patterns were investigated to quantify the nature and incidence of errors arising from the induction technique.

Our findings could be useful for commercial breeding programs and triploid salmon producers.



FRÉCHETTE, M.

THE DUCKSHIELD: A PASSIVE ANTI-PREDATION DEVICE FOR LONGLINE-GROWN MUSSELS

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Predation by sea ducks is a threat to longline mussel culture in many sites. We tested semi-rigid hemicylindrical mesh pieces (“duckshields”) as physical barriers to ducks attempting to access mussel ropes.

Collectors were immersed in July 2020 and duckshields were installed on the collectors in October 2021. The assay was monitored on four occasions. In May 2022, mussels on unprotected rope had been decimated, while survivorship on protected rope was 50% and higher. At the end of the assay, controls indicated that ducks were active at predating on mussels and that the collectors had not touched the bottom. Mean biomass of commercial-size mussels on protected rope was twice as high (roughly 4.0 Kg/30.5 cm) as found in a 2003-2007 reference study (roughly 2.2 Kg/30.5 cm), when duck predation was deemed negligible.

B-N curves (Fig. 1) showed that total biomass (B) was twice as high with duckshields than in the 2003-2007 reference study, irrespective of variability in mussel abundance (N). Presumably duckshields provided extra attachment substrate for mussels that otherwise would have fallen from the ropes. Therefore duckshields appear potentially useful both as a protective device and as a means of doubling yield in sites free of duck predation.

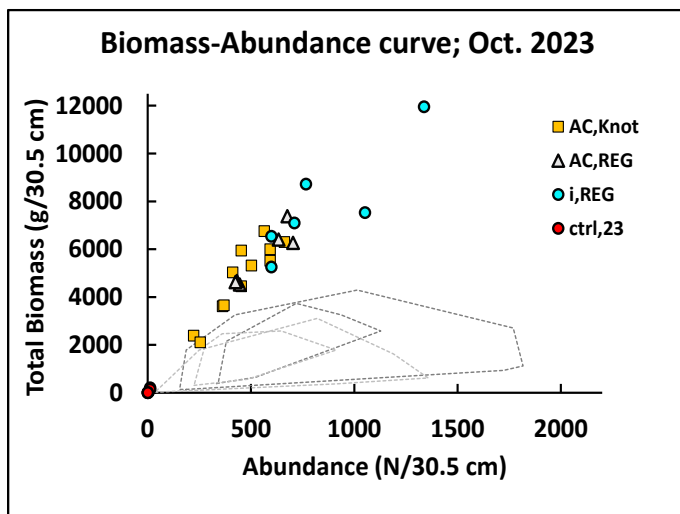


Figure 1. Relationship between total biomass and mussel abundance in October 2023. Squares: knotted rope; triangles: regular, unknotted rope; both groups were tied on the longline in an inverted V configuration; turquoise circles: unknotted rope tied in a vertical configuration; red circles: unprotected control rope. The four dotted polygons are the envelopes of B-N data found in the 2003-2007 reference study. For a given abundance level, all protected treatments yielded twice as much biomass as in the reference study. All controls clumped near the origin.

FRENETTE, C-L.

FACILITATING GLOBAL TALENT ACCESS: THE ROLE OF CANADA'S GLOBAL SKILLS STRATEGY

Cindy-Lynn Frenette

Dedicated Service Channel, Immigration, Refugees and Citizenship Canada, Government of Canada

<https://www.canada.ca/en/immigration-refugees-citizenship/promotion@cic.gc.ca>

In the dynamic global marketplace, Canadian firms recognize the crucial need to access skilled workers from diverse backgrounds. Immigration programs are central to this effort, playing a pivotal role in driving economic growth and innovation. Canada stands out as a leader in economic immigration, thanks to responsive programs tailored to businesses' evolving needs.

A prime example of Canada's commitment is the Global Skills Strategy (GSS), designed to align with the Government of Canada's Innovation and Skills Plan. The GSS attracts skilled professionals, offering streamlined processes with expedited application processing times, work permit exemptions, and improved customer service. Co-led by Immigration, Refugees and Citizenship Canada (IRCC) and Employment and Social Development Canada (ESDC), the strategy embodies collaboration to meet labor market demands.

Leveraging global talent, the GSS fuels innovative enterprise growth and creates employment opportunities for Canadians. This session delves into the pivotal Four Pillars of Canada's Global Skills Strategy, focusing on seamlessly integrating skilled professionals into the Canadian workforce to drive economic prosperity and global competitiveness.

ORAL PRESENTATION

FU, T.

FEED FOR THOUGHT- NOURISHING DIVERSITY IN SKRETTING CULTURE

Tahi Fu

Skretting, North America

www.skretting.com

This presentation will offer an overview of Skretting North America's changing workforce. In recognizing the pivotal role of diversity in fostering innovation and organizational success, SKNA has undergone a transformative shift in its workforce dynamics. Past challenges such as an aging staff, high turnover rates, and difficulty in finding local talent for aquaculture have given way to a more diverse and resilient company culture. Through innovative hiring practices, including recruiting foreign students, accommodating applicants seeking to relocate to Canada, and tapping into expertise from aquaculture hubs globally, SKNA has embraced diversity organically. While navigating common recruitment challenges, such as visa processes and broadening talent pools, SKNA's experience underscores the value of open-minded hiring, targeting new graduates, and leveraging regional expertise. This presentation encourages industry peers to adopt similar strategies, emphasizing the importance of diversity in driving organizational success and resilience.

GALLARDI, D.

BLUE MUSSEL ECOLOGICAL CARRYING CAPACITY IN NEWFOUNDLAND: UPDATES ON MODEL DEVELOPMENT AND DATA USE

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Newfoundland is a significant producer of cultured blue mussel (*Mytilus edulis*) in Canada, with the majority of the sites located in Notre Dame Bay. To ensure sustainability of mussel aquaculture and to support new sites application and expansion, there is a need to evaluate ecological carrying capacity (density of a cultured organism above which unacceptable ecosystem effects are shown). Up to date no studies have evaluated carrying capacity in Newfoundland and Labrador. This study builds on existing models and interregional collaborations, and aims to inform siting decisions and to address knowledge gaps in understanding cultured bivalve environmental impact.

Three stations in South Arm (Notre Dame Bay, NL), a site with active mussel culture, were sampled monthly from June 2021 to July 2022 for physical, chemical and biological water parameters; blue mussels from the aquaculture site were sampled for growth and condition; two oceanographic moorings were placed at two of the three stations for a full year. Current state of carrying capacity model development and validation will be discussed, together with other relevant employments of the data collected.

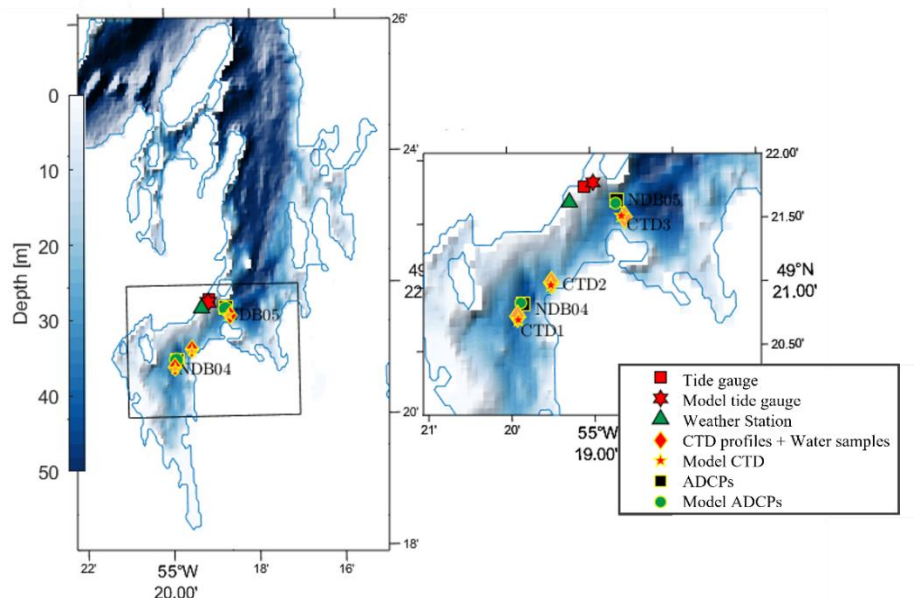


Figure: Map of South Arm, Notre Dame Bay, Newfoundland and Labrador; shapes represent sampling stations and model reference points.

GARDNER, I.

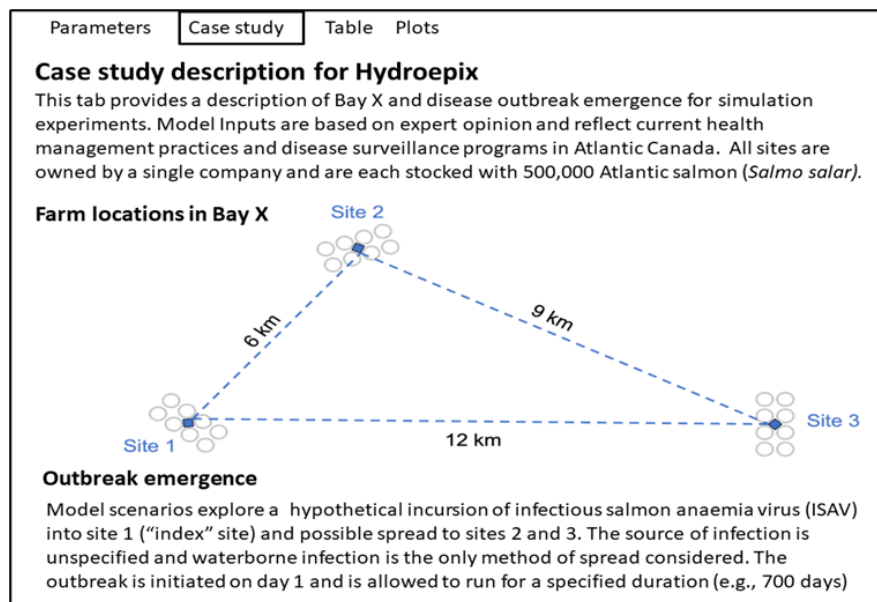
HYDROEPIX: A WATERBORNE TRANSMISSION MODEL FOR INFECTIOUS DISEASES OF FARMED AQUATIC ANIMALS

João F. Romero, Ian Gardner

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HYDROEPIX models waterborne spread of pathogens within and between net-pens in the same site, and to nearby farms. Effects of interventions such as vaccination, surveillance, early detection and depopulation can be evaluated. As part of the Farming in Natural Systems (FINS) carrying capacity project, we created a graphical-user-interface for HYDROEPIX using the R package “Shiny” to allow users without programming experience to easily adjust parameter values to compare different disease outbreak and mitigation scenarios for a predefined location. The user-interface includes reference documentation and has multiple tabs, including a simulation control tab with sliders to set parameter values. Model inputs are based on Nova Scotia data and documentation, and peer-reviewed references. Inputs are considered to be representative of provincial fish health surveillance programs and health management procedures used by salmon aquaculture companies in Atlantic Canada.

An example of a simulation run for infectious salmon anaemia virus infection in Atlantic salmon in a hypothetical bay in Nova Scotia is used to demonstrate how the user-interface works and types of outputs that can be compared. Future modifications will allow users to upload site-specific input parameters instead of using default parameters described in the case-study.



GILBERT, D.

WATER PHYSICOCHEMICAL PARAMETERS FOLLOWING OZONE DOSING FOR RECIRCULATING AQUATIC SYSTEM OF LAND BASED TROUT FARM

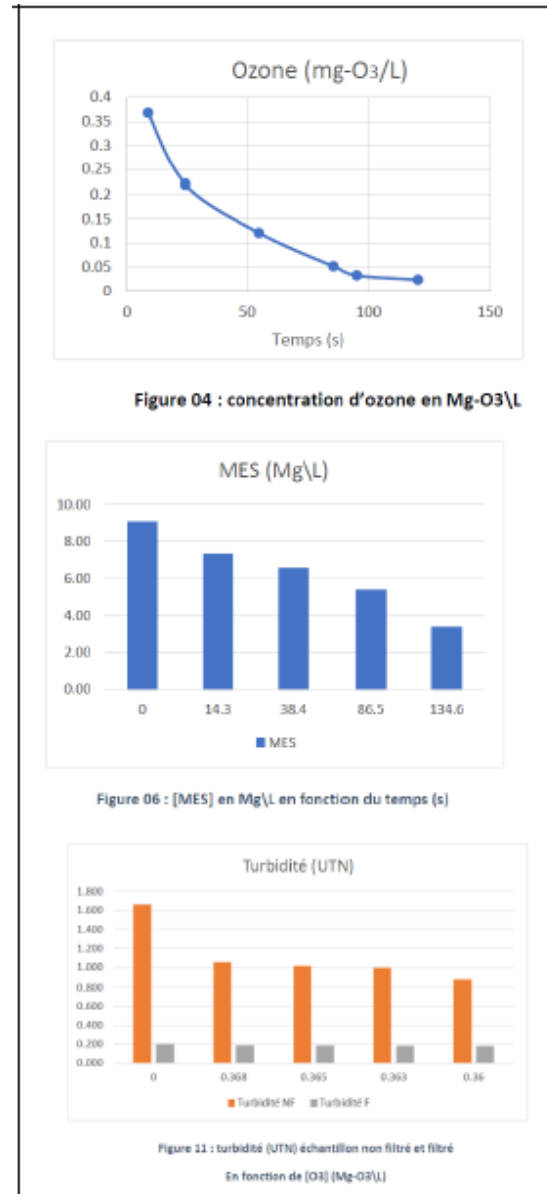
Dave Gilbert, Dominic Marcotte, Robert Hausler., Brigitte Martel

EMO3

This use of ozone in RAS (recirculating aquatic systems) is gaining more interest for farmers however studies analysing the quantitative results related to the water quality parameters are limited. In this presentation, the author will present the physicochemical water parameters following the injection of ozone in side-stream in an actual RAS brook trout (*Salvelinus fontinalis*) fish farm.

Following several outbreaks of lice that were affecting the growth and yield of trout production, the owners in collaboration with MAPAQ and ETS conducted a pilot project in which ozone was dosed in a portion of the recirculated water. The ozonated water maintained a certain contact time before being reintroduced in the main body of the RAS basin. Several sampling ports were installed in order to verify water physicochemical parameters such as total suspended solids (TSS), turbidity, pH, ORP, dissolved ozone, alkalinity and chemical oxygen demand (COD). In addition, the study gathered the yield production as well as pathogens species notably *Trichodina* and *Furunculosis*.

The side stream flow injection, contact time and low ozone dose proved to provide interesting water physicochemical parameter improvements. In addition, the need for use of formaldehyde to control *Trichodina* and *Furunculosis* was eliminated resulting in increased production yield. This presentation will present the results of the study.



GILLIS, M.

**CULTIVATING INCLUSIVE WORK ENVIRONMENTS IN AQUACULTURE:
PRIORITIZING SAFETY AND ACCEPTANCE FOR DIVERSE TEAMS**

Myrna Gillis

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In the realm of aquaculture, the quest for sustainable practices and innovation is inseparable from the imperative to foster inclusive work environments that embrace diversity. Central to discourse is the acknowledgement that inclusivity extends beyond representation to encompass the nurturing of a workplace culture that values diverse perspectives and experiences. Embracing a variety of voices within the organization and building trust within an organization for Team Members to feel free to be themselves.

Key themes explored include the role of leadership in championing inclusivity, the implementation of equitable policies and practices, and the promotion of open communication to address systemic barriers and biases within aquaculture settings. By prioritizing safety and fostering a sense of belonging, aquaculture organizations can harness the collective talents and insights of their workforce to drive sustainable growth and competitiveness in the industry.

In conclusion, this opportunity serves as a conversation point for the aquaculture industry, sharing actionable strategies to create inclusive work environments that empower all individuals to thrive and contribute to the advancement of sustainable aquaculture practices. Through deliberate efforts to cultivate inclusivity, the aquaculture industry can pave the way for a more equitable and prosperous future, where diversity is celebrated as a cornerstone of success.

HEESE, B.

**ANTIMICROBIAL RESISTANCE MONITORING OF FLORFENICOL ON BC
Tenacibaculum ISOLATES**

Brianna Heese, Joseph Nowlan, Spencer Russell

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Antimicrobial susceptibility testing programs are commonly implemented in aquatic and terrestrial animal agriculture to monitor and manage antimicrobial use as well as the emergence of antimicrobial resistance (AMR) among pathogenic bacterial populations. Florfenicol (FFC) is a broad-spectrum antimicrobial used in veterinary medicine to treat bacterial diseases of aquatic species including tenacibaculosis in Atlantic salmon caused by the Gram-negative, marine bacteria *Tenacibaculum* spp.. In British Columbia (B.C.), multiple clinical outbreaks of *Tenacibaculum maritimum* (T.mar) during a single production cycle can affect animal welfare; and necessitate repeated antibiotic treatments, impacting production costs. Timely monitoring of T.mar for AMR and the development of epidemiological cut-off values is necessary to understand *Tenacibaculum* spp. diversity, antimicrobial susceptibility, informing treatment efficacy, and identifying emerging trends in AMR. As part of this study, bacterial swabs and tissues have been collected from Atlantic salmon across four treatment cycles from four B.C. marine production sites. For each collection, the minimum inhibitory concentration (MIC) was determined for three confirmed T.mar isolates using microdilution assays as outlined in CLSI guidelines. This work highlights the importance and value of an AMR monitoring program for pathogens of concern in B.C. aquaculture.

HETLELID OLSEN, R.

EFFECT OF AN ATTENUATED LIVE VACCINE AGAINST SALMONID RICKETTSIAL SEPTICAEMIA IN ATLANTIC SALMON (*Salmo salar*) IS HIGHLY DEPENDENT ON TEMPERATURE DURING IMMUNISATION.

Rolf Hetlelid Olsen, Frode Finne-Fridell, Marianne Bordevik, Anja Nygaard, Binoy Rajan, Marius Karlsen

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The main cause of antibiotics usage in the Chilean aquaculture industry is Salmonid Rickettsial Septicaemia (SRS) caused by the facultative intracellular bacterium *Piscirickettsia salmonis*. A live attenuated vaccine (ALPHA JECT LiVac® SRS, PHARMAQ AS) against the disease was licensed in Chile in 2016 and has since then been used extensively in Chilean farmed salmonids. Here we demonstrate that the vaccine is efficient in protecting against *P. salmonis*-induced mortality in Atlantic salmon (*Salmo salar*) for at least 15 months in experimental injection and cohabitation laboratory challenge models. The protection was however highly sensitive to temperature during immunization. While fish vaccinated and immunized at 10°C and above were found to be well protected, a significant loss of protection was found in groups immunized at 7°C and 8°C, which represents the lower end of the temperature range commonly found in Chile. Good vaccine efficacy was restored when fish were exposed to 15°C the first 5 days after vaccination, before lowering the temperature to 7°C for the remaining immunization period. This suggests that correct temperature the first days after vaccination is pivotal to obtain protection with ALPHA JECT LiVac® SRS. The results underscore the importance of temperature when vaccinating poikilothermic animals with live vaccines.

IGNATZ, E.

GENETIC POPULATION STRUCTURES OF BLUE MUSSELS (*Mytilus* spp.) ACROSS THE EAST COAST OF CANADA

Eric. H. Ignatz, Shelby B. Clarke, Réjean Tremblay, Ramón Filgueira, Tiago S. Hori

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Previous studies of the *Mytilus* spp. complex within eastern Canada mapped their distribution based on morphological assessments and/or by screening small numbers of genetic markers. The reliability of these approaches is questionable given how phenotypically and genetically similar some *Mytilus* spp. are. Therefore, mussel DNA samples from across Québec, New Brunswick, Prince Edward Island, Nova Scotia, and Newfoundland were genotyped using a panel of 69 single nucleotide polymorphisms (SNPs) that originated from recent research on the population structures of *Mytilus* spp. in other parts of the world. These findings will help to delineate *M. edulis*, *M. trossolus*, and hybrid zones within eastern Canada, which is valuable in understanding population dynamics within current and potential future aquaculture sites in the region. Subsets of DNA samples will also be analysed on the 50K SNP array tailored for Prince Edward Island mussels that is currently under development. This array will provide broader insight into the genetic variation present between mussel populations across the Atlantic region and will be essential to the local aquaculture industry in establishing its first genomic breeding program. Ultimately, this work will help inform which populations may be beneficial to optimize commercially relevant traits, such as thermal and hypoxia tolerance.

KALVANI, Z.

NAPHTHENIC ACIDS INFLUENCE SITE-SPECIFIC H₂O₂ EMISSION DIFFERENTLY IN RAINBOW TROUT LIVER MITOCHONDRIA

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Aquatic creatures encounter a variety of environmental stressors, including naphthenic acids. Naphthenic acids cause a physiological disturbance that leads to impaired mitochondrial function and the production of reactive oxygen species. The purpose of this study was to determine if a primary carboxylic acid, moderately hydrophobic naphthenic acid, would cause hydrogen peroxide (H₂O₂) production by mitochondria in multiple bioenergetic states. Mitochondria isolated from rainbow trout (*Oncorhynchus mykiss*) liver were exposed to commercially available 3,5-dimethyladamantane-1-acetic acid. The emission of ROS during States 3 and 4 respirations was quantified using a respirometer. Subsequently, each ROS emission site in the mitochondrial complexes was isolated using inhibitors, and the ROS emission of each site was measured using the AUR-HRP system. The test compound caused ROS emission in state 3 and state 4 with an EC₅₀ of 0.77 mM and increased ROS emission in a dose dependent manner at all ROS production sites, OF, IF, IQ, IIF, and IIIQo. However, some sites were more responsive to ROS production than others, with IQ > IIIQo > IF > IIF > OF. Overall, the research shows that the mitochondrial H₂O₂ metabolism in rainbow trout liver is highly responsive to stressors like naphthenic acid.

