Review of MS# 93869: "Estimating body volumes and surface areas of animals from cross-sections" by Ruizhe Zhao.

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Overview

This manuscript presents a new method (cross-sectional method [CS]) for estimating the volume and surface area of animals, comparing it to two widely used methods (graphic double integration [GDI] and Paleomass). Three tests are implemented to demonstrate that the new method is both more accurate and precise than the other two. The strengths of the manuscript are a relatively simple (but powerful) method and its implementation to a wide number of marine vertebrates, spanning a well-chosen range of shapes (whales and ichthyosaur that can be well approximated by elliptical cross sections plus turtle and manta ray that are decidedly not). The weaknesses are primarily in its presentation and insufficiency of the tests. The manuscript should be revised to be more clearly organized (the background that introduces prior methods is too short). The first test is also too trivial to ensure the patterns are generally true, and this test should be repeated for additional samples. The other tests are appropriate, but it is unclear whether the number of slabs used across methods was correctly chosen, which makes it difficult to know if the results truly reflect methodological differences or instead how the methods were carried out.

Organization and writing

The majority of the manuscript is well written. Much of the writing could be improved by using a native English speaker to correct the numerous typos and grammatical errors. A few examples are listed below.

Mostly importantly, more introduction is needed of how the CS method differs from GDI and Paleomass. Lines 55-64 are insufficient. Text in lines 215–235 is better, and most of that background should be moved to the Introduction.

The text seems to ignore the main weakness of the CS method, that it requires a complete 3D digital model, which is not always easily available. Because GDI and Paleomass assume the cross-sectional shape of most animals is elliptical (or hyperelliptical), they do not require perfectly complete 3D digital models. However, the CS method, because it measures cross-sectional area directly, appears to require a complete 3D digital model. Yes, the manuscript has convinced me that the new CS method appears to be an improvement over prior methods. However, if one has a complete digital model, why is ANY method needed? It can be directly measured in Rhino 7 (as was noted in line 163, and was used to obtain the “true volume” and “true area” in Supplementary Tables). I do not see how CS offers any improvement compared to measuring directly in 3D software. If there are benefits to CS over this alternative, they should be explained.

Tests

Test 1 seems incomplete as a test of how many slabs are generally required for the CS method. Why only use a small portion of a sturgeon (and a portion that is quite morphologically similar throughout)? Using

an entire animal seems more informative to provide a real-world recommendation. Consider adding additional models, and use the entire animal each time, so that a more realistic recommendation can be made for future users. Also, line 185 concludes that the errors stabilize at “10 or more” slabs, but figure 4 clearly shows stability (for this shape) at just 6 slabs. There should also be a sentence added somewhere to relate that this stability at 10 is the reason the author then used 10 slabs for subsequent tests.

It seems there is variation in how the 3D models were cut into slabs. GDI and Paleomass used 10 slabs per specimen, whereas the CS method also used 10 slabs, but then cut each slab into 10 subslabs (making 100 total estimates). How much of the improvement in the CS method (compared to GDI and Paleomass) in tables 2 and 3 is caused by using an order of magnitude more slabs? To make a fair comparison, the number of slabs whose volume and area are estimated must be the same across methods. If subslabs are required for CS, then it seems there should be 1 slab in the first cut (i.e., the entire specimen) and 10 subslabs. Alternatively, there should be 100 slabs used for GDI and Paleomass.

If you really want to highlight the benefits of your method, why not apply PaleoMass and GDI to the very non-elliptical shapes of the sturgeon, ray, and turtle? The third test only compares them to the fins of two of these (albeit the entire body for the sturgeon). I expected this result as soon as I saw the chosen shapes in figure 1. I think it would offer the best possible case to demonstrate the superiority of CS to ellipse-assuming alternatives.

Fig. 1: Consider reversing parts C and D horizontally, so that the anterior end is to the right side (to match the orientation in parts A and B). Unless I am mis-interpreting the shapes.

Minor (line-item) comments (by page number):

13: “dig” seems to be the incorrect verb

14 (and elsewhere): “Volumetirc-density” is mis-spelled.

16 (and elsewhere): “formulae” is grammatically preferable to “formulas”

24: GDI should be written out at its first usage.

246: “tetrapod” mis-spelled