University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

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"Characterizing the Effects of Urbanization on Stream Biota Using a Trait-Based Approach"

Department of Biology

Thursday, August 8, 2019
1:00 P.M.
Clearihue Building
Room B017

Supervisory Committee:
Dr. Rana El-Sabaawi, Department of Biology, University of Victoria (Supervisor)
Dr. Francis Juanes, Department of Biology, UVic (Member)
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Dr. Eric Miller, Department of English, UVic

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Abstract

We live in an increasingly urban world and ecologists are being called upon to provide thorough information on the effect of urbanization on ecosystems. However, urban ecology has historically focused almost exclusively on describing changes in species richness. Although this has been important as a first characterization of the effect of urbanization, the focus on describing species richness has restricted our understanding of the mechanisms determining ecological patterns and processes in cities. In this thesis, I apply a trait-based approach to a widespread urban invasive species, the guppy, *Poecilia reticulata*, in order to explore the mechanisms through which urbanization can affect reproductive and feeding ecology traits of the stream biota. I first review studies that use trait-based approaches in stream ecosystems and develop an intraspecific trait framework that can be used to link urbanization to changes in traits of the stream biota. Then, I combine this framework with existing information on trait evolution of guppies in their non-urban, native range in Trinidad, to explore the effect of urbanization on guppy life history related traits and population density in Brazil. Next, building on a study of drivers of diet and trophic morphology in Trinidadian guppies, I use a trait-based framework to explore the effect of urbanization on guppy diet and feeding morphology in Brazil.

My review shows that intraspecific trait approaches in urban streams are rare, but have the potential to provide a mechanistic understanding of the effects of urbanization on stream biota. By using an intraspecific trait approaches, I show that urbanization increases guppy body length, increases fecundity and improves condition. Concurrent investment in reproduction and somatic tissues suggests that urbanization relaxes life history traits trade offs in guppies. Urban guppies also attain far higher densities than non-urban guppies. These changes in traits and populations are related to the large amount of high-quality food (i.e. chironomids) available for guppies in urban streams. Urban-induced changes in traits enhance guppy invasive potential. By studying guppies in Trinidad, I have found that each population is composed of two resource-use phenotypes with distinct diets and gut morphology (carnivorous guppies with short guts and detritivorous/algivorous guppies with long guts). The frequency of each resource-use phenotype appears to be determined by guppy density: low density appears to increase the frequency of the carnivorous phenotype. Guppy populations in Brazil are also composed of two resource-use phenotypes, and that the

existence of these phenotypes is related to the variation in individual feeding morphology (i.e. cranium shape) that affect feeding efficiency. Neither density nor urbanization appears to shift the distribution of the two resource use phenotypes. However, urban guppies have larger and wider crania, thus a more efficient insect feeding morphology, than non-urban guppies. Overall my study suggests that a trophic mechanism is important for the success of guppies in urban streams, and it is possible that similar mechanism also facilitates the success of other urban dwellers. My study also highlights the power of intraspecific trait approaches for understanding the ecology urban dwellers. Such knowledge can help us refine and advance ecological theories to better predict future ecological change in an increasingly urbanized world.