KORUS, J.

**UTILIZING BIOLOGGERS FOR INSIGHTS INTO THERMAL FISH STRESS:
APPLICATION OF HEART RATE AND ACTIVITY DATA IN PRECISION FISH
FARMING**

Jennie Korus, Ramón Filgueira, and Jon Grant

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Aquaculture farms operate in a complex 3D environment that face regular seasonal challenges during the summer, such as elevated temperatures. The challenges faced by Atlantic salmon farms due to climate change, including rising sea temperatures and increased weather variability, necessitate a thorough understanding of thermal stress and confounding variables specific to commercial farming such as feeding and operations. Fish were tagged on a commercially operating farm using two types of biologgers measuring temperature, heart rate, external acceleration, and depth of fish during seasonal extremes. In summer, two thermal heat events—one short-term and one long-term—were observed. Comparisons were made between periods before, during and after these events. To explore the effects of feeding and farm operations, additional comparisons were made between all combinations of time when operations were and were not occurring during both feeding and non-feeding periods. Fish exhibited signs of secondary and tertiary stress in response to the heat events and both heart rate and acceleration increased in response to feeding. In the context of precision fish farming, this research helps to advance the use of biologgers to recognize early signs of stress, to inform farm management and enhance fish welfare in commercial aquaculture.

LANGILLE, B.

NORTH AMERICAN ATLANTIC SALMON (*Salmo salar*) FILLET COLOUR: TIMING RELATED FACTORS AND GENOME-WIDE ASSOCIATIONS

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Atlantic salmon (*Salmo salar*) is an important source of food globally; however, fillet color can significantly affect consumer purchasing, leading to potential food waste. Our research program has explored the impact of timing factors, such as day and hour, on the colour of fillets. The influence of these factors is also evaluated for use within a commercial breeding program while searching for genomic associations with colour traits.

There was a significant impact on fillet color measured by ChromaMeter (lightness, redness, and yellowness) and SalmoFan, depending on how long it took to process fish after harvest and the day measurements were taken. Generally, as the time to process fish increased, the lightness value also increased; however, the opposite was observed for shorter harvest periods. The hour of the day was significant for SalmoFan calls with lower phenotypes recorded as the hour increased. Using genome-wide association and incorporating these novel factors within the analysis, we found colour phenotypes were significantly associated with the same genomic region on chromosome 26 (Figure 1), which was near the *beta-carotene oxygenase 1* gene.

It is essential to consider the time, day, and hour when evaluating phenotypes during harvest evaluations as it may influence the perceived fillet quality. Understanding how environmental and genetic factors impact fillet quality is a fundamental component of global sustainable aquaculture.

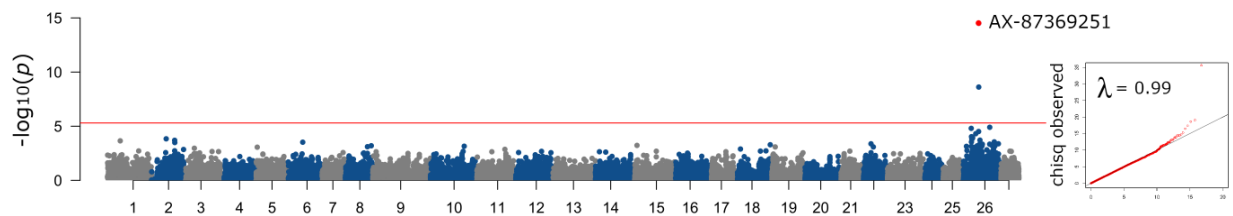


Figure 1: Manhattan and QQ plot of the genome-wide association with redness from the 2018 year class.

LE CAM, S.

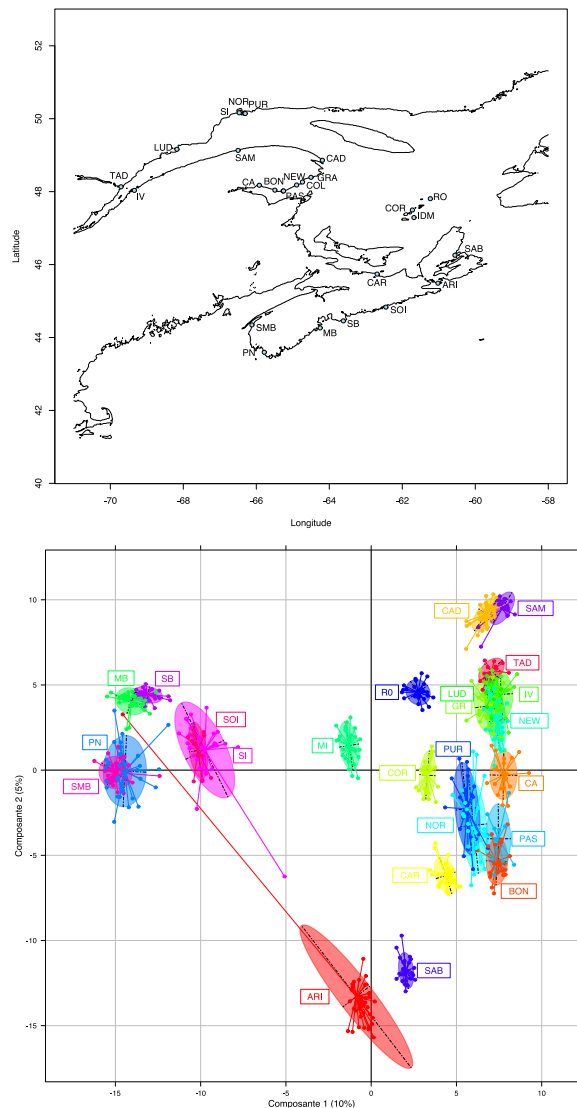
ASSESSING LEVELS AND DISTRIBUTION OF GENETIC DIVERSITY OF WILD SUGAR KELP POPULATION IN QUEBEC AND NOVA SCOTIA: A TOOL FOR SUPPORTING THE LONG-TERM SUSTAINABILITY OF THE SEAWEED AQUACULTURE INDUSTRY OF THE CANADIAN EAST COAST

Sabrina Le Cam, Flora Salvo, Stephen O'leary, Rafael Martin Martin, Marie-Eve Clark, Tristan LeGoff, France Dufresne

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The sugar kelp (*Saccharina latissima*) industry is still in its infancy in East Canada. Aquaculture practices lack standardization and the seeds are gathered and randomly selected from wild populations, which translates into adverse variability in the culture yields and unknown resilience to environmental changes. To document the genetics of natural populations of seaweeds from this region, we have sampled and documented morphotypes of ~650 sporophytes from 22 locations distributed in the Estuary and Gulf of St. Lawrence and along the coast of Nova Scotia. Single-nucleotide polymorphisms (9,939 SNPs) obtained from dartseq revealed high genetic structure among region with F_{st} ranging from 0.01 (within) to 0.35 (between). PCA analyses revealed a strong genetic structure that followed geographical locations. Genome-wide association studies will be carried out to identify SNP linked to specific phenotypic traits (large blades, stipe length). These results will help provide some insights and support to set up a seedbank, significant insights for ecosystems management and will help in defining potential for cross breeding between regions. Current Canadian regulations require collection of local broodstock to stock cultivated lines as a precautionary approach, thus knowledge gained from this project is greatly needed to inform responsible policy and practices.



LEADBEATER, S.

POTENTIAL FOR THE USE OF PROBIOTICS TO SUPPORT THE HEALTH OF ATLANTIC SALMON IN AQUACULTURE.

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Global use of antibiotic has the potential to lead to resistant organisms that can no longer be managed for optimal animal health in food production systems. A Genomics Research and Development Initiative (GRDI) has resulted in a multi-governmental department program with collaborators and partners in industry, provincial interests and academia is looking and the state of antimicrobial resistance (AMR) through a One Health continuum, including agricultural systems (e.g. plant and food-animal production, aquaculture), foods (imported and domestically-produced), human communities, and the environment. One potential method to extend the time antibiotics remain viable is a probiotic application in which a beneficial living micro-organism modulates the microbiome of an animal or stimulates the immune system to resist infection without the need for an antibiotic or reduce the impact. At the Saint Andrews Biological Station, projects funded under this GRDI program as well as Aquaculture Collaborative Research Development Program (ACRDP) are allowing researchers and industry to learn more about the potential of using probiotics to enhance the welfare of fish in farm conditions. In this presentation, research activities preliminary results and challenges will be shared as well as discussing the information to be generated using bioinformatic tools.

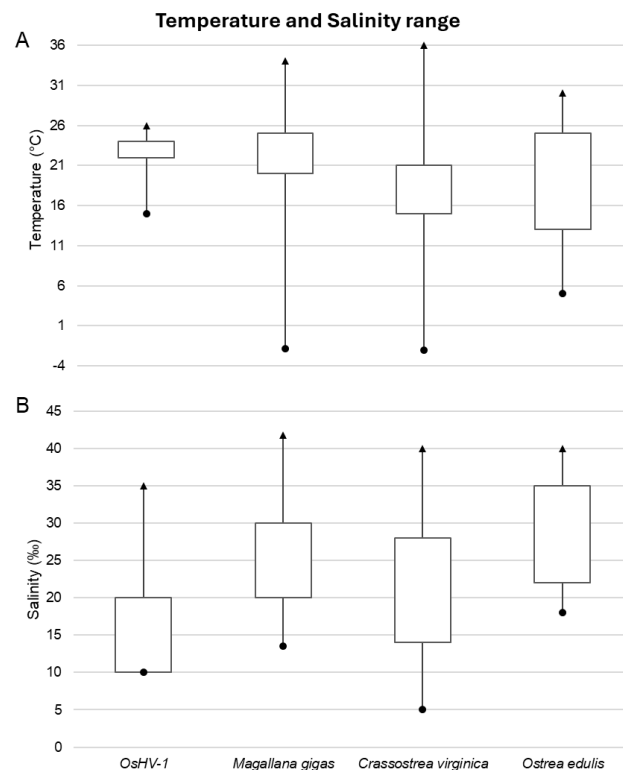
LUCATELLI, D.

CLIMATE CHANGE AND THE POTENTIAL THREAT OF OsHV-1 OUTBREAKS AT OYSTER AQUACULTURE SITES IN NOVA SCOTIA

Debora Lucatelli, Khalil Eslamloo, Leah Lewis-McCrea, Laila Nargis, Gregor Reid.

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Ostreid Herpes virus type 1 (OsHV-1) can cause production losses of up to 100%. It has impacted the oyster industry worldwide. Under climate change this virus has the potential to threaten the oyster culture industry in Nova Scotia, which farms American oyster (*Crassostrea virginica*) and European oyster (*Ostrea edulis*). Culture is heavily influenced by temperature and salinity. *C. virginica*'s optimal growing temperature ranges between 15°C and 21°C, and salinity between 14‰ and 28‰. While *O. edulis* prefers temperatures from 13°C to 25°C, and salinity between 22‰ - 35‰. Climate change projections, from the most likely emissions scenario (RCP 8.5), suggest an increase of up to 4°C extremes in Atlantic Canadian waters by 2050. While oyster production rate is predicted to increase with warmer waters, such temperatures may also augment the spread of the OsHV-1. While OsHV-1 has yet to be detected in Canada, projected warming will bring temperatures within 16-24°C, the range at which OsHV-1-driven oyster mortalities have occurred in Europe. To date, the nearest detection of OsVH-1, has been in Maine, USA, suggesting the need to track its movement as climate change progresses to help ensure the sustainability and future of the NS oyster industry.



MAITLAND, D.

AQUAPONICS LITERATURE REVIEW & TABULATION PROJECT

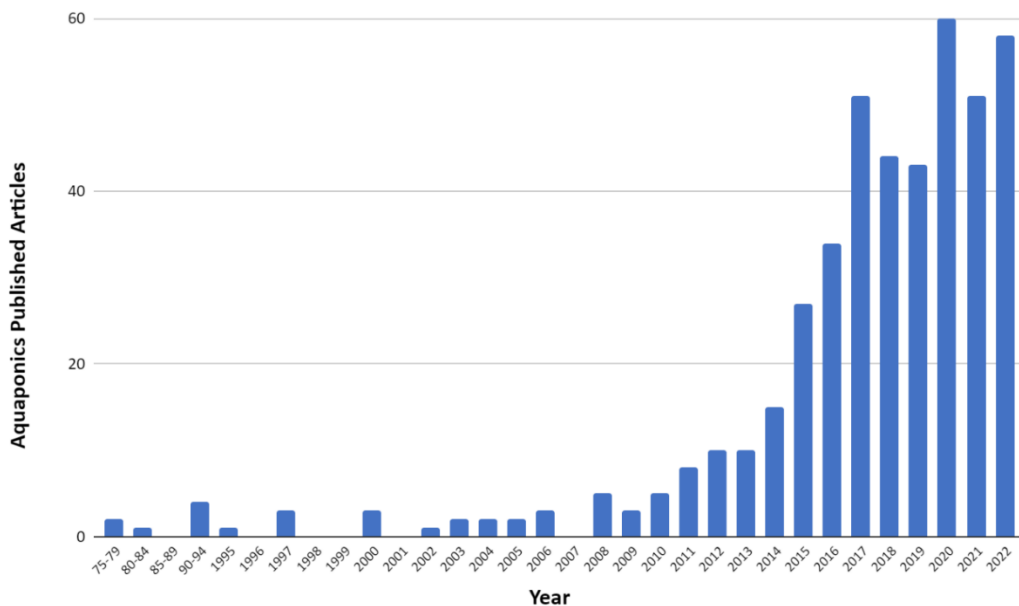
Danielle Maitland, Emma Hornby.

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Aquaponics is an emerging food system with potential to increase the sustainability of crop production and recirculating aquaculture systems by integrating the cultivation of aquatic organisms (e.g. fish, crustaceans) with crop cultivation (e.g. lettuce, tomatoes) in an engineered ecosystem. Aquaponics is a relatively new discipline; while the first studies were published in the 1970s, research and publications did not begin to accelerate until after 2010.

There have been >450 aquaponics articles published between 1977 and 2022. The goal of the Aquaponics Literature Review and Tabulation Project is to record the critical information from each article into a single spreadsheet including: bibliographical (title, authors, publication), article type (experimental, review), species and inputs used, experimental set up details, and results. This has created an easily searchable, comprehensive database of aquaponics literature. This spreadsheet is incredibly useful to researchers trying to complete literature reviews and/or compare their results to previous research. It also serves commercial producers or hobbyists interested in comparing their goals/ideas with activities already completed or looking for guidance in system set-up/operation.

Originally started in May-2021 and made available via the Aquaponics Association, the sheet has since been updated to include articles published in the balance of 2021, with the addition of articles from 2022-2024 ongoing.



MANRÍQUEZ-HERNÁNDEZ, J.

EFFECT OF ASTAXANTHIN FROM THE GREEN MICROALGA *Haematococcus lacustris* ON COLOURATION AND PRODUCTION PARAMETERS OF ATLANTIC SALMON *Salmo salar*.

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Flesh colour is an important quality parameter for salmon because consumers perceive that redder salmon has a higher quality. To meet this requirement, synthetic astaxanthin is added to their feeds, while the use of synthetic products in salmon farming is generating public concerns.

Two forms of natural astaxanthin, extracted from *Haematococcus lacustris*, oleoresin and powder, were tested against a synthetic astaxanthin. Atlantic salmon fed for six months with seven experimental diets, in duplicate. Diets contained zero astaxanthin (Ax, control), synthetic astaxanthin included at 40 and 80 mg Ax/kg diet, and the two natural astaxanthin at the same two concentrations. At the end of the trial, ten fish per tank were sampled to determine flesh colouration and production parameters.

Diets significantly affected weight and flesh colouration (Fig. 1), and also length and protein efficiency ratio. Oleoresin derived from *H. lacustris* provided better flesh pigmentation than that supplied in the powder form and has good potential to replace conventional synthetic astaxanthin by diet.

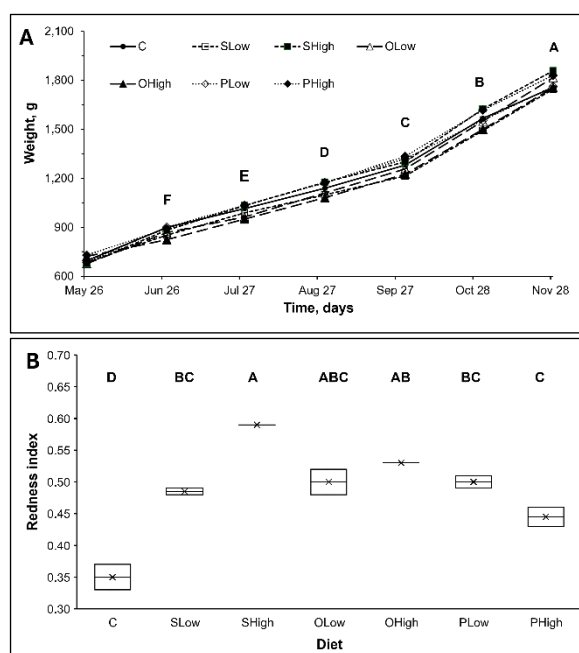


Figure 1. A) Body weight, B) Redness Index of fillet of Atlantic salmon fed during 186 days with seven diets. Including control without astaxanthin (C), and three sources of astaxanthin (Ax): synthetic (S), oleoresin (O), and powder (P), each one at two levels 40 and 80 mg Ax/kg diet (Low and High, respectively). Months (weight) and diets (colour) that do not share the same letter are significantly different (Tukey test, $\alpha = 0.05$)

MISK, E.

THERMAL MODULATION OF GENETIC RESISTANCE TO INFECTIOUS SALMON ANEMIA VIRUS: DIFFERENTIAL GENE EXPRESSION ANALYSES IN ATLANTIC SALMON FAMILIES (*SALMO SALAR*) AT 10°C AND 20°C

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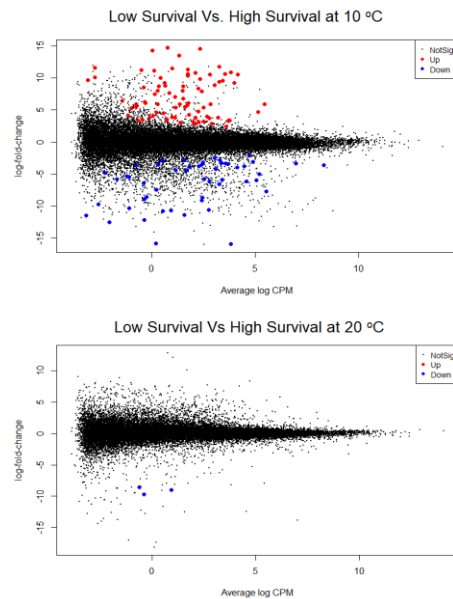
In our previous research (Groves et al., 2023) we explored the effects of Atlantic salmon family genetics and temperature on Atlantic salmon's resistance to infectious salmon anemia (ISA), caused by the orthomyxovirus ISAV. Experimental infection was carried out using cohabitation of study fish with Atlantic salmon IP- injected donors with a highly virulent ISAV isolate (HPR4; TCID₅₀ of 1×10^5 /mL). There was a significant relationship between the fish's family and environmental temperature, revealing that both factors notably influenced the viral load, timing of mortality, and overall mortality rates.

Here, we delve into the transcriptomic responses related to ISA resistance by conducting RNA sequencing analysis on the two families with the highest and the two families with the lowest survival observed at 10°C and 20°C. In addition, we utilized a SNP array to evaluate if genes identified with transcriptomic responses could be also captured through genome wide associations.

At 10°C, a comparison between the high- and low- survival families revealed significant gene expression differences: 51 genes were significantly downregulated, and 81 genes were significantly upregulated in the high-resistance families compared to the low-resistance ones, with 36,578 genes showing no significant change. However, at 20°C, the difference was less pronounced, with only 3 genes significantly downregulated in high-resistance families and 36,707 genes unaffected.

When comparing the high-resistance families' gene expression at 10°C to 20°C, there was a significant downregulation of 121 genes and upregulation of 224 genes, indicating a notable change in gene expression due to temperature increase. Surprisingly, in the low-resistance families, there was no significant change in gene expression when comparing the two temperatures, suggesting that their genetic response to temperature changes might be less variable or pronounced compared to the high-resistance families.

The current work underscores the complex interplay between genetic resistance to disease, environmental factors like temperature, and gene expression in Atlantic salmon. It highlights the potential for temperature to significantly impact the genetic mechanisms underlying disease resistance, with important implications for understanding salmon biology and improving aquaculture practices.



NARGIS, L.

**ACCESS TO COMPLEX SPATIAL DATA IN SUPPORT OF PRAGMATIC
AQUACULTURE DEVELOPMENT**

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The development of novel aquaculture operations requires extensive spatial information on the local environment, infrastructure, and available support services. Assembling and assessing this information is an important prerequisite for business decisions. Despite the availability of data, it requires extensive effort to collect and overlay to support coherent evaluation. To help mitigate this challenge, CMAR developed and published a single geographic information system (GIS) platform that plots important infrastructure, environmental data, and services to support aquaculture development in Nova Scotia, however, can be utilized for other land-based developments. Another initiative published our Coastal Monitoring Program Map (CMP). CMAR conducts high resolution monitoring of coastal ocean data around the province of Nova Scotia. The CMP map enables access to data summary reports and all processed monitoring data is fully downloadable. CMAR's current initiative combines GIS with Multi-Criteria Decision Analysis (MCDA) to spatially assess site suitability for finfish and shellfish aquaculture. Implications on how GIS tools can best support pragmatic decision making for the aquaculture industry are discussed.

