Morphometric Analysis of *Astarte* (Bivalvia: Astartidae) from the Atlantic Coastal Plain

Philip Roberson and

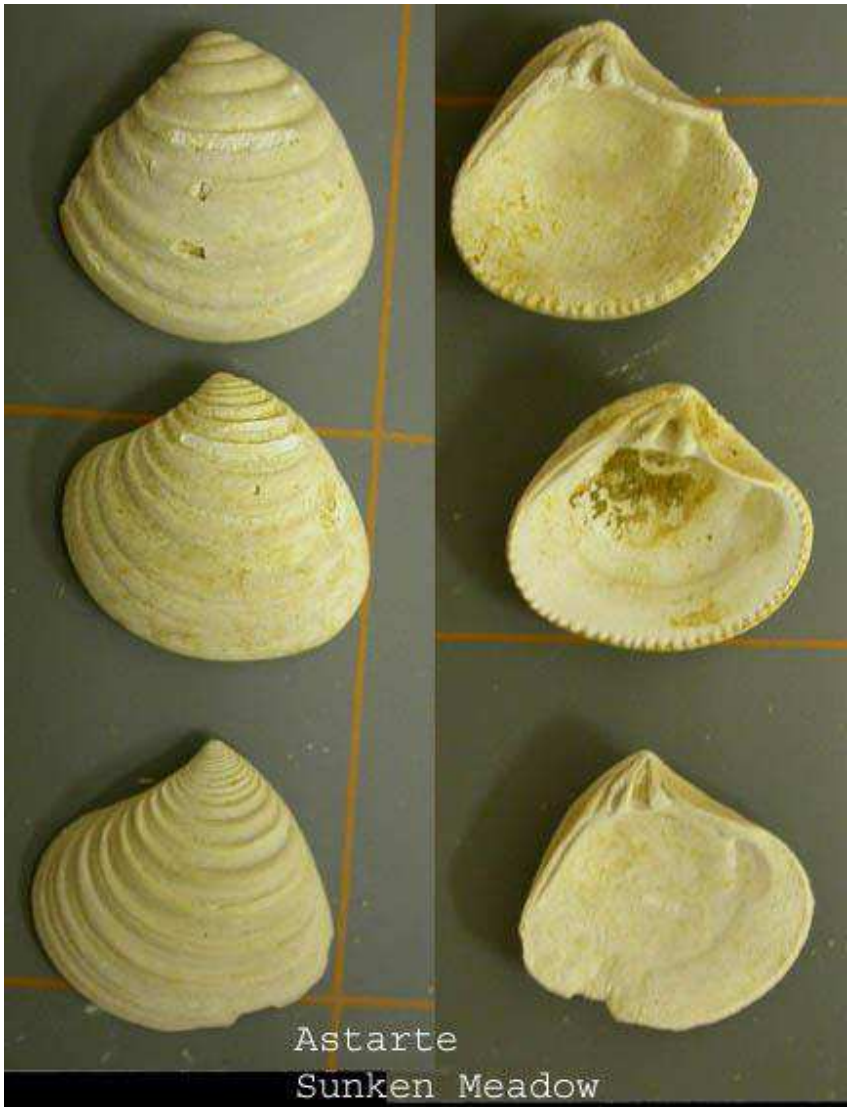
Michelle M. Casey

MURRAY STATE UNIVERSITY

Atlantic Coastal Plain Bivalves

Fauna from the Atlantic Coastal Plain are commonly used to test many different hypotheses (e.g.,Blackwelder, 1981; Saupe et. al., 2014).

Anecdotal evidence suggests that species within *Astarte* lack true morphological distinction.



