

## General Overview

Great paper! This paper is a significant step towards a quantitative understanding of rhino limb morphology and opens the door to some really interesting biomechanical questions. I recommend that this paper pass with minor revisions. My comments below are not meant to criticize the paper, but to clarify some ideas and concepts. I sincerely look forward to seeing this published.

1. My main concerns are with clarity in the methods section (particularly the thin plate spline section) and the use of centroid size as a viable alternative to body mass estimates. The methods section just needs to be expanded a bit so that a reader could fully reproduce the methods used in this paper (comments below).
2. For centroid size, I understand that the authors are looking for a proxy for body mass, but the authors even show that this is not a fully reliable proxy.
3. There are also some definitions that need to be explicitly stated, like ‘robust’ and ‘biotope’.

## Specific Comments

### Abstract

The abstract is probably the weakest part of the paper. The phrases are a bit circuitous when trying to make a point and word choice is not quite correct, but gets close. Please revise.

### Methods

**Line 35** What is your definition of ‘robust’?

**Lines 124-136** How many skeletons per species of rhino?

**Line 186** Which specimen was chosen (need to know for full reproducibility).

**Line 189** I am not sure you can say that interpolated sliding semi-landmarks are true anatomical landmarks. See Botton-Divet et al. 2015: “Due to the impossibility to define anatomically homologous points on curves and surfaces this approach generates landmarks that are spatially homologous after sliding” (emphasis mine). Gunz et al. (2005) calls this ‘geometrical homology’.

**Line 190-193** I read through Bonnon-Divet et al. (2016) and Gunz et al. (2005), on which the analysis is based. From what I can gather, you are following the ‘basic algorithm’ as outlined on page 84 of Gunz (2005). Is this correct? There is also an ‘extended algorithm’ mentioned in Gunz et al. (2005) pages 84-85.

For the Procrustes superimposition with a spline optimized step (Gunz et al. 2005), why did you iterate three times? What was the significance? Did it achieve convergence?

**Line 191** ‘Thin Plate Spline’ misspelled.

**Line 194** Confusing wording. Did you mean Generalized Procrustes Analysis?

**Line 206** Unsure what is meant by “After the sliding step” as the sliding step on line 190 is part of a series of iterative steps. Also, was this performed on the complete data set?

**Line 210** What is meant by ‘specimen repartition’?

**Line 224** How did you determine the number of principle components to include in your Pearson’s Correlation Coefficient analysis?

**Line 225** Was the Procrustes Anova performed on each individual bone or for each species?

**Line 235- 236** Why was centroid size computed? (see also my comments below)

## **Results**

**Line 253** confusing: “...displays a massive morphology”.

**Line 691** medial lip = medial trochlear ridge?

**Line 710** The term ‘biotope’ is taken to mean ‘habitat’ in this context? Or more like ‘Ecology’ as used in Table 1? Please clarify and reference what definition you are using.

**Line 775** Instead of ‘expends’ did you mean ‘extends’?

**Line 786** creates

**Line 801** confusing: “the one of the fibula one”.

**Line 803** fibular

**Line 804** Instead of ‘variate’ did you mean ‘vary’?

**Line 828-831** What is meant by “higher general size”? Are you talking about individual bones or the whole animal? Shoulder height? Why is this a confirmation if, as you say “the centroid size of an isolated bone may neither reflect the actual global size of an animal, nor be strictly correlated with its body mass”?

**Related larger question:** If “Replacing the log centroid size by the cube root of the mean mass of each species results in almost identical theoretical shapes for each bone” (Lines 588 – 589) and “the centroid size of an isolated bone may neither reflect the actual global size of an animal, nor be strictly correlated with its body mass”(Lines 830-831), then why use it instead of mean

mass? It is unclear to me why you would use centroid size. Are there better proxies for body mass than centroid size if the results are so unclear? (Lines 835-836).

**Lines 836-839** Not sure that a study of skull centroid size is an appropriate example if you are only looking at postcranial data.

**Line 846** For “angulated” did you mean “angled”?

## **Figures**

All figures with skeletal specimens need a scale bar.

**Figures 1-7** I really like the layout of the PCAs above the labeled bones. Were actual specimen scans used for the labeled bones or hypothetical extremes? Can you indicate where they do appear or would appear on the PCA?

**Figure 9** Please explain in the figure description how the Shape (Regression Score) was calculated. Also, please use different shapes for each species for colorblind readers.

**Figure S2** Please use different shapes for each species for colorblind readers.

**Figure S4** Also potentially a problem for colorblind readers.

**R Code** Is there any raw R Code you could publish with the data?

## **References**

Botton-Divet, L., Houssaye, A., Herrel, A., Fabre, A. C., & Cornette, R. (2015). Tools for quantitative form description; an evaluation of different software packages for semi-landmark analysis. *PeerJ*, 3, e1417.

Gunz, P., Mitteroecker, P., & Bookstein, F. L. (2005). Semilandmarks in three dimensions. In *Modern morphometrics in physical anthropology* (pp. 73-98). Springer, Boston, MA.