

Variation in cornuti in the leaf-roller moths (Lepidoptera: Tortricidae: Tortricinae)



Salvatore S. Anzaldo¹ and John W. Brown²
¹ Department of Biology, The Pennsylvania State University, University Park, PA
² Systematic Entomology Lab, ARS, USDA



Introduction

Tortricidae is a large family (>10,000 species) distributed world-wide (Gilligan *et al.* 2010).

Cornuti are sclerotized (hardened) features attached to a membranous structure called the vesica, which is inside the phallus. During copulation, the vesica everts out of the phallus and fills the ductus and corpus bursa of the female. The function of cornuti is unknown although they are thought to be taxonomically important.



Fig. 1a. *Eupoecilia ambiguella* with vesica inside phallus.

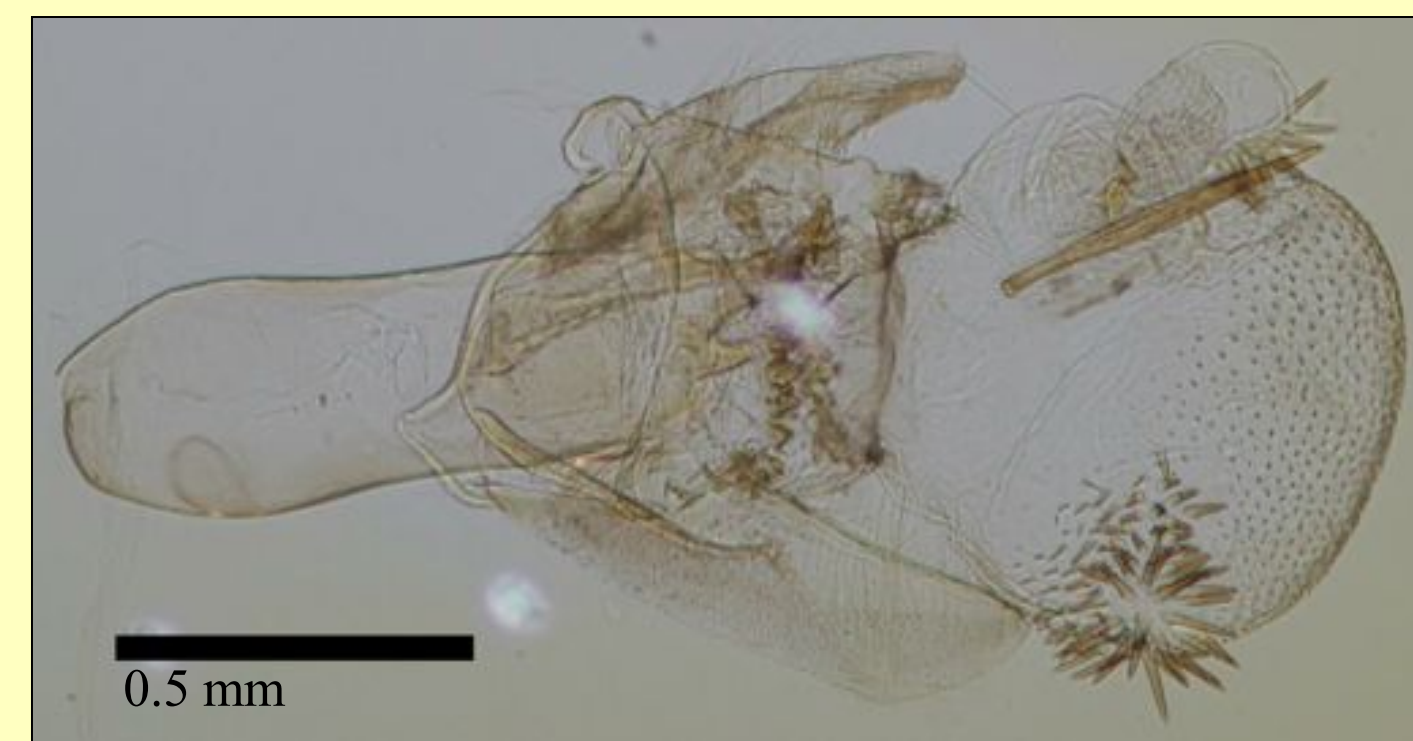


Fig. 1b. *Eupoecilia ambiguella* with vesica everted. Cornuti are oriented as they would be during copulation.

