Comparing University Entomology Outreach Events While Examining Public Views of Arthropods and Pesticides

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Academic Abstract

Hokie BugFest is an annual free event designed by the Entomology Department at Virginia Tech to translate the importance of entomology to the public. The event has grown from 2,000 attendees in 2011 to over 8,000 attendees in 2017. Entomology faculty, staff, graduate students and alumni partner with Virginia Cooperative Extension, Virginia 4-H, and other entities to provide an educational experience to the public. The goal of this outreach event is to showcase entomological research, increase public awareness, elevate the appreciation of entomology, develop better public perceptions of insects and other arthropods, and educate participants about pesticide safety and pest management practices. Although many institutions host entomology outreach events like Hokie BugFest (Frazier, 2002; Hamm & Rayor, 2007; Hvenegaard et al., 2013), little research has been conducted to compare the impact of these activities. Whether these events impact public attitudes toward insects and other arthropods is also lacking (Pitt & Shockley, 2014). Several studies have been conducted in other states to investigate public attitudes toward arthropods and pesticides (Baldwin et al., 2008; Byrne et al., 1984; Frankie & Levenson, 1978; Hahn & Ascerno, 1991; Potter & Bessin, 1998); however, research is missing in Virginia. In order to contribute to this literature, three surveys were developed. One survey focused on investigating entomology outreach events similar to Hokie BugFest. Results revealed that event structure, attendance, funding sources, and popular exhibits impact the hosting institution and the surrounding communities. The other two surveys focused on gauging the impacts Hokie BugFest has on youth and adult attendees. Results indicated the event has a positive impact on attendee perceptions of insects, other arthropods, and pesticides.

General Audience Abstract

Each year, the Department of Entomology at Virginia Tech hosts Hokie BugFest, a free event designed to emphasize the importance of entomology to the public. The event began in 2011 and has grown from 2,000 attendees to over 8,000 attendees in 2017. Hokie BugFest is collaboratively organized by Entomology faculty, staff, graduate students and alumni who partner with Virginia Cooperative Extension, Virginia 4-H, and other entities to provide an educational experience to the public. The goal of this outreach event is to showcase entomological research, increase public awareness and appreciation of entomology, and educate attendees about pesticide safety and pest management practices. Although many institutions host entomology outreach events like Hokie BugFest, little is known of the impact of these activities and how they influence public attitudes toward entomology. Information is available for other states concerning public attitudes toward arthropods and pesticides, however is lacking in Virginia. In order to contribute to this body of work, this study focused on investigating entomology outreach events similar to Hokie BugFest. Results revealed information on event structure, attendance, funding sources, popular exhibits, and impacts on the hosting institution and surrounding communities. This study also focused on gauging the impacts of Hokie BugFest on youth and adult attendees. Results indicated the event has a positive impact on attendee perceptions of insects, other arthropods, and pesticides.

Dedication

To my parents, Samuel J. Blevins and Jane L. Blevins.

You gave me a foundation and roots so that I could grow. You showed me unconditional love, guidance, and comfort. I will never be able to repay you, but I will spend the rest of my life trying.

To my fiancé, Kyle R. Wycoff.

You opened my eyes to a whole new world. Thank you for your endless love and support. I am excited to begin our journey through life together.

To my sister, Samantha J. Blevins.

You made the impossible, possible. I could not ask for a better person to call my sister and my best friend.

To my aunt, Teresa L. McDonald.

You taught me to live life to the fullest; I will never forget.

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CHAPTER 1

INTRODUCTION AND NEED FOR THE STUDY

Festivals dedicated to the celebration of insects and other arthropods have been in place since the 1980s, and are becoming more widespread since the late 1990s and early 2000s (Hvenegaard, Delamere, Lemelin, Brager & Auger, 2013). Insect festivals have been successful in attracting large crowds of people. A prominent international festival called Pestival, drew 200,000 people to London, England in 2009 (http://www.pestival.org/). BugFest, an event held by the North Carolina Museum of Natural Sciences in Raleigh, North Carolina, draws over 30,000 people annually (http://naturalsciences.org/calendar/bugfest/). Another festival, Bug Bowl, held at Purdue University as part of Purdue's Spring Fest in West Lafayette, Indiana, also draws over 30,000 visitors annually (https://extension.entm.purdue.edu/bugbowl/). It is evident that insect festivals are becoming popular attractions. Many of these events will be discussed in this study.

Although these events are seemingly popular, studies have shown that humans often possess negative attitudes toward insects and other arthropods. According to Kellert (1993), "the general public largely expressed feelings of aversion, dislike, or fear toward most invertebrates, particularly insects and spiders" (p. 849). Another study on adult subjects of the United Kingdom found that cockroaches and spiders were identified as two of the most consistently feared creatures among the public (Davey, 1994). Consequently, increasing public awareness of the value of insects and arthropods is often an overarching goal of events dedicated to insects and other arthropods (Hvenegaard et al., 2013).

Each fall, the department of entomology at Virginia Tech hosts an event known as Hokie BugFest. Hokie BugFest started in 2011 and attracted over 7,000 attendees in 2015. The event

began to rejuvenate ongoing entomology outreach and education through the department and to cultivate stronger ties within the university and surrounding community. The many donors who generously sponsor the event, the participating collaborators, and the Entomology Department have made Hokie BugFest possible annually.

Entomology faculty, staff, and graduate students facilitate the event. The department partners with alumni, Virginia Cooperative Extension, Virginia 4-H, several Virginia Tech (VT) affiliates, and other professional entities to provide an educational experience to the public. Virginia Tech collaborators include, but are not limited to: the VT Police Department; the VT Center for Autism Research; the Virginia/Maryland College of Veterinary Medicine; and the Fralin Life Science Institute. Other affiliates include, but are not limited to: the New River Valley Beekeepers' Association; Novozymes Biologicals; Superior Exterminating, the Virginia Pest Management Association; the Virginia Department of Agriculture and Consumer Services; WDBJ7 News; and partners from Radford University, regional natural history museums, and local societies and businesses.

The goal of hosting this outreach event is to showcase entomological research, increase public awareness and appreciation of entomology, develop better public perceptions of arthropods, and promote pest management practices and pesticide safety education. During Hokie BugFest, efforts made to assist in reaching these goals include: graduate students and faculty showcasing research; local professionals displaying their work; hosting of special events; exhibiting different species from the bug zoo; and allowing attendees to express their creativity through arts and crafts. Special events include: the Virginia 4-H Insect Collection Contest; the Bug Eating Contest; a Bug Drawing Class; and special appearances from the Wizards of Entomology, the Bug Whisperer, and the Alberti Flea Circus. Although many exhibits and

collaborators are specifically listed here, this information may change periodically as the event continues to grow and progress.

Need for the Study

Through web searches and literature review, it was found that many events like Hokie BugFest are held annually at institutions across the United States (Frazier, 2002; Hamm & Rayor, 2007). Surprisingly, little research has been conducted to assess these events or to investigate how attendees perceive these events. Whether or not these events impact public attitudes toward insects and other arthropods is lacking in research as well (Pitt & Shockley, 2014). This study focuses on identifying science institutions across the United States that host insect festivals, the purpose for hosting the festivals, the organization of the festivals, and the community and institutional impacts of these events. This study also examines how Hokie BugFest impacts attendee attitudes and perceptions toward insects and other arthropods.

Hokie BugFest includes many interactive displays on pesticide safety and pest management, which are integral facets of the entomology department at Virginia Tech. Studies have been conducted in several states to investigate public attitudes toward pesticides and pest management (Baldwin, Koehler, Pereira & Oi, 2008; Byrne, Carpenter, Thoms & Cotty, 1984; Frankie & Levenson, 1978; Hahn & Ascerno, 1991; Potter & Bessin, 1998). However, research in Virginia is lacking. This study will examine how Hokie BugFest impacts attendee attitudes and perceptions toward pesticides.

Purpose of the Study

This study has two purposes, to examine how Hokie BugFest impacts attendee attitudes and perceptions toward insects, arthropods, and pesticides, and to compare and contrast Hokie

BugFest with similar entomology outreach events of other institutions. The study employed a quantitative research design through the use of closed-ended survey questions (Creswell, 2009).

Research Objectives

The research objectives for this study were:

1. Compare and contrast Hokie BugFest with similar outreach events of other institutions and develop a community/consortium where event organizers can collaborate and share ideas.
2. Evaluate how Hokie BugFest impacts attitudes of youth attendees toward insects and other arthropods.
3. Evaluate how Hokie BugFest impacts attitudes of adult attendees toward insects and other arthropods, and how the event impacts perceptions of pesticides.

Benefits of the Study

The Entomology Department at Virginia Tech can benefit from this study from realizing how Hokie BugFest is impacting the public, and whether or not the event encourages more positive attitudes toward entomology. This information will also be useful in maintaining relationships with stakeholders who have supported the event since its inception, and may provide an opportunity to gain new stakeholders. Another possible benefit of the study is the development of a community/consortium among institutions across the United States. The community/consortium will allow event organizers to network and share experiences with their colleagues and counterpoints at other institutions.

Organization of the Proposed Study

Chapter One provides a brief overview of this study and introduces key concepts that will be addressed by the study. The purpose and need for the study are included, as well as research

objectives and potential benefits of the study.

Chapter Two examines three prominent themes of literature relevant to the study. The first theme focuses on literature describing insect festivals nationally and internationally. The second theme emphasizes literature on human perceptions and attitudes toward insects and other arthropods. The third theme concentrates on literature exploring public perceptions and attitudes toward pesticides and their use.

Chapter Three discusses the research methods used to address the three major objectives of this study. Site selection, researcher role, and research participants are addressed first. Followed by instrumentation design used to evaluate how Hokie BugFest impacts attitudes of youth and adult attendees towards insects, other arthropods, and pesticides. Then, instrumentation design used to examine similar outreach events of other institutions. Finally, this chapter concludes with data collection and analysis techniques.

Chapter Four is divided into three sections presenting the data that was collected for each of the research objectives. The first section includes analysis of data collected at Hokie BugFest for three years regarding youth attitudes toward insects and other arthropods. The second section includes analysis of data collected at Hokie BugFest for two years regarding adult attitudes toward insect and other arthropods, and perceptions of pesticides. The third section includes analysis of a single data set collected regarding entomology, outreach events of other institutions similar to Hokie BugFest.

Chapter Five provides an overview of the study, including study limitations, conclusions of the study, and suggestions for future research.

CHAPTER 2

REVIEW OF THE LITERATURE

The purpose of this study was to determine how Hokie BugFest impacts attendee attitudes and perceptions toward insects, arthropods, and pesticides, and to compare and contrast Hokie BugFest with similar entomology outreach events of other institutions. The literature reviewed for this study focused on three areas of interest: discovering events similar to Hokie BugFest; purposes for the events; impacts these events have on attendees; and public views of insects, other arthropods, and pesticides. The review of literature for this study pursued answers to the following questions:

- What are the entomology outreach events similar to Hokie BugFest that are held at other institutions?
- What are the purposes of these events? Have they been studied to gain an understanding of impact on attendees?
- How does the public feel about insects, other arthropods, and pesticides in relation to their home environment? How much pesticide use is occurring among the public?

Entomology Outreach Events

Although it appears that entomology outreach events have become more popular over the years (Hvenegaard, Delamere, Lemelin, Brager & Auger, 2013), few studies have been conducted to investigate the impact of these events on their audience. However, a handful of researchers have gathered some information. A publication titled *The Management of Insects in Recreation and Tourism* (2013) includes a chapter highlighting insect festivals of the northern hemisphere. The researchers conducted web searches and were able to identify 107 insect festivals in the northern hemisphere, 66 of which occur within the United States. Attendance

among the festivals varied greatly, with three festivals reporting over 100,000 attendees. About half of the festivals occurred within a single day, and 51 listed their events as free of charge to the public. Overall, 41 of the festivals focused solely on insects and did not include other arthropods (Hvenegaard et. al., 2013).

The researchers listed common purposes for hosting these events such as education, awareness, decreasing phobias, and species conservation. The researchers also discussed the popularity of insect festivals and the benefits of hosting these events. The benefits addressed included: imparting a sense of pride within communities, stimulating the economy within communities, providing valuable education to attendees, creating a platform where entomologists and the public can interact, and raising awareness about the field of entomology and precious insect species (Hvenegaard et. al., 2013).

A particular event highlighted in the chapter is Pestival, which was first held at the London Wetlands Centre in Barnes, London in 2006. This event is a mobile festival, meaning it travels to selected locations during selected years. The second Pestival was held in 2009 at London's Southbank Centre. The event grew from 10,000 attendees in 2006 to 200,000 attendees in 2009. After visiting Pestival, 98% of attendees reported improved views of the importance of insects to the health of the planet (http://www.pestival.org/).

In 2015, Hvenegaard revisited this subject with a research article focusing on insect festivals of North America. He tallied information from event websites such as years of occurrence, attendance, admission fees, focus of the events, and purposes for hosting the events. The web search discovered 81 active insect festivals, with 85% occurring in the United States and 15% occurring in Canada. A few events reported upwards of 100,000 attendees. Almost half of the festivals focused on insects as a whole rather than a specific insect, and the main purposes

for hosting these events were education, entertainment, celebration, and entomophagy (Hvenegaard, 2016).

