GEOMETRIC MORPHOMETRIC ANALYSES OF SHELL SHAPE CONTRIBUTIONS TO PREY SELECTIVITY: PREDATION IN THE NATICID GASTROPOD AND VENERID BIVALVE SYSTEM OF BIOTIC INTERACTIONS

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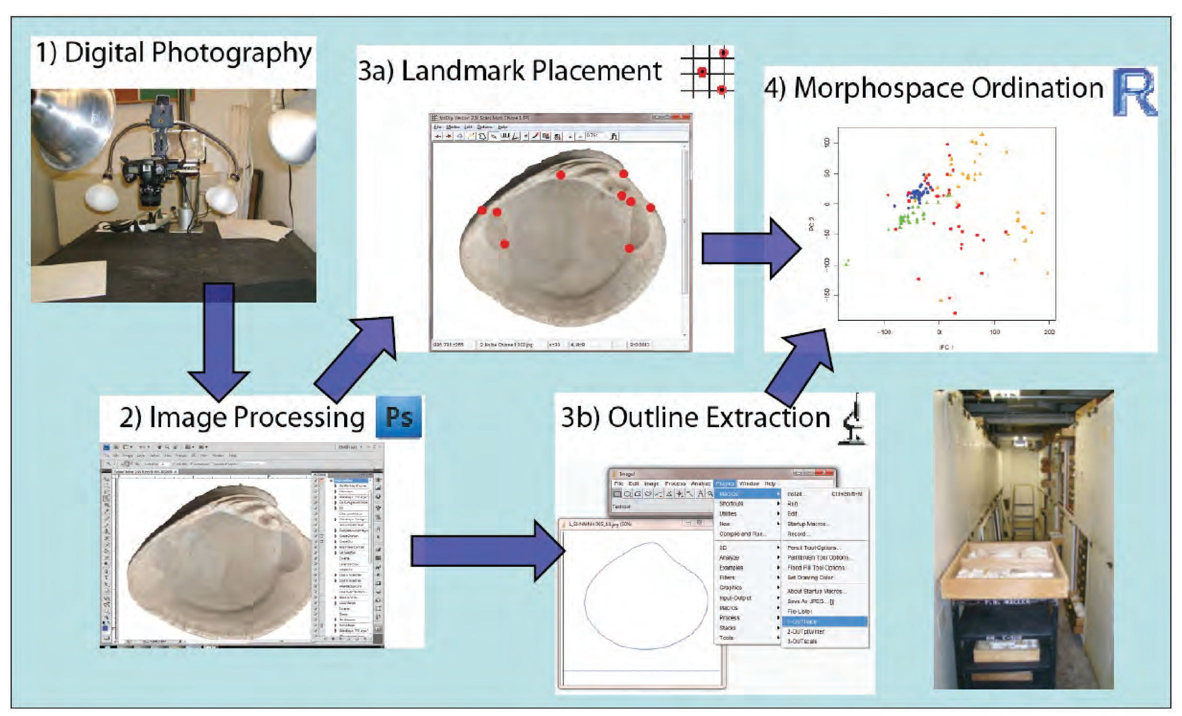
Abstract

Variable life habits, and to a lesser extent shell ornamentation and armor, have been acknowledged to pose some contribution to predation resistance in bivalves throughout their evolutionary history. These factors include deep burrowing, cementation, boring into hard substrates, shell microstructure and more. Of these changes in life habit and behavior, many have a preservable record as a component of shell shape. In long-term and closely-constrained biotic interactions, such as the agonistic relationship between venerid bivalves and their predators (i.e. shell-drilling gastropods), directional changes in shell shape and form may be heritable phenotypic responses to selection pressure by predators. In this project, I diagnose the major contributions of shell shape and morphological diversity (disparity) as they relate to predator avoidance and escape. I report an assessment of morphologic variation, by utilizing both landmarks (discrete homologous points) and digitized shell outlines, among Neogene venerid genera from the Indo-Pacific. I constrain these analyses in a broad stratigraphic and geographic context, taking into account the frequency of drilling predation as a function of morphological variation.

Morphometric analyses of venerid genera demonstrate that taxa are randomly distributed throughout shape space with respect to geographic and temporal distributions. However, when predation instances (i.e. drilled specimens) are superimposed on the ordination in shape space, a bias in prey selectivity is observed.