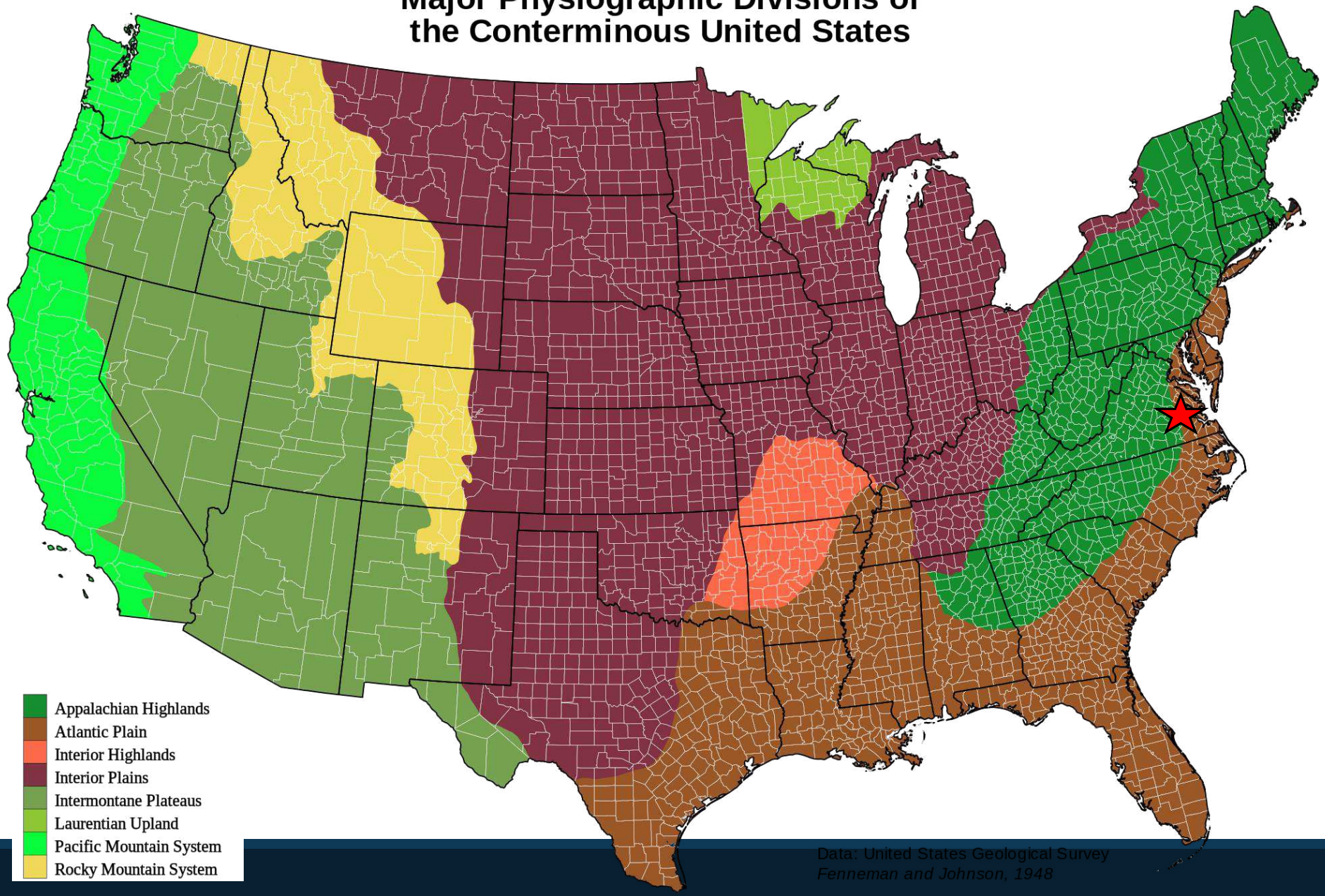
Astarte

Numerous species have been formally named and identified within the genus *Astarte.*

- *However, previous work has noted a lack of diversification within the genus (Stanley, 1968).*

Mostly intermediate morphologies (Glassburn, 1995; Chrpa and Oleinik, 2015).

Major Physiographic Divisions of the Conterminous United States



Data: United States Geological Survey
Fenneman and Johnson, 1948

Specimen Information

46 shells total

4 species represented

- *Astarte concentrica, Astarte symmetrica, Astarte undulata, Astarte undulata vaginulata*

