ABSTRACT:

Grear, Jason, Doranne Borsay Horowitz and Ruth Gutjahr-Gobell. 2010. Inverse demographic analysis of compensatory responses to resource limitation in the mysid crustacean *Americamysis bahia*. Oral Presentation. 95th ESA Annual Meeting. Ecological Society of America, August 1-6, 2010. Pittsburgh, Pennsylvania.

Most observations of stressor effects on marine crustaceans are made on individuals or even-aged cohorts. Results of these studies are difficult to translate into ecological predictions, either because life cycle models are incomplete, or because stressor effects on mixed age populations may differ from those observed in cohort studies. Current manifestations of this problem range from challenges in ecological risk assessment of chemicals by regulatory organizations to futures analyses of ocean acidification, where investigators have acknowledged the need for life cycle approaches in predicting adaptive responses to changing environments. To address this need, we developed an observational scheme using mixed age *Americamysis bahia* populations that allows inverse estimation of stage-specific vital rates. We used this system to examine compensatory demographic responses to resource limitation, which is an oft-cited complication in applied population ecology. We randomly assigned one of four feeding levels to each of 24 laboratory populations. The experiment was preceded by cohort-based size-at-age observations at varying feeding levels and estimation of Laplace-distributed age classification error rates. These relationships were then used to translate weekly length measurements from digital images into a 13-wk time series of age class abundances for each population in our main experiment.

Using inverse demographic analysis of these age-structured time series, the most strongly supported models of resource limitation effects on mysid demography included opposing (i.e., compensatory) linear effects on two parameters (e.g., immature vs. adult survival), as compared with models that included responses in a single vital rate, all vital rates, or no vital rates. Moreover, the feeding effect on fecundity was negative in these compensatory models, partially offsetting positive logit-linear effects on adult survival. This contrasts with cohort-based results, where resource effects on fecundity were positive, and may have been caused by cannibalism. Also, life table response analysis showed that resource effects on overall population fitness were dominated by effects on adult survival. These results suggest that emphasis in stressor-response studies on early life stages and even-aged cohorts may miss important demographic responses and should be augmented by observations of intact populations, especially as methods such as ours become more available.

KEYWORDS: ecological risk assessment; population model; crustacea; mysid; Americamysis bahia; demography; matrix model; inverse demographic estimation; experiment; ocean acidification; survival; fecundity; population growth rate; cohort; dose-response