Cornuti can be deciduous and break off in the ductus and corpus bursa of the female. It is thought that the presence of non-deciduous vs. deciduous cornuti represents a split in the evolutionary history of Tortricidae. A recent molecular phylogeny (Reiger *et al.* 2012) elucidated the tribal relationships within Tortricinae.

The amount of variation in cornuti (in type, number, and configuration) between closely related species, and even among individuals of the same species, suggests that cornuti are evolving rapidly due to sexual selection pressures (Cordero, 2010).

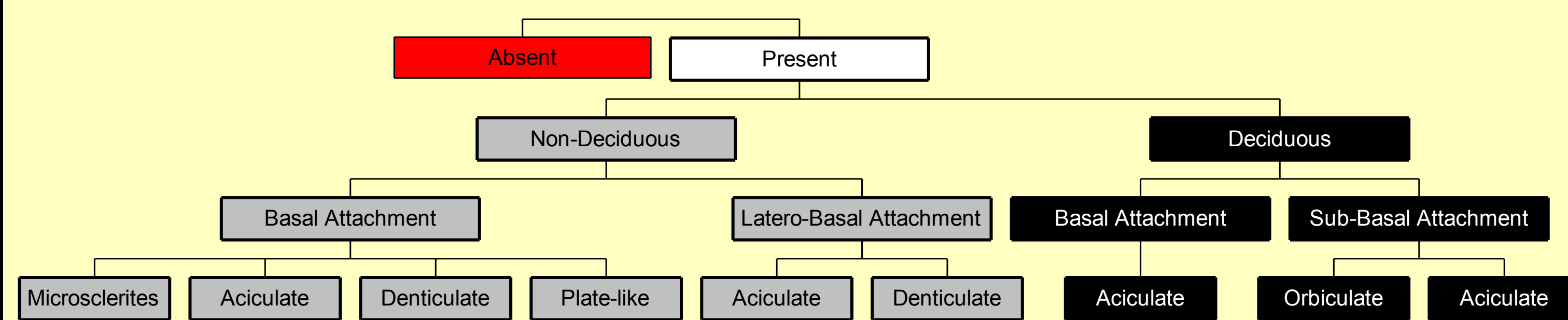
There are two main objectives of this research: we attempt to survey the morphological variation in cornuti throughout subfamily Tortricinae. We will then compare our morphological data to the molecular phylogeny to determine if the tribes where cornuti are deciduous or non-deciduous correspond to the molecular groupings.

Materials and Methods

All specimens for this study were obtained from the Department of Entomology at the Smithsonian National Museum of Natural History. The presence/absence and type of cornuti were recorded for each of the approximately 4,000 specimens examined.

We define a cornutus to be any sclerotization on the vesica, and have identified the following five categories, which are further sorted by their deciduous or non-deciduous nature and point of attachment to the vesica:

- Aciculate: long and slender; apically pointed; with or without a distinctly socketed base.
- Denticulate: pointed; conspicuously broader at base relative to length
- Plate-like: irregularly shaped sclerite; usually with rounded edges
- Microsclerites: variable in size and covering on the vesica; can be flattened or pointed
- Orbiculate: small, flattened, and rounded; sub-basally attached and deciduous; observed in few taxa



Our criteria for determining if deciduous cornuti were present were if two of the following were observed: the presence of cornuti in a male specimen, the presence of scars on the vesica where the cornuti were previously attached, and the presence of cornuti in the ductus and/or corpus bursa of the female specimens (Fig. 2a-c).

Morphological Variation



Fig. 2a. *Sparganothis directana* with sub-basally attached, aciculate, deciduous cornuti.

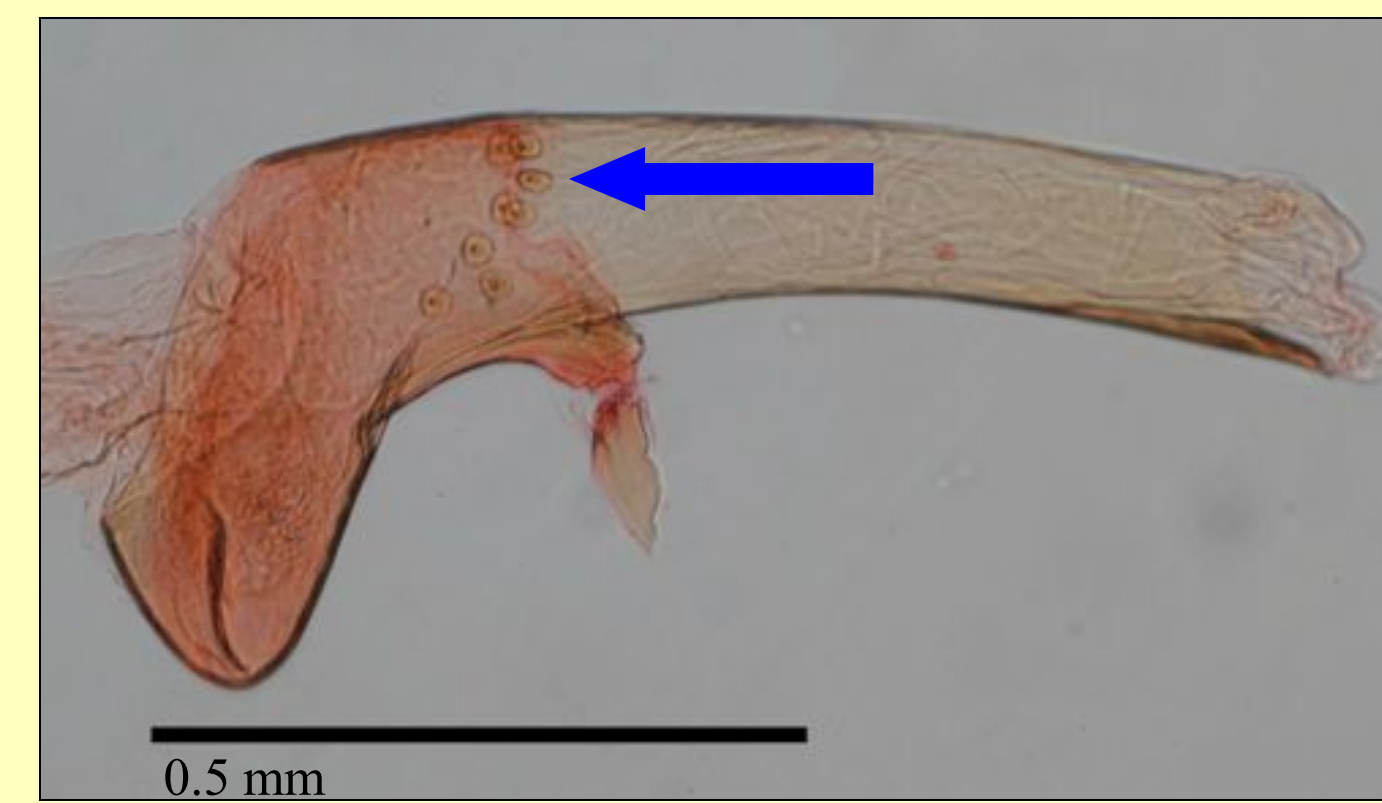


Fig. 2b. *Sparganothis directana* after copulation. Scars remain from point of attachment of cornuti.

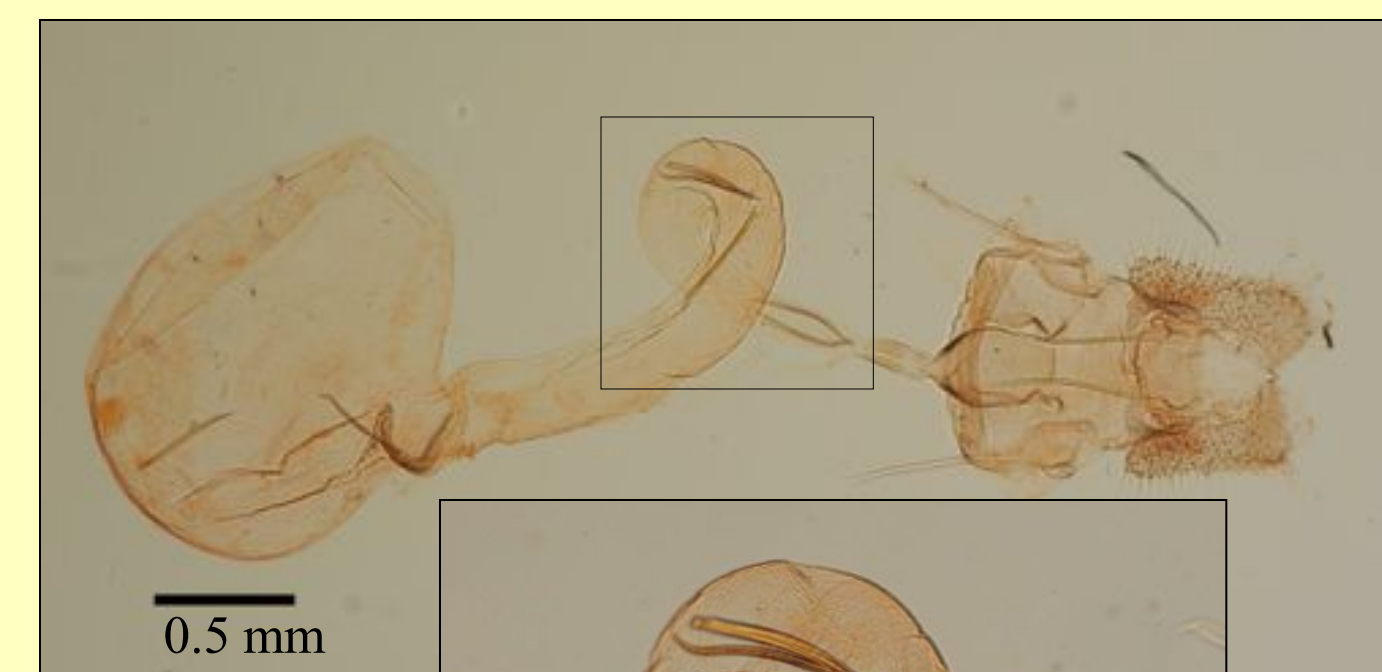


Fig. 2c. *Sparganothis directana* female with cornuti in ductus and corpus bursa.