Though the literature is limited, it is clear that a great number of entomology outreach events have been established and have a strong presence within their locations. The scope of this study will focus on existing entomology outreach events at science institutions across the United States, particularly festivals. The literature on these events is also limited; however, information was supplemented through web searches and will be discussed in the following sections.

Existing events. Several scientific institutions across the United States have chosen to implement entomology outreach events, particularly festivals, as part of their programing. These events are typically held annually as one or two-day events and serve as a means of entomological outreach within their communities. The 14 events chosen for this study are as follows:

1) The Arizona Insect Festival at the University of Arizona in Tucson, Arizona;
2) Bug Bowl at Purdue University in West Lafayette, Indiana;
3) The BugFest at the North Carolina Museum of Natural Sciences in Raleigh, North Carolina;
4) The Bug Fest at the Academy of Natural Sciences of Drexel University in Philadelphia, Pennsylvania;
5) The Bug Fest at the Hilltop Garden and Nature Center at Indiana University in Bloomington, Indiana;
6) The BugFest at the University of Florida in Gainesville, Florida;
7) Hokie BugFest at Virginia Tech in Blacksburg, Virginia;

8) The Insect Fear Film Festival at the University of Illinois at Urbana-Champaign in Urbana, Illinois;
9) The Insect Festival at the University of Arkansas in Fayetteville, Arkansas;
10) Insectapalooza at Cornell University in Ithaca, New York;
11) The Insectival at the Oxbow Meadows Environmental Learning Center at Columbus State University in Columbus, Georgia;
12) The Insect-ival! Family Festival at the University of Georgia State Botanical Garden in Athens, Georgia;
13) The Insect Zoo Open House at the University of Georgia in Athens, Georgia; and
14) The Great Insect Fair at Pennsylvania State University in State College, Pennsylvania.

With the exception of the BugFest in Raleigh, North Carolina, all the events are hosted by their respective universities.

Event information and purposes. Attendance varies greatly among the events, as does years of operation. Some events charge admission fees, but most are free, and are run by volunteers from within the hosting organization and the community. For most institutions hosting these events, their goal is to increase public awareness of insects and other arthropods and decrease negative connotations associated with these animals. The following paragraphs outline each event in further detail.

Arizona Insect Festival (University of Arizona). The Arizona Insect Festival, which began in the Fall 2011, has grown from approximately 2,000 visitors to over 6,000 visitors in 2015. This annual event is free of charge to the public and hosted by the Department of Entomology. In 2015, the event required 150 faculty, staff, students and volunteers to run the festival over a span of five hours (http://www.arizonainsectfestival.com/). The department sees

the Arizona Insect Festival as an opportunity to connect with the community by sharing their knowledge and passion for entomology (Pittenger, 2015).

Bug Bowl (Purdue University). The Department of Entomology hosts Bug Bowl every spring as part of their Spring Fest weekend. The first Bug Bowl was held in 1991, and then later merged with other campus events in 1998 to form Spring Fest (Dittmann, 2015). Collectively, this campus wide event draws over 30,000 people over a two-day period annually. Attendees may participate in events such as cricket spitting and cockroach racing (https://extension.entm.purdue.edu/bugbowl/index.php). The founders of Bug Bowl seek to excite the public about insects and teach them how important insects are in our ecosystems. Through Bug Bowl, the department hopes the public will gain a deeper appreciation and understanding of insects (Florian, 1997).

BugFest (North Carolina Museum of Natural Sciences). Each year the North Carolina Museum of Natural Sciences hosts BugFest, a free 12-hour event that attracts over 30,000 people. Attendees participate in a multitude of displays and workshops, and taste "bug-filled" dishes at Café Insecta, an activity that has been in place since the event started in 1997. The museum views BugFest as an opportunity for visitors to be captivated by the world of bugs through interactions with entomologists and other scientists (http://naturalsciences.org/calendar/bugfest/). Although the event is not a product of the neighboring North Carolina State University, the Entomology Department works closely with the museum to provide educational outreach activities and displays for the event (https://projects.ncsu.edu/cals/entomology/outreach/egsa-bugfest).

Bug Fest (Academy of Natural Sciences of Drexel University). Every year, the university museum at Drexel University hosts Bug Fest, which began in 2008 (Belardo, 2014).

The museum charges general admission fees for Bug Fest and the event spans seven hours. Bug Fest features hundreds of live insects and other arthropods, with special events like roach racing, arts and crafts, and eating bug chef creations (http://ansp.org/get-involved/programs/festivals/bug-fest/). The event organizers strive to promote the importance of insects environmentally, and how their diversity is valuable in understanding evolution (Belardo, 2014).

Bug Fest (Hilltop Garden & Nature Center at Indiana University). Hilltop Gardens hosts Bug Fest yearly, which began in 2013. The event is free of charge to the public and spans five hours. Activities include special presentations from guest lecturers, arts and crafts, mealworm racing, and story telling. The mission of Bug Fest is to celebrate insects and their relatives and teach the public about their biology (http://www.indiana.edu/~landscap/hilltop/community-outreach/bugfest-event/index.shtml).

BugFest (University of Florida). Annually the University of Florida Entomology Club hosts BugFest, an event that began as an open house to recruit students into the department. The event offers activities such as an arthropod petting zoo and painting with maggots, but also offers displays on careers in entomology and citizen science (http://www.entnemdept.ufl.edu/extension/outreach/bugfest/). In 2015, the event became open to the public. It is uncertain how long the event has been running or how many people attend (Giuseppe, 2015).

Hokie BugFest (Virginia Tech). The Department of Entomology hosts Hokie BugFest each fall, which began in 2011. The event has grown from an estimated 2,000 attendees in 2011 to over 7,000 attendees in 2015. Hokie BugFest is free of charge to the public and runs for seven hours. The event features activities such as a flea circus, an insect collection contest, bug bingo,

and arts and crafts. Exhibits display departmental research and programs, and other departments and local community partners also show their work (https://www.hokiebugfest.org/). The architects of Hokie BugFest want attendees to gain a deeper appreciation of entomologist's work, and of insects and their relatives (O'Meara, 2016).

Insect Fear Film Festival (University of Illinois). The University of Illinois Department of Entomology hosts the Insect Fear Film Festival annually. The festival began in 1984 and draws crowds to view two or three insect or spider themed films each year. Between films, the department invites guest to participate in other activities such as tasting cooked insects or viewing/handling insect and spider species (https://publish.illinois.edu/uiuc-egsa/ifff/). According to May Berenbaum, the creator of the Insect Fear Film Festival:

> I can totally relate to people who don't like insects….It's probably because they don't know very much about them. This [festival] is an enjoyable, pleasant way to overcome any aversion to insects that arises from, at least, a lack of familiarity people have. (Wyckoff, 2014, para. 3)

Insect Festival (University of Arkansas). The Entomology Department hosts the Insect Festival, which began in 1993. Instead of being annual, this event occurs every two years. The festival is free and open to the public, and is reported to attract around 3,000 attendees. The event features exhibits such as an insect and arthropod zoo, collections from the Arthropod Museum of Arkansas, and a cotton patch, where visitors can learn about the crop and its insect pests. The goal of the Insect Festival at the University of Arkansas is to educate people about the interesting, beautiful, and valuable world of insects and other arthropods (https://entomology.uark.edu/services-and-outreach/insect-festival.php).

Insectapalooza (Cornell University). Insectapalooza, hosted by the Cornell Department of Entomology each fall, began in 2004 and attracted over 1,500 attendees in 2014 (Salvato, 2014). This event charges three dollars per person, however, children three years of age and younger are admitted for free. The festival runs for 6 hours and includes attractions such as a live butterfly room and arthropod zoo (https://entomology.cals.cornell.edu/news-events/insectapalooza). The department attributes their success to the ongoing commitment of faculty, staff, and students, strong leadership and coordination, a great deal of advertising, and dedicated funding for the event. Insectapalooza is a collaborative departmental effort, where facilitators work to create an outreach event that showcases their department and the field of entomology, while promoting learning through an assortment of activities for all ages (Hamm & Rayor, 2007).

Insectival (Oxbow Meadows Environmental Learning Center at Columbus State University). The Oxbow Meadows Environmental Learning Center at Columbus State University in Columbus, Georgia hosts an annual Insectival that began in 2001. The learning center charges an admission of $5 per person, and children under the age of three are admitted free of charge. A featured activity is the annual honey extraction where visitors can sample fresh honey from honeybee hives (https://oxbow.columbusstate.edu/insectival/). While engaging visitors in a family-friendly atmosphere, the creators of the Insectival educate attendees about the importance of insects for a healthy environment (Columbus State News, 2013).

Insect-ival! Family Festival and Insect Zoo Open House (University of Georgia). The Department of Entomology at the University of Georgia hosts the Insect Zoo Open House annually, which began in 1986. The open house is free of charge for the public and allows visitors to take a closer look at live insect specimens (Shockley, 2015). The department also

works collaboratively with the University of Georgia State Botanical Garden to host an annual Insect-ival! Family Festival, which began in 1993. This event charges five dollars per person, and children two years of age and under are admitted for free (http://botgarden.uga.edu/event/insect-ival/). The festival runs for three hours and includes a popular butterfly release activity (Parks, 2014). At both events, interactive displays are used to teach the public how important insects and other arthropods are to humanity (https://insectzoo.uga.edu/).

The Great Insect Fair (Pennsylvania State University). The first Great Insect Fair was held in 1994 and has grown to attract thousands of visitors (Milazzo, 2013). It is hosted by the department of entomology each fall and free of charge to the public. Attendees can participate in many activities such a honey tasting, observing live insects, and pesticide education games over a span of six hours (http://ento.psu.edu/public/kids/great-insect-fair). The department identifies the most important achievements of the fair as: enhanced public relations, showcasing science careers to young people, and promoting more positive perceptions of insects and entomology to attendees. The goal of the Great Insect Fair is to share with the public the importance of insects, what makes them a diverse and interesting group of the animal kingdom, and why individuals have chosen careers as entomologists (Frazier, 2002).

Studied events. Of the 14 university entomology outreach events chosen for this study, two have published findings of how these events are impacting attendees. Both events occur at the University of Georgia. At the 2010 Insect-ival! Family Festival and 2011 Insect Zoo Open House, researchers conducted pre and post surveys on participants to gauge impact of their events. During both events, participants were educated about many species of insects and arachnids, and were allowed to handle certain specimens. As indicated by their post surveys, the

researchers found that participant experiences at the event had positive impacts on their attitudes and perceptions of insects and arachnids (Pitt & Shockley, 2014).

Learning Theories and Strategies

Hokie BugFest and many similar events provide an opportunity for people of all ages to learn about the field of entomology. Due to this educational opportunity, learning theories and strategies should be considered when studying how these events impact attendees. There are two learning theories that Hokie BugFest provides a platform for; experiential learning theory (Kolb, 2015) and social cognitive theory (Bandura, 1986). Learning strategies included at the event are visual, auditory, reading and kinesthetic (http://vark-learn.com/).

Experiential learning theory. Experiential learning encompasses experience, perception, cognition, and behavior as part of its learning process (Kolb, 2015). David Kolb (1984) offers his definition of experiential learning as "the process whereby knowledge is created through the transformation of experience" (p. 38). Kolb uses learning models of the experiential learning process created by his predecessors John Dewey, Kurt Lewin, and Jean Piaget to form an experiential learning theory. Kolb's model of experiential learning theory portrays a continuous process where concrete experience and abstract conceptualization allow learners to grasp their experience, while active experimentation and reflective observation allow learners to transform their experience into learning.

At Hokie BugFest, attendees are not only encouraged to visit exhibits and speak with entomologists and other exhibitors, but also to participate in activities. Activities range from observing insects and other arthropods, to touching or holding these creatures, to possibly eating pre-packaged insects, or observing other attendees engaging in these activities. As attendees move around the event, they speak with entomologists and other exhibitors who offer expert

information encompassing the field of entomology. They see static and interactive exhibits. This begins the learning cycle with concrete experience and abstract conceptualization. Attendees are surrounded by the event and begin to grasp the experience as information is absorbed; they are sensing and theorizing in the new environment. They may choose to actively experiment by simply observing insects and other arthropods up-close, or may touch one of these creatures. This begins the transformation of their experience, which completes after reflection. Attendees may feel differently about entomology after the event, wherein their experience has transformed into learning. Hokie BugFest employs this experiential learning model year after year in hopes of developing, maintaining or changing one's attitude to be more positive toward entomology.

Social cognitive theory. Albert Bandura spent many years researching and developing social cognitive theory. His findings were published in a book titled *Social Foundations of Thought and Action: A Social Cognitive Theory* in 1986. Bandura (1986) describes social cognitive theory as a continuous cycle where behavior, cognition, personal factors, and one's environment converge and interact to determine human learning. Some of his principal concepts apply to the learning aspect of Hokie BugFest.

Within social cognitive theory lies a type of learning known as vicarious capability. Vicarious capability, also referred to as observational learning, allows people to learn vicariously through others by observing and modeling behavior (Bandura, 1986). Bandura (1986) states that "most human behavior is learned by observation through modeling" (p. 47) and "observers can acquire cognitive skills and new patterns of behavior by observing the performance of others" (p. 49). A typical exhibit at Hokie BugFest includes displays of live insects and other arthropods, where entomologists handle the specimens to show most are non-threating to people. This activity is observed by attendees and sometimes modeled by others. In this instance, the creators

of the event strive to transform attendee behavior and leverage vicarious capability so that insects and other arthropods gain a more positive image in the minds of the attendees.