Yorktown Formation

Pliocene in age

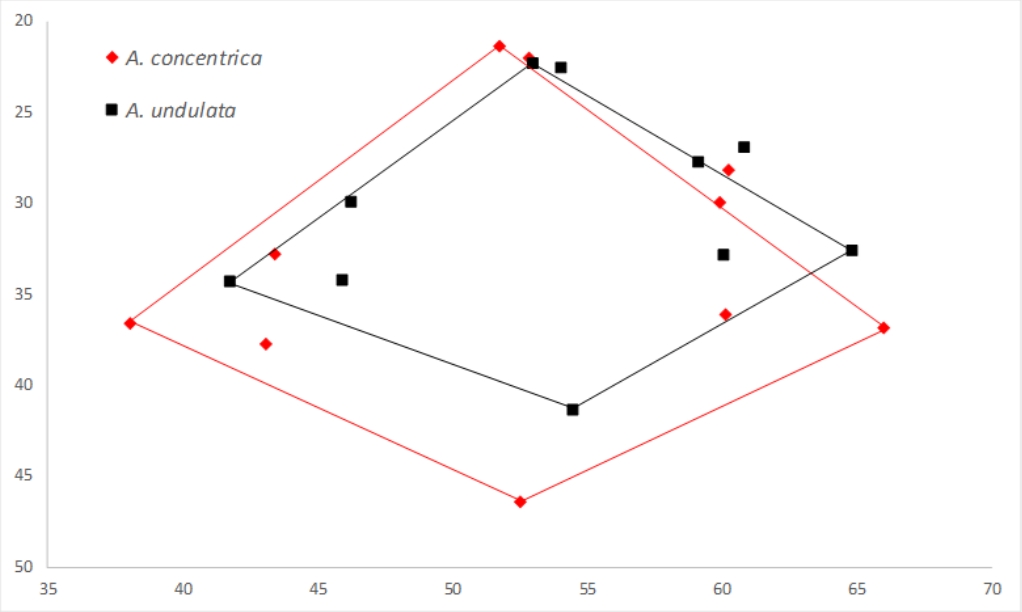
7
1
6
2
4
9
3
10
5
8

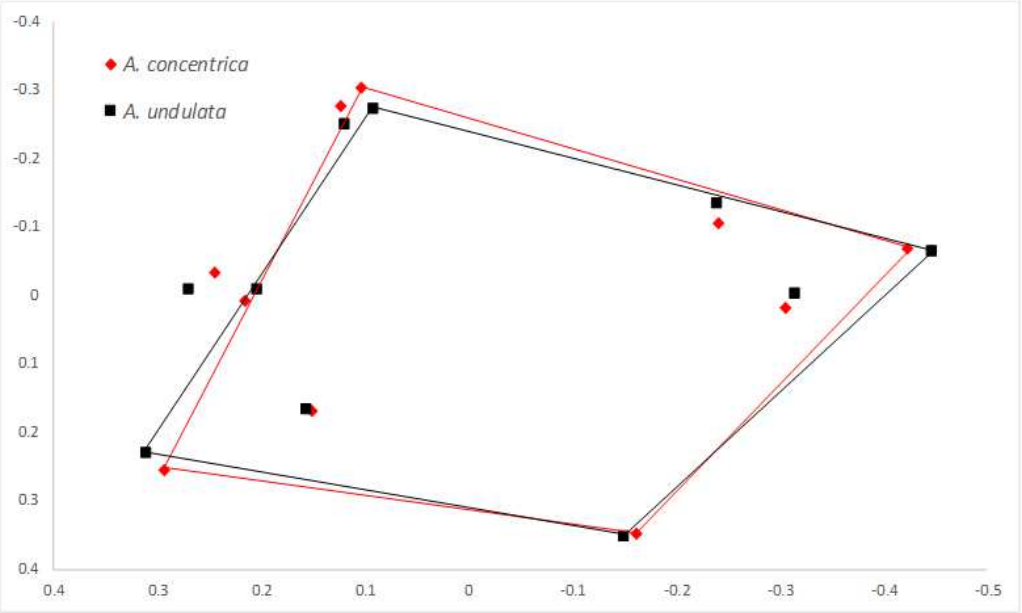
Multivariate Statistics

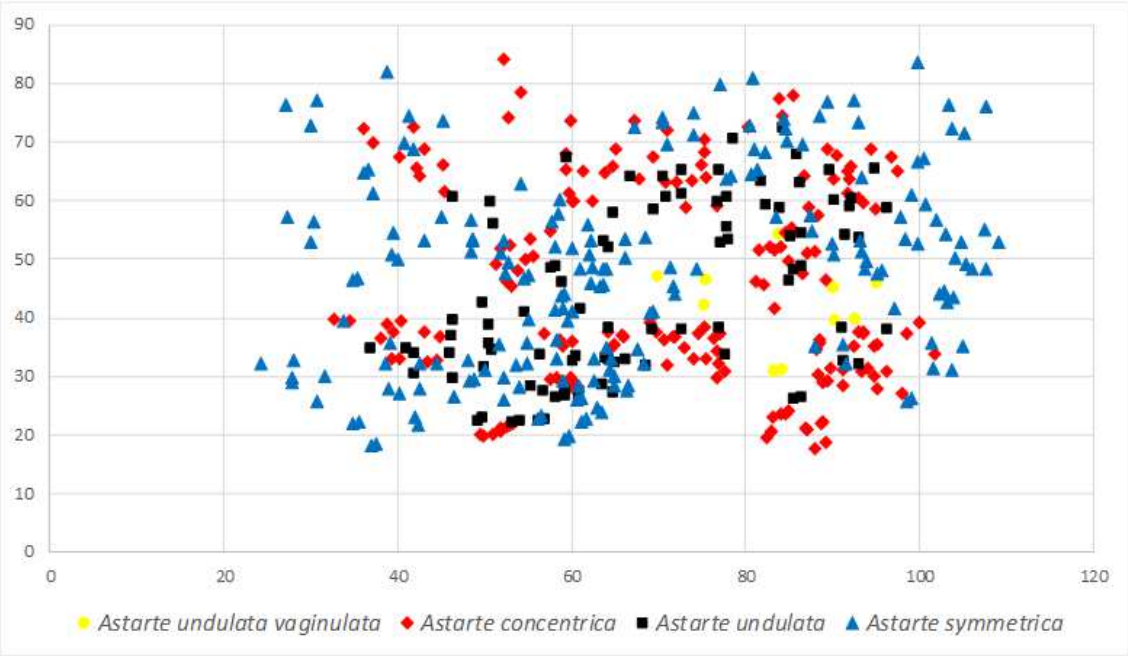
Procrustes transformation was performed to align and resize all the X-Y data.