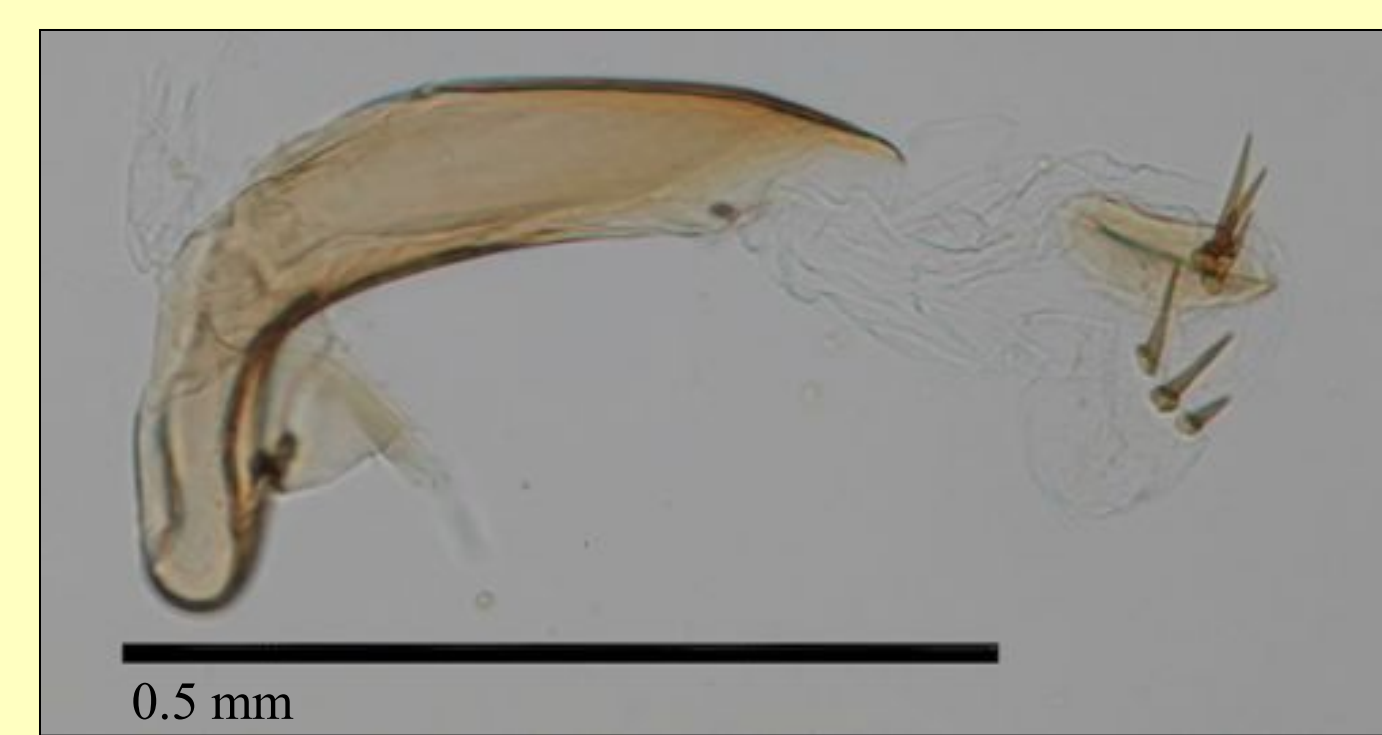
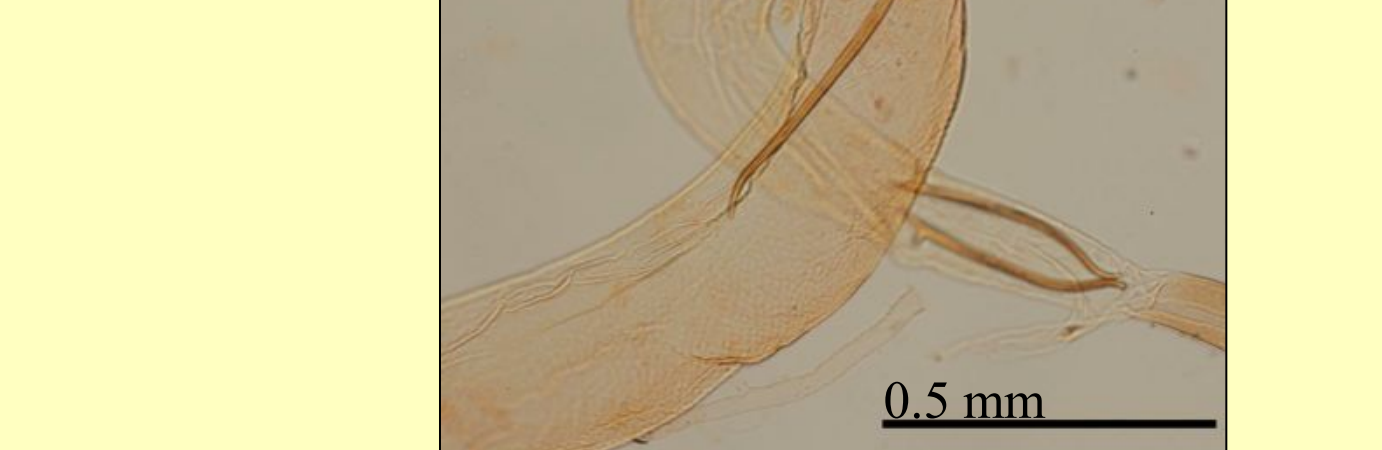


Fig. 3. *Acleris aspersana* with vesica everted. There are six basally attached aciculate cornuti and a plate-like cornutus.



Fig. 4. *Clarkenia superba* with several latero-basally attached aciculate cornuti and a patch of smaller spines.

