University of Victoria | Graduate Studies

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

of

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MSc (University of Victoria, 2010)
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“Defensive Symbiosis in Drosophila: From Multiple Infections to Mechanism of Defense”

Department of Biology

Thursday, December 10, 2015
9:00 A.M
David Turpin Building
Room A137

Supervisory Committee:
Dr. Steve Perlman, Department of Biology, University of Victoria (Supervisor)
Dr. Ben Koop, Department of Biology, UVic (Member)
Dr. Brad Anholt, Department of Biology, UVic (Member)
Dr. Brian Starzomski, School of Environmental Studies, UVic (Outside Member)

External Examiner:
Dr. Greg Hurst, Institute of Integrative Biology, University of Liverpool

Chair of Oral Examination:
Dr. Michelle Wiebe, Department of Curriculum and Instruction, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Multiple infections within the same host are now understood to be common and important determinants of the outcomes of disease processes. Multiple infections are particularly important in insects, which are often infected by vertically transmitted symbionts that are passed from the mother to her offspring. In many cases, these symbionts have evolved to confer high levels of protection against co-infecting parasites, pathogens, or other natural enemies. Despite widespread examples of symbiontmediated defense, there are key outstanding questions in the ecology and evolution of defensive symbiosis. These include the mechanisms through which protection is conferred, the specificity of defensive effects against different parasites and pathogens, and the overall roles of defensive and other symbioses in host communities and ecosystems.

To address these questions, I used a model of defensive symbiosis in which the bacterium Spiroplasma protects the woodland fly Drosophila neotestacea from the nematode parasite Howardula aoronymphium. First, I conducted a series of experiments that included transcriptome sequencing of D. neotestacea infected by Howardula and Spiroplasma to uncover the mechanistic basis of defense in this symbiosis. Through these experiments, I found evidence of a putative protein toxin encoded by Spiroplasma that might contribute to defense. Following this, we characterized the protein as a novel member of a class of toxins known as ribosome-inactivating proteins (RIPs). RIPs are important virulence factors in bacteria such as enterohemorrhagic *E. coli* ; I exploited recent approaches for quantifying RIP activity to design sensitive assays that demonstrate that Howardula suffers a high degree of ribosome cleavage specific to RIP attack during Spiroplasma-mediated defense. This is among the first demonstrations of a mechanism of defense against a specific enemy in an insect defensive symbiosis.

I next worked with collaborators to culture and characterize a novel trypanosomatid parasite of Drosophila that I uncovered during the above transcriptome sequencing. Trypanosomatids are protist parasites that are common in insects, and the causes of important human diseases that include Chagas disease and African sleeping sickness. Despite Drosophila's history as an important model of infection and immunity, little is known of its trypanosomatid parasites, and we describe this parasite as a new genus and species: Jaenimonas drosophilae, the first trypanosomatid formally described from a Drosophila host. We conduct a series of experiments to understand infection dynamics, immune responses and interactions with other parasites and symbionts within the host, beginning to establish Drosophila-Jaenimonas infections as a tractable model of trypanosomatid infection in insects.

Finally, though examples of ecologically important defensive symbioses accumulate, an understanding of their overall roles in ecosystems is lacking. I close with a synthesis of the ways in which symbioses - defensive or otherwise - can affect ecosystem structure and function through their effects on food webs. This work will help to develop a conceptual framework to link reductionist findings on specific symbioses to larger scale processes.