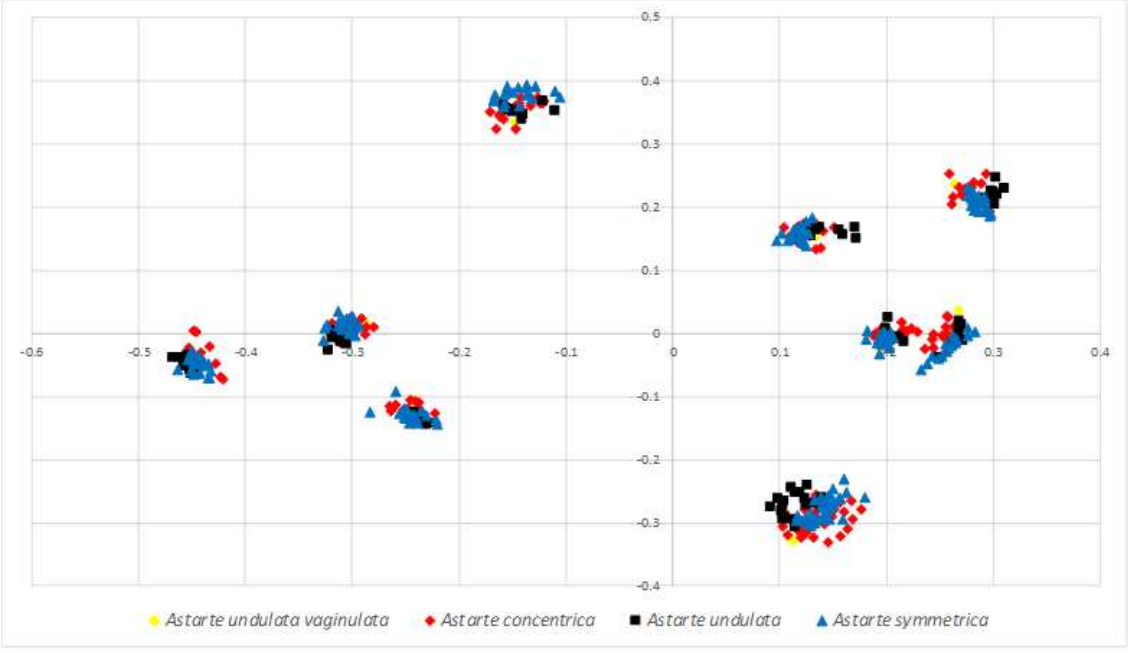
Principal Components Analysis (PCA).

Thin Plate Spline


A. concentrica
A. undulata
20
25
30
35
40
45
50
35
40
45
50
55
60
65
70

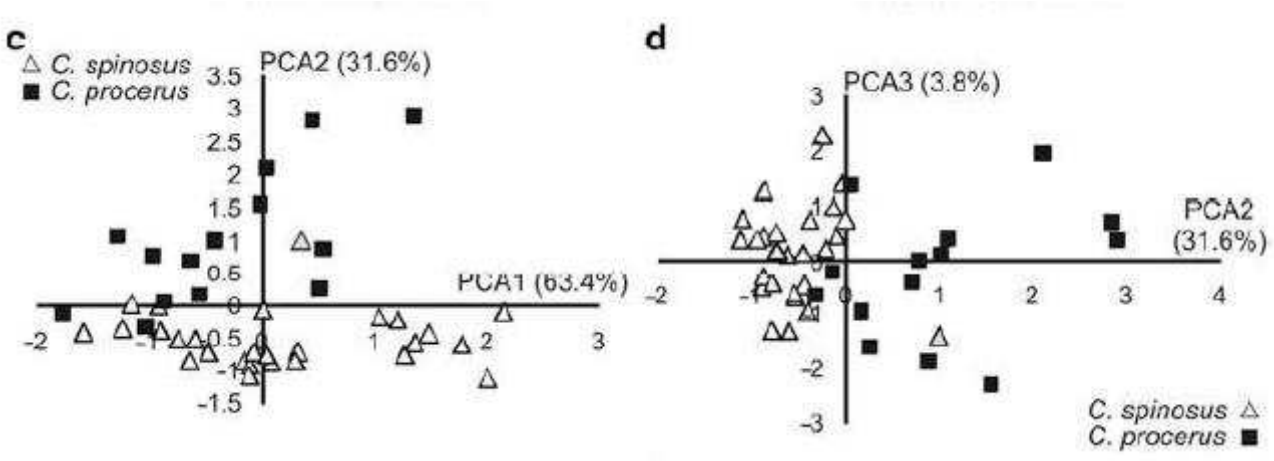

A. concentrica
A. undulata
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5


90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
Astarte undulata vaginulata
Astarte concentrica
Astarte undulata
Astarte symmetrica

