NUTRITION & ELEMENTAL STOICHIOMETRY OF MICROZOOPLANKTON LIFE STAGES IN A WARMING CLIMATE

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ABSTRACT

Nutrition & Elemental Stoichiometry of Microzooplankton Life Stages in a Warming Climate

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Abstract (350 words):

Copepods are abundant microzooplankton with rigid metabolic requirements that must adjust their feeding behavior and/or metabolic rates in order to compensate for imbalances in food stoichiometry. As copepods develop, their demand for limiting nutrients shifts: the highest phosphorus demand occurs during the nauplius stages. The effects of temperature and food stoichiometry are hypothesized to interact in influencing copepod metabolism and phytoplankton consumption, suggesting that changes in nutrient availability and temperature in coastal oceans may alter the flux of biomass through the planktonic food web. To quantify these effects we conducted a series of experiments where measurements of specific zooplankton biomass, grazing rates, and internal stoichiometry were made over a 7-day copepod life cycle from nauplii to adult to assess how reduction in relative phosphorous content of a phytoplankton food source affects the calanoid copepod *Parvocalanus crassirostrus* at different development stages. In addition, to simulate variable sea surface temperature around Hawaii, the same experiment was conducted at three temperatures: 25˚C (mean winter temperature), 28˚C (mean annual temperature), and 32˚C (elevated temperatures of the 2015 El Niño). Temperature decreased survivorship of both copepodites and nauplii, though the effect was stronger for copepodites. Significant differences between food treatments were observed for copepodite biomass where those fed P-rich food were 44.5% larger; nauplii indicated a stronger resilience to both temperature and food treatment. Maximum specific grazing rates for copepodites were observed at 28 °C averaging 72.8% higher than the cooler and warmer incubations. As hypothesized, food stoichiometry significantly altered zooplankton internal C:P with significant temperature interactions in both nauplii and copepodites. For copepodites, internal C:P increasingly diverged in the direction of the food C:P regime (either P-rich or P-limited) as temperature increased, whereas nauplii decreased dramatically with temperature. The results established from this study reinforce that metabolic theory best describes the effects of food stoichiometry and temperature on the measured phenotypic responses, (i.e. survival, body mass, grazing rate, and internal stoichiometry): the way the nutrient content of a food source will be utilized and incorporated by a copepod is directly linked to how the ambient temperature affects the copepod's internal biochemical reactions, most notably metabolism and catabolism.

Keywords: Nauplii, Copepod, Warming, Stoichiometry, Food web, Metabolism