Ph.D. Candidate

Jani Helminen

Graduate Academic Unit

Biology

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September 14, 2021

9:00 a.m. (Atlantic)

Virtual Defence

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Examining Board:
Dr. Mark Sherrard (Biology)
Dr. Karl Butler (Earth Sciences)
Dr. Ian Church (Geodesy & Geomatics Engineering)
Dr. Tommi Linnansaari (Biology)   Supervisor

External Examiner: Dr. François Martignac
 Ecology and Ecosystem Health research unit
 Conservation and Restoration of Aquatic Ecosystems research group
 French National Institute for Agriculture, Food, and Environment (INRAE)

The Oral Examination will be chaired by:
Dr. Patricia Evans, Associate Dean of Graduate Studies

BIOGRAPHY

Universities attended (with dates & degrees obtained):

2016 – present	Ph.D. candidate, University of New Brunswick
2016	M.Sc. (Aquatic Sciences – Specialisation in Fish and Fishery Biology), University of Helsinki
2016	B.Sc. (Biological and Environmental Sciences), University of Helsinki
2013	Minor Degree for BSc studies (Water and Environmental Engineering), Aalto University

Selected Publications:

Helminen, J. O'Sullivan, A.M. & Linnansaari, T. (2021). Measuring tailbeat frequencies of three fish species from Adaptive Resolution Imaging Sonar (ARIS) data. Transactions of the American Fisheries Society. DOI: 10.1002/tafs.10318

Helminen, J. & Linnansaari, T. (2021). Object and behavior differentiation for improved automated counts of migrating river fish using imaging sonar data. Fisheries Research, 237. DOI: 10.1016/j.fishres.2021.105883

Helminen, J., Dauphin, G. J.R. & Linnansaari, T. (2020). Length measurement accuracy of Adaptive Resolution Imaging Sonar (ARIS) and a predictive model to assess adult Atlantic salmon (*Salmo salar*) into two size categories with long-range data in a river. Journal of Fish Biology. DOI: 10.1111/jfb.14456

O'Sullivan, A., Wegscheider, B., **Helminen, J**., Cormier, J. G., Linnansaari, T., & Curry, R. A. (2020). Catchment-scale, high-resolution, hydraulic habitat models. Journal of Ecohydraulics. DOI: 10.1080/24705357.2020.1768600

Selected Conference Presentations:

Helminen J, Linnansaari T. and Dauphin G.J.R (2019) Estimating Atlantic Salmon (*Salmo salar*) Population Size in a Multispecies River Using Adaptive Resolution Imaging Sonars (ARIS) and Underwater Cameras. American Fisheries Society & The Wildlife Society 2019 Joint Annual Conference. 29 September – 3 October. Reno, Nevada, USA.

Helminen J, Linnansaari T, MacIntyre C (2019). Counting fish with ARIS imaging sonars. How to tell if it is a salmon? Atlantic Salmon Ecosystems Forum. 12-13 March. Quebec City, Quebec, Canada. [Poster Presentation]

Curry R.A, Andrews S, Babin A, Carrow R, Corey E, Cunjak R, Gautreau M, Gray M, **Helminen J**, Linnansaari T, Roth D, Samways K, Yamazaki G (2018). Tracking Fish From Freshwater to the Sea. Technologies and Issues Across Spatial Scales and Ecological Considerations. Asian Fisheries Acoustics Society, AFAS meeting 2018. 13-15 November 2018. Jeju, South Korea.

Monitoring Atlantic salmon (Salmo salar) populations using imaging sonar technology in the Miramichi River

Abstract

Atlantic salmon (*Salmo salar*) is an important species culturally and socially, and a target species of multiple fisheries globally. Primarily due to overfishing, water pollution, sedimentation, and damming, Atlantic salmon catches at sea are under a continuing decline; however, the state of different populations varies greatly, and it is important that each population is assessed accurately and independently. In this PhD research, non-invasive imaging SONAR technology was tested for collecting tributary-specific information about migrating fish in the Miramichi River, where the adult Atlantic salmon population is currently monitored using a traditional mark-recapture method.

The accuracy and precision of the length measurements using long-range (up to 30m) imaging sonar data was tested and deemed low; however, a Bayesian model was created with capacity to predict the size class (1SW vs MSW) of Atlantic salmon from the sonar measurements.

For efficient analysis of the sonar data, an automated data processing workflow was created. The automation counted the number of migrating fish similarly as different human-generated counts (with mean of differences between -39 % and 65 %).

The tail-beat frequencies of three-fish species (Atlantic salmon, striped bass (*Morone saxatilis*), and American shad (*Alosa sapidissima*)) were calculated from the sonar data and found significantly (p<.05) different from each other. An automated method was developed showing promising results that can be further developed into models distinguishing different species using sonar data.

Finally, underwater camera sampling was used for apportioning species in the sonar data in the Little Southwest Miramichi River. Hourly migration data indicated that both salmon and striped bass were rarely detected during daylight hours. When compared to downstream trap net catches that were adjusted for realistic values from literature (catchability 10 % and 40 % of fish moving to the same tributary), the counts were in close agreement for Atlantic salmon (sonar count 103-130 % of the adjusted trap net catch).

To combine all the information gathered throughout the project, a guide was produced for monitoring Atlantic salmon in rivers using imaging sonars. In conclusion, the imaging sonar method provides an efficient and non-invasive method for population assessment in the Miramichi River.
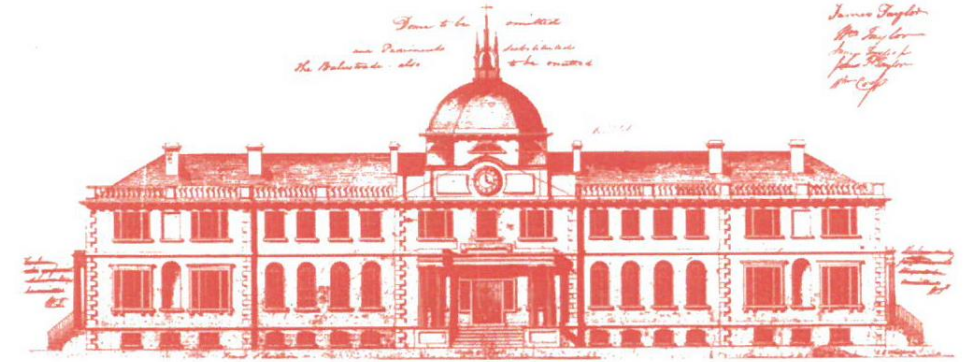
Home of the School of Graduate Studies, Sir Howard Douglas Hall was designed by J.E. Woolford in 1825 and is the oldest university building in Canada still in use.

The University of New Brunswick recognizes that the university sits on traditional Wolastoqey territory. The river that runs right by our university – the St. John River – is also known as Wolastoq, along which live the Wolastoqiyik -- the people of the beautiful and bountiful river.

UNIVERSITY OF NEW BRUNSWICK
SCHOOL OF GRADUATE STUDIES

ORAL EXAMINATION

Jani Helminen

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY