Photogrammetric estimation of pinniped mass: are we making realistic field procedure advancements?

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The ability to estimate body mass of pinnipeds at different stages during their life cycles enhances our capacity for investigating physiological, behavioural and life history parameters affecting individuals and populations. Body mass determination of many pinniped species is however a logistically complicated task. Photogrammetry has been used for the determination of mass for three pinniped species[1,2,3]. The present constraints under which photogrammetry can be used to accurately estimate seal mass are rigid[1,2,3]. Although accurate, such constrained methods are of limited field use. We use 200 calibrated photographs of 28 known mass southern elephant seals (*Mirounga leonina*) from Marion Island, to test a novel approach to minimising constraints on field photogrammetric methods. Previous methods required specific animal postures, substrates, scaling and the observer's adherence to constant focal distance at set angles. Our preliminary findings show that with fewer limitations on the animal and strict adherence to manageable methodology by the observer, accurate mass estimations can be attained. Our method is based on orientation of the substrate upon which the animal is resting in 3-dimensional space. The animal is then cross-referenced upon this oriented substrate to create an enclosed, surfaced 'model' seal. Volumetric measurements are achieved from this 'model' seal. Four calibrated photographs taken at perpendicular angles around the animal improved the mean mass estimate by 55% compared with three photographs (i.e. one side of the animal remains unknown). Six photographs taken from different positions around the animal provided the closest real mass estimates (within 5 – 25% of measured mass). The greatest factor associated with decreasing accuracy is the angle between camera stations (i.e. where each picture is taken from), followed by substrate unevenness and lastly by scaling method. Hidden protuberances/cavities around or under the seal ultimately reduce mass estimation accuracy, but our preliminary results indicate robustness of our method up to intermediate levels of unevenness. Our method provides the first accurate photogrammetric modeling results for non-immobilised pinnipeds on uneven surfaces under usual field conditions. We illustrate where improvements on this method, such as targeting of the substrate for photograph orientation and scale-down rather than scale-up measures improve estimates by up to 40%.

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