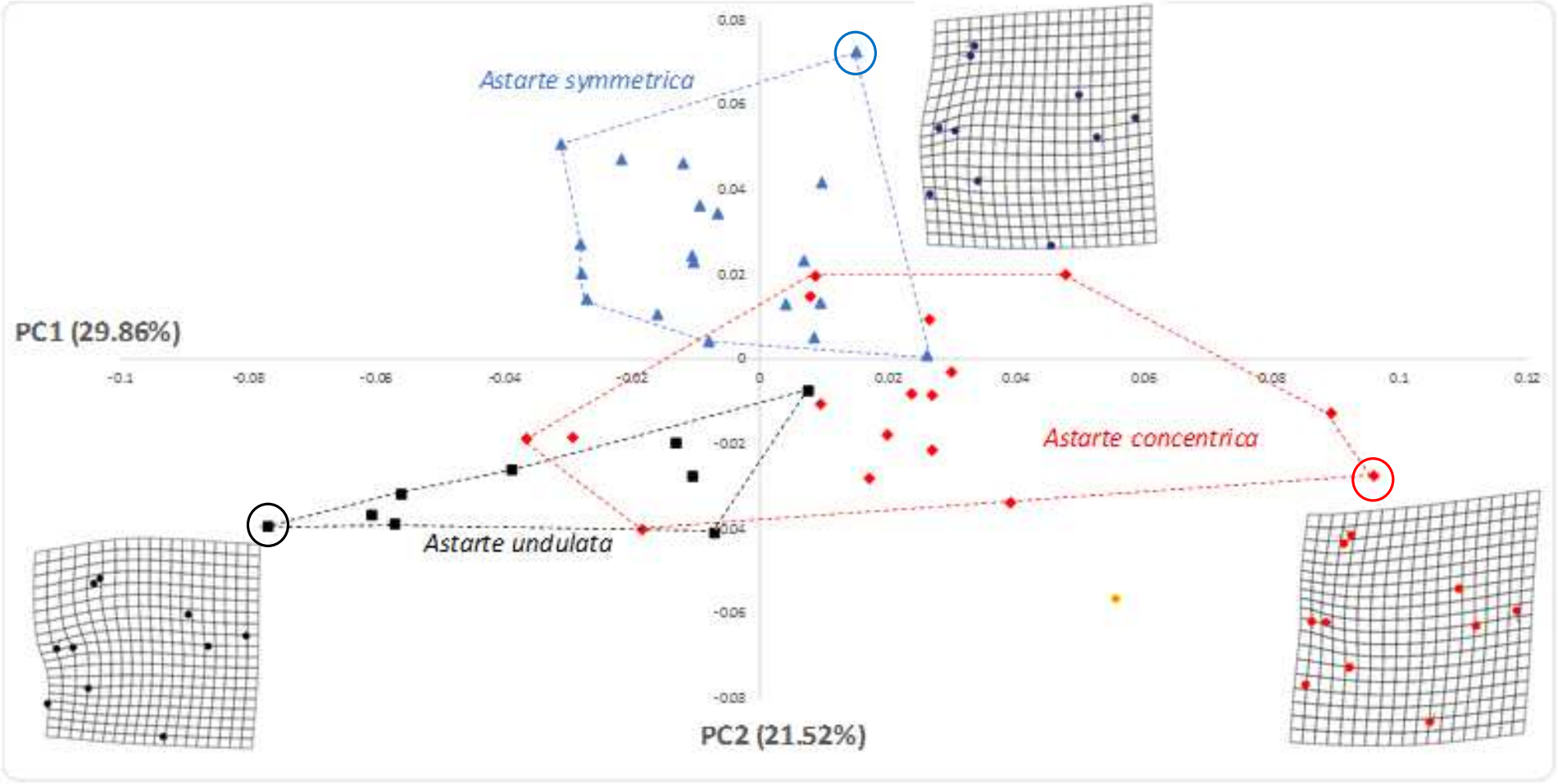

0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.6
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.3
0.4
Astarte undulata vaginulata
Astarte concentrica
Astarte undulata
Astarte symmetrica