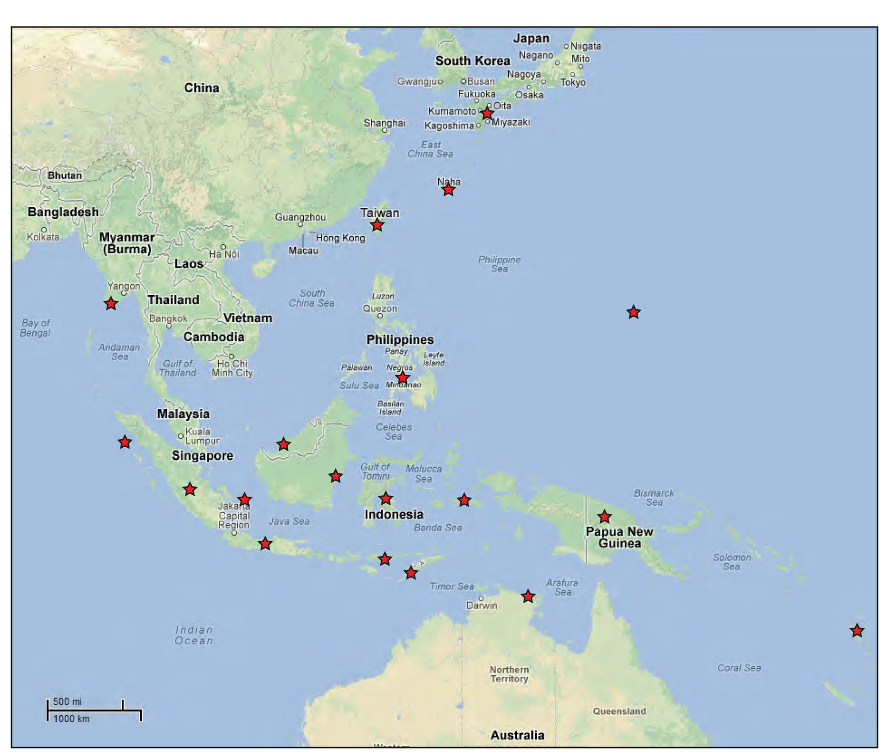
Background

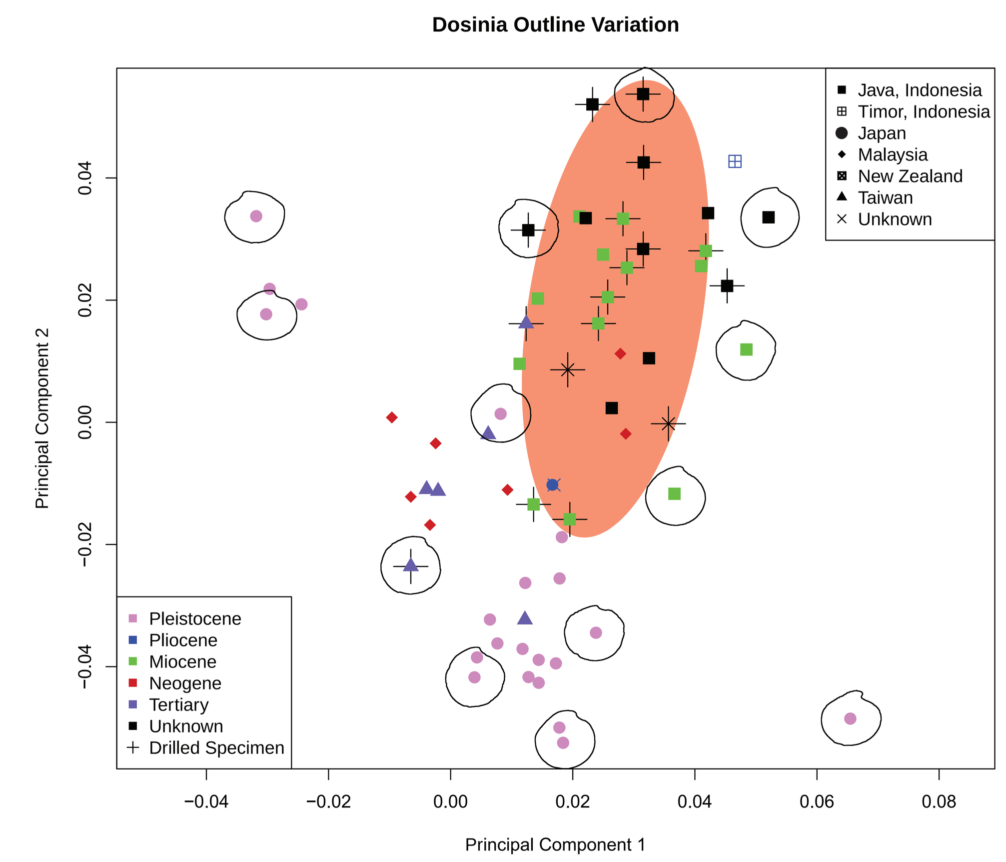
1- Camera and lighted copy stand setup for image capture. Specimens on this table would need to be leveled to plane parallel with the table to ensure standard orientation, often a difficult and tedious process.

