

Shape as a Measure of Weapon Standardisation: A Replication

Corey Christopherson, Thomas Winegarden, Richard Todd,
Zack Garcia

[Repo](#)

Birch, T., & Martinon-Torres, M. (2018). Shape as a measure of weapon standardisation: From metric to geometric morphometric analysis of the Iron Age 'Havor' lance from Southern Scandinavia. *Journal of Archaeological Science*, 101, 34-51. doi: <https://doi.org/10.1016/j.jas.2018.11.002>



Contents lists available at [ScienceDirect](#)

Journal of Archaeological Science

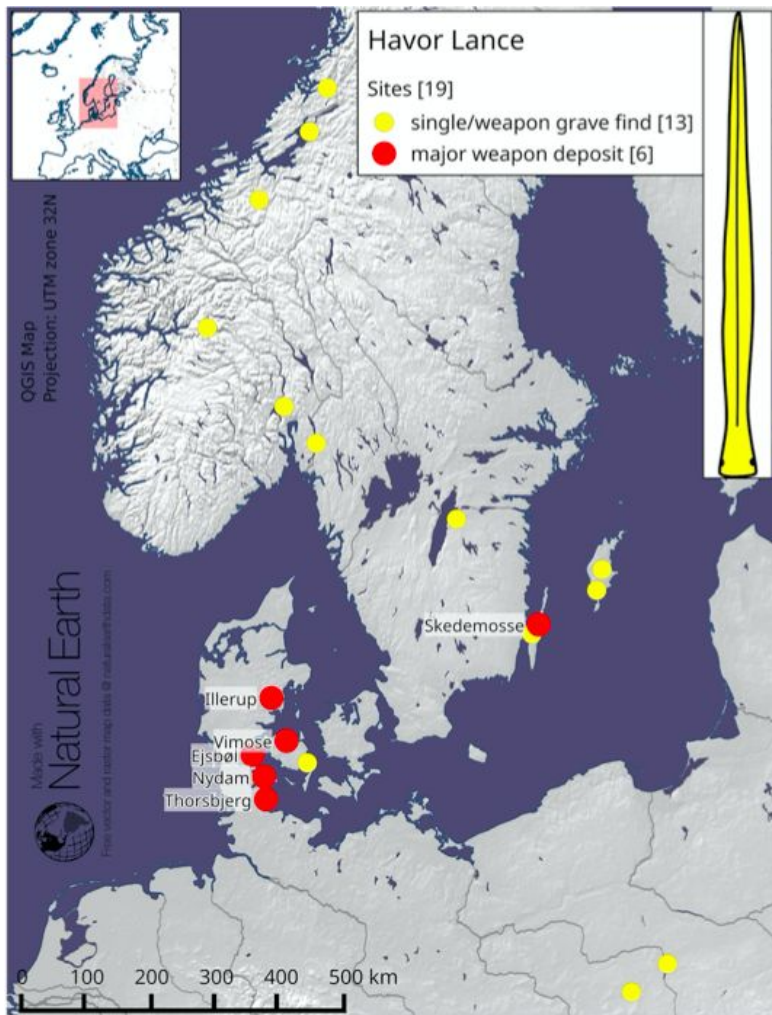
journal homepage: www.elsevier.com/locate/jas



Shape as a measure of weapon standardisation: From metric to geometric morphometric analysis of the Iron Age 'Havor' lance from Southern Scandinavia

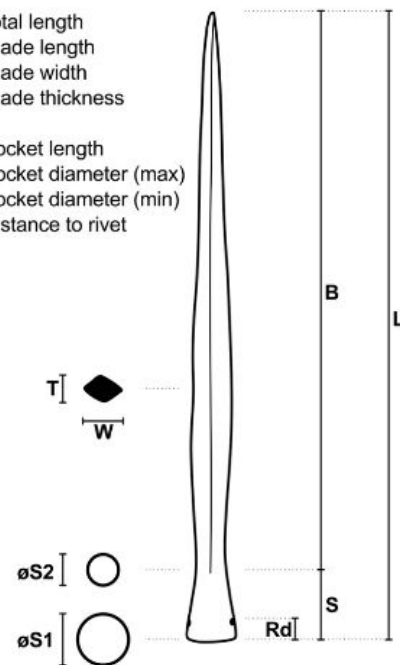
Thomas Birch^{a,*}, Marcos Martínón-Torres^b

- Investigated two approaches to quantify the standardization of manufacturing
- Compared standard measurements to geometric morphometric (GMM) shape analysis
- The authors found that GMM allowed for an analysis of overall shape instead individual dimensions



