A NOTE COMPARING THE VISUAL ACUITY OF DOLPHINS WITH THAT OF SEA LIONS

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ABSTRACT

Although pupillary constriction in the Atlantic bottlenosed dolphin eye may be as important for seeing detail in air as it is for California sea lions, behavioral data on the effects of luminance on aerial and underwater visual acuity in the sea lion indicated that at approximately 100 mL there is an air–water equivalence, but that at 3 mL pupillary changes are already having a greater degrading effect on acuity in air than on acuity under water. This effect increases as luminance is further decreased.

Recently, Dawson, Birndorf and Perez (1972) concluded that on the basis of their measurements, the Atlantic bottlenosed dolphin (*Tursiops truncatus*) eye is emmetropic (with accomodation) in water. More relevent to this note is their finding that in air the eye of the bottlenosed dolphin is myopic. However, these authors suggest that much like my findings (Schusterman, 1972) with the California sea lion (*Zalophus californianus*) aerial acuity in bottlenosed dolphins may be equal to their underwater acuity, due to a pupil which becomes tightly constricted in the brighter light of air as compared to water. To support this notion, Dawson *et al.* go on to cite my work comparing the effects of different luminance levels on the aerial and underwater acuity of the California sea lion, in which I found that aerial acuity deteriorated at a much more rapid rate than underwater acuity in the luminance of 3 mL to 3 X 10^{-6} mL (Schusterman, 1972). The logic here is that as luminance is decreased, the pupil is dilated, which for the bottlenosed dolphin, would result in what Dawson *et al.* (1972: 8) describe as " ... a hopelessly myopic picture of the world in air."

Unfortunately, Dawson *et al.* (1972: 9) state that my research " ... has demonstrated that the California sea lion resolves equivalent angular subtenses in both media at moderate illumination levels (3 mL)." This is simply not true and I partly blame myself for their error in interpretation. I should have emphasized the difference in aerial and underwater acuity, even at the luminance of 3 mL. In Figure 10 of my paper (Schusterman, 1972: 485), in which aerial and underwater visual acuity thresholds are shown as a function of background luminance, because the ordinate is so small the aerial and underwater points appear similar. In fact, at the luminance level of 3 mL the aerial threshold subtends a visual angle of approximately 11 minutes while the underwater threshold subtends a visual angle of approximately 9 minutes. These figures are indirectly available in Table III, which gives the percent correct responses as a function of media, visual angle and luminance (Schusterman, 1972: 486). This table clearly shows, for example, that at a distance of 61 cm the sea lion could readily discriminate a standard target from a target with horizontal black and white stripes 1.7 mm in width with its eyes submerged, but could not

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perform this same discrimination task with its eyes in air. Only when luminance levels were in the range of approximately 100 to 200 mL does the eye of the California sea lion resolve detail equally well in air and underwater (Schusterman and Balliet, 1970). This is an extremely important point if one wants to make significant comparisons of the visual capabilities of marine animals and, more importantly, if one hopes to isolate the dioptric as well as the neurological mechanisms responsible for the similarities and differences currently found.

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