LOSS OF HEARING SENSITIVITY WITH DEPTH IN A FREE DIVING CALIFORNIA SEA LION (*ZALOPHUS CALIFORNIANUS*)

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All current knowledge of underwater hearing in most marine mammals, including pinnipeds, is based on data obtained in small tanks and shallow water. These data may not accurately represent the auditory functioning of free-ranging animals if hearing sensitivity changes with increasing depth. In order to compare hearing ability in shallow water and at depth, we trained a 12-year-old male California sea lion to report detection of pure tones (2.5, 6, and 10 kHz) at three depths (10, 50, and 100m). A go/no-go psychophysical procedure was used, in which the subject pressed a paddle upon detection of a 500-ms tone. Initial results showed systematic changes in response bias with changes in depth; false alarm probabilities (responding in the absence of a signal) decreased significantly with depth, indicating that the sea lion adopted a more conservative response criterion in deeper water. Because of changes in response bias we defined auditory thresholds as signal levels corresponding to a d-prime value of 1.0 (rather than the traditional 50% correct detections). Thresholds increased significantly with increasing depth. There was also a significant interaction between depth and frequency-the depth effect was least pronounced at 2.5 kHz and most pronounced at 10 kHz. Increasing pressure probably alters the impedance characteristics of the pinniped ear, in particular affecting the size of the middle ear air space due to the expansion of cavernous tissue into the middle ear cavity. Our findings are consistent with middle ear impedance changes, which should alter the frequency response and sensitivity of the ear. Therefore we conclude that the middle ear plays a functional role in underwater sound detection in California sea lions. However, contrary to previous speculation, the presence of cavernous tissue in the sea lion middle ear does not appear to enhance sensitivity at depth.