Learning strategies. Several learning strategies are incorporated into Hokie BugFest: visual, auditory, reading and kinesthetic. Departmental research and entomological topics are displayed visually and through reading with handouts and posters containing text, pictures, and diagrams using a wide array of colors and formatting. For auditory learners, entomologists and other professionals are available to discuss their work and answer questions about their exhibits. The event lends itself well to kinesthetic learning, where attendees can use senses such as sight, touch, taste, and hearing to take in the experience. Sight and hearing were discussed as visual and auditory learning styles above; however, the senses apply to other activities as well. Attendees view live arthropods at the event and are able to touch some specimens. They might even taste an arthropod if they choose to enter the bug-eating contest or sample an insect product such as honey. Hokie BugFest offers many opportunities for attendees to learn using a strategy that suits their preference (http://vark-learn.com/).

Scientific Literacy

Hokie BugFest provides attendees an opportunity to develop or broaden their scientific literacy of entomology. A book titled *National Science Education Standards* defines scientific literacy as "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (National Research Council, 1996, p. 22). The standards describe scientific literacy as having "different degrees and forms; it expands and deepens over a lifetime….the attitudes and values established toward science in the early years will shape a person's development of scientific literacy as an adult" (National Research Council, 1996, p. 22).

Since Hokie BugFest incorporates many facets of entomology, visitors can strengthen their scientific understanding of the field. Attendees are able to engage with scientists to learn factual information about pollinators like honeybees, disease vectoring insects like mosquitoes, household pest insects like cockroaches and bed bugs, agricultural pest insects like the brown marmorated stink bug, and proper practices concerning pest management and pesticide safety. This interaction between attendees and scientists allows the public to learn about entomological research and its practical applications, to dispel myths, and enhance their scientific literacy of the primary challenges facing today's entomologists.

Public Views of Arthropods and Pesticides

Hokie BugFest is one of many events that aims at positively impacting attendee perceptions of insects and other arthropods. In addition to learning about these animals, Hokie BugFest provides opportunities to learn about pesticide safety and pest management practices. Many studies have been conducted to try to gain an understanding of public perception toward arthropods and pesticides. These research studies will be discussed in the following sections.

Perceptions of arthropods. Understanding human attitudes toward arthropods has been a topic of interest for many years. In general, the public possesses negative feelings toward insects and other arthropods (Kellert, 1993). According to Kellert (1993), the general public dislikes or fears many invertebrates, and especially expressed feelings of aversion towards insects and spiders. The survey results of the study indicated public dislike of several arthropods including ants, beetles, ticks, cockroaches, mosquitoes, and fleas, and fear of other arthropods including spiders, scorpions, and stinging insects. Kellert (1993) included a great deal of literature that attests to the beneficial nature of invertebrates and recommended further research to understand why the public possesses such negative attitudes toward invertebrates. Other

studies have shown similar negative attitudes, including Bennett-Levy and Marteau (1984) and Davey (1994). According to Davey (1994), many arthropods provoked feelings of anxiety and dislike in humans. Davey's (1994) survey results showed that wasps, cockroaches, spiders, maggots, and bees were consistently ranked in the top ten list of most feared animals.

According to Bennett-Levy and Marteau (1984), people feared certain animals more than others when they considered the animal harmful. Their study surveyed human animal fears in relation to characteristics of specific animals, and included cockroaches, spiders, beetles, ants, butterflies, etc. The results indicated that people attach fear to certain animals based on animal characteristics such as subjective evaluations of ugliness, sliminess, or the ability of the creature to move rapidly. These morphological differences between humans and other animals may greatly contribute to the way humans perceive and develop fears toward these arthropods.

Perceptions of external insect morphology with respect to aversion has been examined by other researchers as well. According to Wagler and Wagler (2012), external insect morphology played a key role in teacher's attitudes toward insects, and whether or not they chose to incorporate insects into the classroom as teaching tools. Both larval and adult forms of three insects: lady beetle, butterfly, and dragonfly (the larval and adult forms of these insects are very morphologically different) were selected for the study. Similar to the study of Bennett-Levy and Marteau (1984), the results indicated that external insect morphology affects human perception of insects. The less aesthetically pleasing insect larvae received more negative reactions than the adult forms of the same insect. The teacher's negative attitudes toward the external morphology of insect larvae negatively impacted the likelihood of the teacher incorporating these insects into future classroom settings, which suggested a causal relationship between external insect morphology and human attitudes toward insects (Wagler & Wagler, 2012).

This research supports the notion that many people possess negative attitudes toward insects and other arthropods. Hokie BugFest provides a safe environment where attendees can learn about insects and other arthropods. One study revealed 60% of respondents developed more positive attitudes toward specific arthropods after learning factual information about their beneficial nature (Harris & Braman, 2016). Hokie BugFest employs this strategy year after year in hopes of changing the general public's aversion toward these animals.

Attitudes toward arthropods found in or near dwellings. The way people perceive arthropods may be different depending on where humans encounter these creatures. Studies have been conducted to investigate how people feel about arthropods when they are found in or around the home, for example Byrne, Carpenter, Thoms and Cotty (1984). According to Byrne, Carpenter, Thoms and Cotty (1984) the Arizona public were more adverse to arthropods when found in and around the home environment. Their study surveyed Arizona residents and found that 88% disliked or felt afraid of arthropods found indoors, and 42% felt the same way about arthropods found in the yard. The researchers suggested that educating the public about arthropods could help develop more positive attitudes toward these animals.

A study of Minnesota residents revealed similar results to the study by Byrne et al. (1984). According to Hahn and Ascerno (1991), Minnesota residents reported a low tolerance for insects found indoors. Survey results revealed that 69.2% of residents liked or tolerated insects found outside the home, while 85.9% disliked or were afraid of insects found inside the home. The researchers noted this low tolerance of indoor insects as an opportunity to educate the public, and enhance resident's decision-making skills for pest management practices concerning household insects. Comparably, Potter and Bessin (1998) discovered that Kentucky residents possessed little tolerance for any type of arthropod found within the home environment. Their

survey revealed that 92.7% of residents believe that finding an insect in their home was cause for concern.

Several other studies have yielded notable results. According to Frankie and Levenson (1978), survey results from rural and urban residents in Texas indicated positive attitudes toward some insects found in or around the home environment, and negative attitudes toward others. According to Kellert (1993), a survey of Connecticut residents revealed aversion to insects found inside the home. In addition, Baldwin, Koehler, Pereira and Oi (2008), found that over two-thirds of Florida residents surveyed believed that insect pests were harmful to their household. Interestingly, responses were based on resident's attitudes toward insects since the term "insect pests" was not defined.

These studies demonstrate there is an obvious correlation between perceptions of insects and other arthropods and the location in which they are encountered by humans. Attendees at Hokie BugFest are given the opportunity to interact with insects and other arthropods outside their home and to learn factual knowledge about these animals from campus and community entomologists. Annual exposure gives the public a chance to become more comfortable with insects and other arthropods regardless of where they are encountered.

Perceptions of pesticides. Understanding public attitudes toward pesticides and pesticide use has been an area of interest for decades. The way pesticides are perceived versus the way arthropods are perceived by an individual may influence one's decision on whether or not pesticide use is acceptable. Several studies have investigated perceptions of pesticides and decisions for use. Frankie and Levenson (1978) surveyed rural and urban populations of Texas to gauge their attitudes toward insecticide use in their home environments. Rural residents tended to use insecticides more often than urban residents, and both populations stated few negative

aspects of insecticide use. Between 1975 and 1976, a downward shift in insecticide use was reported by both populations. Reported reasons for this decrease included negative personal experience, environmental concerns, information presented in media, and so on (Frankie & Levenson, 1978).

According to Dunlap and Beus (1992), residents of the Pacific Northwest indicated great concern over the safety of pesticides in relation to the environment. However, 65% of the respondents agreed that pesticides were necessary for home pest control. Interestingly, Potter and Bessin (1998) found that Kentucky residents possessed negative feelings toward pesticide use in the home. Survey results indicated that 77% of residents were very concerned or somewhat concerned about pesticide use in the home. As mentioned in the previous section, these residents also indicated concern over finding arthropods in their home environment. The researchers concurred their results reinforced a well-known issue in the field of entomology; "consumers want a pest-free indoor environment, but they are also fearful of pesticides" (Potter & Bessin, 1998, p. 146).

Conversely, according to Grieshop and Stiles (1998), 68% of Sacramento, California residents surveyed (who reported regular pesticide use) believed pesticides were less dangerous than other hazards, and that their benefits outweighed their risks. According to Baldwin et al. (2008), 82% of Florida residents surveyed were also regular pesticide users. The residents identified specific reasons for home pesticide use such as seeing live or dead insects around the home and feeling pests might pose a danger to their family. The residents who did not identify as regular pesticide users concurred with regular pesticide users for reasons they might use pesticides (Baldwin et al., 2008). An Indiana survey presented contrasting results. According to

Feinberg and Rathod (1992), Indiana consumers perceived pesticides as environmentally threatening, feeling pesticide use posed more risks than benefits.

A study conducted in the United Kingdom revealed similar attitudes toward pesticides and pesticide use as studies conducted in the United States. According to Nieuwenhuijsen, Grey, Golding and the ALSPAC Group (2005), residents surveyed who reported using pesticides in and around the home were less likely to perceive risks, and more likely to perceive benefits associated with these products. Conversely, those who did not report pesticide use were less likely to perceive benefits of using these products, and associated higher risks with pesticide use. Residents also reported they would use a pesticide inside the home to control a pest problem, but they would not use a pesticide inside the home as a preventative measure. The results suggested a direct correlation exists between attitudes toward pesticides and pesticide use and the perceived benefits or risks of using these products (Nieuwenhuijsen et al., 2005).

This literature indicates there are mixed public opinions toward pesticides and decisions on whether or not to use these products is often varied. The literature also suggests pesticide use decisions may be influenced by how a person feels about arthropods. This lends itself well in supporting the need for events like Hokie BugFest. Attendees have the opportunity to visit many exhibits and speak to experts about arthropods, pesticide safety, and pest management practices, thereby replacing preconceptions with facts concerning these topics and improving their overall perceptions.

Household Pesticide Use in the United States

Some studies have investigated pesticide use of homeowners in specific states of the United States. Data has also been collected on homeowner pesticide use across the United States through research and through government entities. Related to this information are findings which

suggest the need for delivery of pesticide safety education to homeowners. These studies are as follows.

Reported pesticide use. According to Bennett, Runstrom and Wieland (1983), pesticide use is a common practice among households in north central Indiana. Of those surveyed, 87% reported having had an insect problem in an around the home (separate from insect problems in their lawn and garden) and 78% reported pesticide use during the year. Interestingly, 87% of respondents reported attempts to use other methods of controlling their pest problem besides chemical means, and 72% were aware that many insects are beneficial (Bennett, Runstrom & Wieland, 1983). Similarly, Feinberg and Rathod (1992) reported 74% of Indiana consumers regularly use insecticides and 50% regularly use herbicides. According to Grieshop and Stiles (1989), Sacramento, California residents use pesticides at high levels in and around the home. Overall, 88% of respondents reported using pesticides in the home, 91% reported use on lawns, 87% reported use on flowers, and 79% reported use on vegetable gardens (Grieshop & Stiles, 1989).

According to Davis, Brownson and Garcia (1992), many Missouri families use pesticides in an around the home. Almost two thirds of those surveyed use pesticides more than five times annually. The most common use was household pesticides for nuisance pests like fleas and lice, which accounted for 80% of reported home use. Following household use, 57% of families reported using herbicides in the yard, 50% reported flea and tick applications on pets, and 33% reported insecticide use in the garden and orchard (Davis, Brownson, & Garcia, 1992). Similar results were published in a national study. According to Savage et al. (1981), 90.7% of households surveyed in the United States reported pesticide use in the home, garden, and yard. The survey revealed that 83.7% of pesticide use occurred within the household, 28.7% occurred

in the yard, and 21.4% occurred in the garden. High pesticide use occurring within the household was a significant finding of the study (Savage et al., 1981).

Periodically, the Environmental Protection Agency (EPA) publishes market estimates on pesticide industry sales and usage. According to the EPA, an estimated 78 million households were using pesticides in and around the home as of 2007 (Grube, Donaldson, Kiely & Wu, 2011), which increased to 88 million households by 2012 (Atwood & Paisley-Jones, 2017). The home and garden market sector used an estimated 60 million pounds of conventional pesticide active ingredient in 2007 (Grube et al., 2011), which dropped slightly to 59 million pounds in 2012 (Atwood & Paisley-Jones, 2017). The statistics in these reports are significant, especially when correlated with the United States Census Bureau's tabulation of households, which accounted for 116.7 million households in 2010 (Lofquist, Lugaila, O'Connell & Feliz, 2012). Calculation reveals an estimated 75% (88M divided by 116.7M) of U.S. households are using pesticides in and around the home. This percentage lends itself well in establishing a need for pesticide safety education for consumers and homeowners.

