Investigating the Density of Cetacean Middle Ear Bone

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Whales are thought of as big mammals of the ocean that are few and live for long periods of time. Amongst the middle ear bones of aquatic cetaceans there is an anatomical anomaly where different regions of the bone vary in density. Through the use of a precision saw and resin to create effective whale middle ear bone samples and a microscope camera, precise mapping of the density of the samples can begin. Recent studies have shown by using Electric Scattering Spectroscopy (ESS), one can utilize the scattering of photons at different wavelengths for the incus, malleus, and stapes of two different species of whales and relate them to the number density can be used to detail different regions of bones for multiple species. In comparison, the water displacement method could measure the mass density of the material, but not specific areas while the Basilar Membrane Probe could measure the density of the material, but fails at high hearing frequencies. In this experiment, we explore a new way to quantify and understand the density of aquatic cetacean middle ear bones and expand on making it precise by building a fixture to hold the ESS probe. The number density can be achieved through the reduced scattering coefficient found using ESS and then one can find the scattering coefficient and subsequently the number density for regions of the middle ear bone. We demonstrate that using ESS is a much better tool to quantify the density because of its accuracy and precision than other methods.