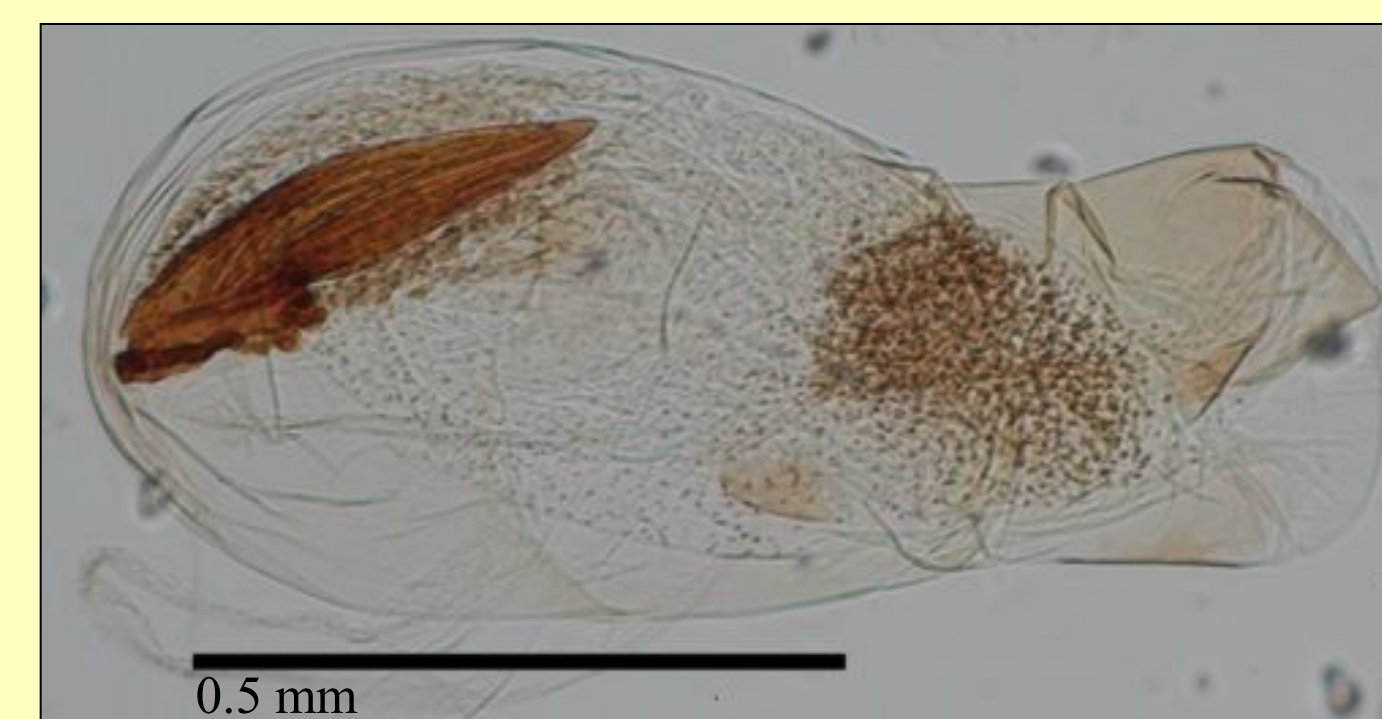
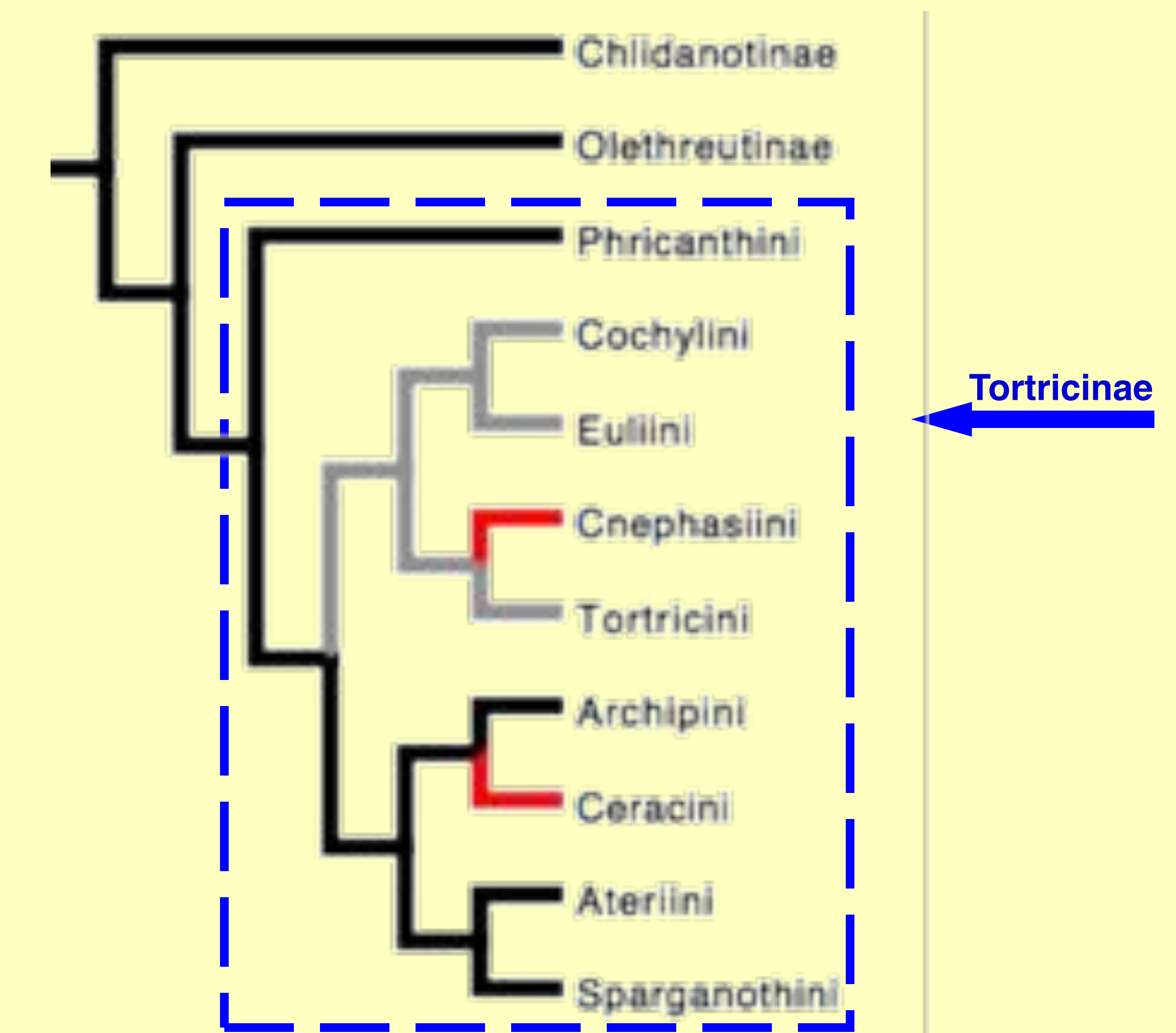


