

Postdoctoral, Ph.D., and 2 MSc. positions in Cleaner fish Behavioural ecology and Genetics:

Positions are available for one postdoc and two MSc and one Ph.D. positions to investigate the foraging ecology and genetics of two cleaner fish species that forage on parasitic lice attached to Atlantic salmon. The postdoctoral position begins in May 2018 and is funded for two years. The two MSc. positions begin in January or May 2018 and are funded for two years. The Ph.D. position begins in January or May 2018 and is funded for four years.

The project is led by Professor Elizabeth Boulding (Integrative Biology, U. Guelph) with co-investigator Professor Emeritus Larry Schaeffer (Animal BioSciences, U. Guelph). Our industrial collaborators are led by Dr. K.P. Ang of Kelly Cove Salmon Ltd. (KCS) a division of Cooke Aquaculture Inc. (CAI). They include Dr. J.A.K. Elliott, Dr. M. Herlin, F. Powell from KCS, and Dr. T. M. Jonassen from Akvaplan-Niva, Norway.

The objective of this NSERC Strategic Project is to provide a sustainable and pedigreed source of cleaner fish to reduce lice densities found on Atlantic salmon living in marine sea cages in Eastern Canada. This project will develop highly-repeatable methods of measuring the functional responses of two proven cleaner fishes: the lumpfish (*Cyclopterus lumpus*) and the cunner (*Tautoglabrus adspersus*). An outcome of this project will be a breeding program for lice-eating performance by lumpfish and by cunners at two existing hatcheries operated by CAI. It will also deepen our understanding of the reciprocal evolution of early mutualisms between facultative cleaner fishes and their clients.

MSc. student position 1 (behavioural ecology of fishes) will help develop methods of predicting lice-cleaning performance of cunners in marine sea cages from observations of their performance in indoor tanks. This will involve comparing condition-dependent performance among different families of cunners from different geographical regions that have been reared in a common environment. Cunner lice-removal performance in marine sea cages will be assessed using video-footage and by examining their stomach contents.

MSc student position 2 (molecular ecology/bioinformatics) will help develop DNA markers to estimate pedigrees for cleaner fish families spawned in the hatcheries. This position will involve high throughput DNA extraction, and bioinformatics using a high-performance computer cluster. This research will identify DNA markers that show larger than expected amounts of genetic divergence among cunner populations and among lumpfish populations from different geographical areas.

Ph.D. student (applied evolution/behavioural ecology of fishes) will help develop methods of predicting lice-cleaning performance of lumpfish in marine sea cages from their performance in tanks. This will involve comparing condition-dependent performance among different families of lumpfish from different geographical regions that have been reared in a common environment. Lumpfish lice-removal performance in marine sea cages will be assessed using video-footage and by examining their stomach contents. Relationships between traditional and DNA barcoding of stomach contents will

be compared for lumpfish and for cunners and used to develop non-lethal methods of monitoring the prevalence of lice in their diets. This may lead to a deeper understanding of environmental factors affecting facultative lice-cleaning performance in the field.

Postdoctoral fellow (with experience in fish applied evolution/applied ethology/behavioural ecology) will help the graduate students develop repeatable methods of measuring posing and other co-operative behaviors by client fish that facilitate parasite-removal by cleaner fishes. Their own project will involve assisting with salmon lice tank challenges of pedigreed Atlantic salmon and measuring posing rates near cleaner fish refuges. It will also involve video-assisted field observations of client behavior near cleaner-fish refuges within marine sea cages. The postdoc will be trained to estimate breeding values for lice-cleaning performance by the cleaner fish and for posing performance by their Atlantic salmon clients. Creating a breeding nucleus containing only cleaner fish and client fish with high breeding values for performance traits would be predicted to increase the reciprocal co-evolution of this mutualism in marine sea cages.

Please apply for the postdoctoral, Ph.D. or MSc. positions by sending an email to Dr. Boulding (boulding@uoguelph.ca) with attachments containing: 1) your curriculum vitae/resume, 2) an electronic transcript of all your university grades, 3) a list of referees with their email addresses and telephone numbers, 4) pdf reprints of your scientific publications (if any), and 5) a statement that you are willing to travel from Guelph to New Brunswick and Newfoundland for fieldwork as needed. She will then request references from the referees of qualified applicants.

Applicants for a M.Sc. or Ph.D. position need to be eligible for admission the Department of Integrative Biology at the University of Guelph: <http://www.uoguelph.ca/ib/> . Check the College of Biological Sciences website for MSc and Ph.D. admission requirements and application procedures <https://www.uoguelph.ca/cbs/admission-requirements> The funding for the graduate student positions is sufficient to cover minimal living costs and University of Guelph tuition rates for Canadian citizens or permanent residents.