

The Response of the Thecosomatous Pteropod *Limacina retroversa* to CO₂ in the Gulf of Maine: Seasonality and Sensitivity.

Maas AE^{1,2}, AM Tarrant¹, AJ Bergan¹, ZA Wang³, GL Lawson¹

¹ Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA, USA

² Bermuda Institute of Ocean Sciences, St. George's, Bermuda

³ Marine Chemistry and Geochemistry Department, Woods Hole Oceanographic Institution, Woods Hole, MA, U

Limacina retroversa is a thecosomatous pteropod found year round in the Gulf of Maine. Carbonate chemistry within this shelf system is spatially variable and exhibits seasonal cycles, thus pteropods in this region may already be exposed to under-saturated, and hence corrosive, waters during certain seasons. To understand the implications of this variability, we have explored the gene expression in animals collected directly from the field at four time points over the course of a year. We also performed laboratory experiments during each season to identify CO₂ specific responses; in these experiments animals were exposed to CO₂ (ambient, 800, 1200 ppm) for 7-14 days and their sensitivity was assessed using an integrated set of metabolic, gene-expression and shell condition metrics. Differential expression analyses (RNAseq) revealed pronounced changes in gene expression among seasons, and during the time course of our culture experiments, while laboratory CO₂ exposure resulted in a lower number of consistently differentially expressed transcripts. Changes in shell condition of exposed adults were discernible after less than 3 days of exposure, while changes to respiration rate were not consistently apparent. There were, however, seasonal variations in respiration rate. These gene expression studies, together with both respiration rate and shell condition metrics provide an integrated picture of the seasonal effect of CO₂ on this sentinel species on time-scales relevant to population level acclimation responses.

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