



Identification of Damaged Female Invasive *Aedes* Mosquitoes: *Aedes aegypti*, *Ae. albopictus*, and *Ae. notoscriptus*

Hannah Alexander^{1,2} & Brian D. Byrd¹

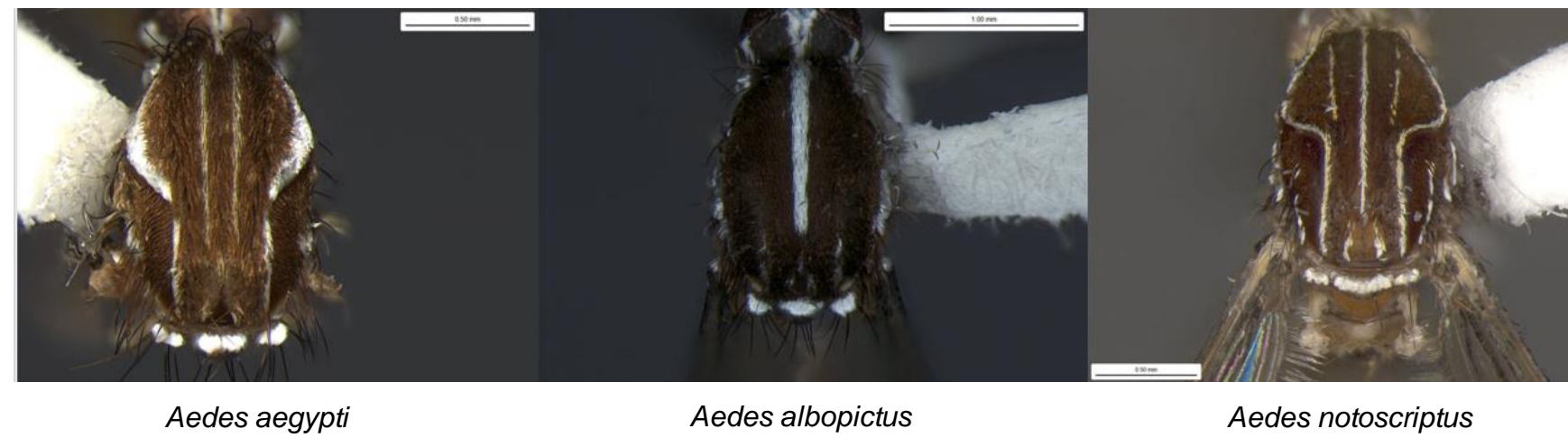
¹Vector-Borne Infectious Disease Laboratory, College of Health and Human Sciences, ²Biology Department, College of Arts and Sciences, Western Carolina University, Cullowhee, NC, 28723

ABSTRACT: *Aedes aegypti* is the primary vector of dengue, yellow fever and Zika viruses. *Aedes albopictus* is also a suitable vector while *Aedes notoscriptus* is not known as an important arbovirus vector for humans but is a competent vector of *Dirofilaria immitis* (dog heartworm). These three mosquitoes are invasive in the United States with overlapping geographic distributions. Collection methods (e.g., fan-based traps) for these mosquitoes can cause structural damage to “key characters” (morphological characteristics used in dichotomous keys) that are heavily relied upon for identification — an essential aspect of vector-borne disease surveillance. Notably, distinct scutal scale patterns found on each of these species can be fully or partially rubbed off during collection. We have identified four “secondary” character states on the pedicel, mesepimeron, abdominal sterna, and third femora that distinguish all three species. In the absence of an intact scutal scale pattern the characters reported here will aid public health personnel when simple and definitive identification of the species is required (e.g., during arboviral outbreaks).

Methods:
This work is based primarily off of a scientific note written by Savage and Smith (1994) that reported useful characters for the differentiation of *Ae. aegypti* and *Ae. albopictus*. Using this reference, useful “secondary” characters were further explored for the recently invasive *Ae. notoscriptus*. Images were obtained with the Leica M205 C stereomicroscope with Z-stacking capabilities. Imaged characters were then compared for distinct differences with a greater emphasis on characters that are less likely to be damaged during collection. All imaged specimens were acquired from the WCU Mosquito and Vector-borne Infectious Disease Laboratory.

Results:

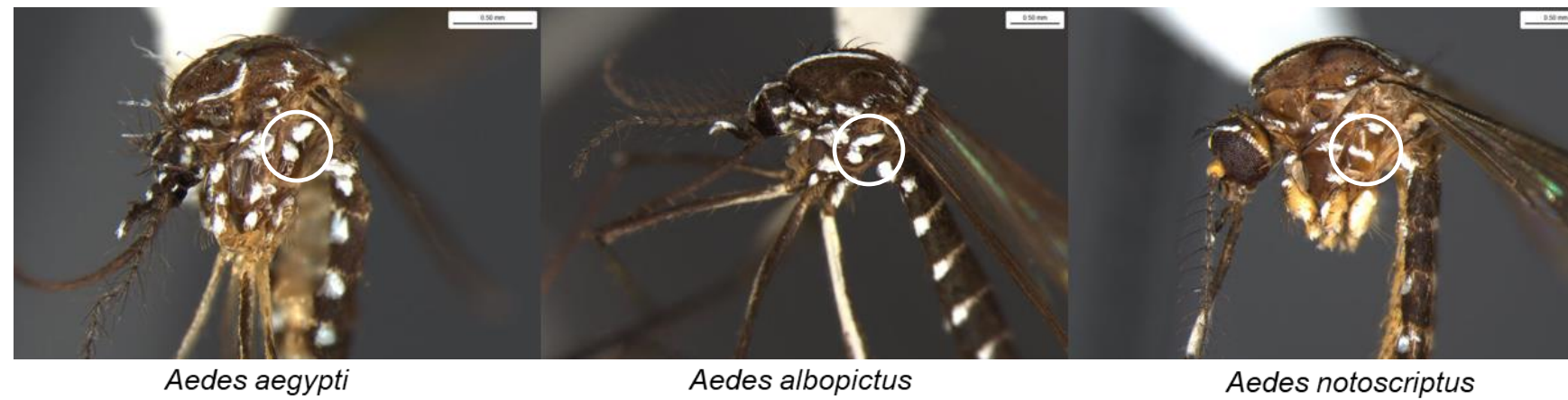
1. Scutal Scale Pattern Character:



2. Pedicel Character:



3. Mesepimeron Character:



4. Abdominal Sterna Character



5. Hind Femur Character

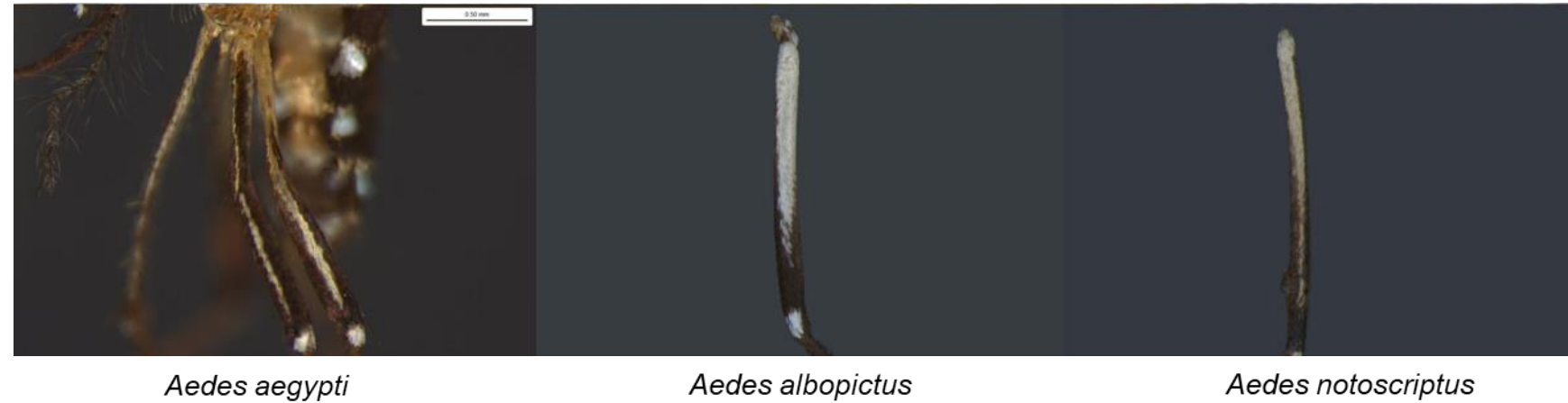


Table 1. Summary of “secondary” character states useful for the identification of damaged female *Ae. aegypti*, *Ae. albopictus*, and *Ae. notoscriptus*. Each character distinguishes all three species.

| Character State | <i>Ae. aegypti</i> | <i>Ae. albopictus</i> | <i>Ae. notoscriptus</i> | Utility |
|------------------------------------|--|---|---|-----------------|
| Pedicel (white scales) | Distinct lateral and medial patches | Large array of anterolateral to anteromedial without distinct patches. More diffuse dorsally. | Small patch medially; integument tan (anterolateral) | Separates all 3 |
| Mesepimeron | Two distinct patches of pale scales; one posterior dorsal, one anteromedial | Very large patch of white scales, with invagination anteromedially | Continuous line of pale scales medially adjacent to similar line on meskatepisterum | Separates all 3 |
| Abdominal Sterna | Large medial patch of scales on I-IV, flanked by lateral patches of scales; V/VI lateral patches are small | Large patch of basolateral pale scales on II-V | Lateral patches of white scales on I-IV, diffuse tan medial scales | Separates all 3 |
| Hind Femur (Fe₃) | Pale scales on basal half of Fe ₃ - tapering laterally | Thick lateral lines of pale scales | Thin lateral lines of pale scales | Separates all 3 |

Next Steps:

- Rear additional *Ae. aegypti* specimens in the WCU Mosquito and Vector-borne Infectious Disease Laboratory for review/imaging
- Refine current images of character states to better represent differences among species
- Add images of an additional invasive container *Aedes* – *Ae. japonicus*, and compare for differences (either identical to the ones listed here or additional)
- Combine this work with another lab mates’ research on molecular identification of container *Aedes* mosquitoes using the rDNA Internal Transcribed Spacer 2 (ITS2) gene

References:

1. Powell, J.R. (2018). Mosquito-Borne Human Viral Diseases: Why *Aedes aegypti*? *Am J Trop Med Hyg*, 98(6):1563-1565.
2. Russell, R. C., & Geary, M. J. (1992). The susceptibility of the mosquitoes *Aedes notoscriptus* and *Culex annulirostris* to infection with dog heartworm *Dirofilaria immitis* and their vector efficiency. *Medical and veterinary entomology*, 6(2), 154–158.
3. Savage, H. M., & Smith, G. C. (1994). Identification of damaged adult female specimens of *Aedes albopictus* and *Aedes aegypti* in the New World. *Journal of the American Mosquito Control Association*, 10(3), 440–442.

Acknowledgements:

Dr. Luiz Lima Da Silveira for providing training and lab space/materials. The *Aedes notoscriptus* were provided by Mike Onn (Brisbane, Australia).

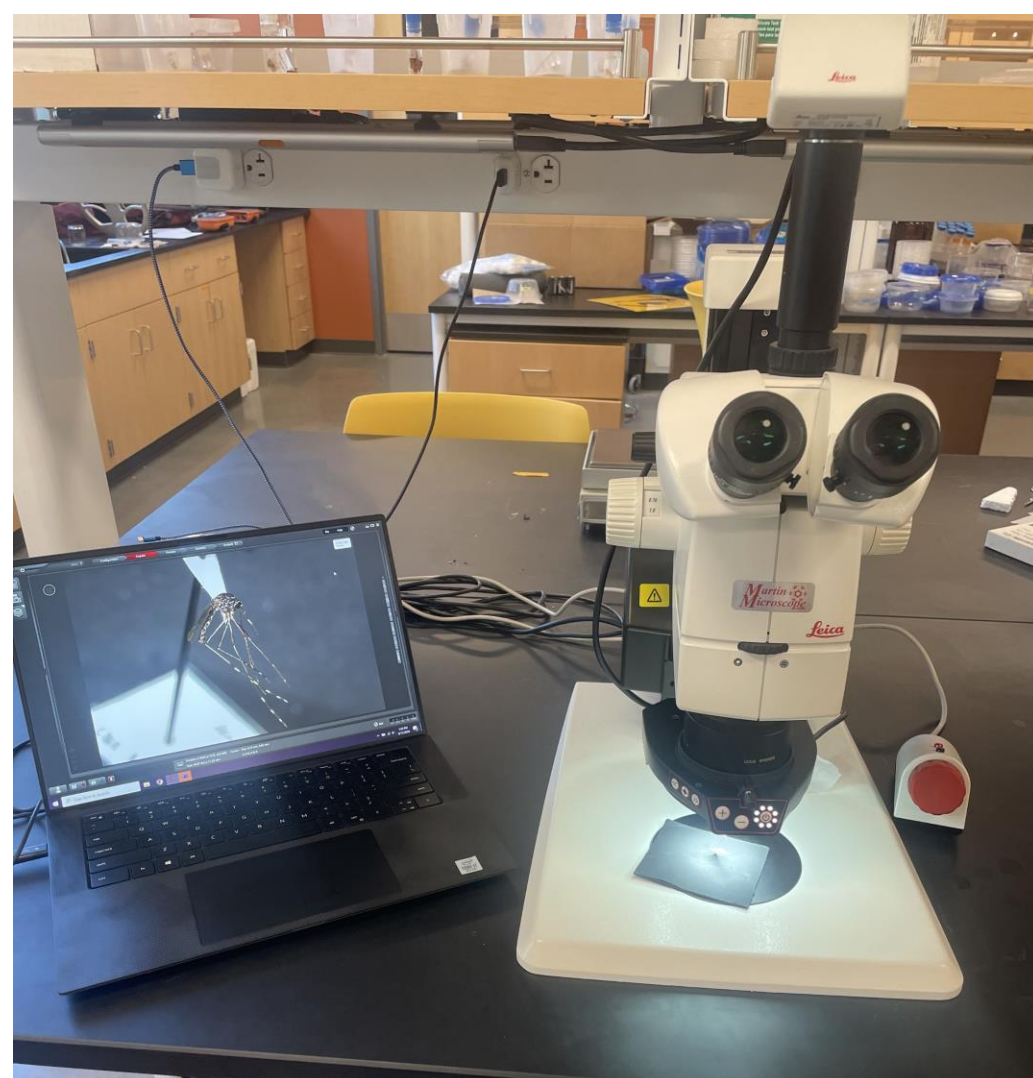


Figure 1. Leica M205 C stereomicroscope used for imaging