Non-invasive estimation of body size of southern elephant seals

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Introduction

Body size is one of the most important phenotypic trait of animals, and has important implications for conservation of wild species. Direct estimation of body size of large mammals requires physical or chemical restrain, that presents risks for subjects and operators. Therefore, indirect methods based on photogrammetry have been developed. A drawback of these methods is that they require an operator to approach the subject to place scale in the picture frame, and a time-consuming processing of digital images. We developed a fast non-invasive method that is based on trigonometry, works from the distance, and does not require any post-processing. We applied it to female southern elephant seals (*Mirounga leonina*).

Fig. 1 – An operator during a measurement session.

Methods

Field work was carried out at Sea Lion Island (Falkland Islands) in 2016-2017 (Fig. 1). Our measurement method is based on the application of simple trigonometry to distances and angles (Fig. 2). We measured distances using a laser range-finder (Leica Disto A8), and angles using a 8" digital protractor (Wixey WR-410). The laser range-finder was mounted on the mobile blade of the protractor. We measured: 1) the distance to the tip of the nose of seals (AD); 2) the distance to the tip of the tail or the rear flipper base (PD); 3) the angle between the two distance segments (A). From these distances and angle we calculated the length (L) of the seal using trigonometry. To assess the reliability of the method we carried out measurement trials on known size objects. In the field we obtained 1104 measurement of seals. The various seal measures obtained are shown in Figure 3. For each measure, we obtained two variants, one to the flippers and one to the tail.

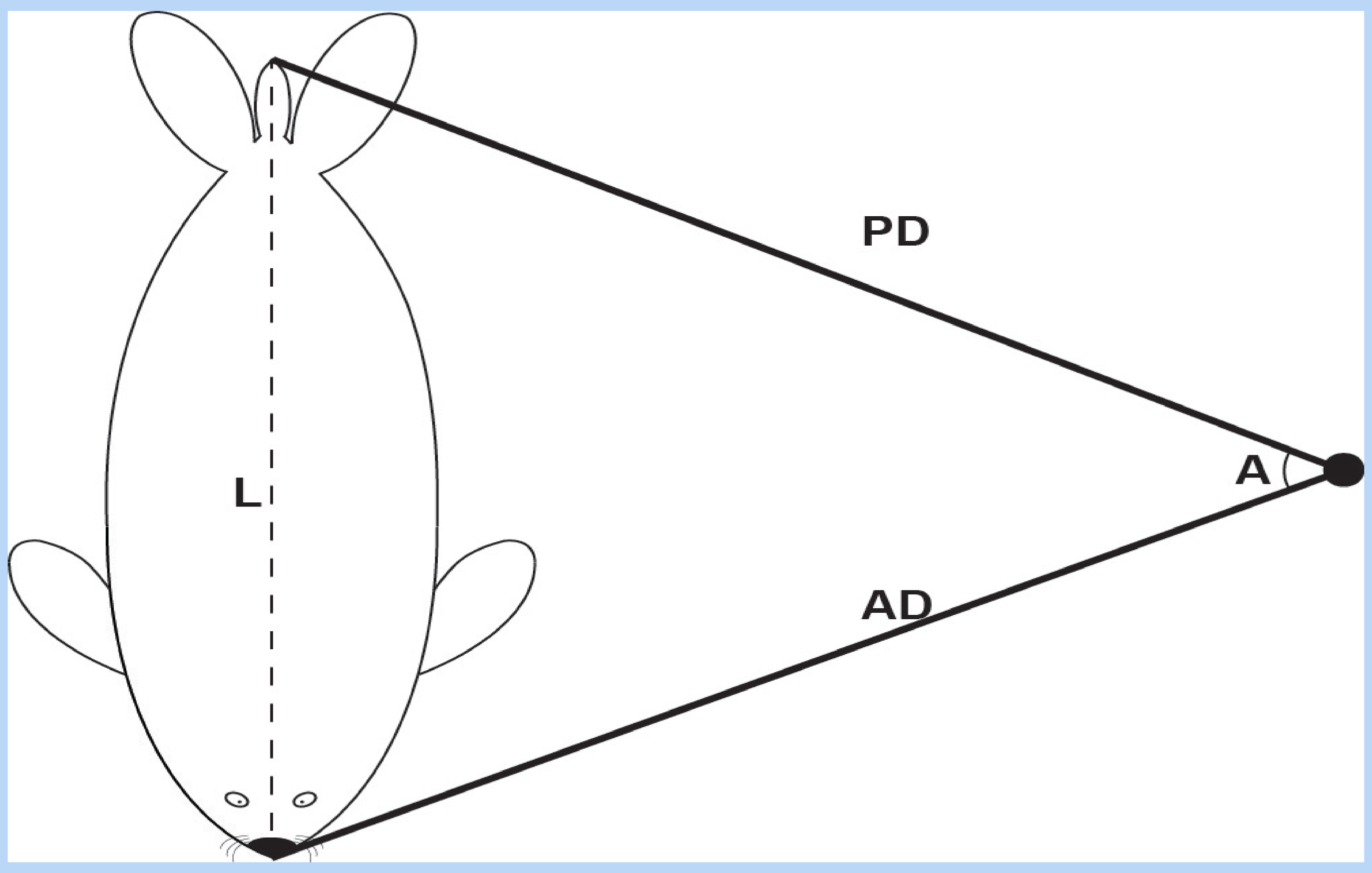

Fig. 2 – Schema of the measurement method.

