The “Buzz” About Digital Insect Collection & Applications for BIOL 374 Curriculum

Charlotte Pfamatter

BIOL 374 Honors Enhancement

Introduction

While being the most diverse and most abundant organisms on the planet, insects are one of the most misunderstood animals (Belamkar & Jadesh, 2012). In Entomology (BIOL 374) at Longwood University, the course strives for students to obtain a well-rounded understanding of insects, identification, entomology literature, field sampling, insect anatomy and physiology, ecological adaptations, behavior, and more. Specifically, the course achieves most of these goals with the laboratory component. The course requires that each student creates an insect box with insects collected in diverse environments over the course of the semester through acquired field techniques (BIOL 374 Syllabus, 2019). The purpose of the insect box is to not only help meet the learning goals of BIOL 374, but it also reflects the type of work that an entomologist may do in the real world.

Insect boxes are a classic way of preserving and presenting insects for museums and collectors. The purpose of this is to serve as a model for identification, as well as to catalog species. However; in today's digital age, there has been a transition to online databases for insect cataloging. This is beneficial because it increases accessibility that was previously limited by insect boxes. Digital collections of insects challenge the idea and purpose of insect boxes. In BIOL 374, modern advancements towards digital collections are not reflected in the curriculum.

This essay will compare insect boxes and digital insect collections, evaluate how insect boxes meet the course objectives for BIOL 374, and compare them to digital insect collections as an alternative. Then, it will determine if digitized insect collections can be realistically integrated in BIOL 374 curriculum, and synthesize a baseline for future directions.

Insect Boxes

Insect boxes are typically made of wood or paper with a cushioned interior lining where pins can be put in place. Once insects are captured and killed by either freezing or using chemicals, insects must be positioned according to convention on a setting board and pinned through the thorax. Once dried, they can be put into the box with an identification tag (Figure 1; Queensland Museum, 2019)

Figure 1. *Insect collection, Australian Museum Entomology Department (Australian Museum, 2019).*

Insect boxes are beneficial to entomologists in many ways. Species identification is critical in entomology, and insect boxes can be used for interactive identification. This is important because insects are the most diverse organismal group, and most remain unknown (Smithsonian Institution, 2019). Second, preserving insects properly can extend the time they can be studied for, which can be up to hundreds of years. This can be useful for researchers to determine past species distributions, abundance, and biodiversity. Also, researchers can reference the preserved insects to study morphology, behavior, and developmental biology. Insect boxes can act as models in museums for future comparisons in species identification. It is common for species names to be changed, therefore they offer as a reputable reference. In addition, insect boxes encourages citizen science. Not only are insects abundant to find, but catching and preserving insects is inexpensive. Because of this, insect collection can foster an understanding for the ecological importance of insects and their roles and interactions with the environment for a general audience (Texas A&M Agrilife Extension, 2019).

However, insect boxes provide challenges. It is possible for insects to degrade over time. Not only do their body parts disintegrate, but their DNA can be permanently damaged as well. This makes identification harder for future researchers. Also, the insect boxes cannot reach students or researchers around the world, unless they are shipped or brought over to a nearby museum. Also, pinning insects can be difficult for smaller specimen or for those with hard exoskeletons. For BIOL 374 students, this can lead to damaged specimen.

Digital Insect Collections

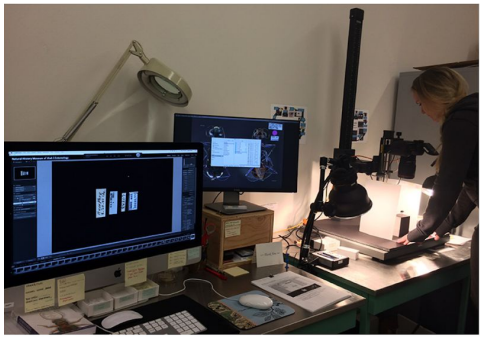

Figure 2. *Entomology imaging station (Natural History Museum of the University of Utah, 2019)*

The process of photographing insects for digital collections involves many delicate steps. First, the insect must be removed from the display case. Next, the identification tag must be removed to fully see the body. Next, the specimens are properly positioned and photographed between 20 and 40 times. The camera refocuses one millimeter after each photograph, and each photograph focuses on a different area of the body. To create depth for macrophotography, these images are stacked together to create one photograph with clear depth and detail. Once the session is completed, the insect gets re-tagged and put back in its display case (Figure 2; Natural History Museum of Utah, 2019).