Need for pest management and pesticide safety education. According to Church, Buhler, Bradley and Stinner (2012), extension educators feel homeowners are in need of pesticide safety information. In 2007, a group of researchers from North Carolina State University in Raleigh, North Carolina conducted a survey to assess needs for homeowner pesticide safety information across the state. The survey was sent out first to North Carolina Extension educators whose responsibilities include providing pesticide safety information to homeowners in their counties. The following year, the survey was sent out through the National Association of County Agricultural Agents to assess the same needs of agents nationally. The extension educators expressed concerns about the attitudes of homeowners toward pesticide use.

They reported that some homeowners believe all pesticides are bad, while others rely solely on chemical pest control. Extension educators also reported that many homeowners had zero tolerance for pests, and lacked pesticide safety knowledge concerning topics such as: the environment, personal safety, selecting proper products, and label directions (Church et. al., 2012).

Other studies have also indicated concerns over homeowners needing pesticide safety education. According to Bennett, Runstrom and Wieland (1983), homeowners in north central Indiana rarely sought information to aid in the diagnosis of their pest problem, had little knowledge of safe and proper pesticide use, and used pesticides in high frequencies. The researchers suggested promotion of pesticide safety and pest management practices by entities such as Cooperative Extension could aid homeowners in safe and proper pesticide usage. Interestingly, another Indiana study of consumers revealed high trust in pesticide information obtained from Cooperative Extension by respondents (Feinberg & Rathod, 1992).

Further, according to Grieshop and Stiles (1989), 65% of Sacramento, California residents referred to the pesticide label for product information. However, 38% admitted not being able to understand the pesticide label. The researchers also found that 53% of respondents did not wear any personal protective clothing or equipment during applications and 22% had placed pesticide containers with leftover product in the trash. Additionally, a national assessment conducted by the Research Triangle Institute revealed that 75% of households surveyed had at least one pesticide product stored insecurely and 67% disposed of leftover chemicals in their regular trash (Whitmore, Kelly, Reading, Brandt, & Harris, 1993).

This research indicates widespread use of pesticides among United States households, even though the public has mixed views concerning pesticides. This research also suggests that

few homeowners seek pest management and pesticide safety information, which is paradoxical considering the high rates of pesticide use being reported. The literature shows that there is a need for sound information on pest management and pesticide safety for the public, an objective that can be partially fulfilled by Hokie BugFest.

This chapter has provided a review of literature on entomology outreach events, learning theories, scientific literacy, public views of arthropods and pesticides, and household pesticide use in the United States. Chapter Three will discuss the methodology that was used to conduct the research for this study.

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this study was to determine the impact of Hokie BugFest on attendee attitudes toward arthropods and pesticides. This study also investigated similar outreach events held at other science institutions in order to compare them with Hokie BugFest. It is anticipated that the information gathered in this study will provide a basis for others seeking to evaluate entomology outreach events and allow event coordinators across institutions to collaborate. This study employed a quantitative research design, which consisted of three surveys to different populations, including two participant surveys and a national event coordinator survey.

Introduction to Study Design

This study used a quantitative approach. Specifically, a cross-sectional survey approach was utilized. Cross-sectional survey research, as defined by Fraenkel and Wallen (2009), collects information from a predetermined sample of a population and occurs at just one point in time. This approach was employed in two different ways. First, surveys were used to obtain information on youth and adult participants that attended Hokie BugFest in order to understand their perceptions of the event. Secondly, an additional survey was developed to obtain information from other similar event organizers across the United States about their hosted, entomology focused events.

Site Selection and Researcher Role

This study was conducted at Virginia Tech, a land-grant research university in the United States. Hokie BugFest began at the university in 2011, which is hosted annually by the entomology department. After its first year, the department concluded the event should be studied to understand the potential impact. The department head and main event coordinator

concurred in their views of the beneficial nature of the study and were eager for the research to further explore the impact of the festival.

The researcher was a part-time graduate student from Fall 2012 to Summer 2018 and is currently a full-time employee of the entomology department. As a graduate student and employee, the researcher aided in the design and facilitation of Hokie BugFest, sustaining activities and implementing new activities as the event evolved. The researcher benefited from being in this position in relation to the research project by being familiar with the entomology department, the goals of the event, and the event audience. However, the researcher was also challenged to remain objective in order to conduct the study.

Research Participants

The target population for the first part of the study consisted of adult and youth Hokie BugFest attendees. This portion of the study focused on these groups to gain an understanding of how attendees perceive and are impacted by the event. The target population for the second part of the study consisted of event coordinators that were selected from other institutions hosting large entomological outreach events like Hokie BugFest. This portion of the study sought to gain an understanding of the impacts of the event on the respective institutions and surrounding communities.

Instrumentation Design

Survey one. In order to collect information on youth attendees at Hokie BugFest, the Junior Entomologist Certificate (JEC) Program was implemented in 2012. This program was designed to enhance youth involvement in the event. Participants were asked to take questionnaires throughout the event, fill them out while visiting exhibits, and return the completed page before leaving the event. In return, participants were issued personalized JECs.

Participation was voluntary; all information collected was anonymous and has remained confidential.

After initial participation in the 2012 JEC Program, questionnaires were revised to collect better information on youth attendees. In 2013, a pilot survey was designed to collect demographic information, sample questions, and test the inquiry style. The pilot survey from 2013 helped build the questionnaires from 2014 to 2017, which continued to survey demographics and youth attitudes toward Hokie BugFest, insects, and arthropods.

The first section of the JEC questionnaire collected demographic information such as age, gender, city, and state (see Figure 1). The second section of the questionnaire collected information regarding attitudes toward Hokie BugFest, arthropods, and insects. Participants were asked to state whether this was their first time at Hokie BugFest. They were also asked about their favorite exhibit, how they felt about arthropods and insects, and if visiting exhibits changed their attitudes toward arthropods and insects. The last section of the questionnaire was reserved as a scavenger hunt to allow youth to interact with exhibitors and inquire about the questions they were unsure how to answer. Scavenger hunt questions were changed regularly to give youth new learning opportunities and prevent recurring questions to repeat participants.

Figure 1: Junior Entomologist Certificate Questionnaire Distributed at Hokie BugFest

Hokie BugFest

Junior Entomologist Certificate Questionnaire

Please provide the following information:

Age: _____ Check one: ☐ Boy ☐ Girl City & State: _____

Is this your first time at Hokie BugFest? ☐ Yes ☐ No

If not, how many times have you attended this event? *(Please circle.)* **1 2 3 4 5 6**

Please respond to the following statements:

1) I usually feel afraid of insects and arthropods. ☐ Yes ☐ No
2) Visiting the exhibits at Hokie BugFest makes me feel:
   - ☐ Less afraid of insects and arthropods
   - ☐ More afraid of insects and arthropods
   - ☐ No change in feelings
3) Learning about insects and arthropods is an enjoyable experience. ☐ Yes ☐ No
4) I plan to continue learning about insects and arthropods in the future. ☐ Yes ☐ No
5) My favorite exhibit at Hokie BugFest is: _____

Please visit several booths and select the best answer for each question. Return the completed questionnaire to the Junior Entomologist table and receive your certificate!

1) Insects have ___ legs and spiders have ___ legs.
   a) 6 & 6 b) 6 & 8 c) 4 & 8 d) 8 & 6
2) True or False Honeybees & ants live socially in colonies, while termites live alone.
3) True or False Insects have an external skeleton referred to as the exoskeleton.
4) The main regions of the insect body are the:
   a) head & abdomen b) eyes, thorax, & legs c) head, thorax, & abdomen
5) True or False Walking stick species are only found in South America.
6) Honey bees were brought to North America from this region of the world:
   a) Australia b) South America c) Asia d) Europe
7) True or False Only female mosquitoes have the mouthparts necessary to suck blood.
8) True or False Bed bugs have no resistance to pesticides and are easily controlled.

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Survey two. In 2015, a more in-depth survey was developed to gauge adult perceptions of the event. The survey was piloted in a biology class at a local community college in order to assist the researcher in refining the tool. The audience consisted of students who were recent high school graduates, as well as those who were retraining for careers. The pilot survey helped build the questionnaire that was used at the event from 2015 to 2017. Participation was voluntary; all information collected was anonymous and has remained confidential.

The Hokie BugFest Survey of Adult Perceptions (SAP) was divided into two sections (see Figure 2). The first section of the survey collected demographic information of the participants such as age, gender, city, state, occupation, and level of education. Participants were also asked whether or not this was their first time attending Hokie BugFest. The second section was a series of Likert-type scale statements designed to capture participant attitudes toward arthropods, pesticides, and the impact the event has on these perceptions.

Figure 2: Survey of Adult Perceptions Distributed at Hokie BugFest

Hokie BugFest Survey of Adult Perceptions

Part One: Demographics
Please fill out the following information regarding your demographics:

Age: _____ Gender: _____ City: _____ State: _____

Occupation: _____ Level of Education: _____

Is this your first time at Hokie BugFest? ☐ Yes ☐ No

If not, how many times have you attended this event? *(Please circle.)* 1 2 3 4 5 6

Part 2: Attitudes Toward Arthropods, Insects, and Pesticides
For each statement, please check the appropriate box regarding your attitudes toward arthropods (i.e. spiders, scorpions, centipedes, etc.), insects, and pesticides:

	Strongly Agree	Agree	Disagree	Strongly Disagree
I am not afraid of arthropods and insects.				
I like some arthropods and insects more than others.				
It is interesting to learn about arthropods and insects.				
Learning about arthropods and insects is an enjoyable experience.				
Learning about arthropods and insects makes me more comfortable to be around them.				
I plan to continue learning about arthropods and insects in the future.				
Exhibits at Hokie BugFest have positively impacted my attitude toward arthropods and insects.				
The presence of an arthropod or insect does not bother me in my home.				
If the presence of an arthropod or insect bothered me in my home, I would capture it and release it outdoors.				
If the presence of an arthropod or insect bothered me in my home, I would kill it using non-chemical means.				
If the presence of an arthropod or insect bothered me in my home, I would kill it using a pesticide.				
I would use a pesticide to keep an arthropod or insect from entering my home.				
I would use a pesticide to control a pest problem in my home.				
I would use a pesticide to control a pest problem in my garden.				
I am not afraid of pesticides.				
Pesticides are not harmful to my health.				
Exhibits at Hokie BugFest have positively impacted my attitude toward pesticides.				

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Survey three. In 2016, an online survey was designed to capture information about similar entomological events at other institutions. Qualtrics, an online survey software tool provided by Virginia Tech, was used to develop and carry out the questionnaire. This survey software can be found at http://virginiatechqualtrics.com. An introductory statement page was included at the beginning of the instrument (see Appendix C).

The survey consisted of 19 questions spanning five sections. The five sections were: event information; attendee demographics and information; community/institutional impacts of the event; attendee attitudes toward arthropods and insects; and interest in collaboration. The majority of the questions were closed-ended, however, the survey allowed participants the option to provide open-ended feedback. A series of Likert-type scale statements captured views of attendee attitudes, as well as views of impacts the event had in their community. The survey was tested internally among colleagues, and then refined before distributing to collaborators.

Data Collection and Procedures

Due to the anonymous nature of the data collection, the Institutional Review Board at Virginia Tech granted an exemption (see Appendix A). Survey one was administered at Hokie BugFest yearly from 2014 to 2017. Survey two was also administered at Hokie BugFest over several years, from 2015 to 2017. Survey three was administered through Virginia Tech's Qualtrics survey system in the summer of 2016.

Surveys one and two. Separate booths were arranged and staffed at the event to distribute the JEC and SAP surveys. Both instruments were paper-based in order to allow participants to take the survey with them and the return it before departing from the event. The paper format also allowed for quick responses at the ease of the participant. After the event,

answers from the paper surveys were entered into Excel spreadsheets to allow for simple statistical analysis.

Survey three. Researching events at other institutions revealed contact information of the coordinators. A list of the coordinators and their contact information was compiled and entered into Qualtrics to form a distribution list. The University Entomology Outreach Events (UEOE) Survey was distributed at the beginning of June 2016, with a reminder e-mail scheduled two weeks later to those who had not responded. A final request was e-mailed two weeks after the initial reminder. Data collection spanned June and July, and when no additional responses arrived, the survey was closed.

Data Analysis Techniques

Surveys one and two. In some cases, surveys were incomplete, and therefore only completed questionnaires were used in analysis. For both the JEC and SAP survey, results were manually logged into Excel spreadsheets. The data sheets were sorted multiple times based on responses, and additional columns were used to assign those answers a numerical value of one. The numerical values were used to write summation formulas, which tallied the survey answers. This allowed for the calculation of percentages and mean for each survey question.

Survey three. Qualtrics was used to collect and analyze the data from the UEOE questionnaire. Those who experienced technical difficulty were allowed to retake the survey to give complete responses. As a result, complete responses from the Qualtrics survey were manually entered into Excel spreadsheets to reanalyze the data. Summation formulas were used to tally responses and calculate percentages, mean, median, and range for survey questions.

This chapter discussed the research methodology that was implemented to conduct this study. Chapter Four will detail the findings of each survey. These details will be conveyed through written descriptions, charts, and graphs.