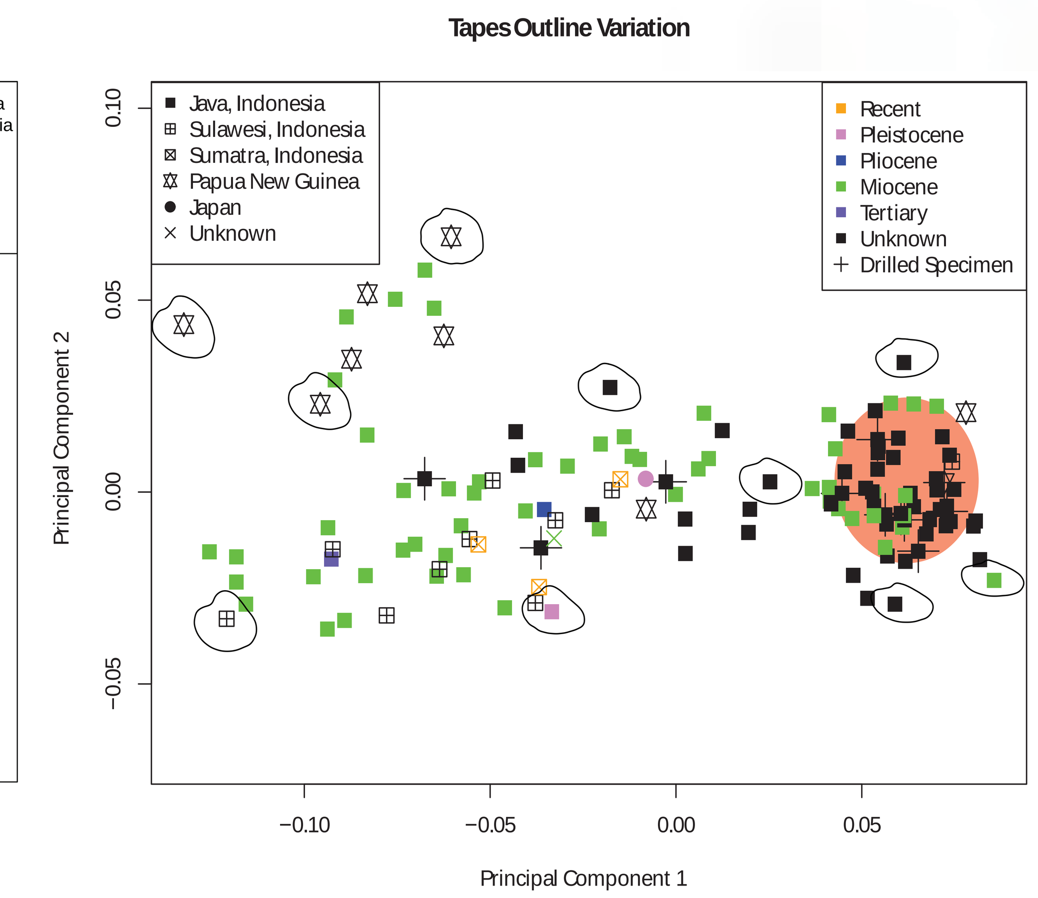
2-Digital images are processed through a series of scripts in Adobe Photoshop to ensure maximum visibility of internal shell characters.

3a-Landmark selection and scaling is performed in tpsDIG.
3b-Outline extraction is performed using ImageJ.

4-All data from both landmark and outline datasets are arrayed in morphospace using Principal Components Analysis (PCA) and plotted using the programming environment R.



