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Aquaculture Collaborative
Research and Development
Program (ACRDP)



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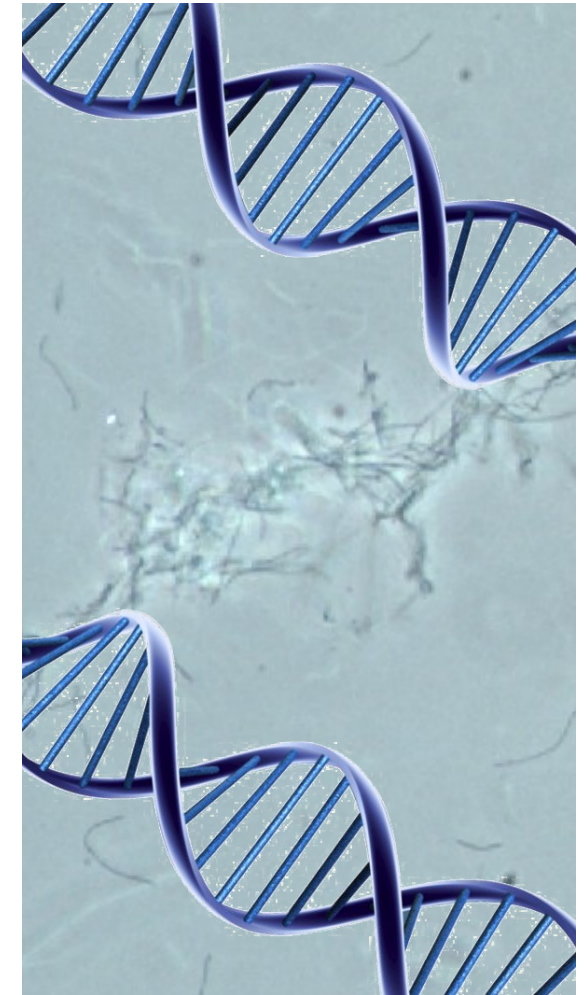
MOWI
Salmon is good. Mowi is Goodness



PHARMAQ

The Aquaculture Collaborative Research and Development Program (ACRDP) is a Fisheries and Oceans Canada (DFO) initiative that promotes collaborative research and development activities between the aquaculture industry and the department.

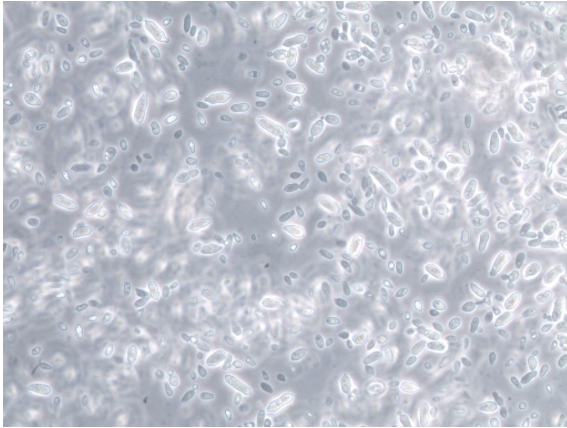
The Program teams industry representatives with DFO researchers.



TENACIBACULUM 2: CURRENT KNOWLEDGE AND FUTURE DIRECTIONS

**October 29 & 30, 2019
Maritime Heritage Centre
Campbell River, BC**

TENACIBACULUM 2: CURRENT KNOWLEDGE AND FUTURE DIRECTIONS



OBJECTIVE

To review the current knowledge of *Tenacibaculum* related diseases, including:

- the regional similarities and differences in outbreaks,
- the epidemiology of the outbreak,
- the genomic features of the infectious species and
- how we deal with outbreaks.

At the end of the workshop, there will be a clear understanding of the future needs for research, identification of the key participants and a pathway forward to investigate and eliminate the knowledge gaps. Research opportunities will be identified and reported.

