Resonance frequencies, $f_0$, of absorption lines due to pelagic fish with swim bladders change at twilight in accord with systematic changes in their depths and separations. Measurements of $f_0$ at night, and calculations of $f_0$, based on measurements of the effective radius, $r_0$, and eccentricity, $e$, of sardine swim bladders, and the average depth of dispersed sardines at night, are in good agreement. This result implies that swim bladder compression by internal organs did not have a large effect on $r_0$ and $e$ during this experiment. Close agreement between laboratory measurements and calculated values of $f_0$ of individual physostomes suggests that this inference is generally valid. Possible exceptions to this “rule” will be considered in the context of Ona’s (1990) laboratory observations of the effects of internal organs on swim bladder compression, and measurements of the state of internal organs of fish in the ocean. The resonance frequencies of absorption lines attributed to sardines in schools, $f_0 \sim 0.6f_0$. This result is consistent with a modified form of d’Agostino and Brennan’s (1988) equation for the fundamental mode of a bubble cloud. Their equation accounts for realistic numbers of fish per school ($10^2 - 10^5$). Modifications, which account for realistic separations between fish in schools and school eccentricity, will be presented. [Work supported by ONR.]

2pAO4. Modeling the target strength of Calanus finmarchicus. David T. I. Francis (School of Electron. and Elec. Eng., Univ. of Birmingham, Edgbaston, Birmingham B15 2TT, UK, francis@ee-admin.bham.ac.uk), Kenneth G. Foote, Tor Knutsen (Inst. of Marine Res., N-5024 Bergen, Norway), and Lucio Calise (Centro Marino Internazionale, I-09072 Torregreco (OR), Italy).

The boundary element method is applied to the copepod Calanus finmarchicus, treated as a composite body, with fluidlike oil sac embedded in a fluidlike, mostly transparent prosome. The generally complex shapes of the two bodies are modeled on the basis of the actual dorsal- and lateral-aspect cross sections, as observed by videomicroscopy with the living, unaesthetized animal encased in a droplet of sea water. Physical properties of the two bodies, namely mass density and longitudinal-wave sound speed, are derived through a combination of measurement and inference. Computations of backscattering cross section as a function of orientation and frequency are presented over the range 25 kHz to 3.2 MHz for a number of specimens. A sensitivity analysis is performed to quantify some uncertainty in the assumed values of the physical properties. [Support by the following is acknowledged: EU through RTD Contract No. MA83-CT95-0031, Norwegian Research Council through Grant No. 113809/122, and Bergen Large-Scale Facility (LSF) for Marine Pelagic Food Chain Research.]