Collaborative Research: Ocean Acidification: Impacts to copepod populations mediated by changes in prey quality

Project Summary

Intellectual Merit: Research shows that ocean acidification (OA) has physiological consequences for individual organisms, even those lacking calcium carbonate skeletal structures. However, this existing research does not adequately address how OA effects to individuals are linked across trophic levels. Pelagic copepods are critical players in most marine biogeochemical cycles. Their consumption of phytoplankton and microzooplankton is the primary mechanism by which bacterial and phytoplankton production is transferred to higher trophic levels. Despite their high abundance and ecological importance, copepods have received little research attention concerning OA. The few extant studies focused on direct acute effects to copepods (e.g. egg hatching, survival) under elevated pCO_2, and few significant effects have been observed at predicted future pCO_2. However, there is increasing recognition that OA significantly affects their phytoplankton prey, including elevating growth rates, increasing cell sizes, altering nutrient uptake and ratios, and chemical composition. Because copepod grazing, egg production, and hatching success all can vary with these prey characteristics, OA mediated changes in phytoplankton quality may be an important indirect mechanism through which OA acts on copepod populations and, ultimately, marine food webs. **We propose a study that will advance our understanding of how copepod populations may be affected by OA, specifically through OA induced changes in phytoplankton quality.** Our core objective is to determine how changes in phytoplankton physiology and biochemistry (e.g. lipid composition) affect copepod egg production, hatching, and ontogenetic development of nauplii. We will also include a subset of experiments to test whether OA affects copepod reproductive output independent of changes to prey. To achieve these research goals, the diatom, *Ditylum brightwellii*, and dinoflagellate, *Prorocentrum micans*, will be cultured semi-continuously under several pCO_2 concentrations, during which time we will characterize changes in their physiology and biochemistry. The copepods, *Calanus pacificus*, a large, high lipid-bearing marine species, and *Acartia clausi*, a smaller, low lipid-bearing estuarine species, will be maintained across varying pCO2 concentrations and fed these pCO_2-acclimated prey, and their grazing and reproductive capability quantified. The copepods and phytoplankton used in this study will be collected from the Salish Sea, a region already experiencing periods of high pCO_2/H^+ (>1000 ppm, pH 7.5) on varying timescales. Therefore, this research addresses a question of how future climate change may impact marine ecosystems, but also is relevant to pCO_2/H^+ variability presently experienced in coastal environments.

Broader Impacts: The PIs of this project are committed to: 1) promoting access to under-represented groups, 2) training and mentoring, 3) broadening knowledge of OA and 4) developing infrastructure for ongoing, multidisciplinary OA research. Under-represented groups will be served through Shannon Point Marine Center's (SPMC) nationally recognized NSF-funded Multicultural Initiative in the Marine Sciences: Undergraduate Participation (MIMSUP: http://www.wwu.edu/mimsup/), and University of Washington's Pacific Northwest Louis Stokes Alliance for Minority Participation (PNW LSAMP) programs. Educational goals are addressed through an array of activities including K-12 outreach, research experiences for undergraduates, including SPMC's summer REU program, and development of widely disseminated curricular materials. The project will support and participate in SPMC's public outreach initiative, increasing awareness of marine issues in the general public. This study will support three early career scientists, a public education outreach specialist, and will train a postdoctoral researcher and a graduate student. Infrastructure improvements to SPMC's existing OA research facility will increase usability, making it more accessible for classroom use and student research. The proposed additional instrumentation will also allow the facility to become a regional resource for monitoring pCO_2 in the Salish Sea.