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Depth-dependent resonant target strength analysis of a dense Atlantic Herring school from wide-area OAWRS and localized 3D morphology sensing

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The depth-dependent target strength of Atlantic Herring is estimated at several distinct bandwidths close to their resonance frequency for a localized, highly dense school observed during the NOPP-sponsored Gulf of Maine Experiment on September 22, 2006. An ocean acoustics waveguide remote sensing (OAWRS) system was deployed near George's Bank to investigate the migration and spawning behavior of fish over wide areas. In conjunction with OAWRS, a Simrad EK60 conventional fish-finding echosounder (CFFS) and a Reson Seabat 7125 multibeam sonar system were deployed to provide local depth extent and 3D volume morphology of the dense herring school. The calibration of low-frequency target strength derived from OAWRS data using localized CFFS density and multibeam 3D volume estimates as inputs is discussed. The correlation between the mean depth of the vertically migrating herring school and its resonance frequency is investigated. The results are compared with a theoretical model for 3D resonance scattering from fish swimbladder modeled as a spheroidal bubble. This analysis may allow inference of fish depth and species classification based on the scattered frequency response of targets imaged by OAWRS. Implications for classifying general localized targets, biological or man-made, are discussed further.