Teaching Morphological Species Identification to Forensic Science Students: Advantages, Problems and Results

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Teaching Morphological Species Identification to Forensic Science Students: Advantages, Problems and Results

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Abstract & Background

Following this presentation attendees will have a better understanding of instructing students in morphological species identification through the use of dichotomous keys. A dichotomous key guides the user through species determination for a specimen by providing a series of dual-choice nodes that center around morphological differences. Each choice leads to either a new set of dichotomous choices or a species decision. Attendees will also observe the ability of students to successfully apply this method to unknown entomological specimens. Of central focus to training students in species identification is the idea that dichotomous key nodal decisions take the user down specific pathways to a final species designation by not focusing on the organism whole, but rather specific parts that the alpha taxonomist has designated as important diagnostically. Thus, if followed correctly, the user should arrive at the correct species designation as long as the species evaluated are included in the dichotomous key.

This presentation will impact the forensic community by providing an understanding on how accurately students can identify adult blow flies (Diptera: Calliphoridae) using a dichotomous key. Insects present at crime scenes need to be successfully and accurately identified to aid in these investigations by providing information such as time of colonization (TOC), which can be linked back to a time since death. Species identification using a morphological dichotomous key cognitively falls under pattern recognition, which is part of the perception and problem solving aspect of cognitive science. The critical difference between other forms of pattern recognition and dichotomous keyed species identification is that the dichotomous key approach provides rigorous, step-by-step, pre-determined instructions to arrive at the pattern conclusion (a species). These patterns are grounded in an extensive scientific literature going back to the Systemo Nourae by Carl Linnaeus in 1735 and currently outlined by the International Code of Zoological Nomenclature (ICZN code). If followed, this approach forces the user out of top-down processing mode and into a bottom-up processing mode, whereby the parts of the organism are first understood and from those partial understandings a full understanding of the species identity of the specimen is achieved. This bottom-up approach has a critical advantage—it eliminates the possibility of forming biases that result from top-down processing.

These data were evaluated from an introductory level forensic science course to understand the student’s ability to utilize a dichotomous key. There were several opportunities for the students to record their nodal decisions along with their confidence level with the use of a tabular format. For each decision the student made, they ranked their confidence level using a Likert scale (1-5). Along with individual decision recording, they also conducted a post-decision comparison with their partner, following a think-pair-share active learning model. If their answers were not the same, they re-evaluated their decision making, along with a re-analysis of the specimen until a mutual evidence-based decision was reached. How successful the students were in making the correct identification was analyzed along with examining the correlation between confidence and correctness. From these data we aim to improve student training in the use of dichotomous keys for species identification, which can then be used to provide standard operating procedures on how forensic entomologists should approach and document the pattern recognition task at hand in a way that limits the influence of bias.

Methods

Subjects

- Students in this study were undergraduate students in ENTM 22820: Forensic Analysis
- 96 students participated during scheduled lab time
- 12 sets of 8 specimens - 4 blow flies and 4 beetles (Figure 1)
- Blow fly specimens were sampled from the Stamer Lab collection
- 5 different species of blowflies (L. coerulescens, L. rufipes, L. sericata, P. regina and C. macellaria) randomly labeled 1-4 or with Accession number
- Beetle specimens were sampled from the Stamer Lab collection and Lauren Weidner’s personal collection
- 8 different species of beetles (N. tomentosus, O. rugulosum, O. novosorbice, N. arboricollis, N. americana, C. mexi, Histeridae and Dermestidae) randomly labeled 5-8 in the set or with Accession numbers

Preparation

- Working in pairs, students obtained specimen sets and microscopes
- Student #1 used dichotomous key (Cutter & Dahlem 2004) to identify the flies, while Student #2 used field guide (Caster et al. 1995) for beetles
- Once both had identified their specimens they would trade specimens and identify those for themselves
- After individual identifications, students shared results and made corrections to initial identifications if partners in disagreement

Process repeated until identification of specimen was achieved

Data were analyzed using Paired Samples T-tests and Independent Samples T-tests where appropriate

Results

Following are the results for a sample size of 82:

- Significant difference between the initial identifications of Flies and Beetles (Paired T-test: p=0.001)
- No significant difference between the final identifications of Flies and Beetles (Paired T-test: p=0.001)
- No significant difference was found with the fly initial and final identifications (Paired T-test: p=0.117) or the Beetle initial and final identifications (Paired T-test: p=0.287)

No significant differences between males and females identification or either flies or beetles (p>0.05)

Discussion

Our work would not have been possible without the effort put forth by the ENTM 22820 Students from the Spring of 2016. We also wish to thank Emily Bonem from the Purdue University Center for Instructional Excellence for her work in helping us obtain the IBB approval for this study.

Acknowledgements

References

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