NESS, M.

***Moritella viscosa* IN CANADA: ISOLATE CHARACTERIZATION AND CHALLENGE STUDIES**

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Winter ulcer disease caused by *M. viscosa* is a major problem for the Canadian salmon farming industry as it causes animal welfare challenges and significant economic losses due to mortality and downgrades at slaughter. All commercial vaccines currently available in Canada with a winter ulcer disease component contain a classic/typical strain of this pathogen. Field use of winter ulcer commercial vaccines in Canada has resulted in moderate to good protection against the variant strains identified.

In this study we have characterized several Canadian field isolates from multiple regions in both Western and Eastern Canada using genetic sequencing as well as antibody-based methods. Furthermore, we have assessed the efficacy of commercial multivalent vaccines against Canadian *M. viscosa* field isolates in laboratory challenges.

Our results show that Canadian *M. viscosa* is serologically similar to the strain used in the multivalent core vaccines despite there being genetic differences. Furthermore, Canadian *M. viscosa* was shown to be virulent and we found that commercial multivalent vaccines do elicit protection in challenges with Canadian *M. viscosa*.

The use of experimental animals in this study was approved by the Norwegian Food Safety Authority. The study was also approved by the internal Zoetis Animal Ethics Committee.

NICKERSON, P.

PRACTICAL OBSERVATIONS IN REFRIGERATION FOR AQUACULTURE CHILLER AND HEAT PUMP SYSTEMS USING CARBON DIOXIDE AS A REFRIGERANT IN PLACE OF REFRIGERANTS WITH HIGHER GLOBAL WARMING POTENTIAL

Philip A Nickerson

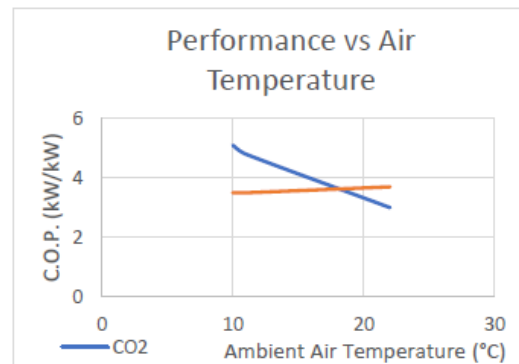
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Refrigeration to heat or cool water for land-based aquaculture often accounts for a significant portion of the capital expense, and the electrical energy operating expense. In recent years, refrigeration has also been flagged as a significant portion of the environmental footprint. This real-world case study was conducted to compare the performance and market reception of CO₂ chillers alongside one of the most efficient conventional refrigerant chillers available. The findings, notes, and observations are presented here in an effort to help those who design and/or buy refrigeration equipment for aquaculture to make informed choices when evaluating refrigeration options for aquaculture operations.

Two of each chiller were constructed and installed in a live shellfish holding operation. Each chiller was supplied by an identical pump that solely serviced that chiller. An ultrasonic flow meter was used to measure flow rate. Water temperature was measured before and after each chiller always ensuring that the inlet and outlet temperature differential was calibrated to zero before the chiller was turned on.

What are believed to be the first chillers in the world to use CO₂ in a live seafood system were designed and built by a company in Nova Scotia, and commissioned in Prince Edward Island in 2022. Data shows that below the transcritical point the efficiency of the CO₂ refrigerant is higher than conventional refrigerants. Above the transcritical point, the efficiency is reduced below the point of conventional refrigerants. Therefore, the verdict on efficiency of CO₂ as compared with conventional refrigerants rests on the ambient temperature or the cooling water temperature which drive the ‘condensing temperature’ or compression ratio.

There are also market advantages to using CO₂ as a refrigerant that are presented herein.



NIEMANN, B.E.

THE EFFECTS OF FULVIC AND HUMIC ACID DIETS FOR FOUR AQUACULTURE SPECIES (*Oncorhynchus tshawytscha*, *Oncorhynchus mykiss*, *Salvelinus alpinus*, AND *Anoplopoma fimbria*)

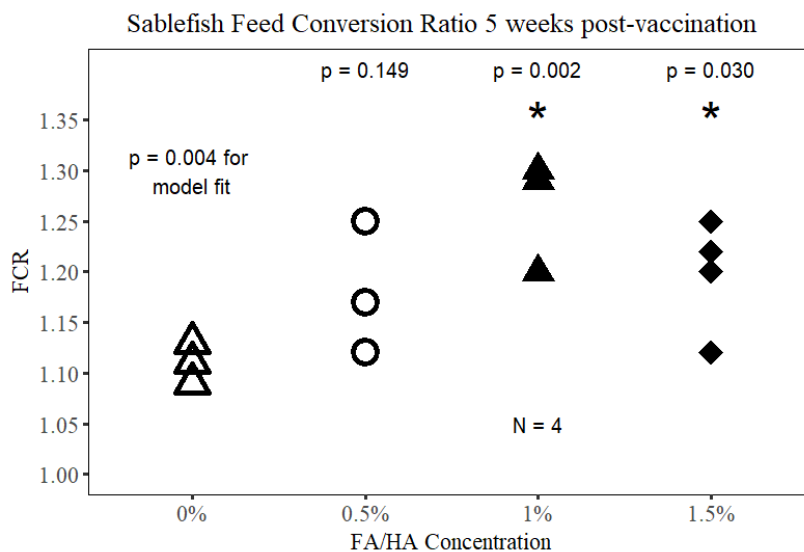
Benjamin. E. Niemann, Ian Forster, Wendy Vandersteen, Laura Parfrey, Andrea Y. Frommel

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Fulvic acids (FA) and humic acids (HA) have been proposed as preventative measures against infections that may require antibiotic treatment. Our goal was to investigate the efficacy of commercial FA and HA products for aquaculture, based on reported improvements to immunocompetence in fish and other livestock species. Presented are data from experiments with FA and HA in a constant ratio [3:7] totaling 0.5%, 1%, and 1.5% with four species: Arctic char (*Salvelinus alpinus*); Chinook salmon (*Oncorhynchus tshawytscha*); rainbow trout (*Oncorhynchus mykiss*); and sablefish (*Anoplopoma fimbria*). After four weeks of feeding, the fish were challenged with a vaccination to *A. salmonicida*. No significant differences were observed in growth and antibody response between treatments after 4-6 weeks post-vaccination. We saw no benefit with the FA and HA trialed within the confines of our study. There is uncertainty concerning the structural composition of FA and HA and its relationship to dissolved organic carbon, which may explain variation in our results compared to other studies. Further research must be done to elucidate what specific compositions, structures, and ratios of FA and HA are beneficial to fish health and culture success.

Metric	df	Arctic Char		Chinook Salmon		Rainbow Trout			Sablefish		
		F	p-value	F	p-value	F (I1)	p-value	F (I2)	p-value	F	p-value
Weight	3	1.57	0.248	0.183	0.906	2.94	0.076	2.16	0.145	1.05	0.408
Feed Conversion Ratio	3	1.58	0.245	0.745	0.546	0.638	0.605	3.21	0.062	5.25	0.015*



NKETIAH BIRIKORANG, H.

THE IN VITRO LIFE CYCLE AND REPRODUCTION CAPACITY OF *ANISAKIS PEGREFFII*

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The heightened focus on *Anisakis* nematodes arises from the increasing cases of anisakiasis in Europe, driving research into *Anisakis* spp., the causative agents. The natural life cycle involves marine mammals as the final host, and crustaceans and potentially small fish as intermediate hosts.

Anisakis pegreffii larvae were isolated and cultured in Schneider’s *Drosophila* media with 10% chicken serum. The transition to adulthood and egg production were observed every two days. Collected eggs were incubated and hatching recorded. *Anisakis* fecundity was evaluated through daily egg counts, while the sex ratio was determined by recording the quantity, gender, and extraction date of adults.

Larvae progress through developmental stages, reaching the fourth stage (L4) by the fourth day post-incubation (dpi), followed by molting into the fifth stage (L5) after 15 days. The adult stage, marked by egg expulsion, is observed on day 17. Eggs are detected from 17 to 133 (dpi), with initial hatching at day 44. Over the next 51 days, eggs hatch into L2 larvae, typically within 5-7 days. Average fecundity peaks at 100 dpi, as shown in Figure 1. A sex ratio of 1:2 for B1 and 1:3 for both B2 and B3 was observed. Cumulative mortality is illustrated in Figure 2.

Figure 1: *Anisakis pegreffii* fecundity (eggs/day/female) in vitro culture calculated for each replicate.

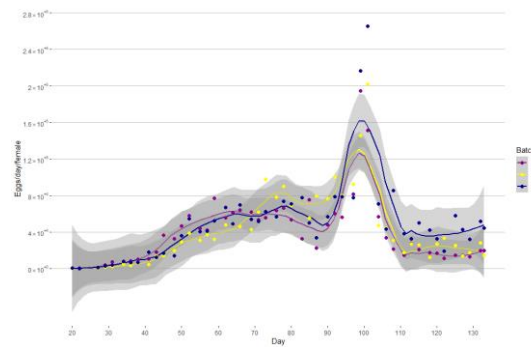
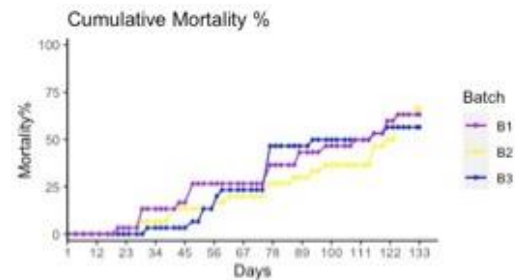


Figure 2: Cumulative mortality (%) of *Anisakis pegreffii* adults kept in Schneider’s *Drosophila* medium enriched with 10% chicken serum.



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Moratal, S., Zrzavá, M., Hrabar, J., Dea-Ayuela, M. A., López-Ramon, J., & Mladineo, I. (2023). Fecundity, in vitro early larval development and karyotype of the zoonotic nematode *Anisakis pegreffii*. *Veterinary Parasitology*, 323, 110050

NOWLAN, J.

HORIZONTAL TRANSMISSION OF *Tenacibaculum maritimum* BETWEEN ATLANTIC SALMON (*Salmo salar* L.) AND CHINOOK SALMON (*Oncorhynchus tshawytscha* W.)

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Tenacibaculum represents a genus of Gram-negative, marine bacteria; with a cosmopolitan distribution. Members of this genus have polarized interactions with innumerable host species, and are interpreted as an opportunistic pathogen to finfish. Several species, most notably *T. maritimum*, affect British Columbia (BC) aquaculture of Atlantic salmon (*Salmo salar* L.) by causing increased mortality and necessitating the use of therapeutic interventions. Intraspecific horizontal transmission of *T. maritimum* and resultant disease called tenacibaculosis is described in several fishes, but not Pacific salmon. Further, no research is available demonstrating interspecific horizontal transmission. It is imperative to determine if interspecific transmission can occur between Atlantic salmon and other Pacific fishes. Using an exposure model developed at Vancouver Island University, Atlantic salmon smolts will be exposed to BC isolates of *T. maritimum* through bath immersion and cohabitated with naïve Chinook salmon (*Oncorhynchus tshawytscha*) smolts. qPCR will be used to determine the presence and load of *T. maritimum* on both species. Skin, gill, spleen, and kidney samples will be used to compare transcriptomes of both fishes and bacteria, investigating mechanisms of resistance in Pacific salmon in contrast to susceptibility in Atlantic salmon.

OKON, E.M.

***Escherichia coli* IN COASTAL WATERS: INSIGHTS INTO GROWTH RATE, GENERATION TIME, AND LAG PHASE DURATION AMIDST ENVIRONMENTAL VARIATION**

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This research assessed the growth rate, generation time, and lag phase duration of *Escherichia coli* in relation to changing temperatures in coastal regions. The study employed the pathogen modelling program to simulate an external model, mimicking similar coastal aquatic environment conditions. The parameters, including water temperature, pH, and salinity, were obtained from reliable online sources specific to each location. The findings reveal that *E. coli* showed varied responses regarding growth rates, generation times, and lag phase duration.

The growth rate (log(cfu/ml)) varied at minimum [0.014 (Baku) to 0.351 (Baleem)] and maximum [0.119 (Estoril) and 0.520 (Alkhubar)] temperatures. Generation time (hours) varied at minimum [0.86 (Baleem) to 22.18 (Baku)] and maximum [0.71 (Miami) to 2.53 (Estoril)] temperatures. There were also variations in lag period duration (hours) at minimum [8.34 (Baleem) to 275.37 (Shanghai)] and maximum [6.99 (Alkhubar) to 26.73 (Estoril)]. The results (Figure 1,2) suggest that temperature plays a crucial role in shaping the growth rate, generation time, and lag phase of *E. coli*. However, the specific mechanisms are not well understood. Further research is imperative to understand the dynamics and

implications of these variations for food safety, public health, and environmental health.

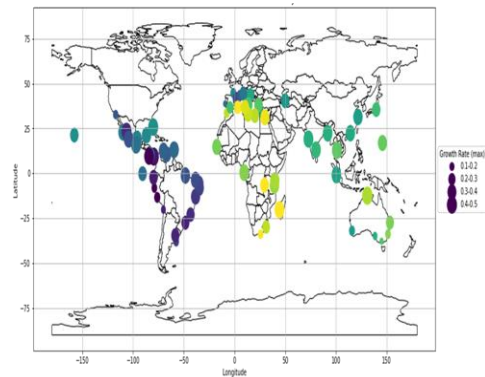


Figure 1. Simulated growth rate of *E. coli* at maximum water temperature along the coastal aquatic environment.

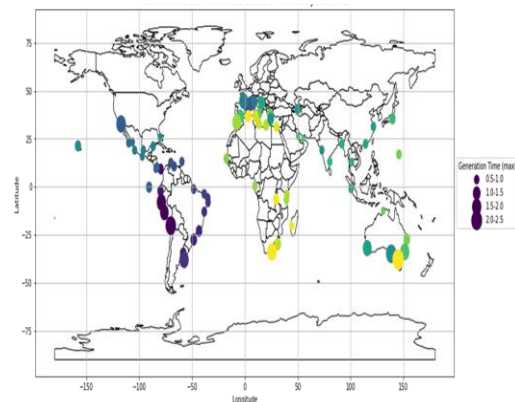


Figure 2. Simulated generation time of *E. coli* at maximum water temperature along the coastal aquatic environment.

OKON, E.M.

TRENDS AND TRANSITIONS OF AQUACULTURE AND FISHERIES RESEARCH IN CANADA (2010 - 2023)

Ekemini Okon, Judith Ehigie, Babatunde Falana, Gift David, Arije Damilare, Adams Kipchumba, Harriet Birikorang, Reuben Okocha, Solaja Sodipe, Mary Adeleke

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Despite aquaculture and fisheries contributions to national development, their trends and transitions have not been documented in Canada. Thus, this study, extracted from 3332 published articles from 2010 to 2023, examined the evolution of aquaculture and fisheries research in Canada. The study was divided into eight research categories: Environment, Health/Welfare, Genetics/Breeding/Reproduction, Systems, Socioeconomics, Feed/Nutrition, Production/Products/Processing, and Multi Study. The Health and Welfare category had the highest number of published studies (24%, n=393) in aquaculture. In comparison, the Environment category was the highest (32%, n=547) for fisheries (Figure 1).

British Columbia led in aquaculture (26%, n=414) and fisheries (27%, n=466) studies, and overall (26%, n=880), followed by Newfoundland and Labrador (14%, n=478), Ontario (13%, n=443), Nova Scotia (12%, n=411) and New Brunswick (10%, n=337) (Figure 2). Atlantic salmon (*Salmo salar*) was the most researched individual species, highlighting its importance for both sectors. More studies were conducted in fisheries (n=1718) than aquaculture (n=1614). In recent years, however, there has been a slight decline in total publication output for both sectors. Therefore, scaling up research, especially in the Atlantic region, is

imperative, as the region contributes about 75% of fish production in Canada.

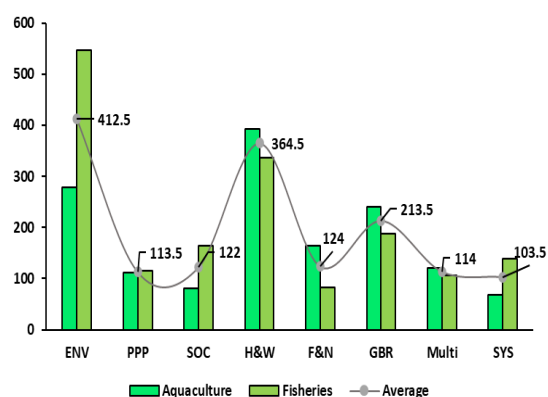


Figure 1. Number and average of aquaculture and fisheries research publications in Canada based on defined categories.

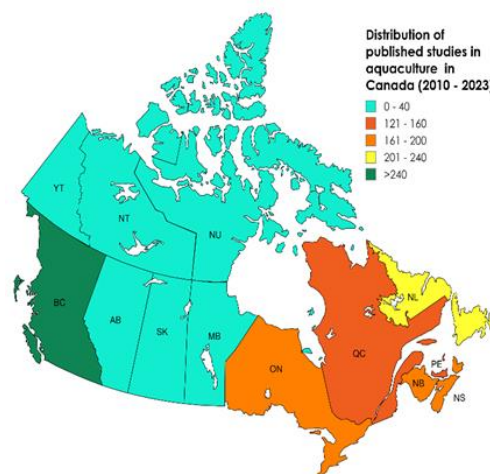


Figure 2. Distribution of aquaculture research in Canada within the study period

PAQUET, M.F.

EXPLORING THE POTENTIAL ROLE OF OUTER MEMBRANE VESICLES AS A DEFENSE MECHANISM AGAINST BACTERIOPHAGES IN THE FISH PATHOGEN *Aeromonas salmonicida* subsp. *salmonicida*

Maude F. Paquet, Valérie E. Paquet, Steve J. Charette

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Aeromonas salmonicida subsp. *salmonicida* (*A. sal.*) is the etiological agent of furunculosis. This disease affects salmonids in fish farms and generates economic losses for the Canadian aquaculture. To eradicate furunculosis, antibiotics are currently used in fish farms but, this increases the phenomenon of antibiotic resistance of the pathogen *A. sal.* As an alternative treatment, phage therapy is considered. Bacteriophages (or simply phages) are viruses that affect specifically bacteria. Using a cocktail of phages in the fish pond could be a promising strategy to control furunculosis.

However, bacteria can protect themselves against phages by different mechanisms. One of them is outer membrane vesicles (OMVs). OMVs are produced by the outer membrane of Gram-negative bacteria like *A. sal.* by budding. This natural process has a lot of functions such as phages protection, antibiotic resistance, detoxification of toxic components and more.

The study and characterization of OMVs produced by *A. sal.* is essential to understand how to block this possible protection mechanism against phages. OMVs have been seen by transmission electron microscopy (see **Figure 1**) and their protein component have been studied by mass spectrometry. Their potential protection against phages is still currently being studied.

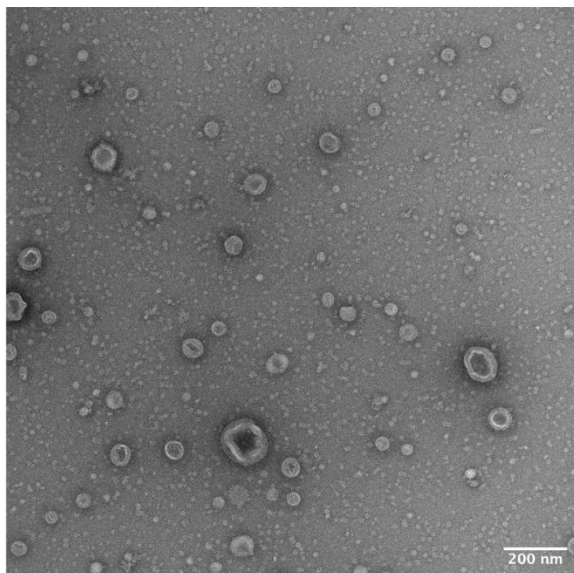


Figure 1. OMVs by *Aeromonas salmonicida* subsp. *salmonicida* Shy-15-2461-R1 seen in transmission electron microscopy with uranyl acetate 2% on copper grids.

PARRISH, C.

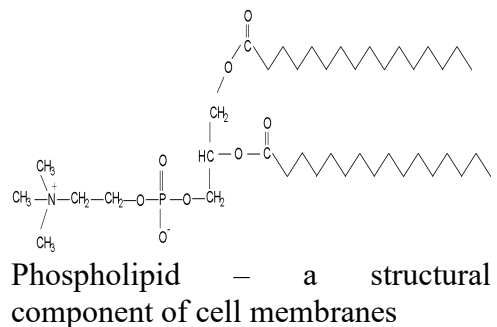
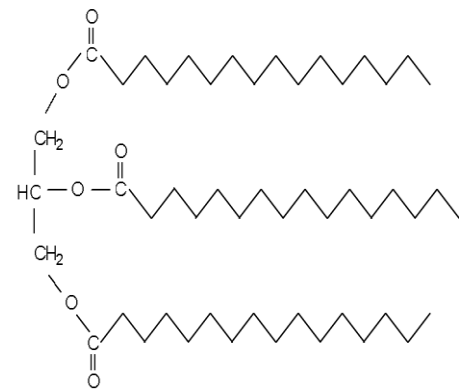
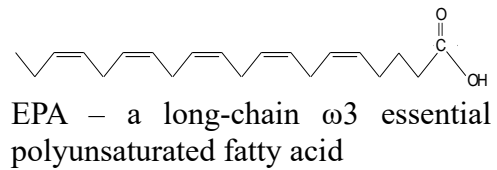
REPLACEMENT OF FISH OIL BY A HIGH-DHA MICROBIAL OIL IN SALMON DIETS: EFFECT ON LIPID MOLECULAR SPECIES AND GENE EXPRESSION

Christopher Parrish, Stefanie Colombo, Mohamed Emam, JuDong Yeo

Department of Ocean Sciences,
 Memorial University, St. John's, NL
cparrish@mun.ca

The omega-3 fatty acids eicosapentaenoic acid (EPA; 20:5 ω 3) and docosahexaenoic acid (DHA; 22:6 ω 3) are essential nutrients for farmed fish and their consumers. Fish oil is a major source of EPA and DHA; however, there is a need for alternative sources that are sustainable and cost-effective. We investigated the replacement of fish oil with a high-DHA, low-EPA oil extracted from single-celled thraustochytrids. This study provided a unique opportunity to determine how these dietary fatty acids independently influence lipid metabolism and physiological pathways.

