

# OIE Collaborating Centres Reports Activities

## *Activities in 2021*

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<b>Title of collaborating centre:</b>	Epidemiology Aquatic Animal Diseases (Americas)
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<b>Name of Director of Institute (Responsible Official):</b>	Dr. K. Larry Hammell
<b>Name (including Title and Position) of Head of the Collaborating Centre (formally OIE Contact Point):</b>	Dr. Larry Hammell (Professor and Associate Dean, AVC Graduate Studies and Research)
<b>Name of writer:</b>	Dr. Larry Hammell

**ToR: To provide services to the OIE, in particular within the region, in the designated specialty, in support of the implementation of OIE policies and, where required, seek for collaboration with OIE Reference Laboratories**

**ToR: To identify and maintain existing expertise, in particular within its region**

**1. Activities as a centre of research, expertise, standardisation and dissemination of techniques within the remit of the mandate given by the OIE**

Disease control	
Title of activity	Scope
Developing pituitary adenylate cyclase-activating polypeptide into a treatment for microbial infections in aquaculture.	Examine the in vivo immunostimulatory capabilities of pituitary adenylate cyclase-activating polypeptide (PACAP) in tilapia and salmon and whether this is impacted by administration route, and protective against <i>Flavobacterium</i> .
Epidemiology, surveillance, risk assessment, modelling	
Title of activity	Scope
Disease Intelligence Platform for Shrimp Farms in Indonesia	Biosecurity review of Indonesian farms and standardization of farm data collection.
Data visualization and predictive models for production parameters and disease on shrimp farms	Farm biosecurity survey and analysis of production cycle data from shrimp farms in the Banyuwangi region of Indonesia, to generate risk summaries and recommendations.
Bayesian analysis of diagnostic sensitivity and specificity for detecting infectious salmon anemia virus (ISAV) using either IFAT or real-time RT-PCR testing from laboratories in Atlantic Canada.	Comparison of ISAV laboratory tests from different laboratories in Atlantic Canada.
Provision of aquatic animal health surveillance advice to responsible authorities	Provision of advice for aquatic animal health risk policy and modelling; contribution to design and assessment of surveillance plans.
Fish-iTrends industry support system	Provide a database for the use of industry and government to input and track sea lice numbers at active marine farms in Atlantic Canada.
Infectious salmon anemia virus (ISAV) strain evaluation of samples collected from two confirmed cases in Atlantic salmon farms	Determine how the CT values associated with positive ISAV cases relate to subsequent strain typing data on those samples.
Risk factors associated with complex gill disease (CGD) in farmed Atlantic salmon in British Columbia and their possible mitigation.	Identifying risk factors for complex gill disease and potential mitigation measures.
Risk factors of Infectious Salmon Anaemia Virus (ISAV) in Atlantic Canada.	Identify risk factors for ISAV outbreaks in Atlantic Canada through the analysis of retrospective data, including environmental, production, mortality, treatment, and diagnostic information collected from marine sites from 2010 to 2020. The goal is to identify risk factors that can be mitigated by the salmon aquaculture industry to reduce outbreak occurrence.

