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Acoustically cryptic fish mask Southern Ocean mesopelagic biomass

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Active acoustics provides an unparalleled method of assessing abundance and distribution patterns of marine fish across oceanic scales. It is used to estimate biomass of mesopelagic fish species, where in general higher levels of acoustic backscatter are considered to indicate greater mesopelagic biomass. However, acoustic signal reflection is largely linked to body morphology and density, and species with a gas filled swim bladder return a considerably stronger acoustic signal than those without. Thus, an acoustic assessment of Southern Ocean mesopelagic fish biomass needs to account for this variation.

Improvement to acoustic methods for mesopelagic biomass estimation requires information on the tissue density and swim bladder composition of constituent species. Thus, we used X-ray Computed Tomography, together with a modified density bottle method, to quantify tissue density and swim bladder condition of dominant mesopelagic fish species in the Scotia Sea. We found considerable differences between species in these key density and swim bladder characters, which we relate to patterns of habitat occupation.

Together, these results have significance for how we interpret large scale patterns in the Southern Ocean. Acoustic data from the Scotia Sea indicates a decrease in total water column backscatter with an increase in latitude. While this could signify a decrease in fish biomass toward the Antarctic continent, our results suggest this may also represent a community shift from acoustically dominant gas-bladdered fish species at the polar front, to acoustically cryptic non-gas-bladdered fish species further south. These results should help improve estimates of biomass from long-term acoustic monitoring of fish within the Scotia Sea and wider Southern Ocean.