A 16-week feeding trial was conducted with Atlantic salmon fed diets with a complete or partial replacement of fish oil with microbial oil. There was no significant difference in growth performance, but we observed differences in lipid composition and gene expression. We investigated lipid molecular species using mass spectrometry. The microbial oil diet increased certain EPA-containing storage triacylglycerols, and DHA was efficiently incorporated into membrane phospholipids indicating microbial oil is an excellent source of ω 3 lipids. Bioactive prostaglandins were identified and quantified for the first time in salmonid tissue. These results correlated with muscle and hepatic lipid metabolism biomarkers; however, some transcript levels were the same with either diet indicating successful replacement of fish oil with microbial oil.



ORAL PRESENTATION

PAUL, T.

**INTRODUCTION TO ABEGWEIT FIRST NATION'S SALMONID BIODIVERSITY
ENHANCEMENT HATCHERY**

Tyrone Paul

Placeholder – No Abstract Submitted

PAYKAN HEVRATI, F.

MAJOR SPERM MOTILITY PARAMETERS IN NEOMALE TETRAPLOID RAINBOW TROUT *Oncorhynchus mykiss*

Fatemeh Paykan Heyrati, Hajar Sadat Tabatabaei Pozveh, Majid Talebi, Salar Dorafshan, Tillmann J. Benfey

Department of Natural Resources, Isfahan University of Technology, Isfahan, 54156-83111, Iran
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All-female triploid (sterile) populations of rainbow trout are generally produced by induction of triploidy in eggs that have been fertilized with milt from diploid neomales. In theory, this need for direct triploidy induction could be circumvented by using diploid XX sperm from neomale tetraploids to fertilize eggs from normal diploid females and thereby generate all-female triploid populations without any treatment of the eggs. In our study, we induced tetraploidy in rainbow trout zygotes through a late thermal shock that halted the first cell division. Following this, the larvae were fed a diet with 17 α -methyltestosterone (3 mg/kg) for 60 days at 11°C, starting from their initial feeding. When these fish reached sexual maturity, we employed flow cytometry to measure nuclear DNA content in fin clips and milt (collected from surgically excised testes), and then utilized diploid and haploid milt from tetraploids and diploids, respectively, to evaluate specific sperm motility parameters.

We assessed sperm motility in 30-month-old mature males (5 tetraploids and 5 diploids) using a computer-assisted sperm analysis (CASA) system (IVOS version 12; Hamilton-Thorne Biosciences, MA, USA) equipped with a digital video camera (Samsung, SDC-313B, Korea) connected to a phase-contrast microscope (Nikon, Eclipse E200, Japan). For each male, we mixed 1 μ L

of sperm with 99 μ L of activator buffer (1 mM CaCl₂, 20 mM Tris, 30 mM glycine, 125 mM NaCl, pH 9.0) and then analyzed a minimum of 300 sperm cells across 10 different fields of view. The CASA-derived parameters were motility percentage, duration, and velocities: curvilinear (VCL), straight linear (VSL), and average path (VAP). We also used Eosin-Nigrosin staining to assess sperm viability.

Table 1. Key motility parameters (mean \pm standard deviation) of milt from diploid and tetraploid neomale rainbow trout

Parameters	Diploid	Tetraploid
Motility (%)	93.33 \pm 1.94	91.22 \pm 5.38
Motility duration (s)	81.89 \pm 25.44	77.00 \pm 9.86
VCL (μ m/s)	110.67 \pm 18.48	117.00 \pm 17.33
VSL (μ m/s)	43.33 \pm 10.02	51.50 \pm 13.27
VAP (μ m/s)	56.11 \pm 12.26	63.00 \pm 14.42
Viability (%)	97.33 \pm 2.08	97.04 \pm 1.07

No significant differences between two groups (*t*-test, *p*>0.05).

We found no significant differences in milt quality between the diploid and tetraploid neomale rainbow trout (Table 1), indicating comparable potential for fertilization and the production of all-female eyed eggs of the desired ploidy (diploid, triploid, or tetraploid) depending on the ploidy of the neomale and the female used to make specific crosses.

PEDRON, E.

COMPREHENSIVE QUALITY ANALYSES OF BENTHIC DIATOM BLUE PIGMENT EXTRACT AS POSTBIOTIC IN AQUACULTURE.

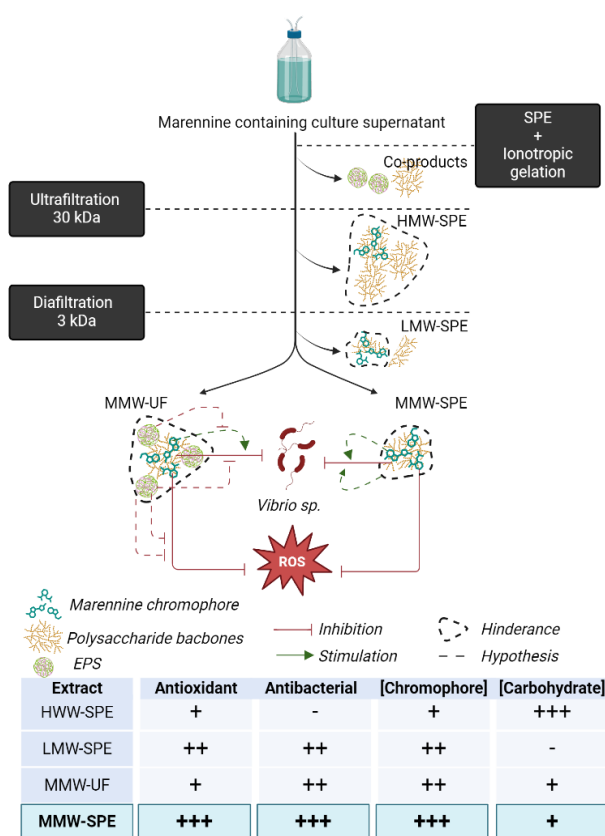
Elodie Pedron, Marylise Duperthuy, Annabelle Mathieu-Denoncourt, William Bélanger, Céline Laroche, Olivier Gonçalves, Anthony Massé, Réjean Tremblay, Jean-Sébastien Deschênes

Institut des sciences de la mer de Rimouski, Université du Québec à Rimouski, Rimouski, Canada
 GEPEA, CNRS UMR 6144, Nantes Université, Oniris, Saint-Nazaire, France
pedronelodie@gmail.com

Marennine is a natural blue pigment produced by *Haslea ostrearia*. Its bioactivities, especially antibacterial and antioxidant, have attracted interest in aquaculture research, where alternatives to synthetic antibiotics have been actively investigated to limit the emergence of resistant strains, an important threat to food safety and a health issue. The success of marennine valorization, however, partly relies on the robustness of its production from the culture of *H.ostrearia* to the refining of sufficient-quality extracts.

In this study, marennine extracts obtained from different refining pathways were physicochemically characterized and their activities were compared using bioassays. The results showed that the addition of solid-phase extraction and ionotropic gelation to the currently used ultrafiltration approach of marennine refining enabled the improvement of both the antioxidant and antibacterial properties of marennine. Antioxidant activity efficiency was increased by a factor of 5, and physicochemical analyses implied that improved chromophore quantity and accessibility were the main causing factors. Meanwhile, our results indicate that the ionotropic gelation step, by removing some co-extracts, could enhance the growth inhibition of pathogenic *Vibrio* while ultrafiltration step appeared to enhance its potency. Altogether, this study confirmed

the potential of this refining pathway to produce a valuable marennine extract.



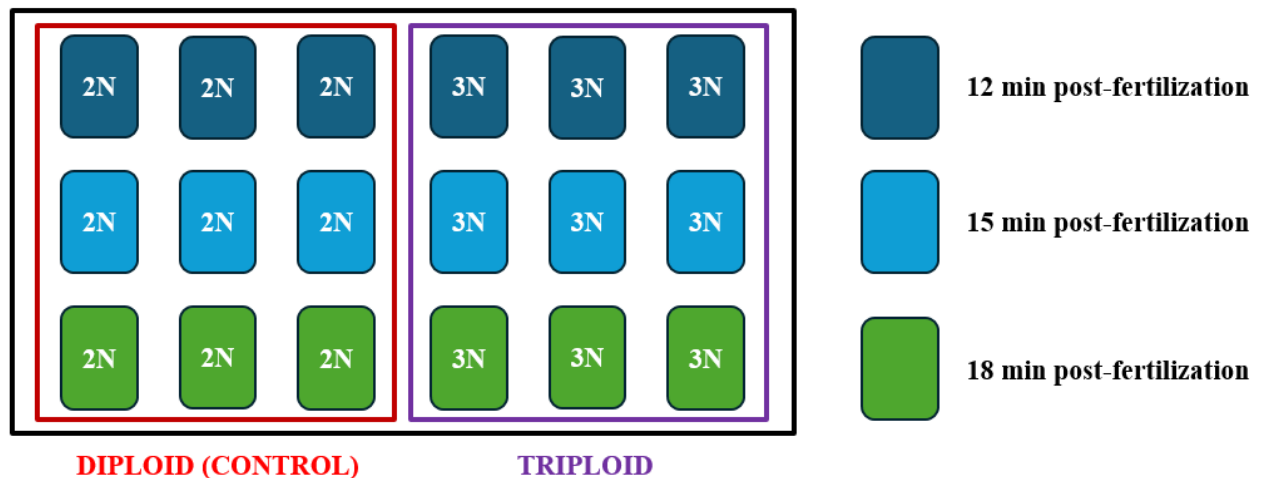
PERRON, F.

TIMING MATTERS: OPTIMIZING PRESSURE SHOCK-INDUCED TRIPLOIDY IN BLUE MUSSELS (*Mytilus edulis*) FOR IMPROVED LARVAL SURVIVAL AND GROWTH

Flavie Perron, Eric H. Ignatz, Guillaume Durier, Tillmann J. Benfey, Réjean Tremblay, Tiago S. Hori, Ramón Filgueira

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 6287 Alumni Crescent, Halifax, NS, B3H 4R2
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In aquaculture, triploid bivalves are becoming increasingly popular as they tend to grow faster, and their reduced energy allocation to gametogenesis ensures that they maintain a consistent market quality throughout the spawning season while minimizing potential impacts on wild populations. However, triploidy induction often results in low triploid percentages and larval survival rates. More research on triploidy induction for the blue mussel (*Mytilus edulis*), especially to avoid chemical-based treatments, is therefore crucial for Canada’s aquaculture industry. This study investigated the optimal time post-fertilization to maximize triploidy induction while minimizing negative effects on larval development and overall spat quality. Eggs were pressure shocked at different times (12-, 15-, and 18-min post-fertilization) using a range of pressures including 8500, 9000, and 9500 psi, each for 5 min, to produce triploids, as assessed by flow cytometry. Full-sibling non-treated eggs (diploids) were correspondingly produced for comparison to the triplicate pressure shock-treated eggs at each time. Physiological parameters such as survival and growth were measured every 2 days until the mussels reached the juvenile stage (< 28 days). Successful establishment of triploid induction protocols could benefit the industry by providing a reliable and easily implementable technology for the optimal production of triploid blue mussels.



POTTER, C.A.

BEAR RIVER FIRST NATION – EXPLORING OYSTER FARMING IN “UNCHARTED” WATERS

Adrian Desbarats, Carol Ann Potter

Bear River First Nation sees an excellent opportunity to develop oyster aquaculture within their territory. Oyster farming offers an excellent opportunity to leverage existing community capacity such as capital assets (eg. boats) and human assets (eg. persons trained in fisheries) to develop this industry as a means of increasing employment opportunities for the Band.

However, the Annapolis Basin offers unique challenges. These waters have very high tidal fluctuations (7m), high currents and is generally more exposed as compared to traditional inland waters where oyster farming is well established.

Since 2019, Bear River First Nation has been developing the systems and processes needed to work in these challenging waters and has been monitoring the growth and survival of oysters under industry standard stocking conditions.

In this presentation, Bear River First will share their findings to date as they pursue oyster production in “uncharted” waters.

RAMSAY, A.

THE VASE TUNICATE: CHALLENGES FOR THE CULTURED SHELLFISH INDUSTRY AND RECENT RESEARCH TO MITIGATE ITS IMPACT

Aaron Ramsay, Jesse Kerr, Amos Champion, Kim Gill, and Neil MacNair

PEI Aquaculture Division
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Ciona intestinalis is the foremost nuisance species on mussel farms on Prince Edward Island. Until recently, this species had only been detected along the eastern coast of PEI; however, it has now been found in several shellfish production bays along the north shore. The movement of shellfish from areas of a known population of *C. intestinalis* has not been permitted, as there was no accepted mitigation to reduce the risk of spread to an acceptable level. As a result, the shellfish industry has been restricted in the movement of their seed stocks to their grow-out areas, which has created operational challenges. Small scale trials using freshwater as a treatment had been conducted previously to determine the exposure required to cause mortality of the vase tunicates; however, no large scale (industry relevant) trials had been completed. The results of a large-scale trial indicate that a minimum 12hr freshwater exposure is required to cause near 100% mortality of the vase tunicate in mussel seed and on mussel socks.

RANDALL, M.

AN INTRODUCTION TO THE BIDEFORD MARINE SHELLFISH HATCHERY OWNED & OPERATED BY LENNOX ISLAND FIRST NATION

Mike Randall

Prince Edward Island's oyster industry is currently experiencing astounding growth fueled by ever-increasing demand. PEI's cultured oysters have earned an internationally-renowned reputation for its supreme taste and quality, and have thus found its way into fine-dining restaurants and oyster bars around the world.

As this industry growth continues, demand for seed also increases placing ever increasing pressure on the wild seed supply. This increased demand for wild seed is coming at the same time that factors such as climate change and disease are putting greater risk on the continued stability of wild seed.

The Bideford Shellfish Hatchery was started in 2016 by Lennox Island First as an effort to supplement wild seed supply and help provide stability and sustainability to the industry. The hatchery was established as a static culture system and has since been retrofitted to a flow through system in an effort to continue meeting market demand.

REID, G.

**CLIMATE CHANGE VULNERABILITY ASSESSMENTS FOR NOVA SCOTIA
AQUACULTURE**

Gregor Reid, Lewis-McCrea, Debora Lucatelli, James Cunningham, Therese Wilson, Khalil Eslamloo, Ryan Horricks

Centre for Marine Applied Research
27 Parker Street, COVE, Dartmouth, NS, B2Y 4T5
greid@perennia.ca

Climate change is intensifying risks of many existing aquaculture hazards while also introducing novel impacts which will manifest across different timelines. Determining which threats are most pressing and where to focus resources for adaptation is crucial for developing a climate resilient aquaculture industry. A climate change vulnerability assessment is one process to help identify exposure to climate change stressors, the sensitivity to exposure, and the capacity for adaptation. Each of these components, *Exposure*, *Sensitivity*, and *Adaptive Capacity*, form a scored index which can further be partitioned into metrics to tailor assessments for specific aquaculture sub-sectors (e.g., shellfish or finfish culture) or even individual farms. The Centre for Marine Applied Research has started three climate change vulnerability assessments for Nova Scotia: finfish aquaculture, shellfish aquaculture, and a deeper dive into fish health. This presentation reviews the climate change vulnerability assessment process, preliminary data to date, and implications for planned adaptation of aquaculture in Atlantic Canada.

REID, G.

OPERATIONALIZING AQUACULTURE CARRYING CAPACITY MODELS: THE FARMING IN NATURAL SYSTEMS (FINS) MODELING PLATFORM FOR NOVA SCOTIA

Gregor Reid, Ramón Filgueira, Ian Gardner, João G. Ferreira, Leah Lewis-McCrea, Kiersten Watson, Jon Grant, Alexander van Oostenrijk, Anne McKee

Centre for Marine Applied Research
27 Parker Street, COVE, Dartmouth, NS, B2Y 4T5
greid@perennia.ca

Farming In Natural Systems (FINS) is a spatially explicit software application which operationalizes published aquaculture carrying capacity models to enable scenario modeling and scoping exercises for decision support. Modules include finfish and shellfish production, organic deposition, ammonium dispersal, seston depletion (shellfish), benthic sulphide generation and the relative risk of disease transfer between sites. The Finite Volume Community Ocean Model (FVCOM) provides the underlying hydrodynamic model, although other hydrodynamic models or measured current data can be used. Maximum wind and wave conditions can be layered to inform infrastructure exposure risk. Given the bay-specific modelling requirements for ocean models, FINS has not been applied along the entire provincial coastline to date, but implemented for a dozen key aquaculture bay ecosystems around Nova Scotia. FINS is nearing completion and currently being optimized to balance speed and accuracy of computationally intensive calculations. This presentation highlights FINS operational capacities, current development status and implications for decision support.

ROBINSON, T.

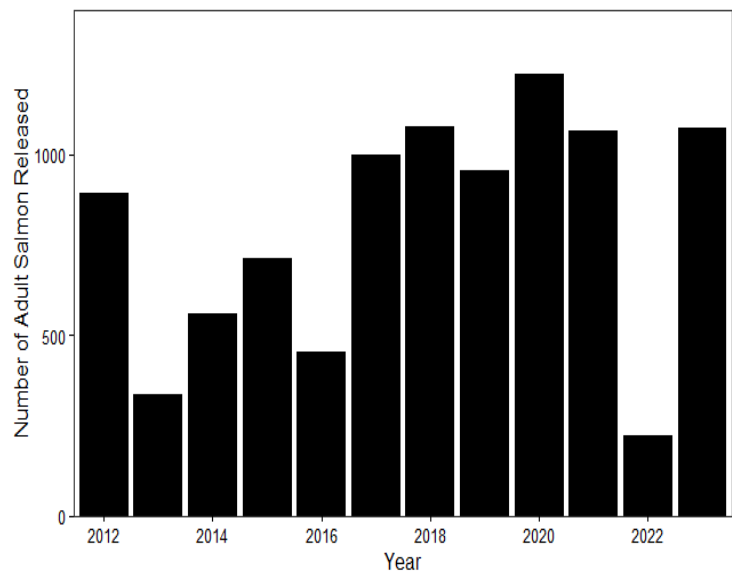
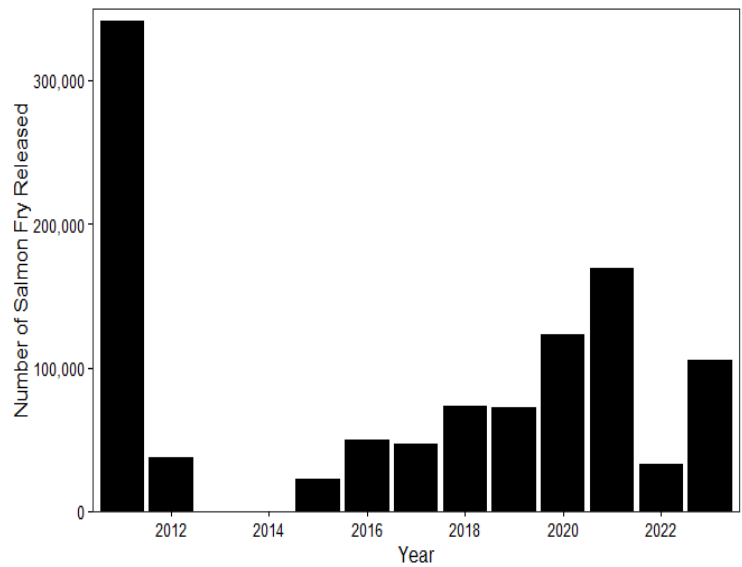
RECOVERY OF INNER BAY OF FUNDY ATLANTIC SALMON (*SALMO SALAR*) IN THE PETITCODIAC WATERSHED

Tim Robinson, Wendy Epworth, Alanah Bartlett

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88 Bernard Trail, Cherry Burton, NB
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Since 2010, Fort Folly First Nation has been leading the re-introduction of endangered Inner Bay of Fundy (IBoF) Atlantic Salmon in the Petitcodiac watershed. This watershed is critical to IBoF Atlantic salmon recovery, as it once provided habitat to ~20% of the entire IBoF population. In 1968, a causeway was constructed on the Petitcodiac River, impeding salmon from reaching their spawning habitat. The population declined precipitously, to the point of extirpation. Advocacy by grassroots organizations triggered an environmental impact assessment, ultimately resulting in the replacement of the causeway with a new bridge in 2021.

Inner Bay of Fundy Atlantic salmon are now present at all life stages in the Petitcodiac watershed due to the success of the Fundy Salmon Recovery (FSR) project. Through the FSR model, wild juvenile salmon are captured and transported to the world's first conservation farm in Dark Harbour, Grand Manan, where they are grown to maturity. Once mature, the salmon are released to their natal rivers to spawn naturally. This collaborative and innovative approach is changing the face of IBoF Atlantic salmon recovery.



SABIONI, R.