Infectious salmon anemia virus (ISAV) spread model for Atlantic Salmon aquaculture in Newfoundland and Labrador.	Simulate, using computer models, the dynamics of between site spread of ISAV among NL Atlantic salmon farms and explore scenarios to mitigate the spread and evaluate cost effectiveness.
Comparison of fish level prevalence of Infectious Salmon Anaemia virus (ISAV) among fresh dead, apparently healthy and moribund Atlantic salmon from an ISA-positive site in Newfoundland.	Design a targeted sampling approach to the groups with highest probability of detecting the virus which would inform surveillance programs, resulting in increased system sensitivity and earlier detection of the virus.
<b>Training, capacity building</b>	
<b>Title of activity</b>	<b>Scope</b>
Provision of training in sampling and pathogen identification of fish diseases	Training participants in Atlantic Canada in ongoing monitoring of salmon diseases.
Sea lice identification training in support of ongoing epidemiological research and data management	Provide industry and government participants with standardized training on how to identify and classify life stages of sea lice <i>Lepeophtheirus salmonis</i> .
<b>Wildlife</b>	
<b>Title of activity</b>	<b>Scope</b>
The Impact of Climate Change on Ecological Determinants of Epizootic shell disease (ESD) in American lobsters ( <i>Homarus americanus</i> )	Characterization of the shifting carapace microbiome and the cuticular epithelial transcriptome of Canadian lobsters with and without ESD. Forecast risk of ESD in key lobster fisheries areas (LFA) under varying IPCC emissions scenarios.
Epidemiological, genomic and ecological determinants of Epizootic shell disease in American lobsters in Canada.	Examine and characterize haemolymph microbiome from lobsters with and without epizootic shell disease. Extracted DNA/RNA and all metadata collected during sampling (e.g. disease/lesion status, GPS location, date of sampling, carapace length, sex, ovigerous status) will be analyzed.
<b>Aquatic animal diseases</b>	
<b>Title of activity</b>	<b>Scope</b>
Evaluation of the virulence and pathogenicity of Infectious salmon anemia virus (ISAV)	A review of diagnostic tests completed over an eight year period to examine changing patterns in disease events and test results.
Comparison of fish level prevalence of ISAV among fresh dead, apparently healthy and moribund Atlantic salmon from an ISA-positive site in Newfoundland	Diagnostic test results from the 3 categories of samples will be analyzed/compared to determine if prevalence rates can be predicted from all groups equally.
Prudent antibiotics use (AMU) through improvements in treatment management in Atlantic Salmon ( <i>Salmo salar</i> ) aquaculture	Evaluate effectiveness of current treatment practices on Atlantic salmon farms, develop novel intervention strategies that avoid the need for commonly-used therapeutants, determine the current AMR genetic profile of the bacterial assemblages associated with farmed/wild populations, and identify focal points of AMR development and mitigation of these impacts.
LiceRESIST - Evaluation of sea lice infestation susceptibility in different salmonid species.	Determine underlying cross-species variation in host resistance to sea lice and identify signals and genes responsible for these differences. This knowledge will allow informed decisions about how technology should be deployed as part of an integrated long-term sea lice management strategy.

Characterization of virulence factors in the salmon louse using post-transcriptional silencing.	Development of a virulence challenge model by rearing lice originating from wild and farm sources and compared virulence on their host. Use post-transcriptional silencing to ascertain physiological function of several key VF's during infection and their importance on successful parasitism on Atlantic salmon.
Lower vertebrate immunostimulation and effects on host-parasite interaction.	This work supports the LiceRESIST and PACAP projects.
Improving sustainability and mitigating the challenges of aquaculture	Evaluate emamectin benzoate (EMB) susceptibility/tolerance markers and marker selection in appropriate populations of lice in British Columbia, with the goal of developing a multiplex PCR test that is functional as a diagnostic assay to determine lice susceptibility/tolerance to EMB.

**ToR : To propose or develop methods and procedures that facilitate harmonisation of international standards and guidelines applicable to the designated specialty**

**2. Proposal or development of any procedure that will facilitate harmonisation of international regulations applicable to the surveillance and control of animal diseases, food safety or animal welfare**

Proposal title	Scope/Content	Applicable area
N/A	n/a	<input type="checkbox"/> Surveillance and control of animal diseases <input type="checkbox"/> Food safety <input type="checkbox"/> Animal welfare

**ToR: To establish and maintain a network with other OIE Collaborating Centres designated for the same specialty, and should the need arise, with Collaborating Centres in other disciplines**

**ToR: To carry out and/or coordinate scientific and technical studies in collaboration with other centres, laboratories or organisations**

**3. Did your Collaborating Centre maintain a network with other OIE Collaborating Centres (CC), Reference Laboratories (RL), or organisations designated for the same specialty, to coordinate scientific and technical studies?**

Yes

Name of OIE CC/RL/other organisation(s)	Location	Region of networking Centre	Purpose

Norwegian Veterinary Institute - Epidemiology and Risk Assessment of Aquatic Animal Diseases (Europe) CC	Oslo, Norway	<input type="checkbox"/> Africa <input type="checkbox"/> Americas <input type="checkbox"/> Asia and Pacific <input checked="" type="checkbox"/> Europe <input type="checkbox"/> Middle East	Maintain collaboration as OIE Collaborating Centres for similar discipline.
OIE CC for Diagnostic test Validation Science in the Asia Pacific Region	Australia	<input type="checkbox"/> Africa <input type="checkbox"/> Americas <input checked="" type="checkbox"/> Asia and Pacific <input type="checkbox"/> Europe <input type="checkbox"/> Middle East	Co-edit & write chapters for the OIE thematic issue on diagnostic test validation science -- vol. 40(1), 2021. The material covers terrestrial, aquatic and wild animals.(Gardner)