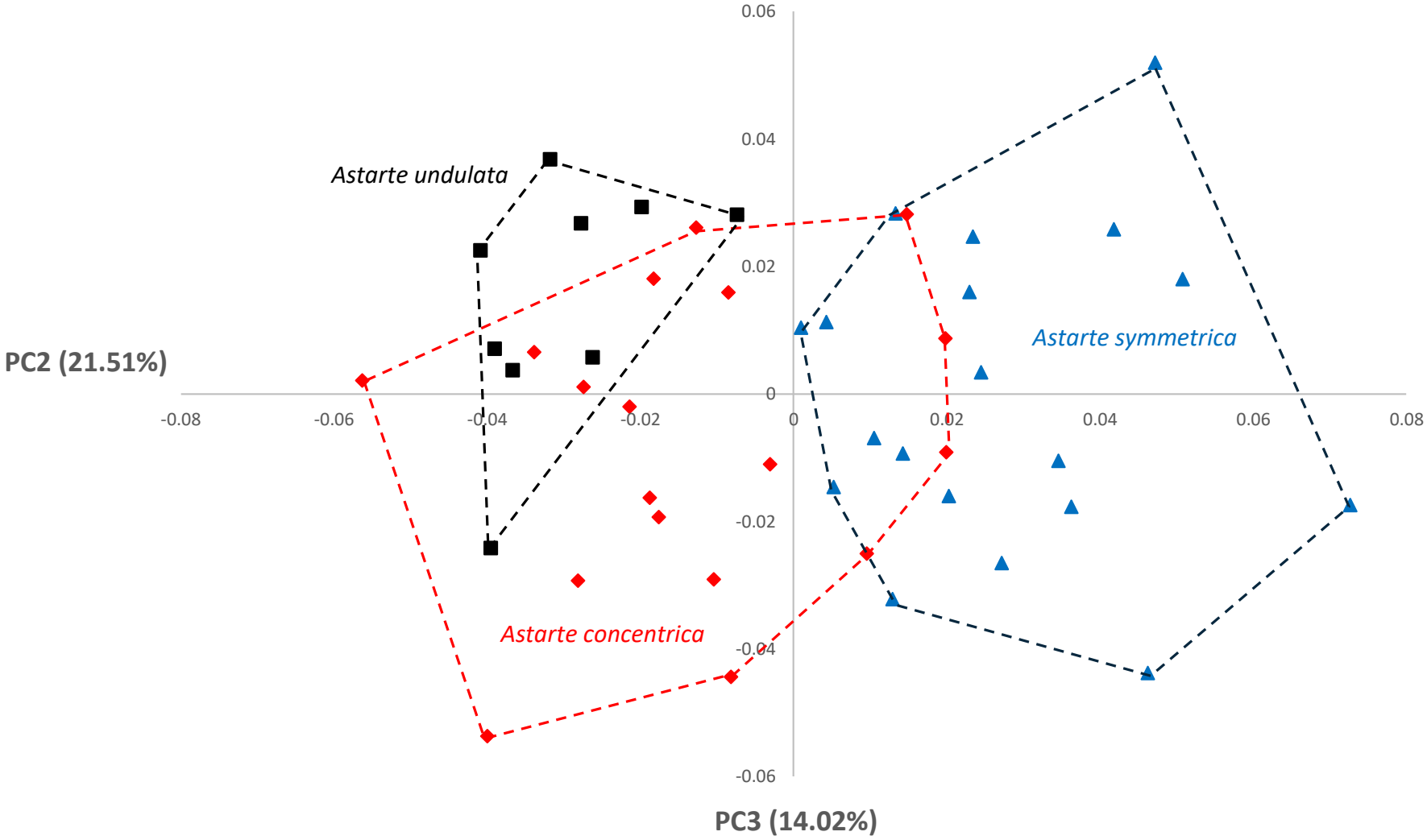
Principle Components Analysis

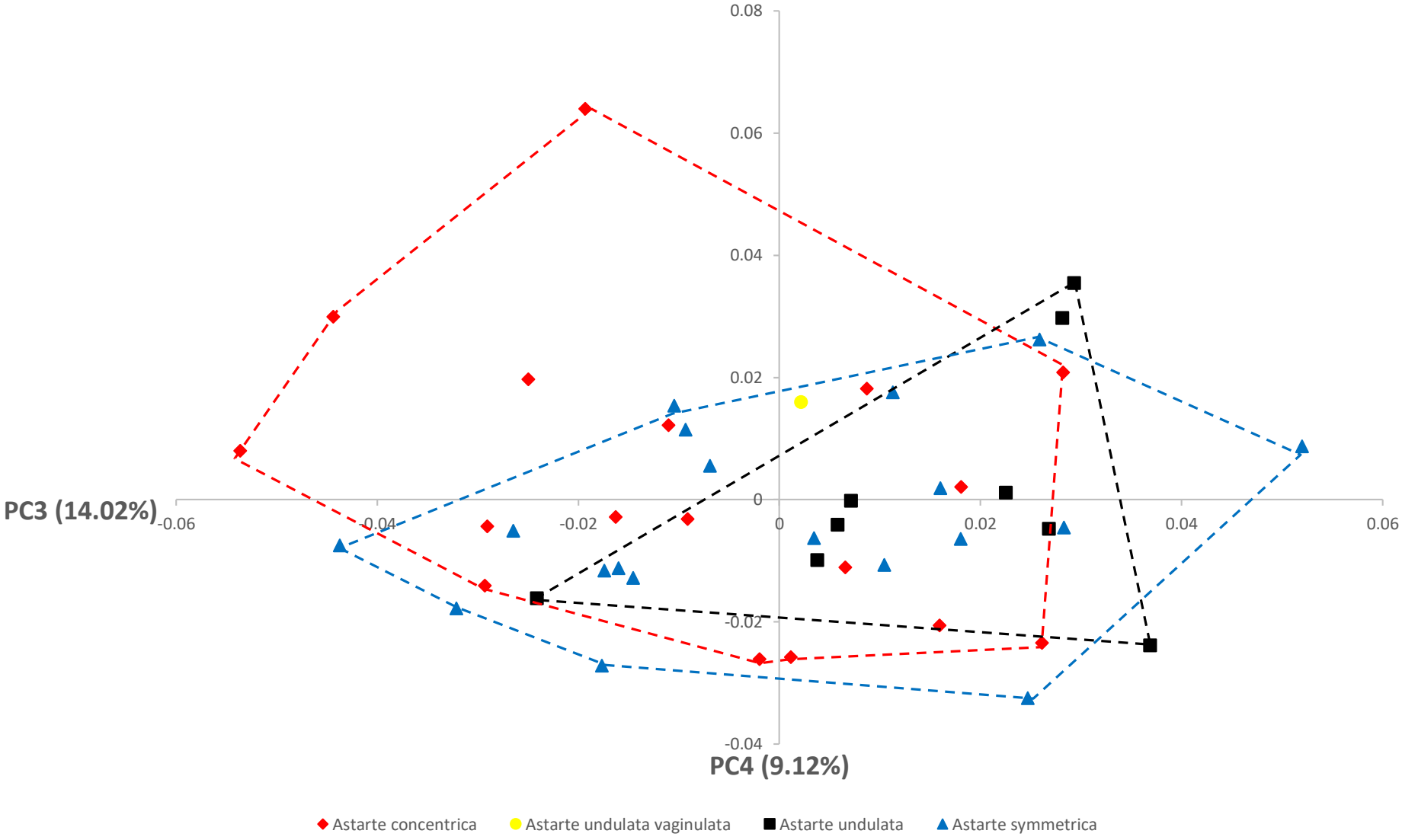
Allowed us to project the multivariate dataset down to a few dimensions, in a way that preserved as much variance as possible, making the analysis easier.

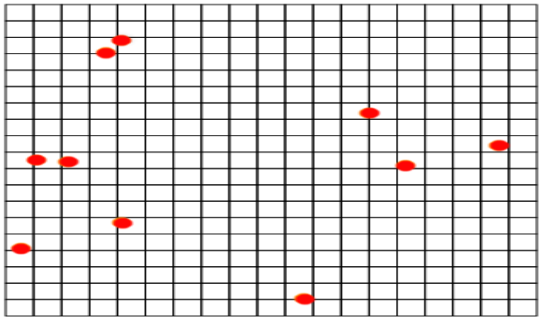


Modified from Laflamme and Casey, 2011.

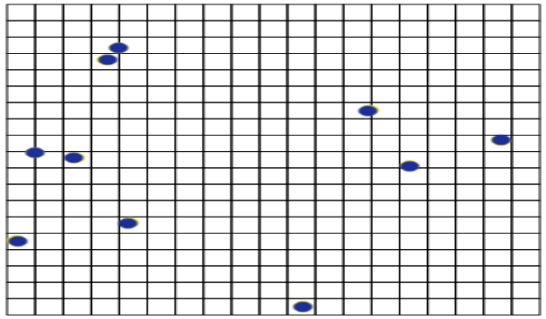

Astarte symmetrica
Astarte concentrica
Astarte undulata
PC1 (29.86%)
PC2 (21.52%)
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.1
0.12


Astarte undulata
Astarte symmetrica
Astarte concentrica
PC2 (21.51%)
PC3 (14.02%)
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08

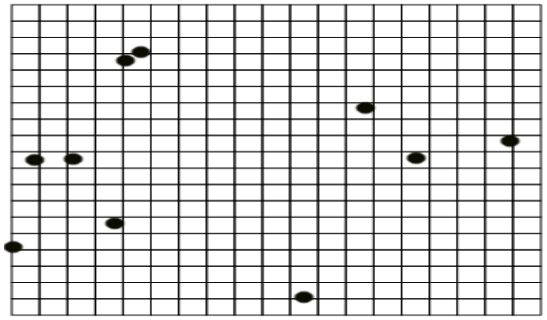

0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
PC3 (14.02%)
PC4 (9.12%)
Astarte concentrica
Astarte undulata vaginulata
Astarte undulata
Astarte symmetrica