SEED DEVELOPMENT IN THE NORTH – STARTING SEAWEED AQUACULTURE IN NEWFOUNDLAND

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Rafael.sabioni@mi.mun.ca

Seaweed aquaculture is consolidated in Asia and is growing in North America. While Newfoundland has a cultural connection to seaweed, local farming is just beginning. The Centre for Aquaculture and Seafood Development (CASD) is collaborating with local companies, the province of Newfoundland and Labrador and The Canadian Centre for Fisheries Innovation (CCFI), to develop seed production and experimental farming initiatives.

The primary objective is to replicate existing techniques for Sugar kelp spore release and seed production, adapting them to environmental conditions in Newfoundland and Labrador, and to establish experimental lines for evaluating seaweed growth.

CASD successfully established five nurseries and seeded four experimental sites, one of which has already been harvested for lab analysis, with three currently ongoing. We observed that mature seaweed is primarily available in mid/late-fall and that nursery times tend to be longer than indicated in the literature. To ensure continuity, CASD is preparing the facility for gametophyte incubation, seed stocking experiments, and multi-species evaluations, as well as conducting new nursery trials.



SALVO, F.

SUPPORTING SEAWEED FARMING IN CANADA AND DEVELOPMENT OF AN ATLANTIC SUGAR KELP SEED BANK

Flora Salvo, Tristan Le Goff, Stephen O'Leary

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Merinov, the largest RD center in Fisheries, Aquaculture and processing in Canada, is supporting seaweed farming in Québec for the last 2 decades and has developed several solutions for seaweed farming in term of species diversification, adaptation, development and optimization of farming techniques as well as researching on added value in seaweed processing. Merinov leads several research projects in the domain and will discuss here the main innovation outcomes.

At sea kelp farming in Atlantic Canada is still in its infancy and there is a high demand from farms to source their juveniles from specialized marine hatcheries, of which there are few in Atlantic Canada. The two kelp species of primary interest for farming are the sugar kelp (*Saccharina latissima*) and the winged kelp (*Alaria esculenta*). In both cases, juvenile production is currently dependent on wild broodstock collection. Merinov is working on transferring conventional hatchery/nursery knowledge to the industry and is also collaborating with NRC to develop the first Canadian Seedbank of sugar kelp in an effort to better characterize and control the production of a reliable source of seed. The seed bank is based on keeping individual male and female gametophytes lines growing vegetatively in isolation. Each line will be cataloged based on its phenotypic and genetic traits. As such, the development of a germplasm bank in a lab environment supports the propagation of sugar kelp without overexploiting wild populations, and can be used to propagate juveniles for use in research, environmental restoration efforts, and aquaculture while protecting natural resources. In the long term, a controlled germplasm bank may allow the selection and breeding of strains for performance while also helping to preserve the genetic diversity of vulnerable populations.

SANDTRØ, A.

VACCINATION AND CHALLENGE AGAINST *Yersinia ruckeri*

Ane Sandtrø, Monica Gausdal Tingbø, Hege Hardersen, Mats Sekkelsten-Kindt, Fredrik Bjørnеста, Børge Nilsen-Fredriksen

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Yersiniosis in Atlantic salmon farmed in Norway is caused by *Yersinia ruckeri* (*Y. ruckeri*). Since 2015 it has mainly been a problem in larger fish (> 1kg), causing elevated mortality over 30 % at cage level. The outbreaks occurring in late sea phase have exclusively been caused by *Y. ruckeri* serotype O1b.

In order to secure long-term protection against Yersiniosis fish farmers started to use injection vaccination in 2016. Efficacy after injection vaccination, assessing RPS, and safety, have been obtained in controlled laboratory studies. Field surveys have been used to collect safety and efficacy data in a commercial setting, with focus on survival, disease detection and antibody responses.

Laboratory challenge studies with different *Y. ruckeri* serotypes have been performed in Atlantic salmon, using different administration methods and challenge models. Results from these studies will be presented and discussed.

The data show high consistency between results from laboratory studies and field surveys. There have been no registered outbreaks on fish groups vaccinated with this vaccine by injection since the start in 2016. The water-based vaccine gives high level of protection against yersiniosis in Atlantic salmon up to slaughter (18 months post vaccination) and is safe to use in co-injection.

SANTANDER, J.

DUAL-SEQ TRANSCRIPTOMICS OF *Aeromonas salmonicida* INFECTION IN *Salmo salar* PRIMARY MACROPHAGES.

Javier Santander, Ignacio Vásquez, Manuel Soto-Dávila, Ahmed Hossain, Hajarrooba Gnanagobal, Jennifer Hall

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A. salmonicida is one of the oldest known marine pathogens with a broad fish host range. *A. salmonicida* causes septicemia and death due to a toxic shock-like. The understanding of *A. salmonicida* infection in early stages of the furunculosis are key for the disease output, including intracellular infection, escape, and dissemination to lymphoid organs. Here, we conducted a dual RNA-seq study in Atlantic salmon (*Salmo salar*) primary macrophages infected with *A. salmonicida* to identify relevant genes for Atlantic salmon cellular immunity and *A. salmonicida* pathogenesis. RNA samples were taken from non-infected and macrophages at 1 and 2 hours post-infection (hpi). A total of 871 and 1,683 dysregulated genes were identified after 1 and 2 hpi, respectively. At 1 hpi we observed *A. salmonicida* modulated expression of genes associated with inflammation, fatty acids synthesis, and apoptosis. At 2 hpi we observed that *A. salmonicida* hijack pathways related to myeloid cell differentiation, cytoskeleton and actin filament organization, lysosome maturation and apoptosis. On the other hand, *A. salmonicida* up-regulate genes encoding hemolysin, aerolysin, type IVa pili, and T3SS effectors. In conclusion these results suggest that *A. salmonicida* preclude lysosome formation to survive in the cell endosome.

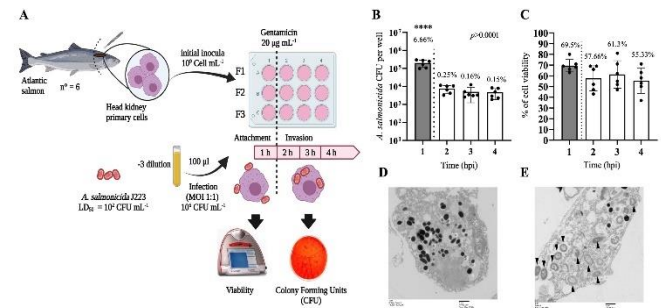


Figure 1. *A. salmonicida* intracellular infection in Atlantic salmon primary macrophages. **A.** Experimental design for primary macrophages infection assays with *A. salmonicida* (MOI 1:1; 1×10^6 cells ml^{-1}); **B.** Recovered *A. salmonicida* at 1, 2, 3, and 4 hpi; **C.** Cell viability after *A. salmonicida* infection * $p < 0.0001$; **D.** Transmission electron microscopy of healthy Atlantic salmon primary macrophages; **E.** Atlantic salmon primary macrophages infected with *A. salmonicida*. Arrow

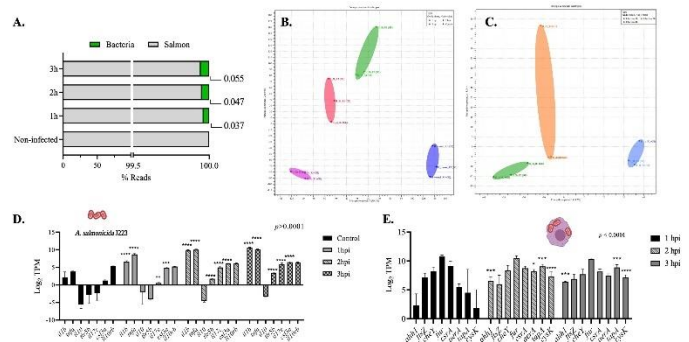


Figure 2. Dual RNA-Seq of primary macrophages infected with *A. salmonicida*. **A.** Principal component analysis of intracellular *A. salmonicida*; **B.** Mapped reads of host and *A. salmonicida*; **C.** Relative gene expression of intracellular *A. salmonicida*; **D.** Relative gene expression of infected primary macrophages. * $p < 0.05$.

SAROWAR, N.

IMPACT OF BACTERIAL COMMUNITY AND ACCLIMATION ON MORTALITY CAUSED BY OYSTER HERPES VIRUS (OsHV-1 μ Var) INFECTION IN JUVENILE PACIFIC OYSTERS *Crassostrea gigas*

Jonathan Day, Nasif Sarowar, Spencer Lunda, Fabio Zanuzzo, Christopher Langdon

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Current understanding of host-pathogen interactions suggests that OsHV-1 disrupts microbiota homeostasis and alters host physiology, ultimately leading to mortality. To investigate microbial role and acclimation impact on infection outcome, this study challenged juvenile Pacific oysters with OsHV-1 μ Var at 22°C with- and without-antibiotic treatments after 2-days (Assay-1) or 16-days of acclimation (Assay-2).

In Assay-1, oysters treated with both Streptomycin and Ampicillin (200 ppm each) had a significantly higher mortality (83.8%) compared to that of the without-antibiotics group (44.9%) at 10 days post-challenge (DPC). In assay-2, oysters treated with Ampicillin alone showed improved survival (19.9%) than the without-antibiotic group (40.6%) after 16 DPC. Although mortalities were comparable in the without-antibiotic group across both assays, longer acclimation led to a slower daily mortality in Assay-2 (44.9% by 10dpc vs 40.6% by 16dpc). Control oysters remained healthy without mortality despite antibiotic exposure and handling without OsHV-1.

The results indicate Streptomycin and Ampicillin negatively impacted oyster survival during OsHV-1 infection. Ampicillin alone improved survival but did not eliminate mortality. Longer acclimation may have altered host physiology, contributing to the observed slower mortality rate in Assay-2. Overall, our findings support the hypothesis that microbial community plays a role in oyster mortality during OsHV-1 infection.

SEMPLÉ, S.L.

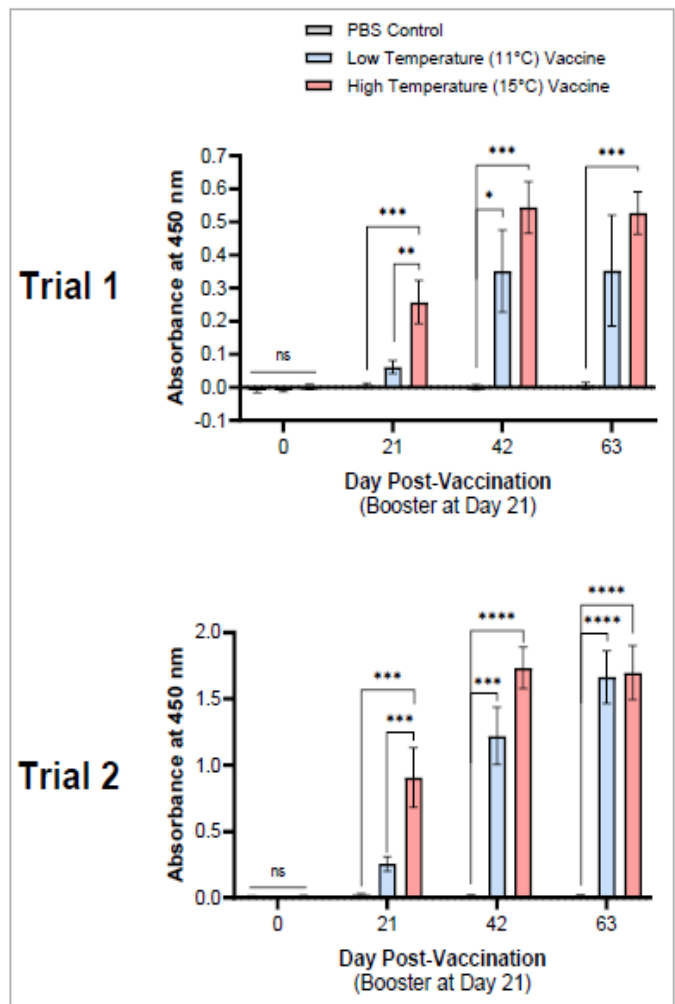
HARNESSING IMMUNE DEFENSES FOR PROTECTION AGAINST *TENACIBACULUM* INFECTIONS IN SALMONID SPECIES

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Tenacibaculum maritimum is the main culprit for yellow mouth (YM) and the leading cause for antibiotic use in BC Atlantic salmon culture. This risks the generation of antibiotic-resistant strains and brings significant costs to aquaculture producers. YM only occurs in fish recently transferred to saltwater, where fish die rapidly with few clinical signs apart from yellow plaques around the mouth. If fish survive the first four months following saltwater transfer, they appear to be resistant to YM suggesting that immune memory plays a role.

To explore this possibility, an indirect ELISA specific for salmonid serum-IgM production towards a North American strain of *T. maritimum* was developed. This assay confirmed that Atlantic salmon cultured in commercial sea pens develop antibodies to *T. maritimum* which significantly increase over 220 days. To determine whether antibody production could be induced, naïve rainbow trout were vaccinated with a formalin-inactivated *T. maritimum* vaccine while being maintained at low- and high-water temperatures. Pathogen-specific antibody development was significantly enhanced by higher water temperatures 21-days post-injection. When a booster was given, any temperature-related differences between vaccinated groups were eliminated. A better understanding of salmonid antibody development towards *T. maritimum* could provide valuable insight into the development of effective prophylactics.



SOTO-DÁVILA, M.

mRNA VACCINE TO PREVENT INFECTIOUS SALMON ANEMIA IN ATLANTIC SALMON

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Infectious salmon anemia is a WOAHP notifiable disease caused by ISA virus. Although vaccines are available for ISAv, they do not offer complete protection against infection. mRNA vaccines are composed of a delivery vehicle and one or more nucleic acids encoding for a single or multiple antigen candidates. In ISAv, P3 or fusion [F] protein and hemagglutinin-esterase [HE] protein have shown promising results for mRNA vaccine development. We evaluated vaccination of single stranded mRNA coding for these virulence factors through a novel delivery system. Fish were intramuscularly injected with a 200 µL dose of either 1 µg/g, 0.1 µg/g, or 0.01 µg/g concentration of each mRNA vaccine. Then, half of the fish per group were boosted after ~1000-degree days. Separately, unvaccinated fish (donors) were infected with ISAv (HPR4 isolate at TCID₅₀ 1x 10⁴) and added to each experimental cohabitation tank to obtain a 5:1 ratio of cohabitant to donor fish. Fish survival was recorded, and serum, head kidney, and spleen were collected from all the groups (n=5) 1 day post initiation of mortality. Our results show that two Fusion protein targets showed significantly higher survival compared to sham vaccinates. Current analyses are focused on determining the presence of salmon antibodies through serum virus neutralization and the modulation of anti-viral responses.

STEWART-CLARK, S.

WHAT DO YOU DO WHEN A BLOB FOULS YOU? TRANSCRIPTOMIC ANALYSIS OF IMPACTS OF *Ciona intestinalis* FOULING ON BLUE MUSSELS

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Blue Mussels, *Mytilus edulis*, grow in the intertidal zone and have adapted mechanisms that help protect against settlement by fouling organisms on their own shells. These include the size and shape of concentric rings on the outer shell, and the production of a protective biofilm. In mussel farms throughout Atlantic Canada, and in many other regions of the world, the Vase tunicate, *Ciona intestinalis*, has become a significant challenge on mussel farms. The vase tunicates attach to mussels and eventually cause byssal threads to snap due to the excess weight added by tunicate biofouling. Understanding which proteins are being up or downregulated while mussels experience fouling can help us understand the true cost of tunicate fouling to the mussel as well as the trade offs that are made by mussels overcoming such significant biofouling. On aquaculture farms in Prince Edward Island, Canada, treatments to remove the Vase Tunicate have been developed which use high pressure nozzles to blast the soft tunicates from mussel lines. During this treatment, mussels close their shells and are protected. While studies have explored the impact of tunicate treatment on mussel growth and farm production, we examine for the first time the transcriptomic impact on mussels to this treatment for invasive tunicates. Understanding the molecular mechanisms of mussel response to fouling and to fouling treatments can help develop novel treatments to prevent tunicate fouling on mussel farms and to understand what trade offs the mussel is making to respond to being fouled and treated on mussel farms.

STEWART-CLARK, S.

**THE COST OF IGNORING FEED CONVERSION RATES IN SHELLFISH
AQUACULTURE**

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Although feed conversion in finfish aquaculture is heavily researched, feed conversion in shellfish has largely been ignored. Since feed on most shellfish farms is supplied by the natural environment, industry members tend to think of this feed as being “free”. However, phytoplankton resources in estuarine ecosystems are limited, and stocking levels on farm sites are restricted so as not to exceed the carrying capacity of the ecosystem. We found a wide variation in conversion rates and metabolic efficiency in individual oysters collected in an oyster farm in New Brunswick. Shellfish that don’t efficiently convert nutrient resources into growth and survival are wasting limited phytoplankton resources on farm sites. Since shellfish seed in Atlantic Canada is largely wild, we measured wide variation within the population with regards to feed conversion and efficient metabolic rates. We used markers assisted selection to select for shellfish that most efficiently convert phytoplankton into growth decreasing the length of the production cycles of farmers, increasing the proportion of seed that ends up as a market size product and increasing the overall production of shellfish farms. This is particularly important in areas where carrying capacity is at or near its limits, in species where market demand exceeds production, and in regions where space for new leases are limited. When we fail to address feed conversion on shellfish farms we leave money on the table and dead shellfish on the bottom.

TABATABAEI POZVEH, H.S.

SEX IDENTIFICATION IN SHORTRNOSE STURGEON *Acipenser brevirostrum* BY MULTIPLEX PCR

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Sex-specific information is crucial for sturgeon culture, conservation, and fisheries management. However, identifying the sex of sturgeon is difficult, especially for immature individuals. Two recent studies identified two female-specific loci (AllWSex2 and SSM4) that are conserved among many Acipenserid species, but they have not been validated for all species within this family. The aim of this study was to determine whether these markers can be used to determine the sex of shortnose sturgeon. DNA was extracted from 36 frozen whole blood and 38 tissue (mainly fin clip) samples from fish which had previously been sexed from gonadal biopsies. A multiplex PCR was then set up using three pairs of primers: AllWSex2 and SSM4 as female-specific loci and mtDNA as an internal control (Table 1) and run on 2 % agarose gel.

All fish showed the 300 bp mtDNA band but AllWSex2 (100 bp) and SSM4 (400 bp) were only present in females (Fig. 1).

Complete agreement was achieved between genotypic and phenotypic sex for both the blood and tissue samples, thereby validating the use of these markers for sex identification in shortnose sturgeon using previously collected samples. Multiplex PCR is a relatively simple method that can be used to improve sturgeon aquaculture for caviar production and for ecological and management studies.

Table 1. Primer pairs used for multiplex PCR.

Loci	Primer sequence (5' to 3')	Reference
AllWSex2	F: TGATCAACCTCTTCAGCAATGTC R: TGAGAGCCACTGTACTAACACA	Kuhl et al. 2021
SSM4	F: TCGGTATCTTAAACTGAACCAA R: AGATGGAGAATTCATTGCCTA	Ruan et al. 2021
mtDNA	F: CCCTGATCCTAATGTTTTTCGGTTGG R: AGATCACGTAGGACTTAAATCGTT	Ruan et al. 2021

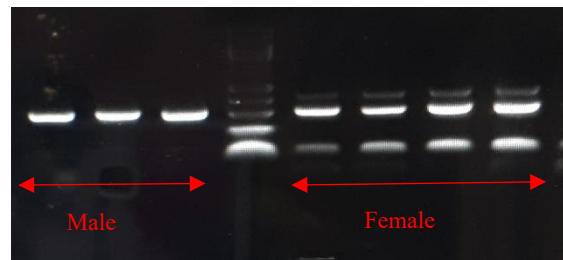


Fig. 1. Validation of female-specific markers in shortnose sturgeon using multiplex PCR. The internal control (mtDNA; 300bp) was amplified in both males and females, whereas AllWsex2 (100 bp) and SSM4 (400 bp) were only amplified in females. Ladder: 100 bp.

References

Kuhl et al., 2021. A 180 Myr-old female-specific genome region in sturgeon reveals the oldest known vertebrate sex determining system with undifferentiated sex chromosomes. <https://doi.org/10.1098/rstb.2020.0089>

Ruan et al., 2021. Screening and identification of female-specific DNA sequences in octaploid sturgeon using comparative genomics with high-throughput sequencing. <https://doi.org/10.1016/j.ygeno.2021.11.012>

TABATABAEI POZVEH, H.S.

FIRST ATTEMPT AT INDIRECT PRODUCTION OF ALL-FEMALE TRIPLOID RAINBOW TROUT *Oncorhynchus mykiss*

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Theoretically, neomale tetraploids can be used as a source of diploid XX sperm for the production all-female triploid (sterile) stocks of fish. In this study, late thermal shock was used to induce tetraploidy in rainbow trout zygotes by blocking the first cell division. The larvae were then fed a diet containing 17 α -methyltestosterone (3 mg/kg) for two months at 11 °C, beginning at first feeding. At sexual maturity, 30 months after fertilization, the fish were screened for ploidy using flow cytometry to measure cellular DNA content. The testes of neomale tetraploids and diploids with clear secondary sexual characteristics were then surgically removed and the DNA content of their spermatozoa analyzed using flow cytometry (Fig. 1). Diploid and haploid milt, from tetraploids and diploids, respectively, was then used to fertilize haploid eggs (from diploid females), and survival rates were analyzed until hatching (Table 1).

Sperm quality was evaluated by its ability to fertilize eggs and produce healthy embryos. However, successful fertilization depends on both egg quality and the interaction between eggs and sperm. Table 1 shows similarity in fertilization success and survival to hatch for crosses using milt from neomale diploids tetraploids.