**4. Did your Collaborating Centre maintain a network with other OIE Collaborating Centres, Reference laboratories, or organisations in other disciplines, to coordinate scientific and technical studies?**

No

**ToR: To place expert consultants at the disposal of the OIE.**

**5. Did your Collaborating Centre place expert consultants at the disposal of the OIE?**

Yes

Name of expert	Kind of consultancy	Subject
Dr. Larry Hammell	Technical advice	Expert in epidemiology of aquatic animal diseases. Head of OIE Collaborating Centre for Epidemiology and Risk Assessment of Aquatic Animal Diseases (Americas).
Dr. Ian Gardner	Technical advice	Expert in Epidemiology.

**ToR: To provide, within the designated specialty, scientific and technical training to personnel from OIE Member Countries**

**6. Did your Collaborating Centre provide scientific and technical training, within the remit of the mandate given by the OIE, to personnel from OIE Member Countries?**

Yes

- a) Technical visits: 0
- b) Seminars: 1
- c) Hands-on training courses: 2
- d) Internships (>1 month): 0

Type of technical training provided (a, b, c or d)	Content	Country of origin of the expert(s) provided with training	No. participants from the corresponding country
B	Eastern Aquaculture Veterinary Association (EAVA)- Continuing Education Conference	USA, Canada	18
C	workshop/training for Unama'ki Institute of Natural Resources (Nova Scotia) for participants in Atlantic Canada	Canada	16
C	Identification and life cycle staging for salmon parasites	Canada	26

**ToR: To organise and participate in scientific meetings and other activities on behalf of the OIE**

**7. Did your Collaborating Centre organise or participate in the organisation of scientific meetings on behalf of the OIE?**

Yes

National/International	Title of event	Co-organiser	Date (mm/yy)	Location	No. Participants
International	ISVEE 2021 (postponed to 2022, planning continues). Participant count is estimate.	ISVEE organizing committee (OIE CC doing Aquatic Epidemiology Session)	08/22	Halifax, NS	500
International	Eastern Aquaculture Veterinary Association (EAVA) Annual Conference	Atlantic Veterinary College - University of PEI	02/22	Virtual	18

**ToR: To collect, process, analyse, publish and disseminate data and information relevant to the designated specialty**

**8. Publication and dissemination of any information within the remit of the mandate given by the OIE that may be useful to Member Countries of the OIE**

a) Articles published in peer-reviewed journals: 23

Braden LM, Michaud D, Groman D, Byrne P, Purcell SL, Fast MD. In review. Rejection of salmon lice driven in part by chitin-sensing is not impacted by size at smoltification or time at sea in coho salmon. Submitted to Sci. Rep.

Caballero-Solares A, Umasuthan N, Xue X, Katan T, Kumar S, Westcott JD, Chen Z, Fast MD, Skugor S, Taylor RG,

Rise ML. In Review. Interacting effects of sea louse (*Lepeophtheirus salmonis*) infection and formalin-killed *Aeromonas salmonicida* in Atlantic salmon skin transcriptome. Submitted to Front Immunol.

Cai W, Umasuthan N, Kumar S, Caballero-Solares A, Carvalho LA, Whyte SK, Purcell SL, Gagné, N, Hori T, Allen M, Taylor RG, Rise ML, Fast MD. 2022. Transcriptome analysis of Atlantic salmon (*Salmo salar*) skin in response to sea lice and infectious salmon anemia virus coinfection under different functional diets. Front Immunol. 22: DOI=10.3389/fimmu.2021.787033

Carvalho LA, Whyte SK, Braden LM, Purcell SL, Taylor R, Rise ML, Gagne N, Fast MD. Submitted. Functional feed impact on Atlantic salmon (*Salmo salar*) systemic immune responses to different levels of single infection with sea lice (*Lepeophtheirus salmonis*) and co-infection with sea lice and infectious salmon anemia. Fish Shellfish Immunol Rep.

Delphino MKVC, Mardones FO, Heise JN, Gallardo A, Jimenez D, Peña A, Rozas-Serri M, Gardner IA. 2021. Cost-effectiveness of longitudinal surveillance for *Piscirickettsia salmonis* using qPCR in Atlantic salmon farms (*Salmo salar*) in Chile. Journal of Fish Diseases 44:315-326. DOI: 10.1111/jfd.13285

Delphino MKVC, O'Brien N, Laurin E, Whelan D, Burnley H, Hammell KL, Thakur K. Submitted. Bayesian analysis of diagnostic sensitivity and specificity for detecting infectious salmon anemia virus (ISAV) using either IFAT or real-time RT-PCR testing from laboratories in Atlantic Canada.