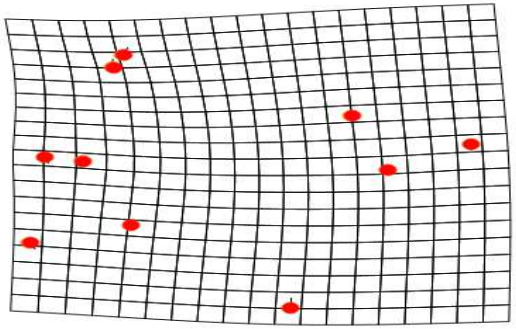
A. concentrica



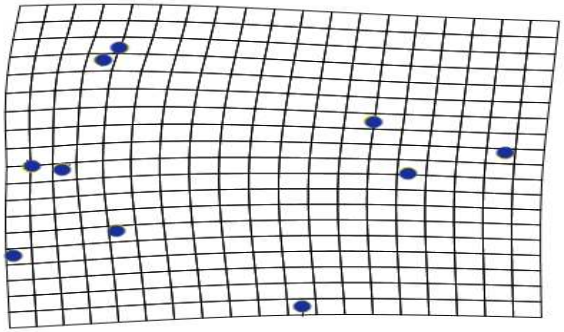
A. symmetrica



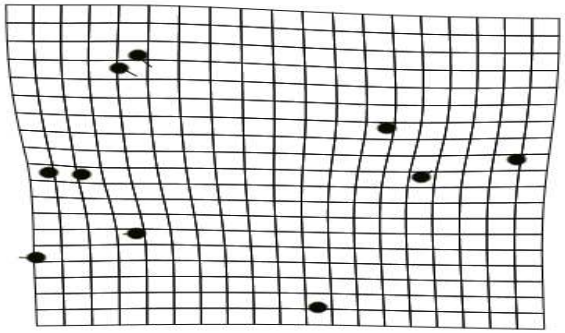
A. undulata



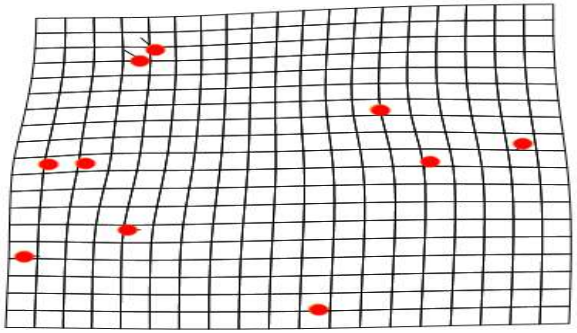
A. concentrica to *A. symmetrica*



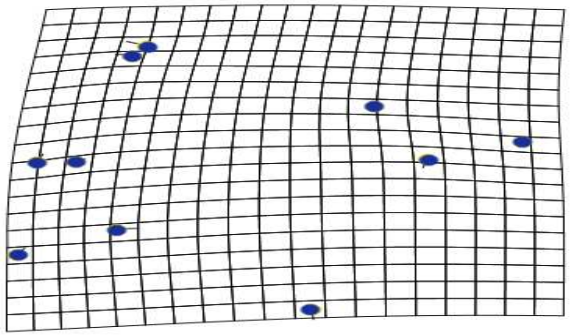
A. symmetrica to *A. concentrica*



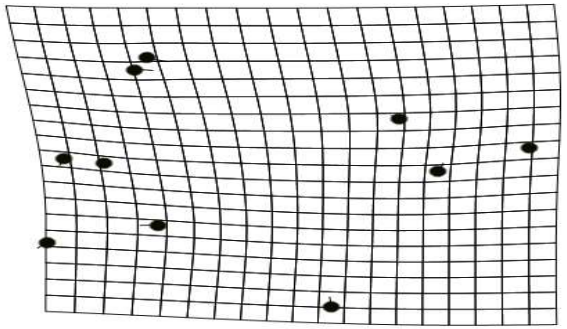
A. undulata to *A. concentrica*



A. concentrica to *A. undulata*



A. symmetrica to *A. undulata*



A. undulata to *A. symmetrica*

PCA Results

Each species occupies its own morphospace.

- However, there is some overlap between a couple of the species.

PC1 and PC2 account for 51.4% of the variance.

Astarte concentrica shows the most variation.

- It occupies its own morphospace, but also overlaps into the morphospace of the other two species.

Thin-Plate Spline Results

Astarte concentrica and *Astarte symmetrica* show similar changes when morphed to *Astarte undulata*.

- The posterior and anterior widen.
- The dorsal side and beak move laterally toward the anterior.

This shape change has been previously noted by Glassburn (1995).

- The shift in the dorsal side indicates a move to a trigonal shape away from the cuneiform shape exhibited in the other two species.

Impact of Research

The resulting data can be used to pinpoint easily identifiable features.

- This will help create a reliable taxonomy for this genus within the Atlantic Coastal Plain.

Can also suggest which species should be synonymized.

Full use of dataset will depend on how the current ouput responds to the addition of more shells and species.

Future Research

More shells need to be photographed and added to the dataset

- Florida Museum of Natural History and Virginia Museum of Natural History

More landmarks can be added between the current landmarks

Outline analysis

Ornamentation on the outside of the shell

Acknowledgements

Susan Barbour

Roger Portell, Florida Museum of Natural History

Alex Hastings, Virginia Museum of Natural History

Department of Geosciences, Murray State University

Rachel Racicot

Carissa Roberson