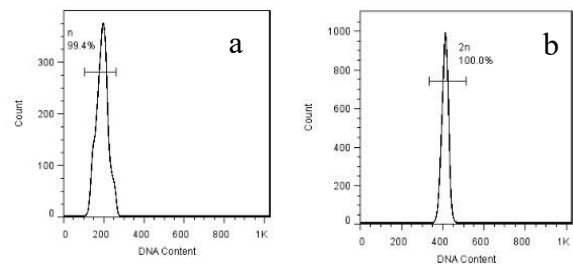


Fig.1. Flow cytometric measurement of DNA content of sperm from representative diploid (a) and tetraploid (b) neomale rainbow trout.

Table 1. Percent fertilization success and early survival rate (mean \pm standard deviation) using milt collected from diploid and tetraploid neomale rainbow trout to fertilize

Parameter	Diploid	Tetraploid
Fertilization	95.33 \pm 1.53	92.00 \pm 6.08
Eyed stage	83.19 \pm 6.04	73.45 \pm 4.93
Hatching	66.33 \pm 6.24	63.33 \pm 4.93

To best of our knowledge this is the first report of producing all-female triploid rainbow trout using neomale tetraploids. This “indirect” approach is a promising alternative to the typical direct approach currently used for the mass production of triploids that holds relevance for both scientific inquiry and practical applications in aquaculture.

TEASDALE, M.

AI AND SEAWEED DEVELOPMENTS IN ST MARY'S BAY AND CONCEPTION BAY SOUTH, NL

Michael Teasdale, Mikhailey Wheeler, Nick Mercer, Myrah Graham

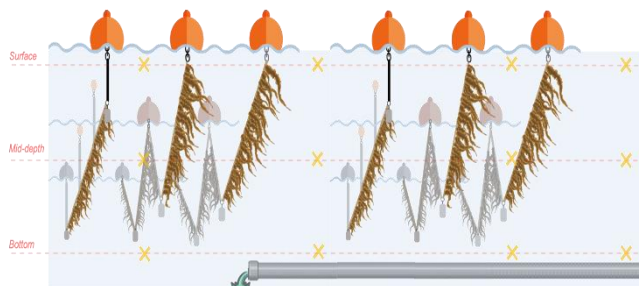
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Seaweed farming is a sustainable and environmentally conscious industry that is being investigated globally as one of the potential avenues to reducing greenhouse gases and acting as a carbon sink. However, seaweed also serves as a nutrient sink, absorbing pollutants from various sources like municipal sewage and agricultural runoff, thereby improving water quality and preventing the formation of dead zones.



In the Atlantic provinces, where many coastal communities lack adequate wastewater treatment, integrating seaweed biofilters at saltwater discharge points shows promise in meeting effluent quality standards. For instance, in Conception Bay South (CBS), where primary treatment facilities struggle to meet regulations, seaweed biofilters could significantly reduce contaminants and prevent ecological harm.

Here we present HoldFastNL's planned and ongoing pilot projects in Newfoundland that utilize seaweed both as a product and a service; a seaweed farm in St. Mary's Bay and a service project for biofiltering wastewater in CBS. Both projects also have a technological component with our colleagues at Coastal Carbon using remote sensing, near-field sensors, and ground truthing data to help build the AI models furthering the development of seaweed as an aquacultural resource in North America in terms of both a commodities market and an ecosystem service.



TETTEH, P.

INTERACTION OF FEED RESTRICTION AND ZINC EXPOSURE ON LIVER AND HEART MITOCHONDRIAL BIOENERGETICS IN RAINBOW TROUT *Oncorhynchus Mykiss*

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Feed restriction (starvation) has been explored as a strategy to reduce the production costs and environmental impacts of aquaculture. Although starvation causes redirection of energy resources towards maintenance and survival, the underlying mechanisms of this metabolic shift are not fully understood. The liver plays a key role in maintaining metabolic homeostasis while the heart is the main energy consumer by weight in the body. Thus, the liver and heart are attractive organs to investigate metabolic plasticity of altered food availability. Because mitochondria comprise the cellular energy conversion hubs, we interrogated the effect of starvation and refeeding on their bioenergetic function. Additionally, we assessed how zinc (Zn), an essential trace element required for growth and normal physiology in fish, moderates the effects of starvation and refeeding on mitochondrial bioenergetics. Rainbow trout (*Oncorhynchus mykiss*) were maintained under three feeding regimes: satiation feeding (control), 7-day food restriction (starved), and one-time satiation feeding following 7-day food restriction (re-fed). Liver and heart mitochondria were isolated, and the respiration activities driven by complex I, (CxI) and complex II (CxII) were measured without and with Zn exposure. Liver and heart mitochondrial CxI and CxII respiratory activities were reduced by starvation, but liver mitochondria were more responsive to refeeding. Compared with liver, heart mitochondrial CxI and CxII respiratory activities were more sensitive to the inhibitory effect of Zn. Notably, our study suggests that low Zn concentrations temper the inhibitory effects of starvation on mitochondrial bioenergetics and can be used to mitigate metabolic disturbances associated with feed restriction.

TORRIE, N.

SUPPORTING AQUACULTURE THROUGH COASTAL OCEAN MONITORING: PROGRESS, LESSONS LEARNED, AND FUTURE PLANS

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The Coastal Monitoring Program, operated by the Centre for Marine Applied Research (CMAR), fills a critical gap in ocean monitoring, providing high resolution ocean data for coastal Nova Scotia. CMAR maintains a network of over 70 nearshore oceanographic monitoring stations to measure key ocean variables including temperature, dissolved oxygen, salinity, and currents. The resulting long-term datasets can supplement offshore or remote sensing data for strategic decisions on climate change preparedness for aquaculture.

CMAR has identified challenges, implemented data best practices, and developed novel approaches to optimize field operations and data sharing efforts. Ongoing challenges to data collection include equipment vandalism, accessing remote locations, and biofouling. If left unaddressed, these can result in economic losses and disruptions to long-term timeseries. The Coastal Monitoring Program data team follows metadata best practices and has implemented careful QAQC (Quality Assurance, Quality Control) procedures to uphold high quality data products. Detailed standard operating procedures which ensure standardized methods for deploying sensors, processing data, and generating reports, can help to address impacts of identified challenges.

CMAR is continuing ongoing partnerships with industry and government to provide useful datasets, expand program scope, and support the development of collaborative monitoring programs in adjacent regions. Implications, lessons learned, and future plans for CMAR's Coastal Monitoring Program are discussed.

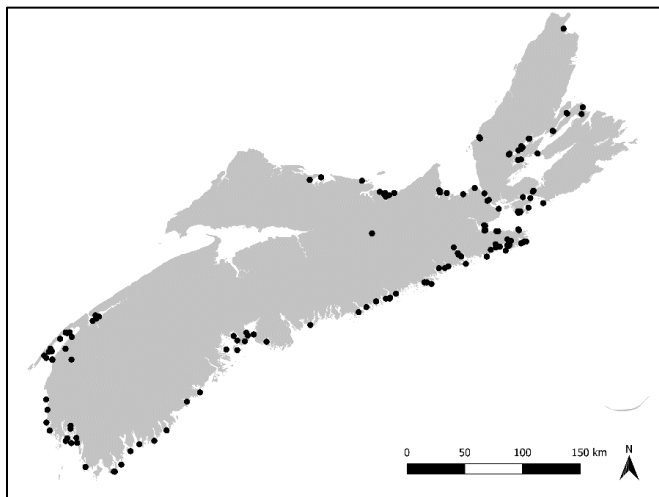


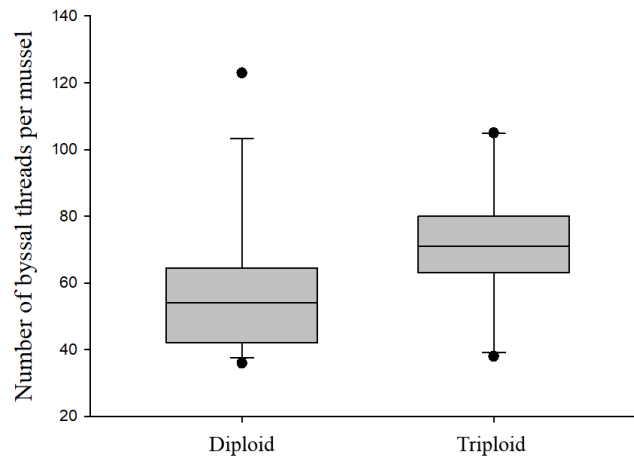
Figure 1: Deployment locations for autonomous sensors collecting temperature, dissolved oxygen, and/or salinity data

TREMBLAY, R.

TRIPLOID MUSSELS WITH BETTER ATTACHMENT MAY ACT AS IMPROVED EXTRACTIVE SPECIES

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Mussels are considered as an extractive species by their phytoplankton consumption and, when harvested, extract nutrients from the environment, thereby mitigating eutrophication. However, mussels inadvertently falling off suspended collectors and socks can result in economic loss and the return of excess nutrients to the environment. Mussels which fall onto fine-silted bottoms eventually die from clogging of their gill apparatus. The fall-off rate is particularly high during the reproductive season when mussels invest most of their energy in reproduction. In this study, we tested the hypothesis that curtailed reproductive investments in triploid mussels benefits the production and quality of byssal threads. Specifically, we compared the production and mechanical properties of byssal threads of 1- and 2-year-old diploid and triploid mussels in relation to their reproductive investment. We challenged mussels in a hydrological flume to induce byssogenesis and then counted the number of threads and measured their tensile strength. We found that 1- and 2-year-old triploid mussels produced respectively 40% and 25% more threads than diploid mussels; moreover, the threads from triploids had enhanced mechanical properties. Triploid mussels had significantly reduced gonadosomatic index and gonad volume. In conclusion, our laboratory observations suggest triploidy could potentially mitigate the lost of mature mussel crops prior to their harvest, which from an ecological perspective could enhance the extraction of excess nutrients.



Production of byssal threads by diploid and triploid mussels over three days under hydrodynamic flume conditions

TREMBLAY, R.

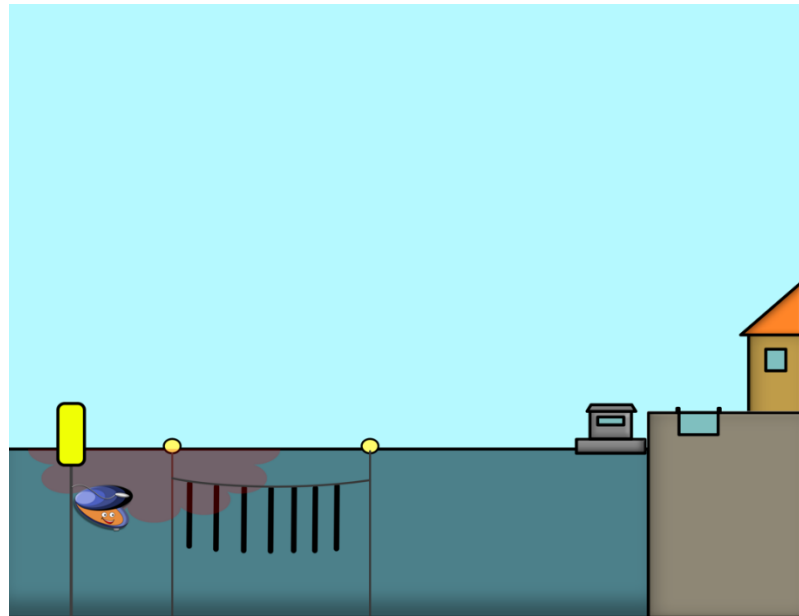
USE OF MUSSEL GAPING BEHAVIOUR TO DETECT ENVIRONMENTAL PERTURBATIONS IN DIPLOID AND TRIPLOID MUSSELS (*Mytilus edulis*)

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Aquaculture realized in open coastal areas exposed individuals to environmental issues, as water contamination by pollutants, toxins or global warming. Thus, cultivated organisms need to be monitored to anticipate stressful conditions or intoxication. An *in situ* continuous monitoring tools for gaping behaviour has been developed to detect the performance of mussels (*Mytilus edulis*). In previous studies, we demonstrated that this gaping behaviour of mussels can be used to detect water pollution and toxic algae blooms. In the presence of chemical toxins, a systematic closure was detected and could be used as an index of pollutant contamination. Similarly, during exposure to *Alexandrium catenella*, producing paralytic shellfish poisoning, partial paralysis was detected by valvometry 10 days before the harvest closure threshold. Valvometry coupled to probes (temperature, salinity, fluorescence, turbidity, light intensity), will be used to assess the fitness of different stocks, like triploid and diploids produced in hatcheries and spat from wild collection, will be compared, particularly with heat wave events. The study will focus on identifying a behavioural index to anticipate mass mortality. The frequency of heatwaves is suspected to increase with the global warming. Thus, it is important to know their effect on the triploid mussels before their commercial use.



TRUDEL, M.

MODELLING THE DISPERSION OF THE INFECTIOUS SALMON ANEMIA VIRUS (ISAV) FROM ATLANTIC SALMON FARMS IN THE QUODDY REGIONS OF NEW BRUNSWICK, CANADA, AND MAINE, USA

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Pathogen dispersal from infected aquaculture sites into the surrounding ocean poses risks of infection to wild and farmed species, but is difficult to predict. This study aimed to build a framework using an ocean circulation and a particle tracking models in conjunction with a dynamic infection model and a virus inactivation model to simulate the dispersal of the infectious salmon anemia virus (ISAV) from Atlantic salmon farms. Simulated particles were released from hypothetically infected farms, and advected by modelled currents. Inactivation of viral cohorts by ambient ultraviolet radiation and natural microbial communities was simulated during advection. Simulations showed that ISAV concentration varied spatiotemporally with the progression of the outbreak, current speed and direction, tidal elevation amplitude, and environmental decay. Connectivity among aquaculture sites varied in relation to seaway distances, though simulations showed that connectivity can also be asymmetrical between farm sites. Sensitivity analyses showed that the dispersal of ISAV was moderately sensitive to uncertainty associated with the viral decay model, highlighting the importance of obtaining accurate estimates of inactivation rates of ISAV. This framework provides an approach to simulate waterborne viral transmission that considers the biology and epidemic features of significance for pathogens and the dynamic conditions of the ocean.

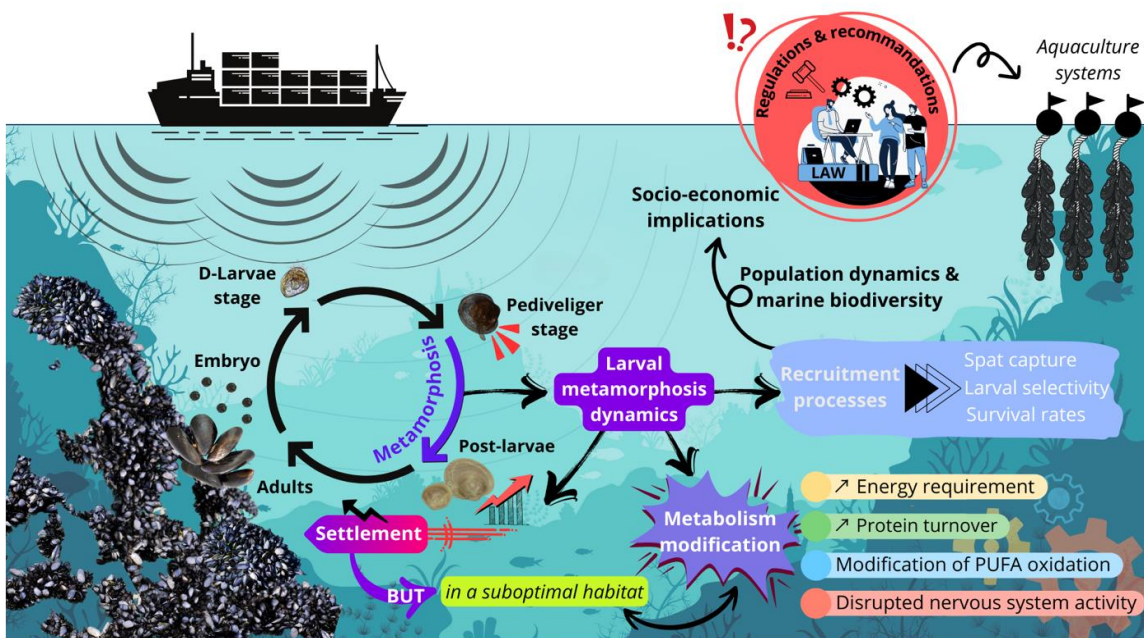
VEILLARD, D.

MOLECULAR EVIDENCE OF SHIPPING NOISE IMPACT ON THE ONTOGENY OF THE BLUE MUSSEL, *Mytilus edulis*

Delphine Veillard, Stéphane Beauclercq, Alexandre A. Arnold, Elena Palacios, Bertrand Genard, Frédéric Olivier, Anne Choquet, Dror E. Warschawski, Isabelle Marcotte, Réjean Tremblay

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Anthropogenic oceanic noise due to shipping has increased up to 32-folds in the last five decades, prompting growing global apprehension regarding its potential effects on wildlife. Here we use *Larvosonic* mesocosms tanks to investigate the effect of shipping noise during crucial early life stages, embryogenesis, and metamorphosis, on the metabolome, development, and survival of the blue mussel *Mytilus edulis*. We found that during the embryogenesis, exposure to shipping noise induces stress-related inflammation, a metabolic imbalance or cellular stress due to increased energy demand with a disruption of glycolysis. Metabolome results also indicated the development of defenses against oxidative stress in embryos submitted to shipping noise. In competent larvae from the same cohort, shipping noise promoted settlement rates with greater metabolic costs, which may be used by mussel farmers to increase spat collection. However, in natural environment shipping noise could impact the ecosystem as competent mussel larvae struggle to select suitable development habitats. Noise generated by maritime traffic has a direct impact on the development of bivalve larvae, negative on embryos and natural recruitment, but could be positive for spat collection on artificial collectors. Our work, on an ecologically and socioeconomically important taxon, demonstrates that anthropogenic noise can affect natural recruitment potential implications for community structure and function. Without action to limit underwater noise, such impacts could disrupt population structures and marine biodiversity.



WEITZMAN, J.

DEVELOPING A COASTAL CLASSIFICATION SYSTEM FOR AQUACULTURE IN NOVA SCOTIA: A SUITABILITY ASSESSMENT

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Effective spatial planning is critical for sustainable aquaculture development and management. To promote holistic siting and zoning, identifying suitable areas for aquaculture is paramount, requiring comprehensive evaluations to account for multiple biophysical and ocean use factors.

To support the development of a Coastal Classification System (CCS)¹, the Centre for Marine Applied Research is assessing the spatial suitability of coastal waters for aquaculture in Nova Scotia (Fig 1).



Fig 1. Coastal waters within 3km off Nova Scotia will be assessed for aquaculture suitability within the CCS

Through an evidence based and collaborative process, this project will identify and assess factors that influence aquaculture suitability, in consideration of critical needs for species health and welfare, potential area-use overlap with other marine users, and proximity to important coastal habitats. Using Multi-Criteria Decision Analysis (MCDA), diverse criteria will be assigned suitability ratings based on expert insights. By assigning suitability ratings to each data layer, suitability maps will be derived within Geographic Information Systems (GIS) that can identify areas with the highest potential suitability for sustainable aquaculture development, unique to different types of aquaculture (salmon, trout, mussels and oysters).

This project is also developing an online mapping platform to provide stakeholders and the public interactive access to these findings. By embracing spatial planning perspectives, the integrated GIS-MCDA approach coupled with an interactive mapping platform can help support evidence-based and holistic aquaculture decision-making.

¹ Developed for the Nova Scotia Government - <https://novascotia.ca/coastal-classification-system-engagement/>

WILSON, E.

COMMERCIAL SCALE ON-LAND (*Palmaria palmata*) CULTIVATION AT ACADIA SEAPLANTS, NOVA SCOTIA.

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Acadian Seaplants Limited (ASL) operates the world's largest on-land seaweed cultivation facility for human food production. From this facility in Nova Scotia, ASL now produces multiple finished products from cultivated *Chondrus crispus* and *Palmaria palmata*. The on-land cultivation of *Chondrus crispus* (Irish Moss) produces Hana-tsunomata®, Kaiso Salad ingredients with excellent acceptance in Japanese markets. Hana-tsunomata® production continues to be successful, but to diversify product offerings and to increase total farm productivity, recent research at ASL has focused on the domestication of *Palmaria palmata*. The on-land cultivation of *Palmaria palmata* in Nova Scotia is now being fully commercialized and its domestication signals a shift away from wild harvest dependency.

WILSON, T.

IS THERE OPPORTUNITY FOR THE DEVELOPMENT OF COMBINED OFFSHORE WIND AND AQUACULTURE IN NOVA SCOTIA, CANADA?

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With the production of sustainable food and renewable energy an international priority, combining offshore wind (OSW) farms with offshore mariculture has seen growing interest. Despite this, offshore commercial aquaculture and wind turbines are absent from Nova Scotia waters. Recently, however, the province has experienced a surge in interest and investment in OSW energy development, driven by the region's abundant wind resources and renewable energy commitments. In the past year, two separate assessment reports - one by The Regional Assessment of Offshore Wind Development in Nova Scotia and another by Aegir for Net Zero Atlantic - have identified potential development areas (PDAs) using different metrics. These reports suggest many proposed locations may not be conducive for combined OSW and offshore finfish aquaculture as they are positioned beyond practical travel distances for offshore aquaculture management or within waters of known superchill. However, there may be greater possibility for offshore shellfish cultivation. As such, there is reason to consider the potential of shared multi-use spaces combining OSW and aquaculture in Nova Scotia. This presentation explores necessary biophysical requirements, technological capabilities, and social and economic considerations, to discuss preliminary insights on the development of shared aquaculture and OSW spaces.

ZANUZZO, F.

