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Using multi-frequency acoustic scattering techniques to study mixed zooplankton populations

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Zooplankton populations can be highly heterogeneous and variable on spatial scales of centimeters to kilometers and temporal scales of minutes to years. High-frequency acoustic scattering techniques allow a synoptic view of zooplankton distribution and abundance on these scales. However, there are well-known complications in the interpretation of acoustic scattering returns, often limiting the inference of quantitative parameters (such as size or abundance) to restricted locations and conditions. Multi-frequency and broadband acoustic scattering techniques, combined with sophisticated instrument platforms that combine multiple sensors allowing acoustical, optical, and other environmental measurements, reduce the ambiguities typically associated to the interpretation of acoustic scattering at single frequencies and expand the conditions under which inference of quantitative biological parameters is possible. The focus of this talk is a decade-long study aimed at understanding the distribution and abundance of mixed zooplankton populations in the Gulf of Maine. Simultaneous multi-frequency acoustic, optical, environmental, and net measurements were performed. Insights gained from this study are presented together with recent measurements involving broadband acoustic scattering from zooplankton in the presence of nonlinear internal solitary waves. These studies highlight the importance of an integrated approach to understanding heterogeneous zooplankton populations on relevant spatial and temporal scales.