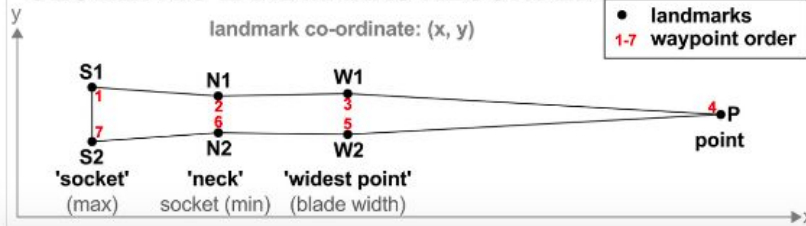
METRIC DIMENSIONS MEASURED

- L:** total length
- B:** blade length
- W:** blade width
- T:** blade thickness
- S:** socket length
- øS1:** socket diameter (max)
- øS2:** socket diameter (min)
- Rd:** distance to rivet

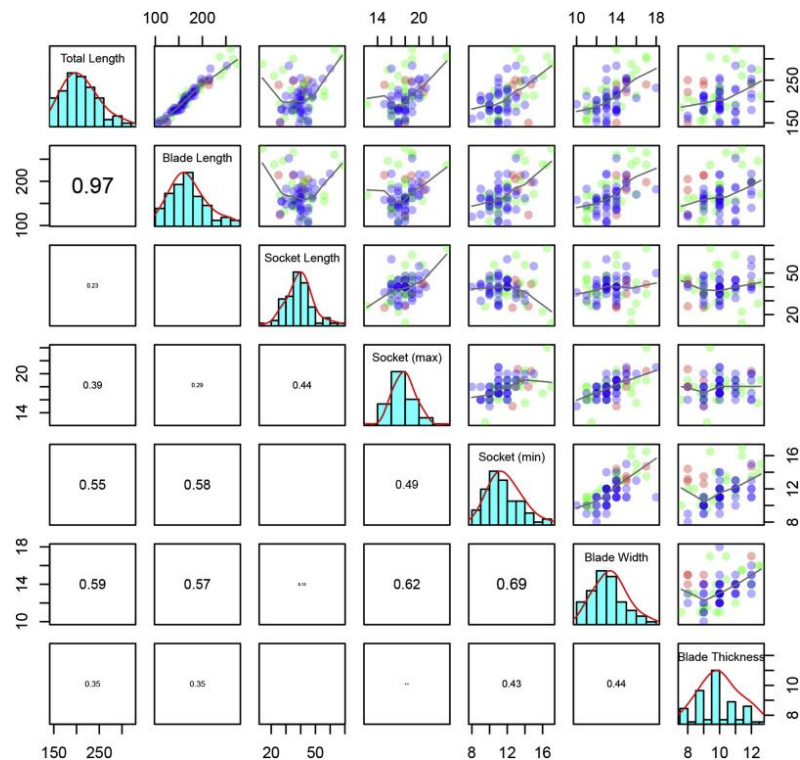


The 'Havor' lance
(example image)

GEOMETRIC LANDMARKS RECORDED



Claims Addressed



Is this the same underlying data?