CHAPTER 4

RESULTS & DISCUSSION

Study Overview

The purpose of this study was to gain an understanding of attendee perceptions of insects, other arthropods, and pesticides, and how Hokie BugFest impacts these attitudes. This study also identified and compiled events hosted by other institutions with similar scopes to Hokie BugFest. In order to accomplish this goal, surveys were developed and distributed at Hokie BugFest over multiple years and a separate survey was developed and distributed to event coordinators at other institutions. The findings of all surveys are discussed in the following sections.

Findings of Survey One

As described in Chapter Three, the Junior Entomologist Certificate (JEC) Survey was divided into three sections: participant demographics and information, participant attitudes toward the event, and a scavenger hunt. The scavenger hunt has no bearing on the study; therefore, only data collected from the first two sections was analyzed. The JEC Survey was administered annually over four consecutive years. Incomplete and invalid responses were omitted.

2014 JEC survey. In 2014, 906 JEC surveys were distributed, and 672 were returned. These yielded a response rate of 74%. Of the 672 returned surveys, 139 (21%) surveys were incomplete or invalid and 533 (79%) were complete and valid responses.

Participant demographics and information. Participants were asked to provide demographic information. Ages of respondents ranged from 4 to 15, and over 70% were ages 5 to 9. Gender was close to equal as 49% (263) of participants listed male and 51% (270) listed female. Eighty-nine percent (473) of participants were from within a one-hour travel distance of

the event. Within the one-hour travel distance, majority locations included 40% from Blacksburg, VA (213); 19% from Christiansburg, VA (100); 8% from Radford, VA (40); and 8% from Roanoke, VA (41).

Participant attitudes toward the event. When participants were asked if it was their first time attending Hokie BugFest, 63% (338) responded "yes" and 37% (195) responded "no". Twenty-nine percent (154) indicated they usually felt afraid of insects and arthropods, while 71% (379) indicated no fear. Of the 29% (154) who indicated fear, 59% (91) indicated feeling less afraid of insects and arthropods after visiting exhibits.

Overall, respondents were asked how visiting the exhibits at Hokie BugFest made them feel. Three percent (13) indicated exhibits made them feel more afraid of insects and arthropods, 44% (235) indicated they were less afraid, and 53% (284) indicated no change in feelings.

2015 JEC survey. In 2015, 631 JEC surveys were distributed, and 501 were returned. These yielded a response rate of 79%. Of the 501 returned surveys, 108 (22%) surveys were incomplete or invalid and 393 (78%) were complete and valid responses.

Participant demographics and information. Participants were asked to provide demographic information. Ages of respondents ranged from 4 to 17, and over 65% were ages 6 to 10. Forty-seven percent (185) of participants listed male for gender and 53% (208) listed female. Eighty-five percent (334) of participants were from within a one-hour travel distance of the event. Within the one-hour travel distance, majority locations included 32% from Blacksburg, VA (126); 20% from Christiansburg, VA (79); and 13% from Radford, VA (52).

Participant attitudes toward the event. When participants were asked if it was their first time attending Hokie BugFest, 51% (199) responded "yes" and 49% (194) responded "no". Twenty-nine percent (115) indicated they usually feel afraid of insects and arthropods, while

71% (278) indicated no fear. Of the 29% (115) who indicated fear, 58% (67) indicated feeling less afraid of insects and arthropods after visiting exhibits.

Overall, respondents were asked how visiting the exhibits at Hokie BugFest made them feel. Three percent (10) indicated exhibits made them feel more afraid of insects and arthropods, 45% (178) indicated they were less afraid, and 52% (205) indicated no change in feelings. Overwhelmingly, 97% (383) of participants indicated that learning about insects and arthropods was an enjoyable experience, which was a new question added to the survey in 2015.

2016 JEC survey. In 2016, 579 JEC surveys were distributed, and 493 were returned. These yielded a response rate of 85%. Of the 579 returned surveys, 181 (31%) surveys were incomplete or invalid and 398 (69%) were complete and valid responses.

Participant demographics and information. Participants were asked to provide demographic information. Ages of respondents ranged from 4 to 17, and over 70% were ages 4 to 9. Forty-five percent (179) of participants listed male for gender and 55% (219) listed female. Eighty-nine percent (355) of participants were from within a one-hour distance of the event. Within the one-hour travel distance, majority locations included 36% from Blacksburg, VA (144); 21% from Christiansburg, VA (82); 10% from Radford, VA (38); and 5% from Roanoke, VA (19).

Participant attitudes toward the event. When participants were asked if it was their first time attending Hokie BugFest, 44% (177) responded “yes” and 56% (221) responded “no”. Of the 56% who had visited the event before, 53% (118) had attended two years, 26% (58) had attended three years, 13% (28) had attended four years, and 8% (17) had attended five to six years. Thirty-one percent (122) indicated they usually feel afraid of insects and arthropods, while

69% (276) indicated no fear. Of the 31% who indicated fear, 60% (73) indicated feeling less afraid of insects and arthropods after visiting exhibits.

Overall, respondents were asked how visiting the exhibits at Hokie BugFest made them feel. Three percent (10) indicated exhibits made them feel more afraid of insects and arthropods, 45% (179) indicated they were less afraid, and 52% (209) indicated no change in feelings. Overwhelmingly, 97% (388) of participants indicated that learning about insects and arthropods was an enjoyable experience. Additionally, 86% (344) of respondents indicated they plan to continue learning about insects and arthropods in the future, which was a new question added to the survey in 2016.

2017 JEC survey. In 2017, 622 JEC surveys were distributed, and 515 were returned. These yielded a response rate of 83%. Of the 515 returned surveys, 94 (18%) surveys were incomplete or invalid and 421 (82%) were complete and valid responses.

Participant demographics and information. Participants were asked to provide demographic information. Ages of respondents ranged from 4 to 15 years old, and over 60% were 5 to 9 years old. Gender was close to equal as 51% (214) listed male and 49% (207) listed female. Eighty-four percent (354) of participants were from within a one-hour travel distance of the event. Within the one-hour travel distance, majority locations included 31% from Blacksburg, VA (132); 17% from Christiansburg, VA (73); 10% from Radford, VA (40); 6% from Roanoke, VA (26); and 5% from Salem, VA (19).

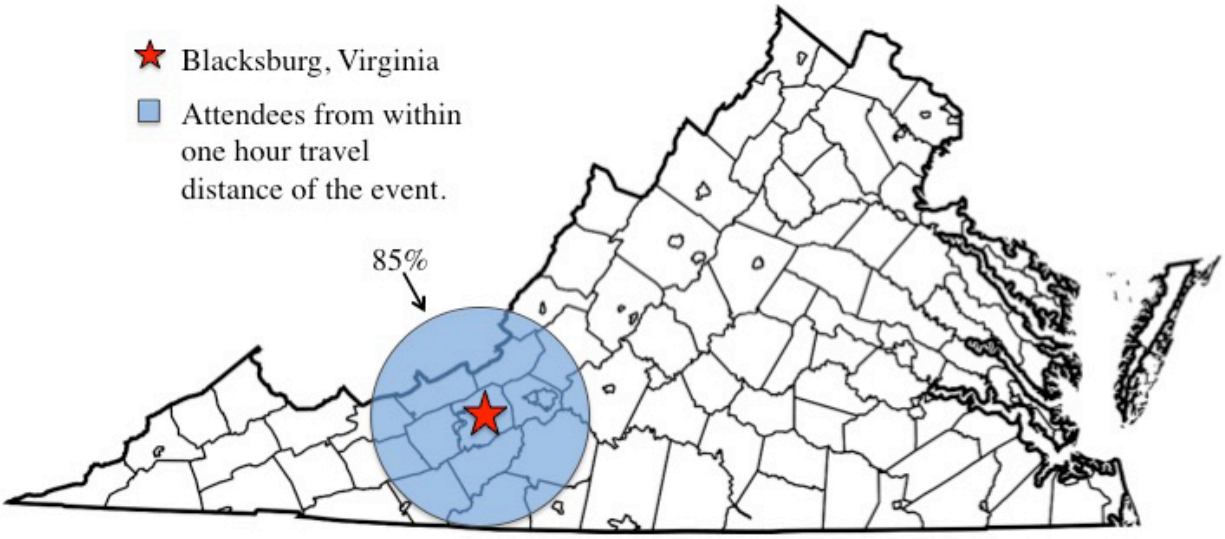
Participant attitudes toward the event. When participants were asked if it was their first time attending Hokie BugFest, 42% (177) responded “yes” and 58% (244) responded “no”. Of the 58% who had visited the event before, 42% (103) had attended two years, 33% (79) had attended three years, 15% (37) had attended four years, and 10% (25) had attended five to seven

years. Thirty percent (125) indicated they usually feel afraid of insects and arthropods, while 70% (296) indicated no fear. Of the 30% who indicated fear, 58% (72) indicated feeling less afraid of insects and arthropods after visiting exhibits.

Overall, respondents were asked how visiting the exhibits at Hokie BugFest made them feel. Two percent (11) indicated exhibits made them feel more afraid of insects and arthropods, 43% (180) indicated they were less afraid, and 55% (230) indicated no change in feelings. Eighty-six percent (361) of respondents also indicated they plan to continue learning about insects and arthropods in the future. Additionally, 86% (360) of participants indicated that learning about insects and arthropods increases their comfort level around these animals, which was a new question added to the survey in 2017.

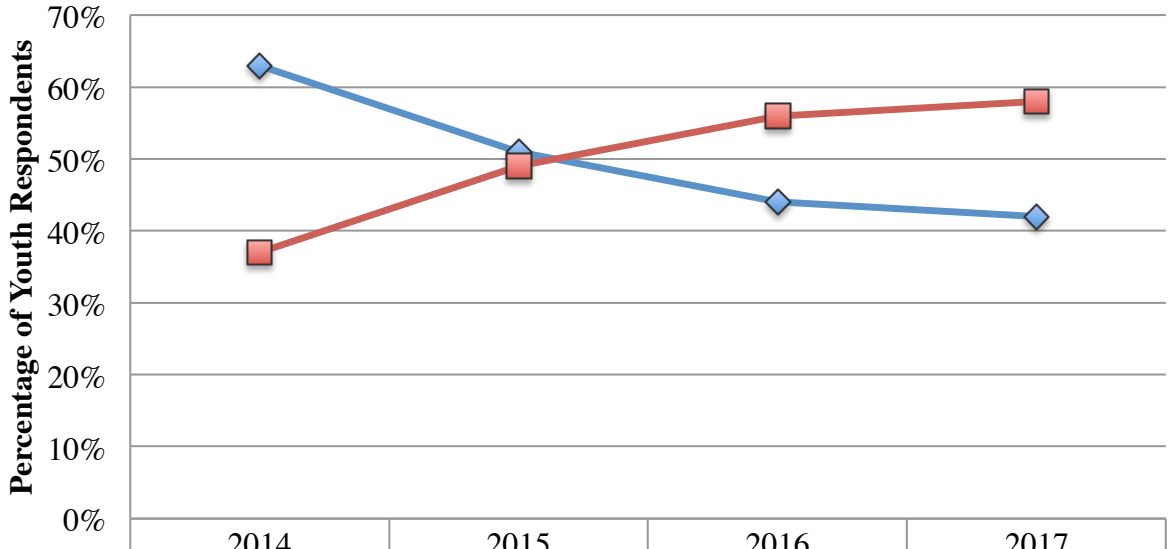
Below is a set of figures displaying JEC survey responses from 2014 to 2017. Figure 3 shows the average percentage of youth who traveled within a one-hour distance to attend Hokie BugFest. Figure 4 displays the number of youth respondents who indicated whether or not they had attended the event before. Figure 5 illustrates youth responses regarding their feelings toward insects and arthropods. Figure 6 illustrates youth responses of those who reported fear of insects and arthropods, and how they felt after visiting exhibits.

