

A New Model For Estimating Potential Diapause Duration
in *Calanus finmarchicus*

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Abstract

Deep basins in the Gulf of Maine act as refuge for a large population of diapausing *Calanus finmarchicus* during the summer and fall. This population acts as the primary seed population for Georges Bank in the spring. The current paradigm suggests that the diapausing population is primarily composed of individuals that developed during the previous spring bloom. Dynamics of the summer-fall population are not well understood however and loss terms from advection and starvation may be large. To assess energetic limitation and loss of *C. finmarchicus* from the Gulf of Maine basins, a new nitrogen specific respiration model has been developed for the resting stage of the species. Stage CV *C. finmarchicus* were collected during July, September, and December of 2003 from Wilkinson and Georges Basins using MOCNESS tows and zooplankton samplers on the Johnson Sea Link II submersible. Metabolic rates were measured using a Micro-Oxymax gas analyzer and Winkler incubation techniques both at sea and on animals placed in culture on shore. Rates measured in the field were not significantly different from those measured on shore with a mean of $130 \mu\text{mol O}_2 \text{ gN}^{-1} \text{ hr}^{-1}$ ($14.4 \mu\text{mol O}_2 \text{ gC}^{-1} \text{ hr}^{-1}$) at 0°C and a Q_{10} of 2.77 (2.58 for carbon specific respiration). Using the nitrogen specific rates in conjunction with visual estimates of nitrogen weight and lipid stores we derived a discrete function for predicting potential diapause duration based on an animal's length, oil sac volume, and the *in situ* temperature. The maximum potential diapause duration for a CV *C. finmarchicus* is predicted to range from 280 days at 0°C to approximately 90 days at 11°C . Maximum potential diapause duration in the Gulf of Maine is predicted to be between 3.5 and 5.5 months. These results suggest that energetic limitation is an important factor for diapausing *C. finmarchicus* in the Gulf of Maine and that a rethinking of the standard spring production paradigm may be required to account for the year-round presence of *C. finmarchicus* on the Northeast American Shelf.