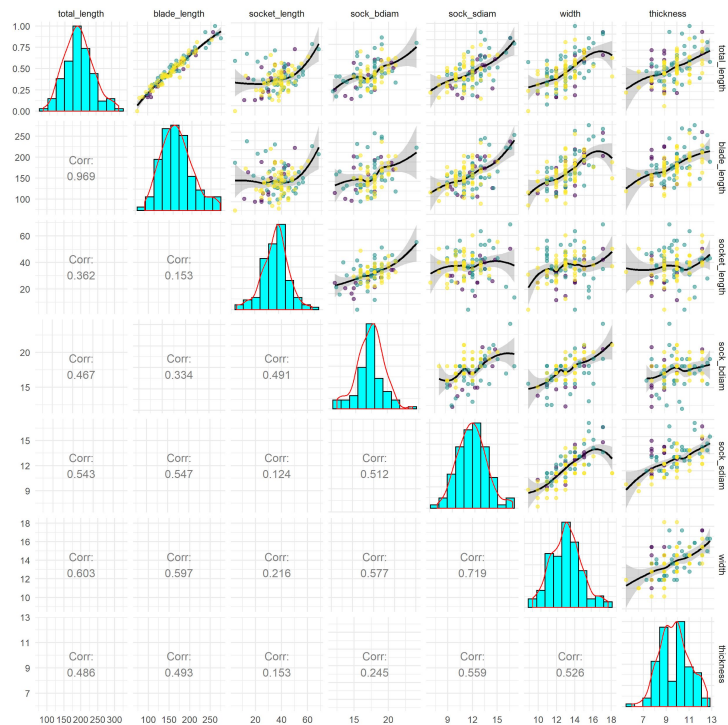
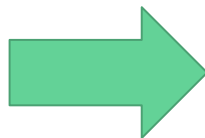
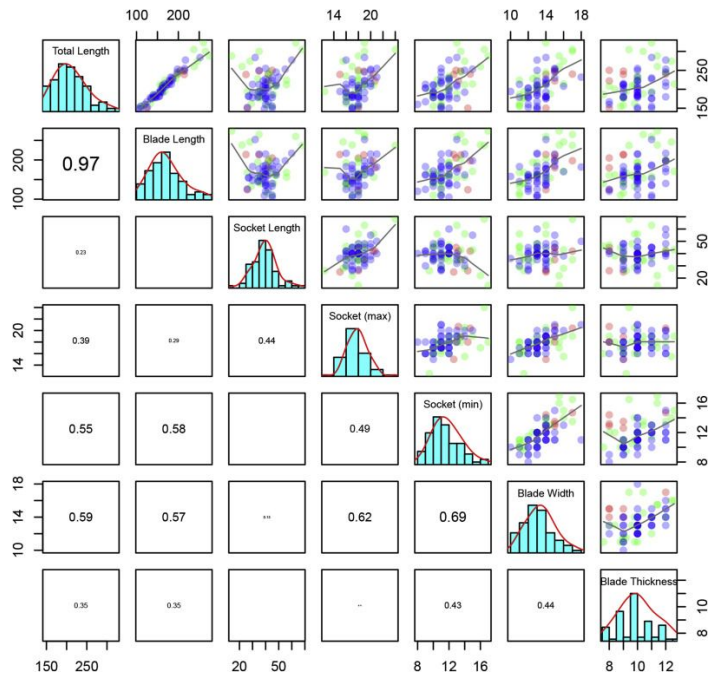
- Pairwise correlations of lance features
- Correlation coefficients recorded in R code comments

Replicate ANOVA Analysis Finding

- There was found to be an association between overall centroid size and shape that could not be explained through site difference

```
69 # Pairwise correlations of lance features
70 cor(socket$socket_length,socket$sock_bdiam,use="pairwise.complete.obs") # 0.52
71 cor(socket$sock_bdiam,socket$sock_sdiam,use="pairwise.complete.obs") # 0.52
72 cor(lances_M$width,lances_M$thickness,use="pairwise.complete.obs") # 0.53
73 cor(blade$blade_length,blade$width,use="pairwise.complete.obs") # 0.58
74 cor(blade$blade_length,blade$thickness,use="pairwise.complete.obs") # 0.47
```

Highlights/Changes 1 - pairwise correlation



Highlights/Changes 2 - spatial ANOVA

```
##
## Homogeneity of Slopes Test
##
## Allometry Model
##
## Call:
## procD.allometry(f1 = shape ~ size, f2 = ~site, print.progress = FALSE,
##   data = lances_geomorph, method = "PredLine")
##
## |
##
## Homogeneity of Slopes Test
##           Df      RSS      SS      Rsq      F      Z Pr(>F)
## Common Allometry 74 0.76683
## Group Allometries 72 0.74137 0.025466 0.030754 1.2366 0.73767 0.234
##
## The null hypothesis of parallel slopes is supported
## based on a significance criterion of alpha = 0.05
##
## Based on the results of this test, the following ANOVA table is most
## appropriate
##
## Type I (Sequential) Sums of Squares and Cross-products
## Randomized Residual Permutation Procedure Used
## 1000 Permutations
## ANOVA effect sizes and P-values based on empirical F distributions
##
##           Df      SS      MS      Rsq      F      Z Pr(>F)
## log(size)  1 0.05502 0.055024 0.06645 5.3098  1.87975 0.012 *
## site       2 0.00619 0.003096 0.00748 0.2987 -0.83913 0.812
## Residuals 74 0.76683 0.010363 0.92607
## Total     77 0.82805
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Reflections 1

- Exposure to a new academic field
- Had to switch papers after the first check-in
- Important core chunks of the original R code were missing
- Knitting on each machine early on was DIFFICULT
- Solid balance of work (R wrangling, writing, managing supplemental files)

Reflections 2

- Corey Christopherson was our team leader throughout the project
- Zack quickly became our subject matter expert on archaeological vocabulary, procedure, and methods of measurement
- Thomas was our package versioning and environment reproducibility guru
- Richard was our star player on replication of the statistical analysis and visualization