| Oct 29 | SPEAKER | TOPIC |
|----------------------|--------------------------------|---|
| 8:30 - 8:40 | Jim Powell | Welcome |
| 8:40 - 8:45 | Mayor Andy Adams | Welcome to Campbell River |
| 8:45 - 9:15 | Eva Jacob & Gareth Butterfield | Genesis of the <i>Tenacibaculum</i> 2 Workshop |
| 9:15 - 10:00 | Duncan Colquhoun | Tenacibaculosis in Norway: One disease or several? |
| 10:00 - 10:30 | Break | |
| 10:30 - 11:15 | Rute Irgang | Insights on Chilean Tenacibaculosis |
| 11:15 - 12:00 | Tim Hewison | Yellow Mouth – the Grieg Seafood Experience in BC |
| 12:00 - 1:00 | Lunch | |
| 1:00 - 1:20 | Øyvind Brevik | A brief history of Tenacibaculosis in Arctic salmon farming |
| 1:20 - 1:40 | Kathleen Frisch | Tenacibaculosis (mouthrot) in Western Canadian salmon farming |
| 1:40 - 2:00 | Sverre Småge | Bacteriology of <i>Tenacibaculum</i> spp. |
| 2:00 - 2:20 | Rolf Hetlelid-Olsen | Challenge model and vaccine development- past, current and future work |
| 2:20 - 2:30 | All | Q & A |
| 2:30 - 3:00 | Break | |
| 3:00 - 3:45 | Ahmed Siah | Genomic characterization of <i>Tenacibaculum</i> spp. – Insight on virulent and antibiotic resistant factors |
| 3:45 - 4:30 | Daniel Barreda | Functional tools for amelioration of disease based on dynamic temperature control |
| Oct 30 | | |
| 8:30 - 9:15 | Steve Leadbeater | <i>T. finmarkensis</i> challenge model - Canada |
| 9:15 - 10:00 | Bogdan Vornicu | <i>Tenacibaculum</i> spp and the marine environment: missing links between environmental conditions and MMY outbreaks |
| 10:00 - 10:30 | Break | |
| 10:30 - 11:15 | Krishna K. Thakur | Epidemiological investigation of Tenacibaculosis in farmed salmon in BC: what we know and our proposed approach |
| 11:15 - 12:00 | Simon Jones | Identifying Knowledge Gaps and Research Opportunities |

This workshop is organized by the BC Centre for Aquatic Health Sciences and is moderated by Jim Powell, CEO of the BC Centre for Aquatic Health Sciences.

PRESENTERS

Eva Jakob, Cargill Innovation

Title: Genesis of the *Tenacibaculum* 2 Workshop



Eva is a Senior Scientist within the Cargill Animal Nutrition R&D health team and the scientific lead for the antiviral and antibacterial diet development in salmon. She joined Cargill in February 2016 to support the team in the newly established Cargill Innovation Center Colaco, located in southern Chile. Eva grew up in Cologne Germany and holds a BSc and MSc in Biology (Heinrich Heine Universität Düsseldorf, Germany) and a PhD in Fish Parasitology and Virology (Christian Albrechts Universität Kiel, Germany).

After finishing her PhD in 2009, she moved to Canada and started to work in salmon health projects conducting research as a Postdoctoral Fellow at Fisheries and Oceans Canada, (Vancouver Island) and joined in 2012 the Epidemiology team of the Atlantic Veterinary College (Prince Edward Island) working on salmon diseases. After four years in Canada it was time for a new adventure and to take the jump from academic research to more applied science within the salmon industry. Since 2013, she lives in Chile, with work experience in Fraunhofer Chile (2013-2014) and Elanco Animal Health (2014-2016).

Gareth Butterfield, Cargill Aqua Nutrition



Gareth is an experienced professional with a long history in the aquaculture industry including feed manufacture and fish production. He has experience in both the industrial and academic sectors. He holds a PhD in Aquaculture Genetics and Disease from the Institute of Aquaculture, University of Stirling where he focussed on selective breeding against PKD. As well, he has an MSc in Mariculture Science and Technology and BSc in Aquaculture and Fishery Management. He has worked alongside some of Britain's largest producers of salmonid species, making him familiar with the varying techniques and practices used on the farm.

Duncan J. Colquhoun, Norwegian Veterinary Institute / University of Bergen

Title: *Tenacibaculum* in Norway: One disease or several?



Duncan J. Colquhoun is a senior researcher at the Norwegian Veterinary Institute, Oslo and adjunct Professor at the University of Bergen. He started his further education with a B.Sc. (Hons.) in Aquaculture and an M.Sc. in Aquatic Pathobiology, at the Institute of Aquaculture, Stirling, Scotland. He gained his Ph.D. on *Vibrio salmonicida*, the causative agent of coldwater vibriosis in sea-farmed Atlantic salmon, at the Norwegian School of Veterinary Science. He has over 20 years' experience in diagnostics and research relating to bacterial pathogens of fish. His work focuses mainly on taxonomic studies and molecular epidemiology of bacterial diseases important for Norwegian aquaculture.