Elghafghuf A, Raphael Vanderstichel R, Hammell L, Stryhn H. 2021. State-space modeling for inter-site spread of sea lice with short-term population predictions. Ecological Modelling 452:109602. <https://doi.org/10.1016/j.ecolmodel.2021.109602>

Eslamloo K, Kumar S, Xue X, Parrish KS, Purcell SL, Fast MD, Rise ML. In Review. Global gene expression responses of Atlantic salmon skin to *Moritella viscosa*. Submitted to Sci. Rep.

Jeong J, Stormoen M, Thakur K, Revie C (2021). Imperfect estimation of sea lice abundance and its impact on sea lice treatment in salmon farms. Front Mar Sc (Accepted)

Jeong J, Stormoen M, McEwan GF, Thakur KK, Revie CW. 2021. Salmon lice should be managed before they attach to salmon: Exploring epidemiological factors affecting *Lepeophtheirus salmonis* abundance on salmon farms. Aquaculture 541:736792. <https://doi.org/10.1016/j.aquaculture.2021.736792>

Medcalf KE, Hutchings JA, Fast MD, Kuparinen A, Godwin SC. 2021. Warming temperatures and ectoparasitic sea lice impair internal organs in juvenile Atlantic. MEPS. 660: 161-169. DOI: <https://doi.org/10.3354/>

Miller KM, Kaukinen KH, Li S., Schulze A, Cannon B, Rundle T, Marty GD, Saksida SM (in preparation) Histopathology and genomic characterization of jaundice syndrome in cultured Chinook salmon (*Oncorhynchus tshawytscha*)

Ojasanya R, Garnder I, Groman D, Saksida S, Saab M, and Thakur K. 2021. Antibiotic sensitivity patterns of bacteria commonly isolated from farmed salmonids in Atlantic Canada (2000-2021). 2021 UPEI Graduate Studies and Research Conference.

Ojasanya RA, Gardner IA, Groman D, Saksida S, Saab ME, Thakur KK. (submitted) Antimicrobial susceptibility patterns of bacteria commonly isolated from farmed salmonids in Atlantic Canada (2000-2021). Frontiers in Microbiology.

Parent MI, Stryhn H, Hammell KL, Fast MD, Grant J, and Vanderstichel R. 2021. Estimating the dispersal of *Lepeophtheirus salmonis* sea lice within and among Atlantic salmon sites of the Bay of Fundy, New Brunswick. Journal of Fish Diseases 44:1971-1984. <https://doi.org/10.1111/jfd.13511>

Polinski MP, Laurin E, Delphino MKVC, Lowe GJ, Meyer GR, Abbott CL. 2021. Evaluation of histopathology, PCR, and qPCR to detect *Mikrocytos mackini* in oysters *Crassostrea gigas* using Bayesian latent class analysis. Diseases of Aquatic Organisms 144:21-31. <https://doi.org/10.3354/dao03566>

Romero JF, Gardner I, Price D, Halasa T, Thakur K. 2021. A simulation framework for modelling waterborne spread of highly infectious pathogens in marine aquaculture Transboundary and Emerging Diseases 1:1-16. DOI: 10.1111/tbed.14195

Romero JF, Gardner IA, Saksida S, McKenzie P, Garver K, Price D, Thakur K. In Press. Simulated waterborne transmission of infectious hematopoietic necrosis virus among farmed salmon populations in British Columbia, Canada following a hypothetical virus incursion. *Aquaculture* 548 (2).  
<https://doi.org/10.1016/j.aquaculture.2021.737658>

Romero J, Price D, Gardner I, Thakur K. DTU-DADS-Aqua: a simulation framework for modelling waterborne spread of highly infectious pathogens in marine aquaculture. *Transboundary and Emerging Diseases*.  
[doi.org/10.1111/tbed.14195](https://doi.org/10.1111/tbed.14195)

Saksida SM, Fast M, Garver K, Johnson S. (in preparation) Transmission of infectious agents between wild and farmed fish. In *Diseases and Disorders of Finfish in Cage Culture* (3rd edition).