Figure 3: Average Percentage of Youth Who Traveled an Hour or Less to Attend Hokie BugFest from 2014 to 2017



More than an hour travel, locations included:
NC, DE, FL, GA, IN, KY, MD, NY, SC, TN, TX, WV and other areas of VA

Figure 4: Youth Responses Regarding Attendance at Hokie BugFest



	2014	2015	2016	2017
Yes	63%	51%	44%	42%
No	37%	49%	56%	58%
Number of Respondents:	533	393	398	421

Figure 5: Youth Responses Regarding Perceptions of Insects and Other Arthropods

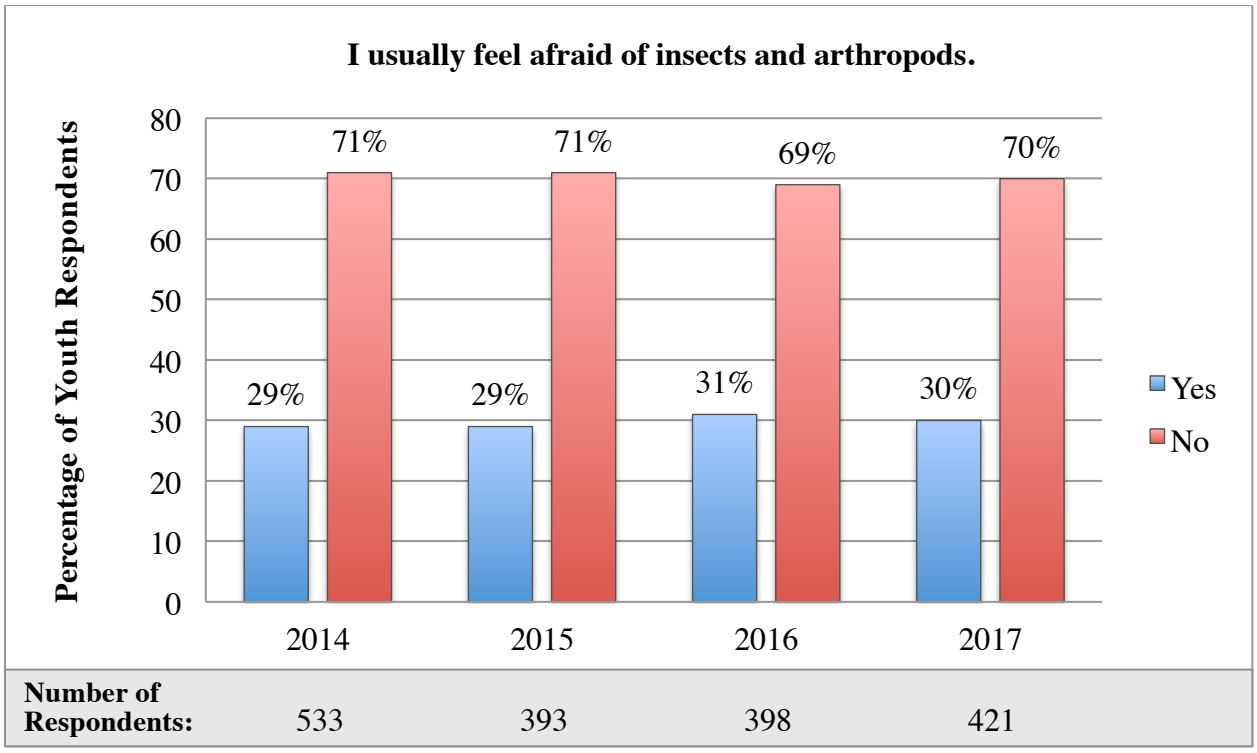
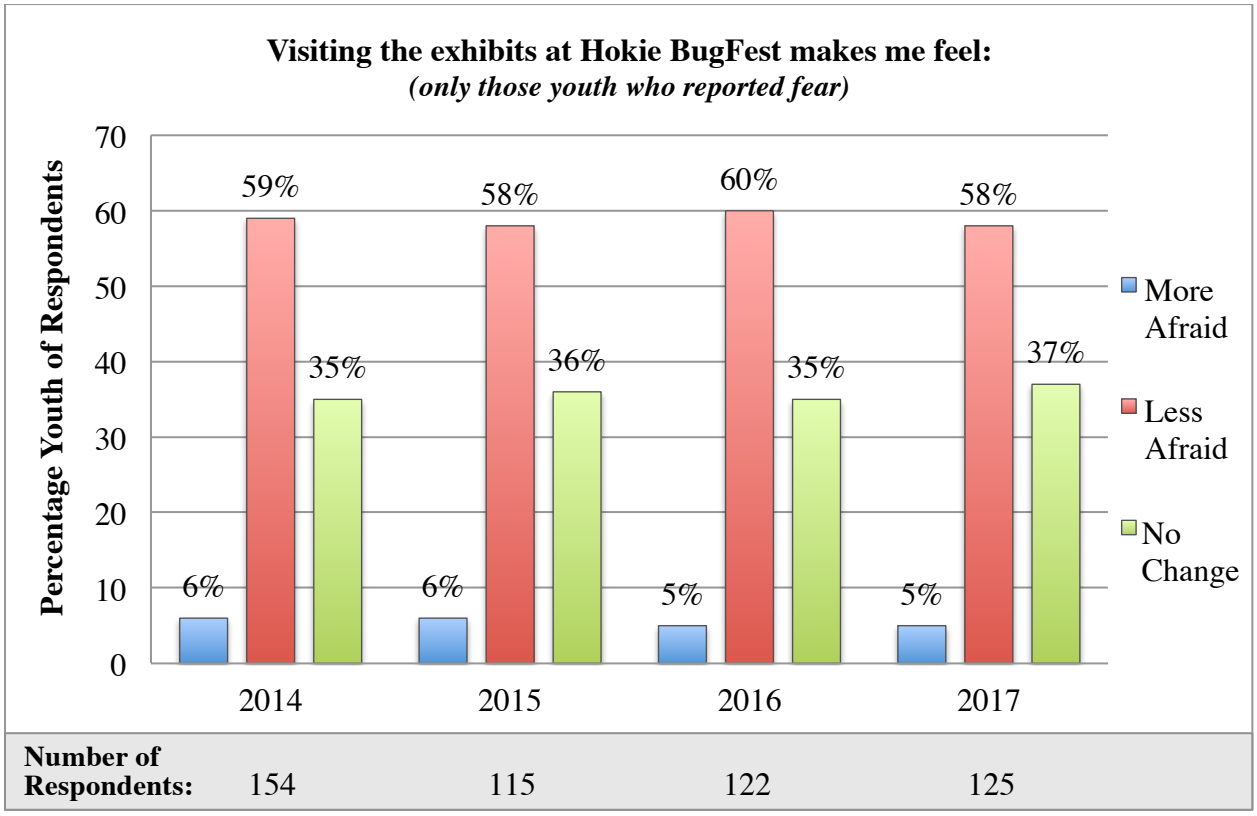


Figure 6: Youth Responses Regarding Change in Attitude Toward Insects and Arthropods



Findings of Survey Two

As described in Chapter Three, the Hokie BugFest Survey of Adult Perceptions (SAP) was divided into two sections: participant demographics and information and participant attitudes toward arthropods, pesticides, and the event. The SAP was administered annually over three consecutive years. Incomplete and invalid responses were omitted.

2015 Hokie BugFest SAP. In 2015, 123 SAP surveys were distributed, and 122 were returned. These yielded a response rate of 99%. Of the 122 returned surveys, 17 (14%) surveys were incomplete or invalid and 105 (86%) were complete and valid responses.

Participant demographics and information. Participants were asked to provide demographic information. Ages of respondents ranged from 19 to 75 and over 60% were age 30 to 49. Thirty percent (32) of participants listed male for gender and 70% (73) listed female. Seventy-nine percent (83) of participants were from within a one-hour travel distance of the event. Within the one-hour travel distance, majority locations included 27% from Blacksburg, VA (28); 22% from Christiansburg, VA (23); and 11% from Radford, VA (12).

Participant attitudes toward the event. Participants were asked if it was their first time attending Hokie BugFest. Sixty percent (63) responded “yes” and 40% (42) responded “no”. Participants were asked to respond to a series of Likert-scale questions, which totaled 17 questions altogether. Respondents were asked if they felt afraid of arthropods and insects. Thirty-five percent (37) of participants responded strongly agree, 44% (46) responded agree, 18% (19) responded disagree, and 3% (3) responded strongly disagree. Respondents were asked if they liked some arthropods and insects more than others. Forty-seven percent (49) of participants responded strongly agree, 45% (47) responded agree, 7% (8) responded disagree, and 1% (1) responded strongly disagree. Respondents were asked if they found learning about arthropods

and insects interesting. Sixty percent (63) of participants responded strongly agree, 39% (41) responded agree, and 1% (1) responded disagree.

Respondents were asked if they believed learning about arthropods and insects was an enjoyable experience. Sixty percent (63) of participants responded strongly agree and 40% (42) responded agree. Respondents were asked if learning about arthropods and insects made them feel more comfortable to be around these creatures. Forty-four percent (46) of participants responded strongly agree, 48% (51) responded agree, and 8% (8) responded disagree. Respondents were asked if they planned to continue learning about arthropods and insects in the future. Thirty-eight percent (40) of participants responded strongly agree, 58% (61) responded agree, and 4% (4) responded disagree. Respondents were asked if exhibits at Hokie BugFest had positively impacted their attitude toward arthropods and insects. Forty-six percent (48) of participants responded strongly agree and 54% (57) responded agree.

Respondents were asked if it did not bother them to find an arthropod or insect in their home. Nineteen percent (20) of participants responded strongly agree, 42% (44) responded agree, 30% (31) responded disagree, and 9% (10) responded strongly disagree. Respondents were asked if they would capture an arthropod or insect and release it outdoors if its presence was bothersome in the home. Thirty-five percent (37) of participants responded strongly agree, 43% (45) responded agree, 18% (19) responded disagree, and 4% (4) responded strongly disagree. Respondents were asked if they would kill an arthropod or insect using non-chemical means if its presence was bothersome in the home. Eleven percent (12) of participants responded strongly agree, 43% (45) responded agree, 32% (33) responded disagree, and 14% (15) responded strongly disagree. Respondents were asked if they would kill an arthropod or insect

using a pesticide. Five percent (5) of participants responded strongly agree, 23% (24) responded agree, 39% (41) responded disagree, and 33% (35) responded strongly disagree.

Respondents were asked if they would use a pesticide to keep an arthropod or insect from entering their home. Six percent (6) of participants responded strongly agree, 43% (45) responded agree, 31% (33) responded disagree, and 20% (21) responded strongly disagree. Respondents were asked if they would use a pesticide to control a pest problem in their home. Eight percent (8) of participants responded strongly agree, 54% (57) responded agree, 21% (22) responded disagree, and 17% (18) responded strongly disagree. Respondents were asked if they would use a pesticide to control a pest problem in their garden. Eight percent (8) of participants responded strongly agree, 34% (36) responded agree, 42% (44) responded disagree, and 16% (17) responded strongly disagree.

Respondents were asked if they were afraid of pesticides. Thirteen percent (14) of participants responded strongly agree, 29% (30) responded agree, 44% (46) responded disagree, and 14% (15) responded strongly disagree. Respondents were asked if they felt pesticides were not harmful to their health. Nine percent (9) of participants responded strongly agree, 13% (14) responded agree, 45% (47) responded disagree, and 33% (35) responded strongly disagree. Respondents were asked if they felt exhibits at Hokie BugFest had positively impacted their attitudes toward pesticides. Twenty percent (21) of participants responded strongly agree, 54% (57) responded agree, 24% (25) responded disagree, and 2% (2) responded strongly disagree.

2016 Hokie BugFest SAP. In 2016, 131 SAP surveys were distributed, and 123 were returned. These yielded a response rate of 94%. Of the 123 returned surveys, 32 (26%) surveys were incomplete or invalid and 91 (74%) were complete and valid responses.

Participant demographics and information. Participants were asked to provide demographic information. Ages of respondents ranged from 19 to 70 and over 70% were age 30 to 49. Forty-one percent (37) of participants listed male for gender and 59% (54) listed female. Ninety-one percent (83) of participants were from within a one-hour travel distance of the event. Within the one-hour travel distance, majority locations included 24% from Blacksburg, VA (22); 25% from Christiansburg, VA (23); 11% from Radford, VA (10); and 14% from Roanoke/Salem, VA (13).

Participant attitudes toward the event. First, participants were asked if it was their first time attending Hokie BugFest. Forty-five percent (41) responded "yes" and 55% (50) responded "no". Of the 55% who had visited the event before, 52% (26) had attended two years, 26% (13) had attended three years, 14% (7) had attended four years, and 8% (4) had attended five to six years. Next, participants were asked to respond to a series of Likert-scale questions, which totaled 17 questions altogether. Respondents were asked if they felt afraid of arthropods and insects. Thirty-four percent (31) of participants responded strongly agree, 41% (37) responded agree, 21% (19) responded disagree, and 4% (4) responded strongly disagree. Respondents were asked if they liked some arthropods and insects more than others. Thirty-two percent (29) of participants responded strongly agree, 59% (54) responded agree, 7% (6) responded disagree, and 2% (2) responded strongly disagree.

Respondents were asked if they found learning about arthropods and insects interesting. Fifty-seven percent (52) of participants responded strongly agree and 43% (39) responded agree. Respondents were asked if they believed learning about arthropods and insects was an enjoyable experience. Sixty-two percent (56) of participants responded strongly agree and 38% (35) responded agree. Respondents were asked if learning about arthropods and insects made them

feel more comfortable to be around these creatures. Forty-six percent (42) of participants responded strongly agree, 46% (42) responded agree, 7% (6) responded disagree, and 1% (1) responded strongly disagree. Respondents were asked if they planned to continue learning about arthropods and insects in the future. Forty-five percent (41) of participants responded strongly agree, 49% (45) responded agree, and 6% (5) responded disagree.

Respondents were asked if exhibits at Hokie BugFest had positively impacted their attitude toward arthropods and insects. Forty-eight percent (44) of participants responded strongly agree, 50% (45) responded agree, and 2% (2) responded disagree. Respondents were asked if it did not bother them to find an arthropod or insect in their home. Nineteen percent (17) of participants responded strongly agree, 42% (38) responded agree, 28% (26) responded disagree, and 11% (10) responded strongly disagree. Respondents were asked if they would capture an arthropod or insect and release it outdoors if its presence was bothersome in the home. Thirty-one percent (28) of participants responded strongly agree, 49% (45) responded agree, 18% (16) responded disagree, and 2% (2) responded strongly disagree. Respondents were asked if they would kill an arthropod or insect using non-chemical means if its presence was bothersome in the home. Eighteen percent (16) of participants responded strongly agree, 39% (36) responded agree, 33% (30) responded disagree, and 10% (9) responded strongly disagree.