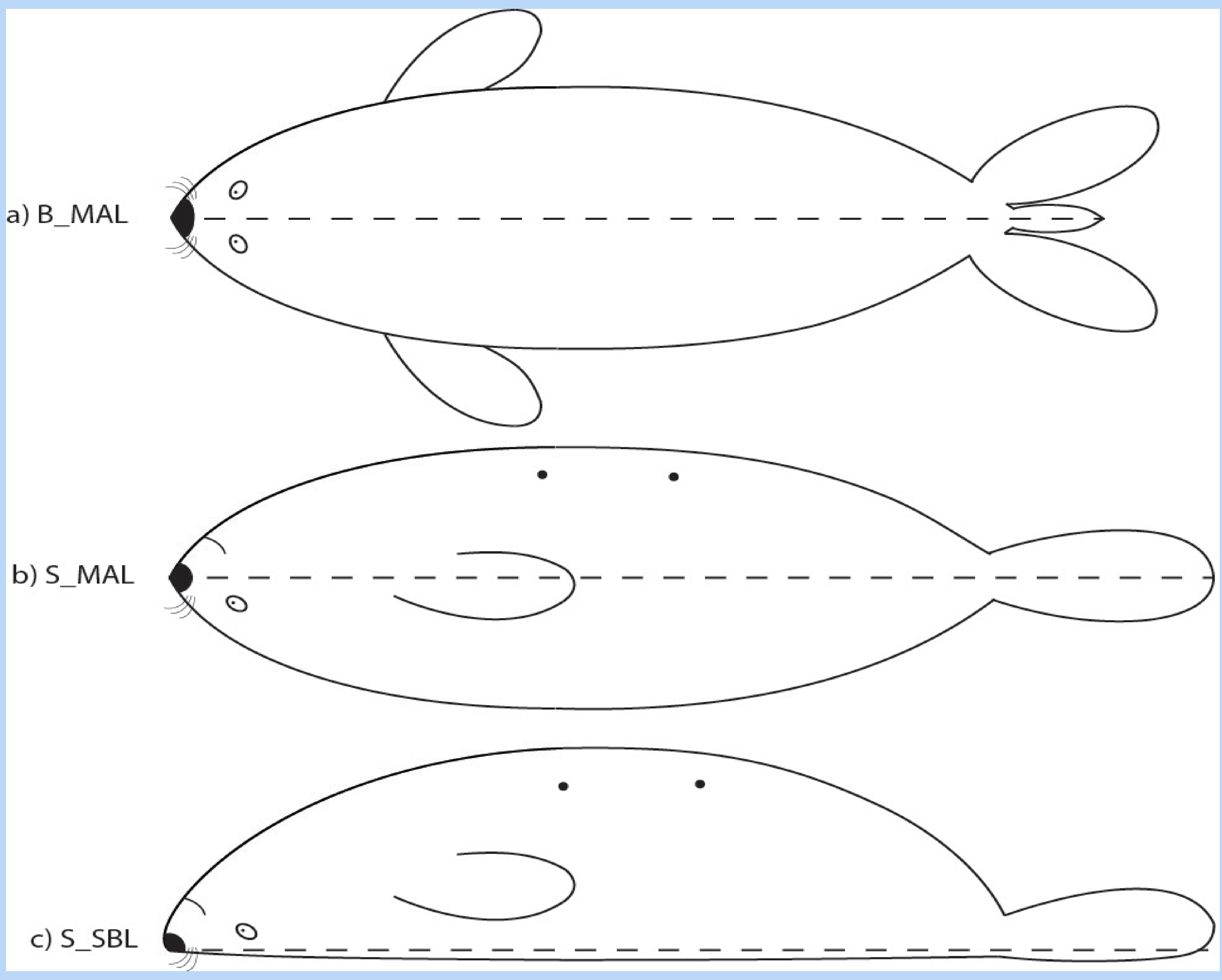

Fig. 3 – The three kinds of seal measurement obtained.