Soto E, Coleman D, Yazdi Z, Purcell SL, Camus A, Fast MD. 2021. Analysis of the white sturgeon (*Acipenser transmontanus*) immune response during immunostimulation and *Veronaea botryosa* infection. *Comp Biochem Physiol Part D* 40, <https://doi.org/10.1016/j.cbd.2021.100879>

Soto E, Fast MD, Purcell SL, Coleman D, Yazdi Z, Kenelty K, Yun S, Camus A. In press. Transcriptomic analysis of the white sturgeon (*Acipenser transmontanus*) immune response during *Veronaea botryosa* infection at different temperatures. *Comp Biochem Physiol Part D*.

Yamkasem J, Roy SRK, Khemthong M, Gardner IA, Surachetpong W. 2021. Diagnostic sensitivity of pooled samples for the detection of tilapia lake virus and application to the estimation of within-farm prevalence. *Transboundary and Emerging Diseases* 68:3519-3528.  
<https://doi.org/10.1111/tbed.13957>

b) International conferences: 11

Cardé EMQ, Littman E, Yun S, Fast MD, Griffin M, Brown CT, Soto E. Latent Acipenserid Herpesvirus 2 results in higher mortality of White sturgeon after *Streptococcus iniae* challenge. Conference of Research Workers in Animal Disease, Chicago Illinois, December 3-7, 2021. (Oral presentation by Cardé)

Cardé EMQ, Littman E, Yun S, Fast MD, Griffin M, Soto E. Role of Acipenserid Herpesvirus 2 during co-infections with *Streptococcus iniae* in White sturgeon (*Acipenser transmontanus*). 52nd Annual International Association for Aquatic Animal Medicine Meeting, Tampa Florida, May 22-26, 2021. (Oral zoom presentation by Cardé)

Fajei E, Cai WC, Whyte SK, Purcell SL, Fast MD. Boosting tilapia (*Oreochromis niloticus*) immune responses to *Flavobacterium columnare* using PACAP (pituitary adenylate cyclase activating peptide). North American Comparative Immunology Workshop, June 8-10, 2021 (Oral zoom presentation by Fajei)

Groves L, Whyte SK, Purcell SL, Parrish K, Perreira J, Garber A, Fast MD. Infectious salmon anemia (ISAv) and climate change; the combined effects on Atlantic salmon's (*Salmo salar*) immunological response. North American Comparative Immunology Workshop, June 8-10, 2021 (Oral zoom presentation by Groves)

Groves L, Whyte SK, Purcell SL, Parrish K, Perreira J, Garber A, Fast MD. Infectious salmon anemia (ISAv) and climate change; the combined effects on Atlantic salmon's (*Salmo salar*) immunological response. AFS-FHS Summer Seminar Series, June 10, 2021 (Oral zoom presentation by Groves)

Hammell, L (digital presentation) The impact of sea lice on the salmon industry, the global perspective and possible solutions: Atlantic perspective. North Atlantic Seafood Forum (FHF), virtual session.

Michaud D, Cai WC, Poley JD, Belliveau P, MacDonald AM, Hardottir H, Dalvin S, Fast MD. Identification of critical enzymes within the salmon louse chitin synthesis pathway revealed by RNAi. AFS-FHS Summer Seminar Series, June 18, 2021 (Oral zoom presentation by Michaud)

Romero J, Gardner I, Thakur K. A mathematical modelling approach to assist infectious disease management in marine aquaculture. Presented at the Aquaculture Europe 2021 – Student workshop session. Funchal, Madeira, Portugal, October, 2021 (presentation by Romero)

Romero J, Gardner I, Saksida S, Price D, Garver K, Thakur K. Epidemiological modelling of waterborne spread of infectious hematopoietic necrosis virus in farmed salmon populations. Presented at the Aquaculture Europe 2021 – Student workshop session. Funchal, Madeira, Portugal, October, 2021 (presentation by Romero)

Thakur K. Sustainability of fisheries and aquaculture at the interface of climate change and emerging infectious



diseases. Invited Speaker. USGS Western Fisheries Research Center Seminar Series, Virtual, April, 2021

Thakur K. Shrimp aquaculture in Southeast Asia: Challenges and opportunities for epidemiological studies to enhance shrimp health and productivity. Invited Speaker. Eastern Aquaculture Veterinary Association Annual Continuing Education Conference, February 3, 2021 (Oral virtual presentation)

c) National conferences: 0

d) Other

(Provide website address or link to appropriate information): 0

**9. Additional comments regarding your report:**

Scientific workshops, training, and conferences, planned for 2021 were postponed due to COVID19 pandemic.