Respondents were asked if they would kill an arthropod or insect using a pesticide. Six percent (5) of participants responded strongly agree, 21% (19) responded agree, 38% (35) responded disagree, and 35% (32) responded strongly disagree. Respondents were asked if they would use a pesticide to keep an arthropod or insect from entering their home. Eleven percent (10) of participants responded strongly agree, 39% (36) responded agree, 30% (27) responded disagree, and 20% (18) responded strongly disagree. Respondents were asked if they would use a

pesticide to control a pest problem in their home. Ten percent (9) of participants responded strongly agree, 48% (44) responded agree, 26% (24) responded disagree, and 16% (14) responded strongly disagree. Respondents were asked if they would use a pesticide to control a pest problem in their garden. Five percent (5) of participants responded strongly agree, 29% (26) responded agree, 46% (42) responded disagree, and 20% (18) responded strongly disagree.

Respondents were asked if they felt afraid of pesticides. Seven percent (6) of participants responded strongly agree, 22% (20) responded agree, 48% (44) responded disagree, and 23% (21) responded strongly disagree. Respondents were asked if they felt pesticides were not harmful to their health. One percent (1) of participants responded strongly agree, 13% (12) responded agree, 45% (41) responded disagree, and 41% (37) responded strongly disagree. Respondents were asked if they felt exhibits at Hokie BugFest had positively impacted their attitudes toward pesticides. Twenty-six percent (24) of participants responded strongly agree, 48% (44) responded agree, 20% (18) responded disagree, and 6% (5) responded strongly disagree.

2017 Hokie BugFest SAP. In 2017, 170 SAP surveys were distributed, and 161 were returned. These yielded a response rate of 95%. Of the 161 returned surveys, 18 (11%) surveys were incomplete or invalid and 143 (89%) were complete and valid responses.

Participant demographics and information. Participants were asked to provide demographic information. Ages of respondents ranged from 18 to 71 and over 60% were age 30 to 49. Twenty-three percent (33) of participants listed male for gender and 77% (110) listed female. Eighty-eight percent (125) of participants were from within a one-hour travel distance of the event. Within the one-hour travel distance, majority locations included 31% from

Blacksburg, VA (44); 19% from Christiansburg, VA (27); and 12% from Roanoke/Salem, VA (17).

Participant attitudes toward the event. First, participants were asked if it was their first time attending Hokie BugFest. Fifty-four percent (77) responded "yes" and 46% (66) responded "no". Of the 46% who had visited the event before, 35% (23) had attended two years, 39% (26) had attended three years, 11% (7) had attended four years, and 15% (10) had attended five to seven years. Next, participants were asked to respond to a series of Likert-scale questions, which totaled 17 questions altogether. Respondents were asked if they felt afraid of arthropods and insects. Thirty-five percent (50) of participants responded strongly agree, 36% (52) responded agree, 24% (34) responded disagree, and 5% (7) responded strongly disagree. Respondents were asked if they liked some arthropods and insects more than others. Thirty-nine percent (56) of participants responded strongly agree, 51% (73) responded agree, 7% (10) responded disagree, and 3% (4) responded strongly disagree.

Respondents were asked if they found learning about arthropods and insects interesting. Fifty-five percent (79) of participants responded strongly agree, 42% (60) responded agree, 2% (3) responded disagree, and 1% (1) responded strongly disagree. Respondents were asked if they believed learning about arthropods and insects was an enjoyable experience. Fifty-six percent (80) of participants responded strongly agree, 43% (62) responded agree, and 1% (1) responded strongly disagree. Respondents were asked if learning about arthropods and insects made them feel more comfortable to be around these creatures. Forty-eight percent (68) of participants responded strongly agree, 46% (66) responded agree, 5% (7) responded disagree, and 1% (2) responded strongly disagree. Respondents were asked if they planned to continue learning about

arthropods and insects in the future. Forty-four percent (63) of participants responded strongly agree, 51% (73) responded agree, and 5% (7) responded disagree.

Respondents were asked if exhibits at Hokie BugFest had positively impacted their attitude toward arthropods and insects. Fifty-three percent (76) of participants responded strongly agree, 45% (64) responded agree, and 2% (3) responded disagree. Respondents were asked if it did not bother them to find an arthropod or insect in their home. Twenty-four percent (34) of participants responded strongly agree, 33% (47) responded agree, and 43% (62) responded disagree. Respondents were asked if they would capture an arthropod or insect and release it outdoors if its presence was bothersome in the home. Thirty-eight percent (55) of participants responded strongly agree, 42% (60) responded agree, 16% (23) responded disagree, and 4% (5) responded strongly disagree. Respondents were asked if they would kill an arthropod or insect using non-chemical means if its presence was bothersome in the home. Fifteen percent (21) of participants responded strongly agree, 47% (68) responded agree, 26% (37) responded disagree, and 12% (17) responded strongly disagree.

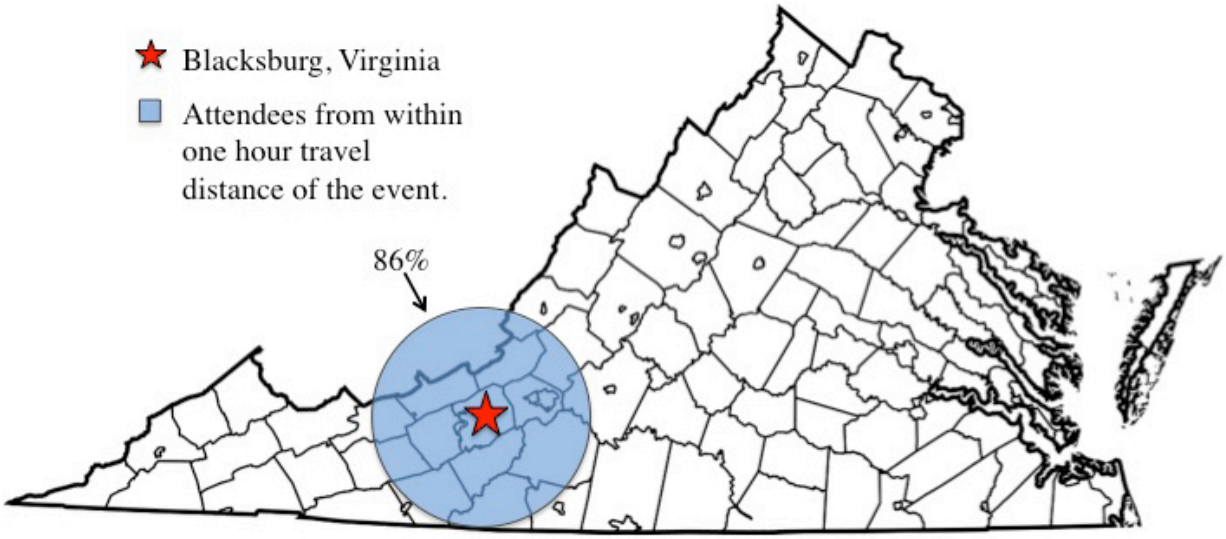
Respondents were asked if they would kill an arthropod or insect using a pesticide. Four percent (6) of participants responded strongly agree, 18% (26) responded agree, 39% (56) responded disagree, and 39% (55) responded strongly disagree. Respondents were asked if they would use a pesticide to keep an arthropod or insect from entering their home. Six percent (9) of participants responded strongly agree, 39% (56) responded agree, 29% (41) responded disagree, and 26% (37) responded strongly disagree. Respondents were asked if they would use a pesticide to control a pest problem in their home. Five percent (7) of participants responded strongly agree, 43% (61) responded agree, 26% (38) responded disagree, and 26% (37) responded strongly disagree. Respondents were asked if they would use a pesticide to control a pest

problem in their garden. One percent (2) of participants responded strongly agree, 30% (43) responded agree, 36% (51) responded disagree, and 33% (47) responded strongly disagree.

Respondents were asked if they felt afraid of pesticides. Nine percent (13) of participants responded strongly agree, 30% (43) responded agree, 39% (55) responded disagree, and 22% (32) responded strongly disagree. Respondents were asked if they felt pesticides were not harmful to their health. Two percent (2) of participants responded strongly agree, 15% (22) responded agree, 36% (52) responded disagree, and 47% (67) responded strongly disagree. Respondents were asked if they felt exhibits at Hokie BugFest had positively impacted their attitudes toward pesticides. Twenty-seven percent (39) of participants responded strongly agree, 52% (74) responded agree, 17% (25) responded disagree, and 4% (5) responded strongly disagree.

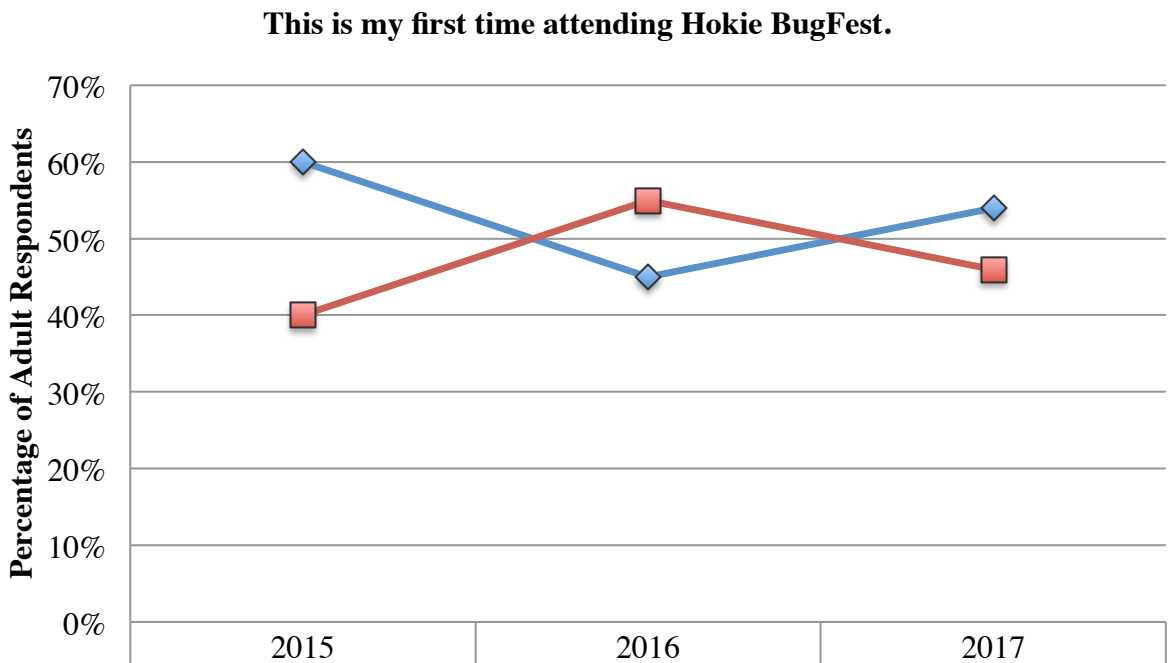
Below is a set of figures displaying SAP survey responses from 2015 to 2017. Figure 7 shows the average percentage of adults who traveled within a one-hour distance to attend Hokie BugFest. Figure 8 displays the number of adult respondents who indicated whether or not they had attended the event before. Figures 9, 10, and 11 illustrate averaged adult responses to Likert scale questions regarding their perceptions toward insects, arthropods, pesticides, and the event.

