In recent decades, great strides have been made in understanding zooplankton population dynamics by coupling life cycle models with physical circulation models. These models can be used to explain and predict distribution patterns of species, for example shifts in abundance at their northern and southern margins. However, understanding of effects of future environmental change, notably in temperature and increasing ocean CO_2 concentrations, will also require understanding of the extent to which individuals can adapt to change by increasing fitness through changes in rates governing feeding, growth, survival and reproduction. This knowledge will require experiments over multiple generations to understand phenotypic, genetic and epigenetic responses and consequences for the parameterization of rates needed for the population models. These rate shifts also have implications for models of the role of zooplankton in biogeochemical cycles and for models of trait-based community structure. In this talk I will review pioneering studies of individual responses to environmental challenge, the challenges for future research and the implications for understanding and predicting population and community responses to global change.