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

of

MALCOLM COWAN

BSc (University of Victoria, 2016)

“Exploring the Mechanisms of Pacific Oyster Summer Mortality in Baynes Sound Aquaculture”

Department of Biology

Thursday, August 6, 2020
9:30 A.M.
Conducted Remotely

Supervisory Committee:
Dr. Patrick von Aderkas, Department of Biology, University of Victoria (Co-Supervisor)
Dr. Christopher Pearce, University of Geography, UVic (Co-Supervisor)
Dr. Paul de la Bastide, Department of Biology, UVic (Member)
Dr. Caren Helbing, Department of Biochemistry and Microbiology, UVic (Outside Member)

External Examiner:
Dr. Daniel Cheney, Senior Scientist, Pacific Shellfish Institute

Chair of Oral Examination:
Dr. Merwan Engineer, Department of Economics, UVic

Dr. Stephen Evans, Acting Dean, Faculty of Graduate Studies
Abstract

In recent years, mortalities of unknown aetiology have occurred in Pacific oyster aquaculture in Baynes Sound during the summer. Field studies were conducted to examine environmental, reproductive and microbial factors that could be contributing to these mortalities. In 2017, oysters were observed at three sites from July 5 to Sept 15. Each site had 3 modules containing 7 stacked trays with 80 oysters per tray. Final mortalities ranged from 9.3 ± 1.9 to 38.8 ± 4.9% per module. The mortality per module correlated significantly with gonad length and the proportion of oysters that were female in a multiple linear regression model (R^2=0.824, p=0.002). *Vibrio aestuarianus*, a well-documented pathogen of Pacific oysters in France, was well represented in bacterial cultures from intertidal oysters in 2017 based on recA gene sequencing of 158 isolates. In 2018, juvenile Pacific oysters were monitored to characterize the onset of a summer mortality event in suspended culture. From May 11 to September 17, data on shell size, reproductive development, environmental conditions, and the microbial community of gill tissue was tracked at culture densities of 150, 300, 450, and 600 oysters tray⁻¹. The onset of mortality was associated with a period of rapid growth, reproductive development, and elevated temperatures. Cumulative mortality per tray ranged from 34 to 75%, with the highest density trays having significantly lower mortality (p=0.023), lower shell width (p=0.001), lower shell length (p=0.002) and lower gonad length (p=0.049) than the lowest density trays in a linear mixed-effects regression. Histology of oysters from August 12, during the mortality event, showed a mixed microbial infection in peripheral gill tissue. High-throughput sequencing of the 16S rRNA gene and qPCR of *V. aestuarianus* using species-specific recA primers suggest *V. aestuarianus* is temporally associated with summer mortality. Mortalities observed in 2017 and 2018 for this study occurred in different age classes and with different oyster culture techniques; all were associated with elevated water temperature, increased reproductive effort, and the presence of *V. aestuarianus*. 