By comparison, there are benefits to digital insect collections. Digital insect collections are unique in that they can be accessed all around the world through the internet. If there is an unknown specimen in a collection, it is easier to connect with other experts online and identify species that one may not have been able to previously. Also, the databases can be organized by date, species, geographic location. This powerful tool holds the potential to make researching

insects easier. Not only are they easier to research, but they have zooming features and have high quality definition, as well as pristine anatomical parts for studying (Figure 3). Most obviously, the photographs give an infinite shelf life for specimens. Because photographs can capture insects in peak condition, the degradation of the specimen's body and DNA would no longer be a concern (Natural History Museum of Utah, 2019).

Figure 3. *East Pinebarrens Tiger Beetle in digital catalog (Natural History Museum of Utah, 2019).*

While this advancement in entomology can offer great potential, digitized insect collections can bring complications. First, the limitation of internet access to some areas of the globe would prevent the information from being entirely accessible. Often times, the places in the world with restricted internet access have and thriving, diverse insect populations, which can cause a disconnect with modern findings in entomology. In addition, the equipment to digitally catalog insects is more expensive than the materials to make insect boxes. Also, the process of digitizing an insect collection requires extreme precision and patience. On average, four bugs can be processed for digitalization per hour. With that, removing the specimen from its case for photographic is a gentle process. The manipulation of the body parts is also a risk for damage. In addition, the more three dimensional that an insect body is, the harder it is to capture (Natural History Museum of Utah, 2019).

Fulfilling Course Objectives

To truly determine if digital insect collections would be beneficial in BIOL 374 curriculum, it is important to compare how insect boxes and digital collections would help to fulfill the course objectives listed in the BIOL 374 syllabus. To begin, the first course objective

is understanding insect morphology and and how it is used for classification. Insect boxes and digital collections both help achieve this because identification is a key part of their processes. Both would require students to understand morphology to identify species. Second, the identification of insects to class, order, and family is both utilized in both processes in the same way. Third, field sampling techniques would have to be explored to obtain specimen for either preservation method. Fourth, the processing and preparation of insects would be different for both methods, but would still be relevant. For the fifth objective, interpreting scientific literature is not applicable to either technique. Sixth, understanding physiology and external anatomy would be achieved by both methods through identification. Understanding their ecological adaptations and evolution would also be relevant to both methods through the field work and observations. For the last objective, understanding how insects interact with humans would not be relevant to either technique.

Suggestions

Insect boxes and digital collections can accomplish the same course objectives, but digital collections offer different advancements. For example, a digital insect collection could be a continual project that the class could contribute to in future semesters. This way, an archive for the university can be created and published online. This also could lead to more accurate identification since many students would collaborate on it over time.

However, there would be limitations to this advancement in the course. The main issue would be funding. Grants and proposals to the Dean of Cook-Cole College would be necessary to pay for approximately $3,000 worth of equipment. Also, there would be learning curves with technology. One could argue that it would not be worth it since the time in the semester is

precious and could be used for other things. Additionally, the class is offered at limited times, so this investment may not be sustainable. Considering both mediums of insect preservation, the transition into digital insect cataloging is emerging as an exciting innovation for the field of entomology. The global accessibility and prolonged life of specimen makes this technology worth investing in. However, the value of studying a tangible insect collection is just as worthwhile. In the future, it may be beneficial to consider digital insect cataloging into the curriculum of the course to better reflect on the current developments in entomology, if the course was offered more frequently.

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