Results

- Absolute and percentage error during trials with known size objects were low (0.86 cm and 0.36% respectively).
- Even inexperienced operators obtained correct measurements of known size objects in most environmental conditions.
- Seal measurements showed high repeatability (R > 0.86).
- Middle axis length with seal on the side (S_MAL) was the easiest measure to obtain, and had the highest repeatability (R = 0.96).
- Relationships among different measurements were strong (R^2 = 0.87-0.94, Fig. 4), and, therefore, it was possible to obtain reliable conversion equations among them.
- Wind and light conditions affected the reliability of measurements, but the effect was very small for trained operators.

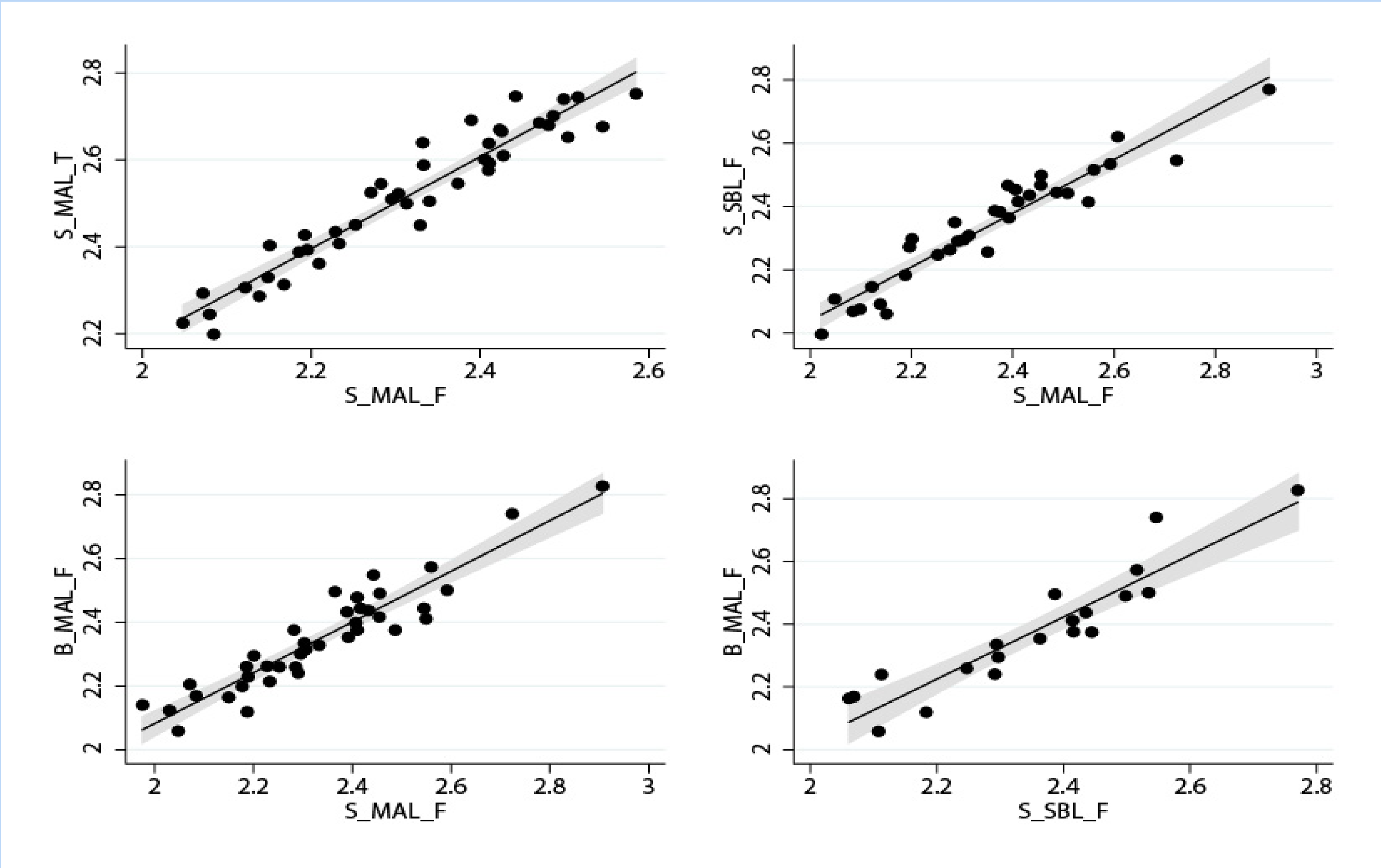

Fig. 4 – Relationships between the various seal measurements.

Conclusions

- Our new method was very reliable in trials with know size objects.
- Repeatability of seal measurements obtained in the field was high.
- The most repeatable measurement was the middle axis length, that is also the easiest measure to obtain in the field
- The method provided size estimates right in the field, that can be very useful for practical purposes (e.g., determination of sedation doses), and no post-processing required
- The method has wide applicability to pinnipeds at large

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