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 Guelph, 2014)

"The reproductive and physiological condition of a deep-sea mussel (*Bathymodiolus septemdierum* Hashimoto & Okutani 1994) living in extremely acidic conditions"

Department of Biology

Monday, November 14, 2016
1:00PM
David Turpin Building
Room A136

Supervisory Committee:
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Dr. Louise Page, Department of Biology, UVic (Member)
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Dr. Karen MacKinnon, School of Nursing, UVic

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Abstract

Oceanic uptake of anthropogenic CO2 emissions is causing wholesale shifts seawater carbonate chemistry towards a state of decreased carbonate ion concentration and reduced ocean pH. This change in water chemistry has potentially dire implications for marine organisms, especially those that build and maintain calcium carbonate structures. Our understanding of how ocean acidification may affect marine organisms is limited, as most studies have been short-term laboratory experiments. The CO2 flux from hydrothermal vent fluids on NW Eifuku submarine volcano (Mariana Volcanic Arc) provides a natural setting to investigate the effects of acidification. Here, the vent mussel, *Bathymodiolus septemdierum*, lives in water with pH as low as 5.22. This study was designed to examine the consequences of a low pH environment on reproduction, calcification and somatic growth in *B. septemdierum*, since the elevated cost of acid-base regulation effectively diminishes available energy for these processes. Histological analysis reveals both females and males display synchronous gametogenesis across collection sites with spawning occurring between late winter and early spring. Mussels are functionally dioecious, although protogynous hermaphroditism occurs in a few individuals – a first record for the genus. In comparison with mussels at near normal pH,we find no evidence that the pattern of gametogenesis is affected by low pH conditions. However, calcification is compromised: at a given shell volume, shells from NW Eifuku weigh about half those from near normal pH mussels. The condition index (CI = body ash free dry weight/ shell volume) was assessed in mussels collected from four low pH sites on Northwest Eifuku and two control sites from Lau Basin and Nifonea Ridge; we show that low pH conditions negatively affect CI, especially when energy availability is limited. *Bathymodiolus septemdierum* acquires energy from chemoautotrophic symbionts in the specialized gill epithelial cells. Using a gill condition index (GCI = gill ash free dry weight/ shell volume) and transmission electron microscopy to determine symbiont abundances in gill tissues, we show that mussels with healthy gills and abundant symbionts have a higher CI despite low pH conditions. Optimal environmental sulphide concentrations appear to sustain higher symbiont abundances. While the survival of mussels on NW Eifuku is remarkable, it comes at a considerable cost to body and shell condition particularly during periods of energy limitation. *Bathymodiolus septemdierum* shows substantial resilience to low pH conditions when energy availability is sufficient due to energy budget adjustments that maximize fitness.