***Aspergillus niger* β-GLUCAN ENHANCES ATLANTIC SALMON RESISTANCE TO ULCERATIVE DISEASE COMPARED TO COMMERCIAL YEAST PRODUCT**

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Tenacibaculosis and winter ulcers, skin-associated diseases, have caused substantial economic losses in the global farming of salmon. The present study investigated the in-feed efficacy of novel *Aspergillus niger* β-glucan (Mycofence®) against ulcerative *Tenacibaculum maritimum* and *Moritella viscosa* infection compared to commercial *Saccharomyces cerevisiae* β-glucan and a non-enriched control.

Atlantic salmon were fed with five different diets (see Fig.1.) for 5-6 weeks before and 8-9 weeks after *T. maritimum* or *M. viscosa* challenge. Different diet groups were monitored for mortality and sampled for immune response parameters and lesion severity.

Mortality after *T. maritimum* challenge was comparably reduced by 0.2 and 0.3% Mycofence® and 0.1% yeast β-glucan, and was reduced significantly after *M. viscosa* challenge by 0.3% Mycofence® (see Fig. 1). *A. niger*-derived β-glucan therefore provided comparable or improved protection against *T. maritimum* and *M. viscosa* infection to commercial yeast β-glucan. Growth performance, severity of lesion, hematology markers, transcript expression of immune markers and absolute quantification of bacteria in different groups will be discussed.

This finding highlights the relevance of investigating non-yeast sources of β-glucan as immunomodulators and reinforces the potential of *A. niger* β-glucan to the salmon industry as a sustainable and environmentally friendly approach to preventing disease outbreaks.

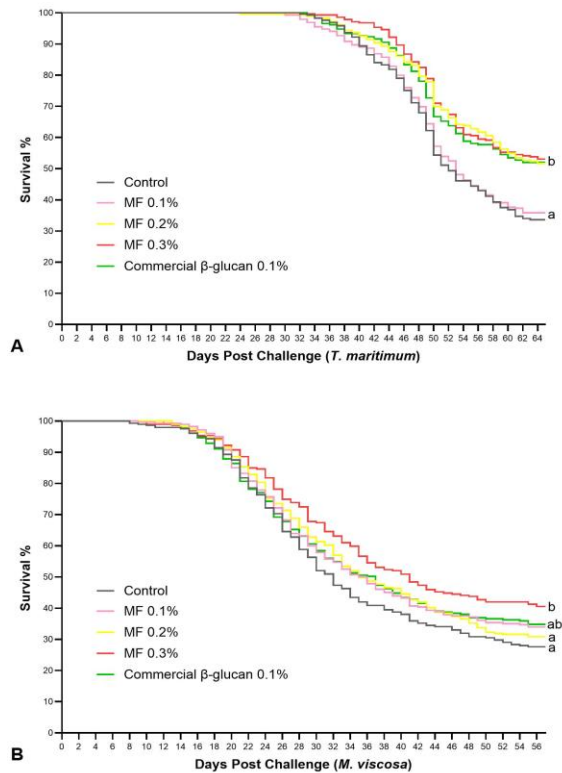


Fig. 1. Mortality in Atlantic salmon challenged with *T. maritimum* (A) or *M. viscosa* (B) after feeding trial for 5-6 weeks with Mycofence® (0; 0.1; 0.2 and 0.3%) or commercial yeast β-glucan. Different letters indicate a difference ($P < 0.05$) between treatments.

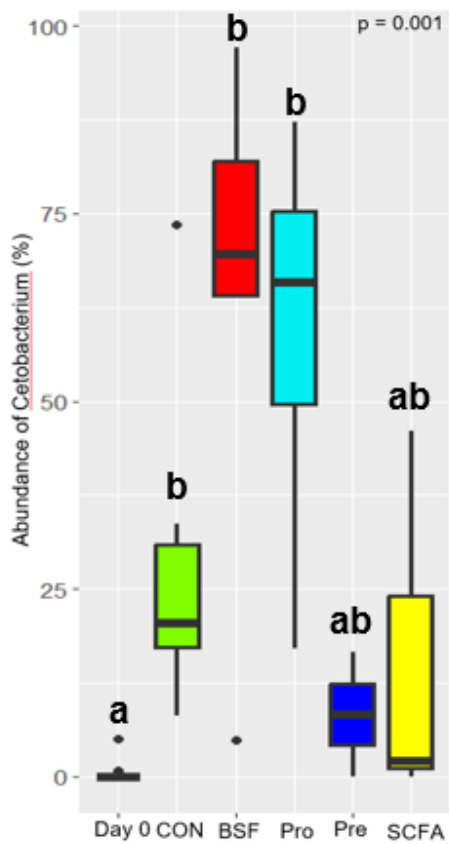
ZHANG, J.

IMPACTS OF FEEDING INSECTS AND YEAST AS FUNCTIONAL FEED ADDITIVES ON THE GROWTH, NUTRITION AND MICROBIOME OF ZEBRAFISH AS A MODEL SPECIES

Junyu Zhang, Nancy Gao, Cody Anderson, Madeline Borland, Ilan Carmi Riesenbach, Niel Karrow, Terry Van Raay, David Huyben

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The industry needs to replace fishmeal with more sustainable alternatives, such as black soldier flies (BSF), in aquafeeds while improving fish health without antibiotics, e.g. using functional ingredients such as yeast and short-chain fatty acids. However, running a feeding trial to evaluate new ingredients on farmed fish is expensive, resource intensive and time consuming. Zebrafish



(*Danio rerio*) are an ideal model for studying responses to new ingredients due to their rapid growth, small size and high reproductive capacity. A 9-week feeding trial with zebrafish (0.1g) was conducted to characterize the growth and microbiome responses when supplementing BSF, probiotic and prebiotic yeasts, and sodium butyrate in the diet. Whole fish carcasses were collected and analyzed for nutrients and the 16S rDNA was sequenced using Illumina MiSeq. Zebrafish fed BSF and butyrate diets had the highest weight gain and the lowest FCR, although not statistically significant. Both BSF and butyrate groups had increased alpha diversities compared to the probiotic and prebiotic diets, and *Cetobacterium* was the dominant genus in the microbiome of the BSF and probiotic groups (Figure 1). This study demonstrated that these ingredients did not impact the growth negatively while BSF and butyrate changed the microbiome of zebrafish.

Figure 1. Abundance of *Cetobacterium* in zebrafish fed a fishmeal diet at day 0 (Day 0), and fed 5 experimental diets containing fishmeal (CON), black soldier meal (BSF), probiotic yeast (Pro), prebiotic yeast (Pre), and sodium butyrate (SCFA) at day 60

ANDERSON, C.

EFFECTS OF BLACK SOLDIER FLY AND YEAST ON THE GROWTH PERFORMANCE AND GUT MICROBIOME OF RAINBOW TROUT USING IN VIVO AND IN VITRO TRIALS

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The aquaculture industry must improve fish health without the use of antibiotics. The aim of this study was to feed black soldier fly (BSF) and yeast to improve fish health. A four-month feeding trial was conducted at the Ontario Aquaculture Research Centre (Elora, ON). The trout (91 g) were divided into triplicate tanks of 30 fish and fed five diets. The diets consisted of a control, 10% BSF, 1% probiotic yeast, 0.1% and 0.2% prebiotic yeast. The BSF and prebiotic diets improved growth and FCR but were not significant (Figure 1.). Early findings of this feeding trial suggest that partially replacing fish meal with BSF leads to faster growing fish. An in vitro method was examined that may alleviate the ethical burden of gut microbiome research. The chemostat method simulates the conditions of the intestine to allow for the culture of otherwise unculturable microbes. The chemostat enabled growth for the genera; *Shewanella*, *Carnobacterium* and *Clostridioides*. The method is still under de

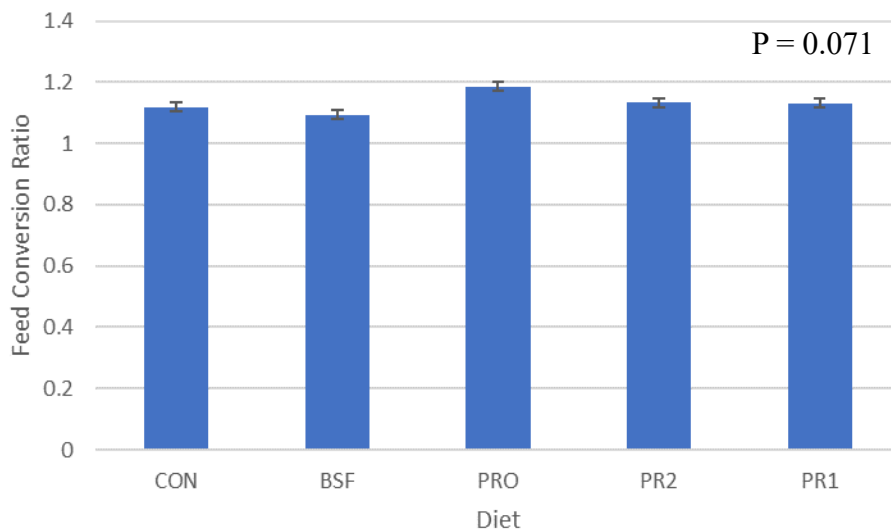


Figure 1. The final average feed conversion ratio for all five treatments after the conclusion of the trial. Control (CON), black soldier fly (BSF), probiotic (PRO), prebiotic 2% inclusion rate (PR2), prebiotic 1% inclusion rate (PR1).

BEAUDREAU, N.

**IMPLEMENTING AN EFFECTIVE STRATEGY FOR AMERICAN EEL *Anguilla rostrata*
AQUACULTURE IN QUEBEC: INNOVATIVE BREEDING PROTOCOLS AND
DEVELOPMENT PROSPECTS**

**VERS UNE AQUACULTURE PERFORMANTE DE L'ANGUILLE D'AMÉRIQUE
Anguilla rostrata AU QUÉBEC : PROTOCOLES D'ÉLEVAGE INNOVANTS ET
PERSPECTIVES DE DÉVELOPPEMENT**

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Food systems must drastically change in the coming decades to provide sufficient nutrients to a growing human population while also reducing and even reversing their harmful ecological impacts. Aquaculture, when properly managed, is capable of acting as a food production system and providing a net ecological benefit in what is known as “restorative aquaculture”. Merinov, a leading applied research centre in Québec, Canada, is partnering with the eel-farming industry and government agencies to implement a joint-program for the commercial production and conservation of American eels (*Anguilla rostrata*). The objectives of this program are to obtain crucial knowledge related to growth parameters in controlled conditions, assess economic feasibility, and measure the impacts of restocking on species recovery in the Gaspésie region. We present preliminary findings of our work and expected outcomes of this restorative aquaculture program for coastal communities.

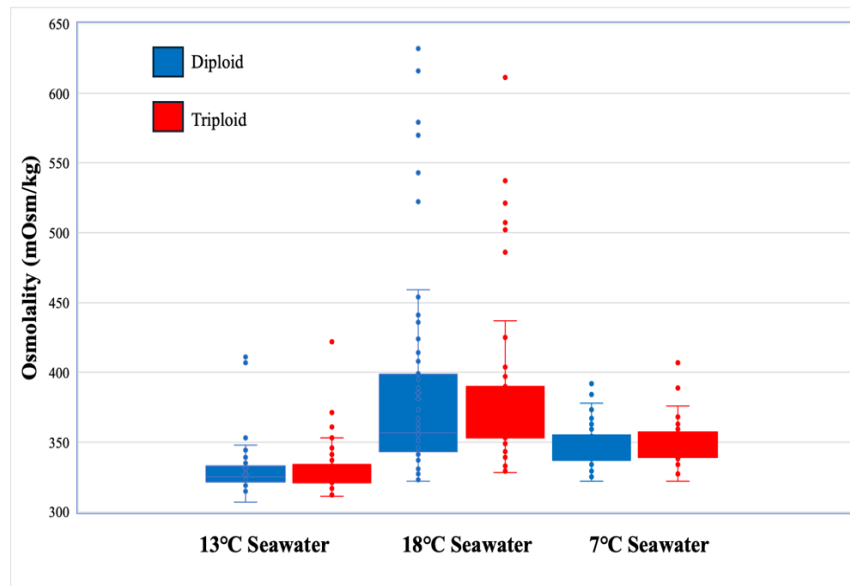
CONCANNON, A.

OSMORESPIRATORY COMPROMISE IN TRIPLOID RAINBOW TROUT (*Oncorhynchus mykiss*)

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This study is examining the effects of family and ploidy on salinity tolerance of all-female populations of rainbow trout. Triploidy renders fish sterile and offers advantages in net-pen production, but triploids often have lower thermal tolerance than diploids. Conducted at the Huntsman Marine Science Centre (Saint Andrews, NB), this experiment used similarly sized sibling diploid and triploid females from the same



eight families. After a two-month freshwater acclimation period at $13 \pm 1^\circ\text{C}$, fish were transitioned to seawater. Temperature was then gradually increased to 21°C at one degree per day, decreased and maintained at 18°C for 10 days, and finally decreased at one degree per day back to ambient temperature ($7 \pm 1^\circ\text{C}$). There was no effect of ploidy on plasma osmolality, but there was evidence of osmoregulatory difficulties (higher and more variable values) for both ploidies at 18°C in seawater (see figure). Additional data will be presented on plasma ion levels and interlamellar cell mass size (an indicator of osmorepiratory compromise) in these same fish. This study is providing valuable insight into the physiological responses of sterile triploids to temperature and salinity challenges that can be encountered in aquaculture.

FAST, M.

EXAMINING TWO FEEDS SUPPLEMENTED WITH PACAP-38 (PITUITARY ADENYLATE CYCLASE-ACTIVATING POLYPEPTIDE) ON ATLANTIC SALMON (*Salmo salar*) RESPONSES TO ENTERIC RED MOUTH DISEASE (*Yersinia ruckeri*)

Fajei Eyesun, Whyte Shona K, Rivera Laura, Velazquez Janet, Dantagnan Patricio, Soto Davila Manuel, Rodríguez-Ramos Tania, Dixon, Brian, Carpio Yamila, Estrada Mario, Fast Mark D

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In salmonids and other vertebrates, pituitary adenylate cyclase-activating polypeptide (PACAP) has been demonstrated to have anti-inflammatory activity, anti-oxidative stress, and cytoprotective impacts against several aquatic pathogens, including *Yersinia ruckeri*, which is the causative agent of enteric red mouth (ERM) disease. Our aim in this study was to evaluate the impacts of feed formulated with two different PACAP variants on subsequent infection with *Y. ruckeri* in Atlantic salmon (*Salmo salar*). Approximately 106 Atlantic salmon were randomly assigned (45 ± 5.6 g) to three replicate tanks per diet, with a base diet (Ctrl), an amidated form of PACAP added to the diet (C-PAC), or a non-amidated form of PACAP (N-PAC) added to the diet. After 28 days on experimental feed, two tanks per diet underwent bath exposure (80 L tank for 60 min with 72 fish; water temperature was 16.6 ± 0.2 °C) to *Y. ruckeri* (isolate U27451-11; at 7.8×10^8 CFU/ml) and one tank per diet was unexposed. Fish were sampled prior to exposure, 24 h, 72 h, 7 days, and 20 days post-infection. Infected salmon that received the amidated form of PACAP, unlike the control diet, showed a significantly higher survival rate from ERM (25%), and bacteriological samples that were collected from the kidney and intestine after analysis led to identifying *Y. ruckeri* as a primary agent of the symptoms. *Yersinia ruckeri* infection induced strong inflammatory responses (*hepc*, *il-1b*) in the kidneys of exposed fish within 1-3 dpi; however, differences in the host responses were observed across different diets. Unlike the control diet, PACAP diets also showed strong *il-6/il-10* responses within 24 hr, and C-PAC exhibited strong *c3a* responses over the same time frame. Due to the anti-inflammatory effects of *il-10* and the pleiotropic nature of *il-6*, this may suggest a more complex regulation of inflammation in the PACAP-fed fish. Further, *mmp9* was observed to be stimulated earlier and maintained longer in the C-PAC diet. The impacts of these responses on the control of inflammation and tissue repair will be discussed.

FAST, M.

THE EFFECTS OF INFECTION WITH SEA LICE ON TRANSCRIPTOME PROFILE OF SKIN AND HEAD KIDNEY OF ATLANTIC SALMON UNDER NORMAL AND INCREMENTAL TEMPERATURE

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Abstract: *Lepeophtheirus salmonis* is the most aggressive species of sea lice in Canada and the primary focus of management strategies in salmon mariculture. As a consequence of climate change, wild and farmed Atlantic salmon are likely to encounter elevated temperatures, which will impact on their physiological responses against possible stressors/infections. The present study was designed to explore the effects of sea lice infection on transcriptome profile of skin and head kidney of Atlantic salmon infected with sea lice under normal and high temperature conditions. Atlantic salmon of different families were infected with the copepodids of sea lice under controlled temperature conditions [i.e. 10 (± 2) and 20 (± 2) °C]. Samples of head kidney and skin were collected from the infected fish, 12- and 35-days post exposure at which point the lice had reached the chalimus II (C) and adult (A) stages. Pairwise comparisons within specific families resulted in 9,667 and 11,447 differentially expressed genes (DEGs) in the skin of fish parasitized with chalimus and adult stages of lice at 10 and 20 °C, respectively. There were 299 shared DEGs among all families infected by both developmental stages of lice at 10 °C, and gene ontology term enrichment analyses showed their involvement in metabolic pathway, collagen trimer complex, extracellular matrix network and oxidoreduction reaction. Pairwise comparisons between all families at two different temperatures revealed 203 and 406 shared DEGs in the skin and head kidney, which were associated with oxidoreductase activity, chemokine/cytokine activity and protein folding chaperone. Our findings suggest that increasing water temperature and infection with chalimus/adult stages of sea lice resulted in remarkable changes in stress-mediated and immune-related markers in the head kidney and/or skin of Atlantic salmon.

FAST, M.

GENE EXPRESSION RESPONSES IN THE INTESTINE OF ATLANTIC SALMON INFECTED WITH THE SALMON LOUSE (*Lepeophtheirus salmonis*)

Reza Ghanei-Motlagh, Yang Feng, Sara L. Purcell, Shona K. Whyte, Amber F. Garber, Mark D. Fast

Department of Pathology and Microbiology, Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, PEI, Canada

Abstract: Sea lice infestation is currently the most important parasitic disease facing Atlantic salmon aquaculture. Although the effects of infection with sea lice has been studied in part on local and systemic gene expression responses of Atlantic salmon, there is no information regarding gene expression responses in the intestine of Atlantic salmon after exposure with sea lice. To address this, posterior intestine specimens were collected from two groups (n=25) of Atlantic salmon infected and non-infected (control) with sea lice, and gene expression responses were examined using real-time quantitative PCR 240-degree days postinfestation (pre-adult stage). The majority of significantly altered genes were found to be down-regulated in response to sea lice infection. These include several genes associated with immune responses/inflammation (*CD8*, *IFN- α* , *IFN- γ* , *IL-4/13a*, *IL-6*, *IL-8*, *IL-12*, *IL-17*, *SAA*, *TLR-9*) and a key regulator of cell proliferation, wound healing and immunoregulation (*TGF- β*). On the other hand, a significant up-regulation of matrix metalloproteinase-9 was noticed in lice-infected fish, suggesting a chronic response induced by the parasite. The expression of other genes examined (*CATH1b*, *CATH2*, *COX-2*, *GAL9*, *IL-1 β* , *IL-10*, *MHC-II*, *SOD2*, *TRIM25* and *TRX*) were not remarkably altered postinfection with sea lice. The gene expression alterations suggested a combination of suppressed inflammation and impaired anti-viral responses in the intestine of fish exposed with lice, and as the consequence, the possible impacts of sea lice infection on the intestinal microbial populations and mucosal immunity would be of interest to be investigated.

FOURNIER, K.C.

STUDY OF THERMOADAPTATION IN THE PATHOGENIC BACTERIA *Aeromonas salmonicida* subsp. *salmonicida*

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Aeromonas salmonicida subspecies *salmonicida* is the causative agent of furunculosis in salmonids, a disease responsible for significant consequences on the fish farming industry. This subspecies is known to be psychrophilic with an ideal growth temperature around 18°C. This is interesting considering that this bacterial subspecies is part of a bacterial species where the majority of bacteria are mesophilic and can grow at temperatures above 30°C. During prolonged exposure to temperatures above 22°C, bacteria from subspecies *salmonicida* can undergo genetic rearrangements which normally lead to the loss of its virulence. Here we demonstrated that when certain psychrophilic strains are subjected to temperature variations over a certain period, they can undergo thermoadaptation and become mesophilic. A characterization of thermoadapted strains showed that this process is, as expected, linked to the loss of certain virulence factors of the bacteria except for about 20% of the strains tested where virulence factors stay intact. It has also been shown that most North American strains with a genetic element, called *AsaGEIIa*, are less prone to become thermoadapted. In a context of climate change, this project aims to identify the mechanisms responsible for this thermoadaptation as well as the impacts on the genome of the bacteria.

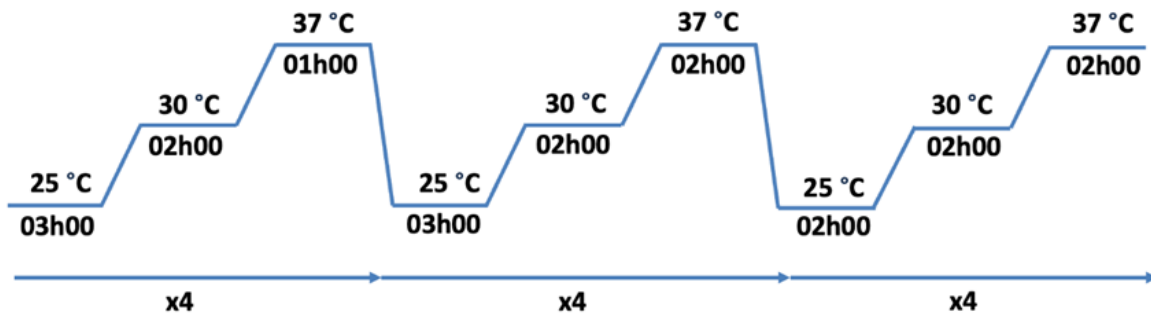


Figure 1: Temperature variations leading to thermoadaptation in some psychrophilic

JOSHUA, F.O.

