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Forensic Identification of Sarcophagidae Species in Central Kerala,India: Application of Wing Morphometrics and Male Genitalia Analysis

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INTRODUCTION & AIM

- In forensic investigations, flesh flies (Sarcophagidae) are among the early colonizers of cadavers, with females often being the most frequent visitors.
- However, species-level identification is challenging, especially for females, as traditional methods rely on male genitalia.
- Wing morphometrics provides a valuable, non-destructive tool for identifying female flies based on wing shape variation.
- Accurate species identification is essential for precise estimation of the post-mortem interval (PMI), making this approach crucial for forensic entomology.

METHOD

- The study analyzed 55 specimens representing four species from three subgenera, all commonly associated with cadavers under various conditions.
- The right wing of each female specimen was carefully removed, and the male terminalia were dissected and imaged using a Leica microscope for detailed morphological analysis.
  Eighteen landmarks were digitized on each wing image using MorphoJ software. Landmark coordinates were analyzed using geometric morphometric methods.
- Species identification was performed through canonical variate analysis (CVA), and classification accuracy was evaluated using leave-one-out cross-validation.

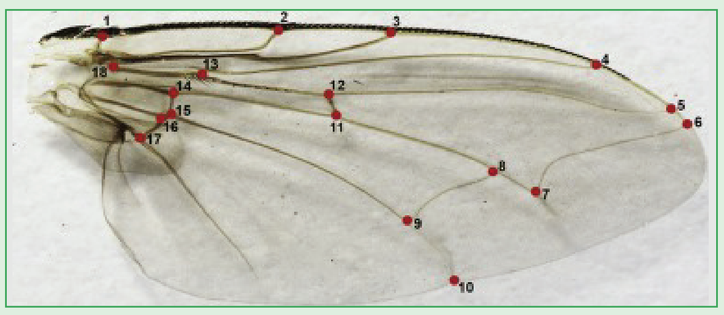

Figure 1: Sarcophagidae wing with vein junctions as 18 land mark

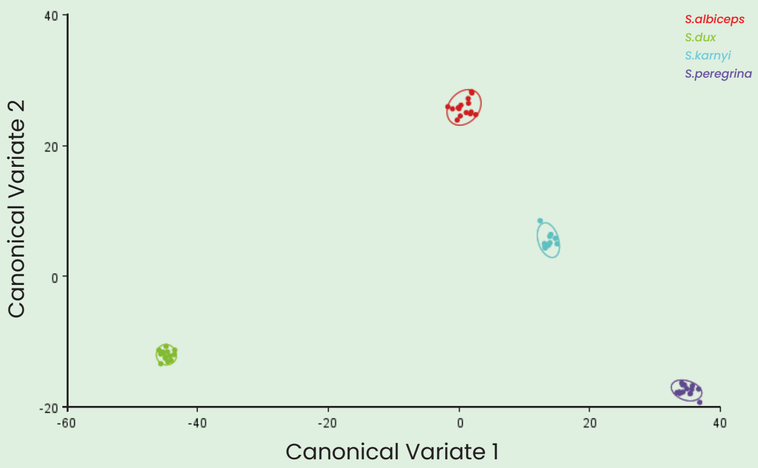

Figure 3: Canonical variate analysis of wing venation of female flesh flies of four different species

RESULTS & DISCUSSION

- All four carrion-visiting Sarcophagidae species were identified with **100% accuracy** through cross-validation of wing morphometrics.
- CVA revealed **clear interspecific separation** and **high discriminatory power**, validating the effectiveness of geometric morphometric techniques for species-level differentiation.
- Species identifications were further **confirmed by examination of male terminalia**, providing **morphological validation** of the CVA-based results.
- Wing morphometrics allowed **accurate identification of females**, addressing a major taxonomic challenge where male terminalia are unavailable.
- Accurate identification of necrophagous Sarcophagidae is critical for **Post-Mortem Interval (PMI) estimation.** This method offers a **rapid, reliable, and scalable** approach for forensic entomology.

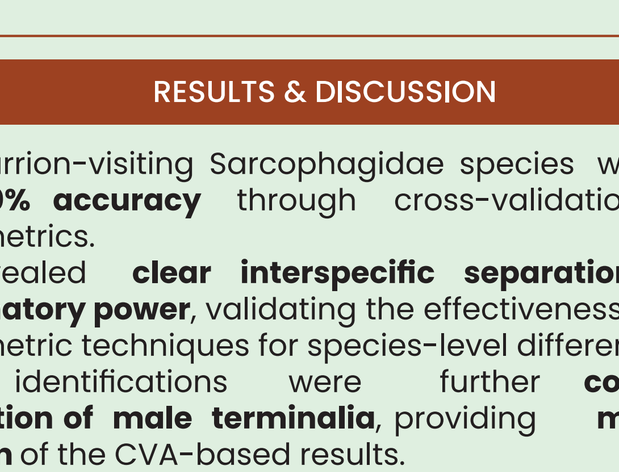

Figure 2: Heat map showing flesh fly species assessed using leave one out cross validation.

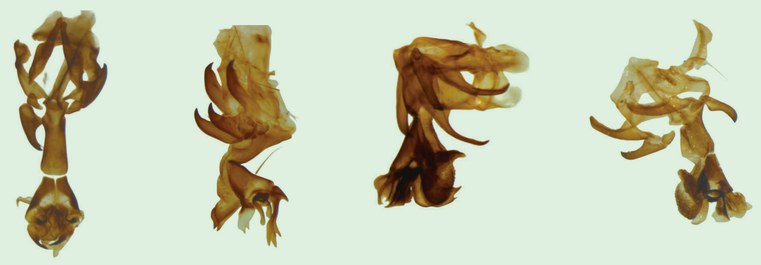

Figure 4: Male terminalia of *S.albiceps, S.dux, S.karnyi and S.peregrina*

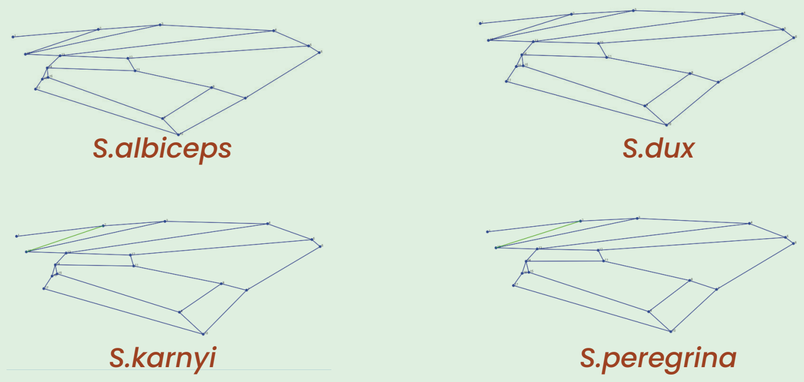

Figure 5: Wire frame graph of species

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CONCLUSION

Automated identification of carrion-visiting Sarcophagidae using wing morphometrics and Canonical Variate Analysis (CVA) proved highly accurate for females along with male terminalia. This approach offers a valuable, expert-independent tool for forensic investigations, particularly in improving PMI estimations.