University of Victoria | Graduate Studies

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

of

MONIQUE RAAP

BSc (University of Victoria, 1994)

"Anthropogenic Modifications and their Impacts on Shellfish Physiology"

Department of Biology

Tuesday, January 8, 2018
10:00 A.M.
Petch Building
Room 206

Supervisory Committee:
Dr. Helen Gurney-Smith, Department of Biology, University of Victoria (Co-Supervisor)
Dr. Benjamin Koop, Department of Biology, UVic (Co-Supervisor)
Dr. Sarah Dudas, Department of Biology, UVic (Member)
Dr. Christopher Pearce, Department of Geography, UVic (Outside Member)

External Examiner:
Dr. Stewart Johnson, Fisheries and Oceans Canada

Chair of Oral Examination:
Dr. Ulrike Stege, Department of Computer Science, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Humans have been modifying marine habitats for centuries, to enhance productivity and collection of natural food sources, such as fish and shellfish have existed. Anthropogenic alterations and impacts on marine habitats include coastal development, aquaculture and fishing, agriculture, transportation, and waste disposal, which have led to a decrease in habitat complexity resulting in loss of biological diversity. The maintenance, regulation and protection of healthy aquatic habitats and the ecosystem services they provide is a global concern. In this study transcriptional analysis was utilized to investigate physiological responses of shellfish to two different types of anthropogenic marine habitat impacts; clam gardens, and microplastic pollution.

Clam gardens are examples of ancient anthropogenic modifications built by the northwest coastal peoples of America to enhance clam habitat and productivity, to provide secure and reliable food sources. Physiological differences of *Leukoma staminea* (Littleneck clams) transplanted in clam garden beaches for 16 weeks compared to clams in reference beaches were investigated using metrics of gene expression, growth and survival. This study found no statistically significant differences in growth and survival, but there were differentially expressed biological pathways in clams from clam gardens and reference beaches. Most biological pathways in both groups were associated with environmental stress, suggesting both habitats contained their own unique multiple stressors. There were also no statistically significant differences in sediment carbonate, organic content, or grain size distributions between the sediment from clam garden beaches compared to reference beaches. An interesting finding in this study was a significant negative correlation between sediment carbonate content and survival. The presence of several highly upregulated viral transcripts from the Dicistroviridae Family had significant correlations with geographical proximity and survival, further confirming that other factors (such as geographical location and sediment characteristics) had a greater influence on Littleneck clam survival and immune status than beach type.

Microplastics are emerging anthropogenic pollutants contaminating marine habitats worldwide, including key aquaculture and fisheries species such as bivalves. To examine the impacts of environmentally relevant concentrations of microplastics on the highly commercial Pacific oyster (*Crassostrea gigas*), oysters were exposed microplastics (5 microplastic fibres per litre)

for 30 days and assessed using condition index, microplastic load, lysosomal membrane stability, and gene expression. There were no statistically significant differences observed in condition index or lysosomal membrane stability. However, there were significant differences in microplastic load and gene expression between the exposed and control oysters. There was an upregulation in biological pathways associated with immunity and stress and a downregulation in pathways associated with reproduction in the exposed oysters, highlighting the potential long-term negative consequences of environmental microplastics on long-term population impacts, especially if microplastic concentrations continue to increase.

These studies demonstrate the sensitivity and power of using RNA sequencing in assessing physiological impacts of anthropogenic modifications, highlighting the benefits of this technique to detect potential stressors for with implications for long-term maintenance of population stability and diversity.