University of Victoria | Graduate Studies

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

of

ALLISON BYRNE

BSc (Mount Allison University, 2012)

"Pacific oyster (*Crassostrea gigas*) and Atlantic Salmon (*Salmo salar*) Integrated Multi-Trophic Aquaculture in British Columbia: Investigation of Bivalve Growth and Natural Sea Lice Mitigation"

Department of Geography

Monday, February 29, 2016
11:00AM
David Turpin Building
Room B215

Supervisory Committee:
Dr. Stephen Cross, Department of Geography, University of Victoria (Supervisor)
Dr. Christopher Pearce, Department of Geography, UVic (Co-Supervisor)
Dr. Simon Jones, Department of Biology, UVic (Outside Member)

External Examiner:
Dr. Ian Bricknell, School of Marine Sciences, University of Maine

Chair of Oral Examination:
Dr. Todd Milford, Department of Curriculum and Instruction, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

The close proximity of net-pen salmon farms and wild Pacific salmon stocks in British Columbia (BC) is an incentive for precautionary management of the environmentally and economically damaging parasites known as sea lice. Bivalves cultured as part of an integrated multi-trophic aquaculture (IMTA) system may contribute natural, preventative louse control through the ingestion of planktonic sea lice larvae. A field trial was conducted to test sea lice mitigation by bivalves at a commercial Atlantic salmon (*Salmo salar*) farm in BC using Pacific oysters (*Crassostrea gigas*). Oysters were cultured in trays around one end of the farm and at a reference site approximately 150 m away from August 2013 until August 2014.

Parasitic and planktonic sea lice (*Lepeophtheirus salmonis* and *Caligus clemensi*) were monitored before and during oyster deployment, beginning in December 2012. Parasite abundance peaked in January 2013 (6.5 lice fish^{-1}, >85% *C. clemensi*), and the following year in February 2014 (3.3 lice fish^{-1}, >80% *L. salmonis*). Larval density within cages peaked in January, both in 2013 (1.28 larvae m^{-3}) and 2014 (0.96 larvae m^{-3}). Parasite abundance was significantly correlated with both surface salinity (r2= 0.28, *p*=0.04) and sea lice larval density (r2= 0.65, *p*=0.01). Observed densities were significantly lower (t=3.41, *p*=0.009) than those calculated for the ed on water emperature and salinity, the number of adult female lice present, and the approximate number of fish.

Sea lice mitigation by oysters was assessed by comparing monthly sea lice larval densities inside bivalve and non-bivalve fish cages, and by analyzing preserved oyster digestive tracts from January 2014 (when larval densities were highest) for presence of *L. salmonis* DNA using PCR. Using these methods, no significant evidence of sea lice mitigation was detected. Oyster growth was monitored by measuring whole wet weight, soft tissue wet, dry, and ash-free dry weight, and shell length, width, and height approximately every four months. Oysters were sampled equally across different sides of the farm and at the reference site (~150 m away from the farm) at three depths: 1, 3, and 6 m. All seven measurements increased significantly over time. Effects of side and depth varied by growth parameter; in general, oysters at 1 and 3 m were significantly larger than those at 6 m, and oysters cultured at the reference site were either significantly smaller or the same size as those cultured around the farm. Oysters from select sides were consistently, significantly larger than those from other sides and from the reference site.

Overall, the findings suggest that sea lice larvae quickly dispersed away from the farm after hatching and were not significantly impacted by bivalve presence around the fish cages. Bivalves grew significantly larger over time and size was significantly impacted by both depth and side of the fish cage. While no evidence of larval sea lice reduction/ingestion by cultured bivalves was detected, this study provides information on all sea lice stages present throughout an Atlantic salmon production cycle, as well as the first detailed growth analysis of Pacific oysters cultured alongside farmed Atlantic salmon in BC.