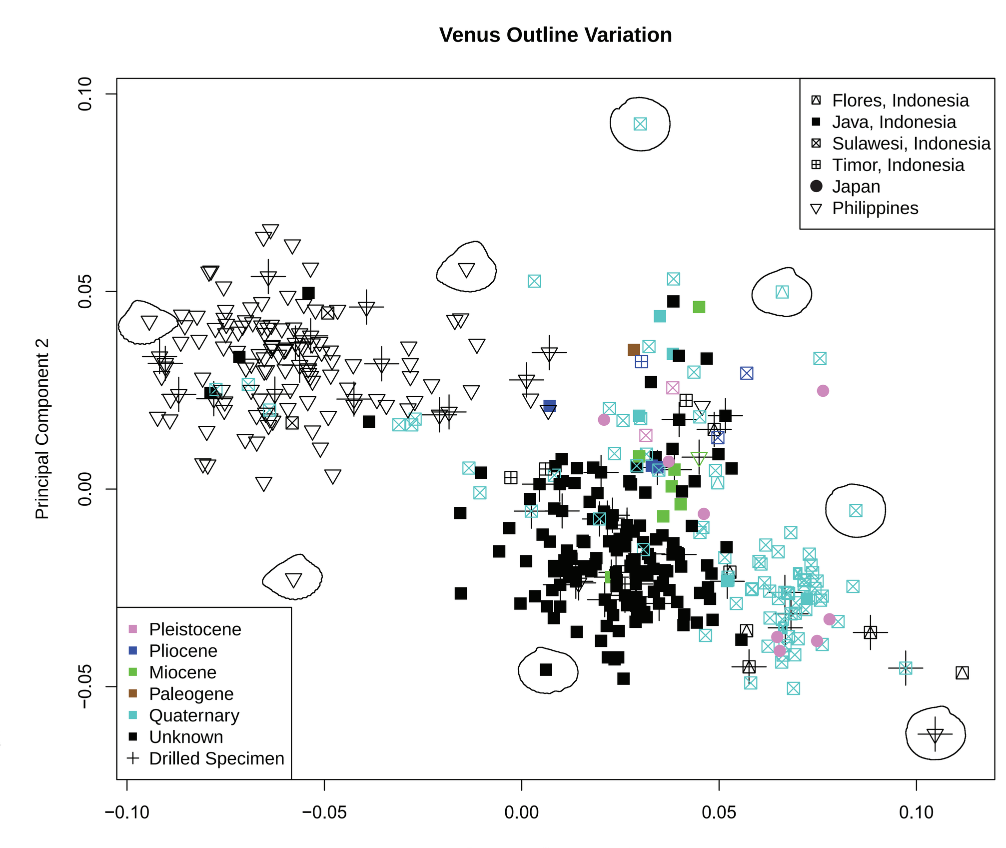


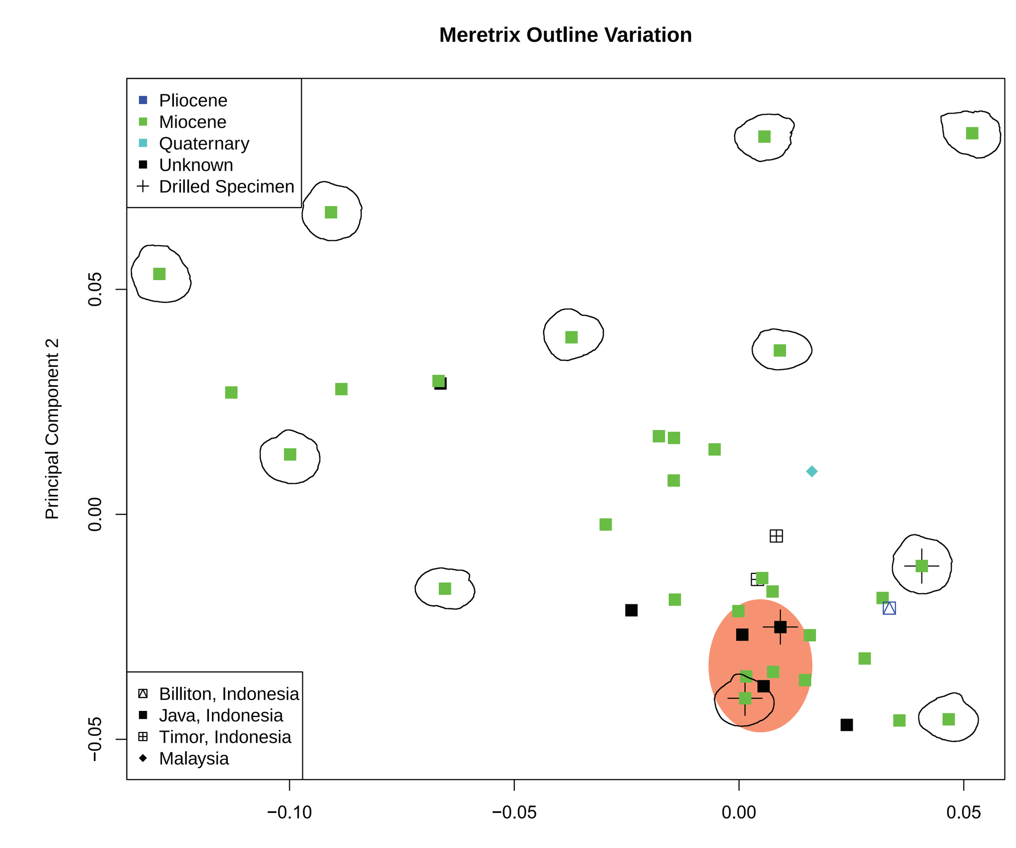


Synthetic outlines are overlaid on an ordination of shell shape parameters for specimens of the venerid genera a) *Dosinia*, b) *Tapes*, c) *Venus* and d) *Meretrix*.

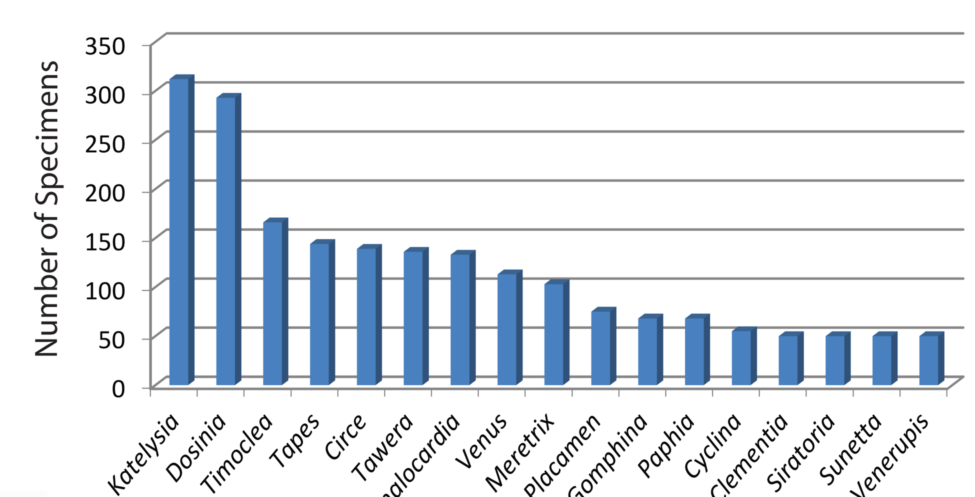
Points arrayed in shape space are coded by color to denote stratigraphic position (specimen age) and coded by shape to denote geographic distribution of each specimen.

Specimens with a large cross (+) behind the symbol have been killed by a predator.





a) *Dosinia* b) *Tapes*
c) *Venus* d) *Meretrix*



n = 62 genera

Conclusions

- Morphologic variation of *Dosinia, Tapes, Venus,* and *Meretrix* shell forms is highly influenced by geography
  - Stratigraphic position may have an influence, albeit somewhat less
- Shell shape seems to have some influence on predation/mortality incidence
  - Could be predator preference (i.e. shell manipulation by propodium)
  - Could be related to depth of burrowing of prey items (i.e. avoidance)
- Further investigation of stratigraphically contiguous and geographically disparate specimens may illuminate true biases in sampling or ecological preferences in biotic interactions

Fossil venerids have been obtained from collections made in the following localities:

Billiton, Indonesia	Australia	New Zealand
Flores, Indonesia	Fiji	Niue
Java, Indonesia	Japan	N. Mariana Islands
Kalimantan, Indonesia	Malaysia	Papua New Guinea
Nias, Indonesia	Myanmar	Philippines
Seram, Indonesia	Taiwan	
Sulawesi, Indonesia	Vanuatu	
Sumatra, Indonesia		
Timor, Indonesia		

Support is gratefully acknowledged from the following sources:

The Malacological Society of London
The Geological Society of America — Science • Stewardship • Service
American Museum of Natural History
Unitas Malacologica
The Malacological Society of Australasia
GSGA Graduate Student Governance Association
University of Cincinnati
The Academy of Natural Sciences
Mizunami Fossil Museum
Smithsonian
National Museum of Nature and Science
Natural History Museum
Carnegie Museum of Natural History
Muséum National d'Histoire Naturelle
Delaware Museum of Natural History
Naturalis Biodiversity Center

Please take one!