University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Science

of

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BSc (University of Victoria, 2015)

"X Chromosome Drive in *Drosophila Testacea*"

Department of Biology

Tuesday, April 17, 2018
10:00 A.M.
Engineering and Computer Science Building
Room 130

Supervisory Committee:
Dr. Steve Perlman, Department of Biology, University of Victoria (Supervisor)
Dr. John Taylor, Department of Biology, UVic (Member)
Dr. Ben Koop, Department of Biology, UVic (Member)

External Examiner:
Dr. Juan Ausio, Biochemistry and Microbiology, UVic

Chair of Oral Examination:
Dr. Martin Boulanger, Department of Biochemistry and Microbiology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Selfish genes that bias their own transmission during gametogenesis can spread rapidly in populations, even if they contribute negatively to the fitness of their host. Driving X chromosomes provide a clear example of this type of selfish propagation. These chromosomes, which are found in a broad range of taxa including plants, mammals, and insects, can have important evolutionary and ecological consequences. In this thesis, I report a new case of X chromosome drive (X drive) in a widespread woodland fly, *Drosophila testacea*. I show that males carrying the driving X (SR males) sire 80-100% female offspring, and that the majority of sons produced by SR males are sterile and appear to lack a Y chromosome. This suggests that meiotic defects involving the Y chromosome may underlie X drive in this species. Abnormalities in sperm cysts of SR males reflect that some spermatids are failing to develop properly, confirming that drive is acting during gametogenesis. Further, I show that SR males possess a diagnostic X chromosome haplotype that is perfectly associated with the sex ratio distortion phenotype. Phylogenetic analysis of X-linked sequences from *D. testacea* and related species strongly suggests that the driving X arose prior to the split of *D. testacea* and its sister species, *D. neotestacea* and *D. orientacea*. Suppressed recombination between the XST and XSR due to inversions on the XSR likely explains their disparate evolutionary histories. By screening wild-caught flies using progeny sex ratios and a diagnostic Xlinked marker, I demonstrate that the driving X is present in wild populations at a frequency of ~10% and that autosomal suppressors of drive are segregating in the same population. Both SR males and homozygous females for the driving X have reduced fertility, which helps to explain the persistence of the driving X over evolutionary timescales. The testacea species group appears to be a hotspot for X drive, and *D. testacea* is a promising model to compare driving X chromosomes in closely related species, some of which may even be younger than the chromosomes themselves.