Ruta Irgang, Universidad Andrés Bello

Title: Insights on Chilean *Tenacibaculum*



Ruta is an Agronomist, who graduated at Universidad Federal de Santa Catarina (Brazil) and since then has been working in different areas of Aquaculture. Currently she is a research assistant at the Laboratory of Dr. Ruben Avendaño-Herrera at the Universidad Andrés Bello, Chile where she is a laboratory manager. Her focus is the bacterial collection, isolation of bacteria and classical microbiology section of the laboratory.

Tim Hewison, Grieg Seafood BC

Title: Yellow Mouth – the Grieg Seafood Experience in BC



Tim graduated from the University of Guelph with a bachelor's of science degree specializing in Marine Biology. Currently, he is the Fish Health and R&D Manager at Grieg Seafood BC Ltd. Previously employed for 20 years at Zoetis Canada Inc (formerly Microtek International Inc) as a Senior Scientist. His fields of experience include disease diagnostics, disease agent isolation and characterization from multiple fish species, vaccine potency testing and field trials.

Øyvind Jakobsen Brevik, Cermaq Norway

Title: A brief history of *Tenacibaculum* in Arctic salmon farming



Øyvind Jakobsen Brevik has a MSc in aquamedicine and a Ph.D. in intracellular pathogenic bacteria in aquaculture. He's been working at Cermaq for the last 8 years and currently holds a position as Senior Scientist in the Fish Health R&D department in Bergen. Øyvind's core competences are in the fields of fish bacteriology, epidemiology, PCR methodology and diagnostics. Most of his published work is within the field of fish pathogenic bacteria.

Kathleen Frisch, Cermaq Canada

Title: *Tenacibaculum* (mouthrot) in Western Canadian salmon farming



Kathleen completed an industrial PhD project in the field of infectious aquatic diseases at the University of Bergen in collaboration with Pharmaq. She received her veterinarian certification at the University of Melbourne in Australia and then specialized in aquatic animals by earning a Masters in Aquatic Veterinary Studies from the University of Stirling in Scotland. As Fish Health Director of Cermaq Canada, she leads and coordinates projects and screening programs. As a veterinarian, she investigated fish health and product quality concerns, with a focus

on prevention.

Sverre Småge, Cermaq Norway

Title: Bacteriology of *Tenacibaculum* spp.



Sverre Bang Småge has a Masters in Aqua medicine from the University of Bergen (UiB) and is a qualified aqua medicine biologist. He has worked as a Clinical Scientist in the R&D department of Cermaq Group AS in Bergen since 2014. During this period (2014 to 2018), he completed an industrial PhD titled "Tenacibaculum in Norwegian farmed Atlantic salmon" at UiB.

Rolf Hettlelid-Olsen, Pharmaq Norway

Title: Challenge model and vaccine development - past, current and future work



Rolf Hettlelid-Olsen is a clinical scientist in the clinical department of Pharmaq and has held that position since 2011. He has a B.Sc.Eng. in environmental and aquaculture technology and a MSc. in fish health biology. Prior to working with Pharmaq, Rolf was Head Engineer at the wet-lab at the Institute of Marine Research from 2001-2011.

Ahmed Siah, BC Centre for Aquatic Health Sciences
Title: Genomic characterization of *Tenacibaculum spp.* – Insight on virulent and antibiotic resistant factors



As a Senior Scientist, Ahmed is leading numerous research projects at the BC Centre for Aquatic Health Sciences focussed on developing new technologies in the field of aquatic health diagnostics and implementing and validating molecular biology technologies for diagnostics. Dr. Siah pursued his Postdoctoral studies in Molecular Ecotoxicology at the University of Le Havre in France after earning his Ph.D. in Oceanography at the Institute of Marine Sciences in Rimouski, Quebec. As a Research Associate at Prince Edward Island's Atlantic Veterinary College, he led and managed several projects on mollusk health management and the development of molecular diagnostic tools in salmonids. Ahmed has published in the field of fish and shellfish pathogens, their isolation, genomic sequencing and detection. His germane work in the area of genomics and bioinformatics has led to several advancements in the pathogen diagnostic capability in farmed and wild salmonids stocks.

