What's on the Outside Counts: Comparing Methods of estimating the Surface Area of juvenile *Mirounga angustirostris* Using Morphometry vs. Photogrammetry

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In studying large marine mammals and their relationship to the aquatic environment, accurately determining an animal's dimensions can prove to be a uniquely difficult, but important task. Various methods have been explored in an attempt to find the most accurate yet feasible way of obtaining mass, volume, and density, with surface area remaining under explored in comparison. One way of estimating dimensions involves modeling the animal as a series of circular or elliptical-shaped truncated cones, while modeling the head and tail-end of the animal as either a cone, cylinder, or a combination of the two. This method requires sedation and handling of the animal for an extended period of time to obtain accurate morphometric measurements such as mass, length, and girth. Conversely, 3D models can be made using the image-based modeling program Photomodeler by taking multiple pictures around a sedated animal. We compared the accuracy of the aforementioned morphometric and photogrammetric methods in calculating the surface area of five juvenile northern elephant seals (*Mirounga angustirostris*) from Año Nuevo State Park. Our results showed that the program Photomodeler estimated a higher body surface area, although no significant difference was found between the two methods ($p > 0.05$). When using the volumes estimated from these same methods to calculate mass with density values obtained from the literature (Innes et al., 1990), we found that elliptical truncated cones, with the head of the seal modeled as a cone and the tail-end as a cylinder, had the smallest percent error when compared to the actual mass of the animal. We used this result in our reasoning to validate the accuracy of this morphometric method for estimating surface area. The elliptical truncated cones method vs. Photomodeler did not show a significant difference in surface area and mass estimations, signifying that a decision can be made on which is best utilized for the situation of the study without sacrificing a large percentage of accuracy.

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