MANNAN OLIGOSACCHARIDE FROM COCONUT WASTE IMPROVES INTESTINAL HEALTH OF ATLANTIC SALMON (*Salmo salar*) PARR

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The mucosal barriers of fish are an important first line of defense against pathogenic invasion. Functional feed additives such as mannan oligosaccharide (MOS) have the potential to promote improved mucosal physiology and barrier function, which can lead to improved fish robustness, health and welfare. The Atlantic salmon is a valuable production species, with global production exceeding 2.8 million metric tonnes in 2022.

In this study, Atlantic salmon parr (ca. 11.68 ± 0.11g) were fed with either a control diet or diets comprising the same basal formula but supplemented with one of three levels of MOS (0.25%, 0.35% or 0.5% Pretego™, Greensage Prebiotics Inc) (Table 1). Fish were reared in a freshwater RAS system (16.22 ± 0.16oC) for a period of 70 days, with three replicated tanks per treatment group. At the end of the trial, there were no significant differences between the treatment groups in terms of growth performance and nutrient utilization (Table 2). However, histological appraisal revealed that dietary MOS increased the length of distal intestinal villi and increased the number of goblet cells in the distal intestine and the dorsal region of the skin.

Table 1: Dietary formulations and proximate composition (%).

Ingredients	Control	0.25Pre	0.35Pre	0.50Pre
MOS	-	0.25	0.35	0.50
Wheat	10.83	10.30	10.13	9.83
Wheat gluten	17.93	17.96	17.93	17.93
Fish oil	6.67	6.67	6.67	6.67
Fish meal	30.00	30.00	30.00	30.00
Rapeseed oil	6.39	6.39	6.39	6.39
Faba bean dehulled	7.00	7.00	7.00	7.00
Phosphate	0.56	0.56	0.56	0.56
SPC	20.00	20.00	20.00	20.00
Astaxanthin	0.01	0.01	0.01	0.01
Vitamin premix	0.19	0.19	0.19	0.19
Mineral premix	0.56	0.56	0.56	0.56
Total	100.00	100.00	100.00	100.00
Proximate compositions (g/100g)				
Moisture	8.00	8.1	8	7.9
Crude protein	50.20	50.7	51	51.1
Crude fat	18.70	18.5	18.8	19.1
Ash	5.40	5.6	5.5	5.5

Table 2: Growth performance metrics. Data presented as mean ± standard deviation of the mean (n = 3)

	Control	0.25Pre	0.35Pre	0.50Pre
IBW (g)	11.64 ± 0.42	11.60 ± 0.40	11.87 ± 0.14	11.60 ± 0.41
FBW (g)	32.44 ± 1.32	32.19 ± 0.44	35.02 ± 4.05	33.35 ± 2.02
WG (g)	20.46 ± 1.16	20.17 ± 0.75	22.48 ± 3.78	21.24 ± 1.90
SGR (%/day)	1.34 ± 0.09	1.33 ± 0.05	1.41 ± 0.15	1.38 ± 0.09
FCR	1.00 ± 0.06	1.03 ± 0.05	0.97 ± 0.10	0.98 ± 0.11
SR (%)	98.10 ± 1.65	100.00 ± 0.00	100.00 ± 0.00	99.05 ± 1.65
C.F	1.20 ± 0.06	1.24 ± 0.02	0.95 ± 0.02	1.22 ± 0.02

IBW, initial body weight; FBW, final body weight; WG, weight gain; SGR, specific growth rate; FCR, feed conversion ratio; SR, survival rate; C.F, condition factor.

Table 3: Histological analysis. Data presented as mean ± standard deviation of the mean (n = 9).

	Control	0.25Pre	0.35Pre	0.50Pre
MFL (µm)	329.64 ± 91.71 ^a	523.05 ± 184.01 ^b	435.31 ± 98.50 ^{ab}	447.34 ± 147.01 ^{ab}
IGCC (n/100 µm)	10.14 ± 2.25 ^a	13.43 ± 2.71 ^b	14.20 ± 1.78 ^b	11.32 ± 2.88 ^{ab}
SGCC (n/200 µm)	11.11 ± 1.84 ^a	13.78 ± 4.0 ^{ab**}	11.53 ± 2.66 ^a	16.29 ± 1.67 ^b
MVC (%)	95.11 ± 0.31	97.03 ± 0.19	96.68 ± 0.21	96.07 ± 0.22
MVL (µm)*	1.25 ± 0.31	1.44 ± 0.19	1.21 ± 0.21	1.21 ± 0.22

MFL, mucosal fold length; IGCC, intestinal goblet cell count; SGCC, skin goblet cell count; MVC, microvilli coverage; MVL, microvilli length.

In conclusion, feeding Atlantic salmon with MOS derived from coconut by-products has the potential to improve mucosal barriers. This potential will be further explored in on-going analysis which includes intestinal microbiome analysis and intestinal and skin gene expression profiling.

KWABIAH, R.R.

EXPRESSION OF IMMUNE LINEAGE CELLS IN THE EYES OF LUMPFISH *Cyclopterus lumpus* L. INFECTED WITH *Myxobolus albi*

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Lumpfish (*Cyclopterus lumpus* L.) effectively minimize ectoparasite infestation in Atlantic salmon aquaculture by feeding on the parasites on the salmon skin. Lumpfish require high visual acuity and properly functioning eyes to both survive in the wild and function efficiently as cleaner fish. However, lumpfish are susceptible to disease and can transmit infection to salmon, causing increased mortality and decreased economic yield.

We have previously observed parasitic infection (*Myxobolus albi*) in the scleral cartilage layer of wild lumpfish eyes. Expanding on this observation, herein we present an analysis of the expression of immune-related cell markers and cartilage development markers in the scleral cartilage of lumpfish infected with *M. albi*. We evaluated the expression of immune and cartilage antibodies in the lumpfish scleral cartilage using immunohistochemistry (IHC). We also established differing levels of cartilage maturity using histological stains.

We observed that myxozoan infection affects scleral cartilage growth and disrupts the normal cartilage morphology. Additionally, cells expressing cartilage growth and immune markers were observed near parasitic cysts formed from infection.

The results from this paper contribute to lumpfish immunological knowledge and provide a further understanding of the intraocular immune response in lumpfish, an economically important and globally threatened teleost species.

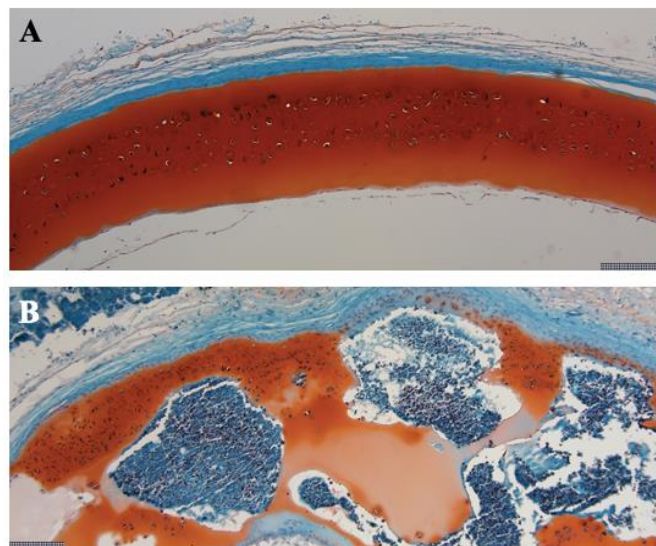


Figure 1. Safranin O/Fast Green histological stain of **A.** Normal wild lumpfish scleral cartilage and **B.** Wild lumpfish scleral cartilage infected with *Myxobolus albi*. Morphological disruption of the scleral cartilage of infected fish can be observed. Both panels magnified 50X, scale bar divisions = 10 microns.

NOWLAN, J.

PREDICTORS OF CHINOOK SALMON (*Oncorhynchus tshawytscha* W.) SMOLTIFICATION IN BRITISH COLUMBIA (CANADA) AQUACULTURE

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Smoltification is a crucial preparatory transition among salmonids enabling saltwater tolerance. However, most information on smoltification is based on Atlantic salmon (*Salmo salar* L.) and rainbow trout (*Oncorhynchus mykiss* W.), with less information for Pacific salmon. Chinook salmon (*Oncorhynchus tshawytscha* W.) are a valuable aquaculture species in British Columbia (Canada), and developing novel techniques such as reverse-transcriptase qPCR (RT-qPCR) assays may assist designations of smolt-status in production and conservation fish. Novel techniques to clarify Chinook salmon smolt-status could improve survival and growth when transferred to marine waters. Two production groups of Chinook salmon were collected monthly from freshwater to saltwater entry. Fish were evaluated using classical techniques (i.e., condition factor, ATPase activity, parr marks, silvering, and black fin margins) and three developed RT-qPCR assays (NKA α 1a, NKA α 1b, and NKCC). The inclusion of RT-qPCR assays along with other techniques explained significant variation between collections in freshwater and saltwater. The application of RT-qPCR also led to the interpretation of desmoltification within the fall production group based on the reduced expression of target genes prior to saltwater transfer and increased mortality post saltwater transfer. In conjunction with previous techniques, developed assays may further clarify smolt-status and improve fish welfare.

OKON, E.M.

GLOBAL PERSPECTIVES ON CARP EDEMA DISEASE: INSIGHTS FROM RESEARCH

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Two of the most significant freshwater fish in global aquaculture are carp and koi. Regrettably, various diseases, such as viral infections, impact their production. In recent years, carp edema disease (CED), caused by the carp edema virus (CEV), has emerged as one of the fatal viral infections. Addressing this health challenge requires understanding the disease dynamics. This study employed a mixed approach, integrating findings from field surveys, laboratory analyses, and data syntheses to assess the current understanding of CED, focusing on epidemiological and impact assessment. The literature assessment encompassed one hundred and forty-nine relevant studies on CED until May 2023 (Figure 1) using the Scopus and Web of Science databases. The United States of America, Germany, Japan, China, Poland, and the Czech Republic played major roles in CED research, contributing about 50% of the studies. However, there were limited studies on the disease prevalence in Africa, making it difficult to assess the region. Major CED risk factors were water temperature, seasonal variations, immune suppression, fish age, and fish pathogen levels. Fish without clinical signs could harbour a relatively high viral load, indicating the risks of international trade in spreading the virus and difficulty eradicating the pathogen.

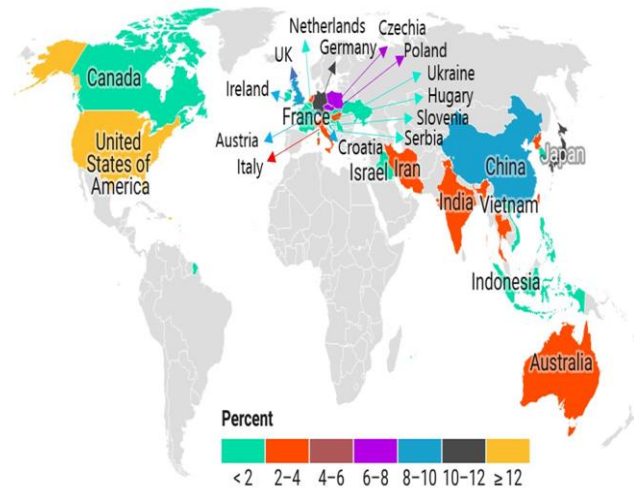


Figure 1. Global distribution of research on CED up until May 2023.

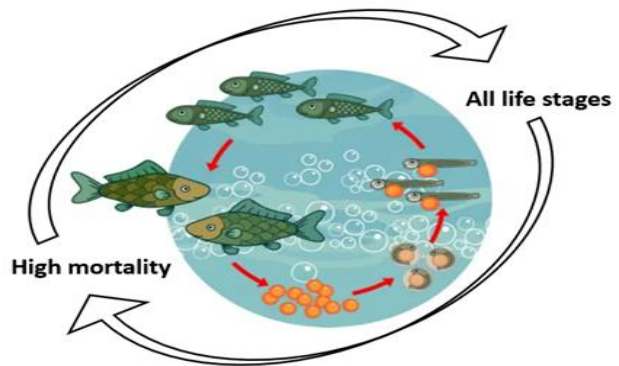


Figure 2. Mortality and life stages of carp and koi affected by CED.

RIESENBACH, I.C.

IMPACTS OF FEEDING LOW-LEVEL BLACK SOLDIER FLY *Hermetia illucens* MEALS, OIL, AND CHITIN ON GROWTH PERFORMANCE AND NUTRIENT RETENTION IN RAINBOW TROUT *Oncorhynchus mykiss*

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Black Soldier Flies (BSF) have garnered attention as a sustainable alternative to fishmeal and fish oil in aquafeeds. These insects are often processed into defatted meals which entails the removal of oil and chitin to increase protein content and nutrient digestibility. There are few studies which investigate both full and defatted BSF meals as feed additives for fish and research is lacking on the effects of BSF isolates such as oil and chitin. For 168 days, triplicate tanks of rainbow trout (30g) were fed one of seven diets that included a control, 5 and 10% full-fat BSF (ff05 and ff10), 5 and 10% defatted BSF (df05 and df10), 4% BSF oil (oil) and 1% BSF chitin (chtn). The oil diet resulted in the highest average weight at day 84 and 168, followed by the chitin diet. Defatted BSF meal diets consistently resulted in the lowest weight gain (Figure 1). Nutrient retention followed a similar pattern. The findings of this study suggest that BSF oil promotes growth in rainbow trout and should not be removed from BSF meals produced for aquafeeds.

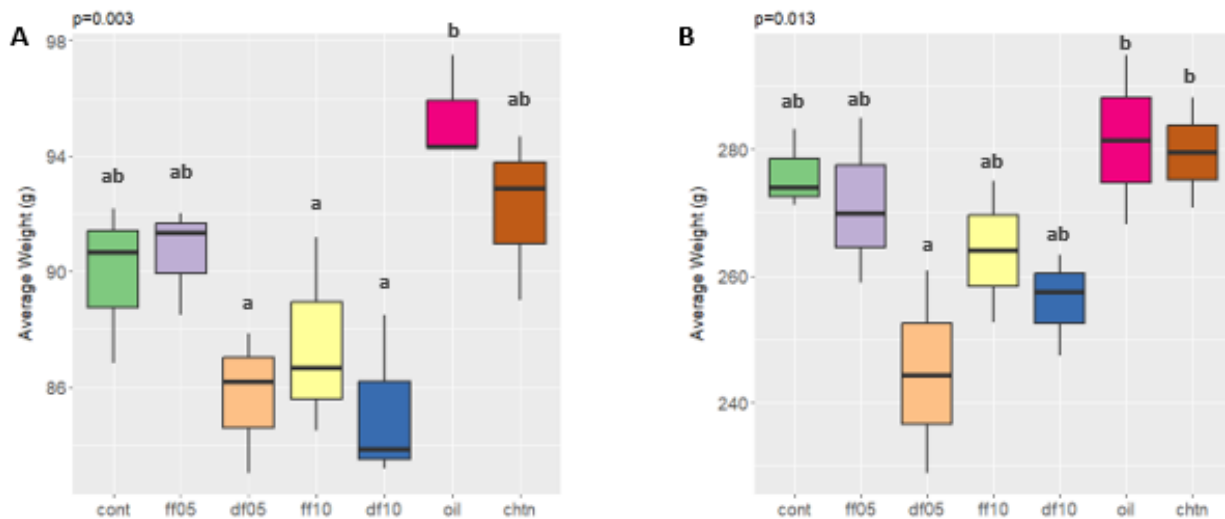


Figure 1. Average weight of rainbow trout fed a control, 5 and 10% full-fat BSF (ff05 and ff10), 5 and 10% defatted BSF (df05 and df10), 4% BSF oil (oil) and 1% BSF chitin (chtn) diet after 84 (A) and 168 (B) days.

SALVO, F.

A SEMI-AUTONOMOUS MOBILE SEAWEED HATCHERY FOR KELP

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Seaweed cultivation and processing for the food and cosmetics industries is booming worldwide. The production of juveniles for at sea cultivation requires several specialized infrastructures and distinct expertise. At sea farming in Canada is still at its infancy and there is a high demand from farms to source their juveniles from specialized marine hatcheries, but a few of them are present in Atlantic Canada. This project aims to secure the supply of seaweed juveniles by developing a compact, mobile and semi-autonomous hatchery module for the standardized production of young macroalgal seedlings (sugar kelp *Saccharina latissima* and winged kelp *Alaria esculenta*). The project is being carried out in partnership with the AGHAMW (Mi'gmaq Wolastoqey Indigenous Fisheries Management Association), which operates a marine farm in the Gaspé Peninsula. Merinov has drawn on several years of research and development on macroalgae to propose this innovative solution, which promises to improve transfer of this knowledge to industry and give them independence in sourcing and operating.



Figure 1: Picture of the semi-autonomous hatchery module developed between Merinov and AGHAMW.

of the inside of the mobile hatchery

TIBBETTS, S.

NUTRITIONAL EVALUATIONS OF ‘MADE-IN-CANADA’ MICROBIAL SINGLE-CELL PROTEIN (SCP) MEALS FOR ATLANTIC SALMON *Salmo salar* L. PRE-SMOLTS.

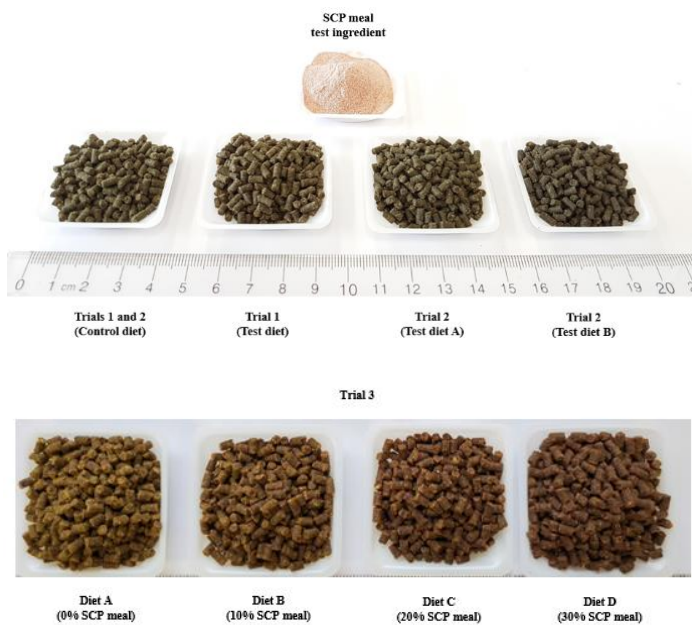
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Scalable continuous aerobic fermentation of methylotrophic (methanol-oxidizing) bacteria has potential to convert single-carbon (C₁) substrates like methanol, derived from industrial point-source flare-gas methane (a potent GHG) emissions, into protein-rich biomass.

Results will be presented from three trials to comprehensively evaluate the nutritional quality of *Methylovorus mentalis* single-cell protein (SCP) meals as sustainable low-trophic aquafeed ingredients for Atlantic salmon during the freshwater growth phase. In a standard substitution digestion assay (80:20), Trial 1 established ‘single-ingredient’ apparent digestibility coefficients (ADCs) of *M. mentalis* SCP meal; while Trial 2 assessed feed intake (a proxy for palatability) and determined nutrient ADCs for nutritionally-balanced diets containing *M. mentalis* SCP meal at partial (50%) or complete (100%) displacement of conventional plant-proteins. Trial 3 evaluated the effects of graded dietary inclusion levels (up to 30%) of *M. mentalis* SCP meal at partial or complete displacement of conventional marine and terrestrial plant-protein ingredients on growth, nutrient utilization, and fish health.

Preliminary results suggest that protein-rich SCP meals produced under scalable continuous aerobic fermentation from a *M. mentalis* strain isolated in Canada can be used in the diet for Atlantic salmon pre-smolts with minimal effects on feed intake, nutrient digestibility, production performance, whole-body composition, nutrient utilization, and fish health.



WILSON, T.

SEA AND SOCIETY: EXPLORING NOVA SCOTIAN'S AESTHETIC VALUES AND PREFERENCES FOR OCEAN AND COASTAL SPACES

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Nova Scotia's coastal areas offer a myriad of cultural benefits like enjoyment, inspiration, and aesthetic experiences which are essential for human well-being. The development of ocean spaces for industries like aquaculture can create visual changes in these spaces, potentially leading to conflicts and negatively impacting perceptions. While modern sustainability frameworks increasingly recognize the need to integrate social factors, there are still gaps in understanding the cultural benefits of coastal spaces. To better understand these factors, this study employed a public survey to capture Nova Scotian's perceptions and values towards the visual properties of coastal and ocean seascapes. The survey findings show that the ocean's aesthetic value was generally considered important, but visual appeal differed across seascape types, particularly across seascapes with commercial activities such as fishing and aquaculture. Furthermore, visual appeal preferences were found to be intertwined with values related to place attachment and moral judgements about the impacts of human influence. Findings from this study have broader implications of the need for considering and understanding the visual impacts and changes created through ocean developments in Nova Scotia. This provides insight that could be valuable to reducing public conflicts, fostering more socially sustainable ocean development, and guiding future studies.