Daniel R. Barreda, University of Alberta
Title: Functional tools for amelioration of disease based on dynamic temperature control



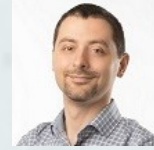
Dr. Barreda earned a B.Sc. in Microbiology/Biochemistry from the University of Victoria and a Ph.D. in Physiology and Cell Biology from the University of Alberta. It is here where he became interested in comparative model systems and fish health. He went on to a PDF in Medical Immunology and Drug Development at the University of Pennsylvania School of Medicine in 2003 and was recruited back to the University of Alberta in 2006 as the first cross-appointment between the Faculty of Science and the Faculty of Agricultural, Life and Environmental Sciences. He was promoted to the rank of Professor in 2016. Daniel is well recognized for his contributions to the development of high-resolution quantitative tools for evaluation of cell function, animal immunity and health. Since 2006 Dr. Barreda has secured over \$10M in research grants (21 grants as a principal investigator), published over 60 peer-reviewed articles, and mentored 57 trainees in fundamental and applied projects. In addition to research and innovation awards, he has received a number of teaching awards including an Inspirational Instructor Award and the University of Alberta Provost Award for Excellence in Undergraduate Teaching.

Steven Leadbeater, Fisheries and Oceans Canada
Title: *T. finmarkensis* challenge model – Canada



Steve Leadbeater has been a Biologist with Fisheries and Oceans Canada in Saint Andrews New Brunswick since 2007. Steve is the lead of an aquatic animal health program and manages a Level III aquatic animal biocontainment laboratory. His research has been focused on disease and parasite issues for Atlantic salmon, including projects examining the potential for breeding genetic resistance for sea lice, ISAV and BKD, studies on skin ulcer disease, the changing bacterial ecology following sea lice infection and the physiological impacts of sub-lethal infection with ISAV.

Bogdan Vornicu, Mowi Canada West
Title: *Tenacibaculum spp.* and the marine environment: missing links between environmental conditions and MMY outbreaks



Bogdan is a PhD graduate focused in Zoology/Animal Biology area and an experienced Water Quality Support Manager. He has over 10 years of Environmental, Regulatory Affairs and Certifications Management experience and is currently working with MOWI Canada West in the Saltwater Production Department. Research areas of interest are relations between environmental conditions and algal blooms and also Atlantic salmon response to environmental challenges.

Krishna K Thakur, University of Prince Edward Island
Title: Epidemiological investigation of Tenacibaculosis in farmed salmon in BC: what we know and our proposed approach



Krishna Thakur is an Assistant Professor in Infectious Disease Epidemiology at the University of Prince Edward Island (UPEI) and is focused on understanding the dynamics of aquatic animal diseases. He started his graduate training at Purdue University, USA as a Fulbright scholar and earned Masters degree in Comparative Epidemiology in 2011 followed by completion of PhD degree in Epidemiology from UPEI. He furthered his training in Aquatic Epidemiology by joining Dr. Ian Gardner led Canada Excellence Research Chair program in Aquatic Epidemiology as Post-Doctoral Fellow Here he led several projects applying quantitative methods related to health, production, the interaction between wild and farmed aquatic animals, including salmon. Krishna has looked closely at the dynamics of farmed and wild salmon interaction and has acquired a very good understanding of the epidemiology of several infectious agents affecting salmonid health in BC.

Simon Jones, Fisheries and Oceans Canada
Discussion: Identifying Knowledge Gaps and Research Opportunities



Simon completed his B.Sc. in Marine Biology and went on to obtain his M.Sc. and Ph.D. in aquatic parasitology from the University of Guelph. He took up an NSERC PDF in fish immunology at Wageningen University in the Netherlands. He then spent 8 years researching the development of commercial vaccines for use in salmon aquaculture against piscirickettsiosis, infectious salmon anaemia and cold water vibriosis, among others. In 2000, Jones accepted a research scientist position with DFO at the Pacific Biological Station in Nanaimo where he now leads the Marine Parasitology Program. Currently, he is interested in disentangling the roles of environmental, host and infectious factors in the occurrence of proliferative gill disease, which is emergent and of considerable significance to marine cultured salmon in BC. His long-term interest in salmon lice seeks to better understand mechanisms underlying the highly variable susceptibility to sea lice among species of Pacific salmon and the significance of the three-spine stickleback to the ecology of salmon lice in western Canada. In addition, he plays a central role in ongoing efforts to advise the Federal Government on the likelihood and consequences of risks to wild salmon in BC posed by infection and disease in marine-reared Atlantic salmon.