Fig. 5. *Cochylimorpha cultana* with one large aciculate cornutus and microsclerites on vesica.

Results and Discussion

• The majority of the specimens examined from the tribes Phricanthini, Sparganothini, Ateriini, Ceracini, and Archipini contained deciduous cornuti; non-deciduous cornuti were found in most of the specimens examined from the clade of Tortricini+Cnephasiini and Euliini+Cochylini.



- The presence of deciduous cornuti in the outgroups and in the most basal branch of Tortricinae, Phricanthini, suggest that deciduous cornuti are an ancestral trait among the leaf-roller moths.
- The Ceracini and Cnephasiini both display a loss of cornuti in most of their species. However, as with most of the tribes there are a few exceptions at the species level.
- Trends were observed in the distribution of the types of cornuti. For example, sub-basally attached cornuti were never seen in the clade containing non-deciduous cornuti, even in the very few exceptions where cornuti were observed to be deciduous. Thus sub-basal attachments could also be a characteristic of deciduous cornuti found in the ancestor to Tortricinae.

Conclusions and Further Research

- This study provides morphological evidence for the relationships shown by the molecular phylogeny using one character.
- Ancestral Tortricines that developed non-deciduous cornuti radiated into the clade formed by present-day Cochylini+Euliini and Cnephasiini+Tortricini.
- Cornuti are highly conserved in some groups (in number, type, and configuration), but in other groups the number of cornuti is not always identical among members of the same species. Cornuti therefore vary in their reliability as taxonomic characters.
- Much is still unknown about the function and ontogeny of the different types of cornuti. A more in-depth analysis of the trends in presence/absence and type of cornuti at the species level is in progress.

Acknowledgements and References

We would like to thank the National Science Foundation for allowing us to conduct this research, Dr. Liz Cottrell and Dr. Gene Hunt, the NHRE program directors, and Virginia Power, the NHRE administrator. Also, we would like to thank Dr. Mark Metz for providing help with the imaging system.



Gilligan, T. M., J. Baixeras, J. W. Brown & K. R. Tuck. 2012. T@RTS: Online World Catalogue of the Tortricidae (Ver. 2.0). <http://www.tortricid.net/catalogue.asp>
 Reiger, J., Brown, J., Mitter, C., Baixeras, J., Cho, S., Cummings, M., & Zwick, A. 2012. A molecular phylogeny for the leaf-roller moths (Lepidoptera: Tortricidae) and its implications for classification and life history evolution. *PLoS ONE*, 7(4): art. no. e35574.
 Cordero, C. 2010. On the function of cornuti, sclerotized structures of the endophallus of Lepidoptera. *Genetica* 138: 27-35.