Figure 7: Average Percentage of Adults Who Traveled an Hour or Less to Attend Hokie BugFest from 2015 to 2017



More than an hour travel, locations included:
AK, KY, MD, NC, OH, PA, NY, WV and other areas of VA

Figure 8: Adult Responses Regarding Attendance at Hokie BugFest



	2015	2016	2017
Yes	60%	45%	54%
No	40%	55%	46%
Number of Respondents:	105	91	143

Figure 9: Average of Responses from 2015 to 2017 Regarding Adult Perceptions of Insects, Arthropods, and the Event

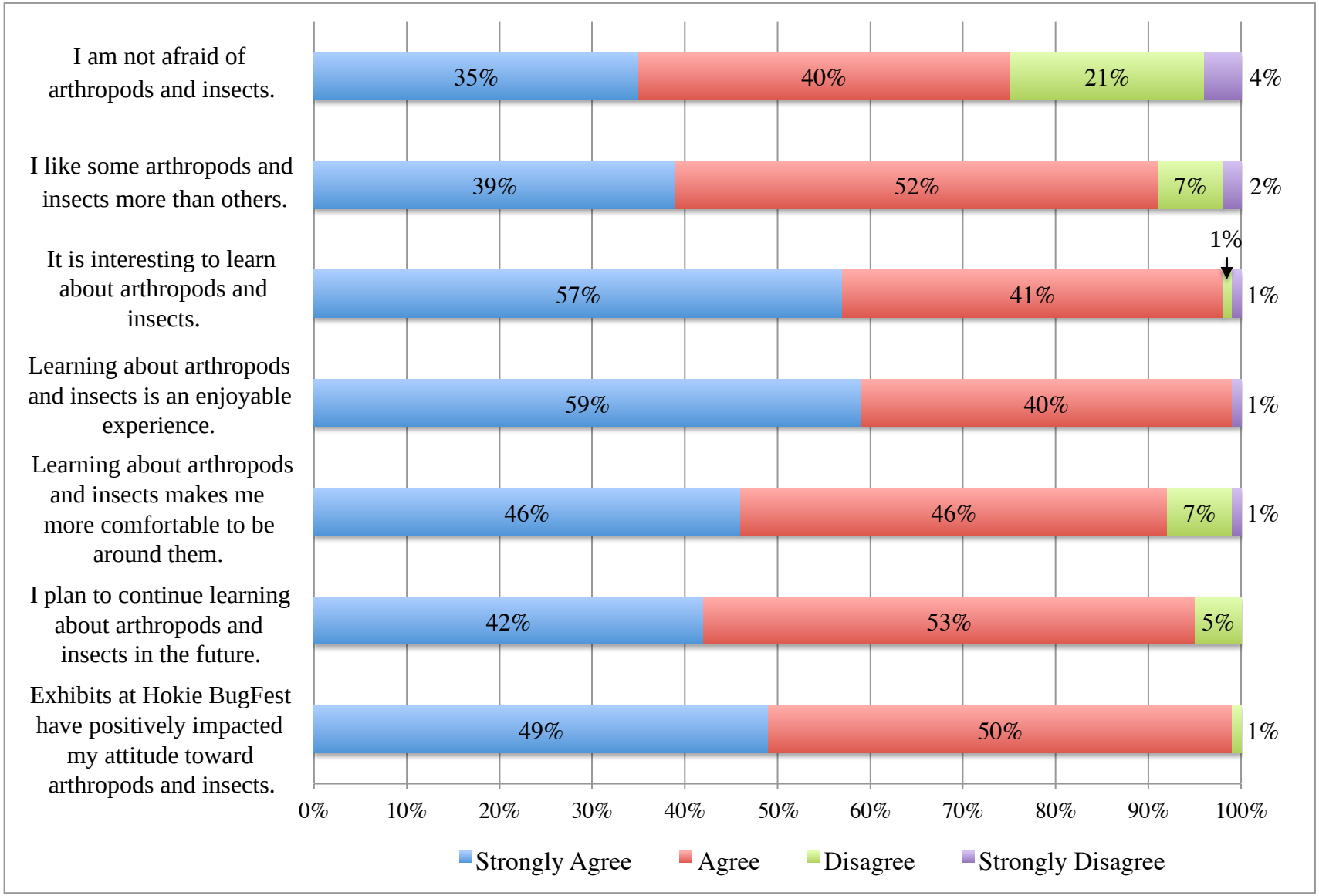


Figure 10: Average of Responses from 2015 to 2017 Regarding Adult Perceptions of Insects, Arthropods, and Pesticide Use

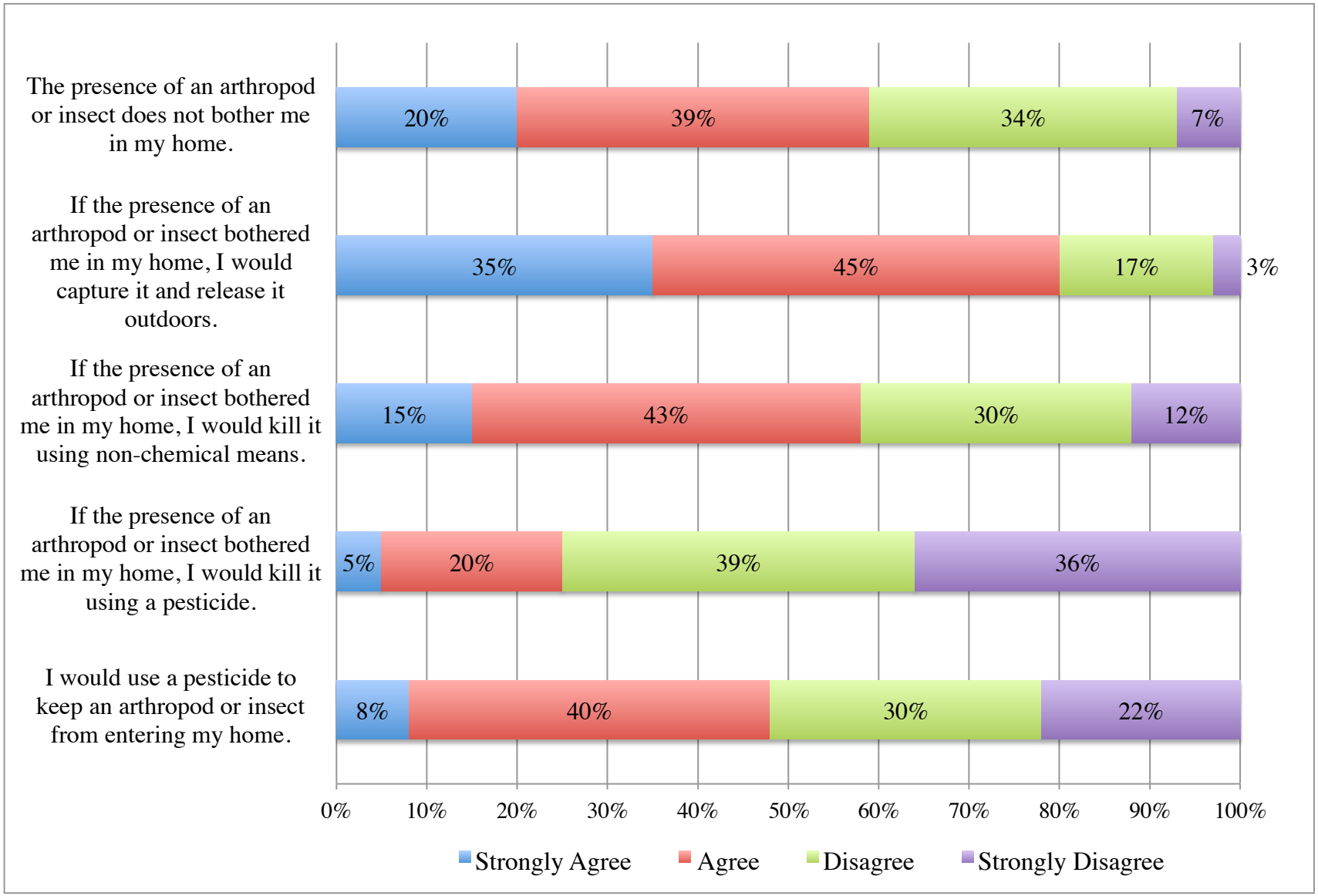
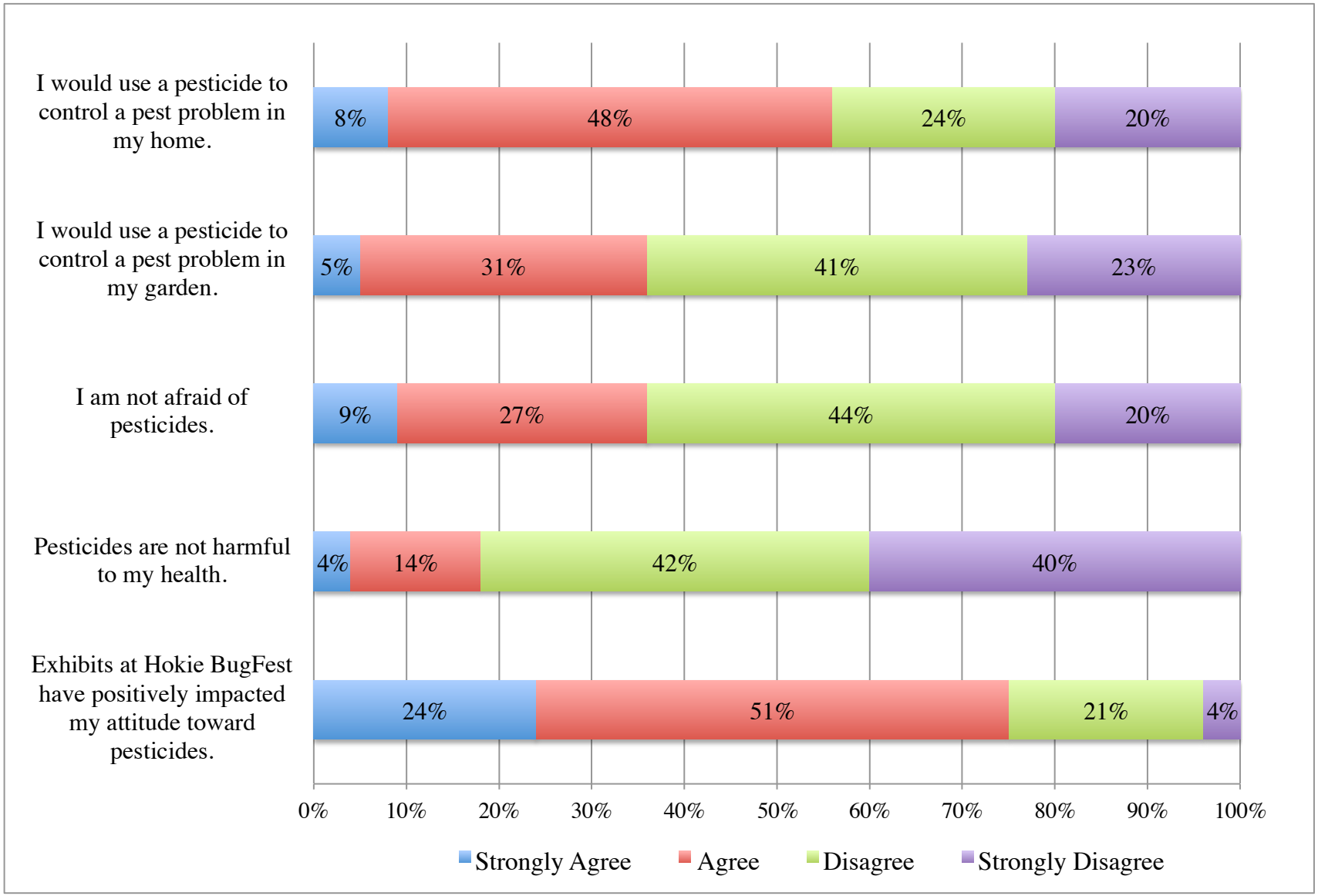


Figure 11: Average of Responses from 2015 to 2017 Regarding Adult Perceptions of Pesticides, Pesticide Use, and the Event



Findings of Survey Three

As described in Chapter Three, the University Entomology Outreach Events (UEOE) Survey consisted of 19 questions spanning five sections: event information; attendee demographics and information; community/institutional impacts of the event; attendee attitudes toward arthropods and insects; and interest in collaboration. The UEOE Survey was administered in the summer of 2016 and was sent to collaborators at 14 institutions. Thirteen institutions responded to the survey, yielding a 93% response rate. According to Baruch and Holtom (2008), typical response rates for online surveys are 52%, plus or minus 20%. Thus, the response rate for this survey can be considered exceptional.

Event information. Participants were asked to provide details on who is responsible for hosting their event, such as a museum, department within a university, or extension unit. The hosting entity typically secures a space for the event, organizes the event, and manages sources of funding to sustain the event. Participants were allowed to identify multiple hosts per institution. Eighty-five percent (11) of respondents identified their department as a host. Two institutions identified their university or college as a host, three identified a college within a university as a host, one identified Agriculture and Natural Resources Cooperative Extension as a host, one identified 4-H Cooperative Extension as a host, and three identified local museums as a host.

Twelve of the thirteen events reported being hosted annually. One event, the Insect Festival at the University of Arkansas, reported being hosted every other year. Eleven of the thirteen events were single day events and averaged over five hours of contact in one day. The Bug Bowl at Purdue University and the Bug Fest at Drexel University reported events spanning two days, which averaged over eight hours of contact per day. Of the overall hours reported, the

range was 15 and the median was six. Eleven of the thirteen events occurred on a Saturday or Sunday. The Insect Festival at the University of Arkansas occurred on a Thursday, and the Insect Zoo Open House at the University of Georgia occurred on a Friday. The Insect Fear Film Festival of the University of Illinois was the longest-lived event, reporting 33 years of occurrence. The youngest event was the Bug Fest at Indiana University, which reported 5 years of occurrence.

The BugFest at the North Carolina Museum of Natural Sciences reported 500 volunteers as necessary to run the event, which was the highest amount reported of all thirteen events. The Bug Fest at Drexel University reported the fewest volunteers needed to support their event. However, they required the highest amount of paid event staff, reporting 30 staff needed to run the event. Several institutions, like Penn State University – The Great Insect Fair, relied solely on volunteers to run their events.

Respondents were asked to identify sources of event funding, such as grants, admission fees, or donations. Twenty-three percent (3) of participants reported admission fees for their event, with the Bug Fest at Drexel University topping out at $15 for admission. None of the institutions reported exhibit fees within their event, however, 38% (5) reported collecting donations. Thirty-eight percent (5) of participants reported merchandise sales as a source of funding. Fifty-four percent (7) of institutions reported corporate and private entities as sponsors and 54% (7) reported financial support from their university or college. Twenty-three percent (3) of participants reported obtaining grants to fund their event. Respondents were asked to provide their best estimate of annual support. Monetary estimates totaled $172,770 and in-kind estimates totaled $117,540, which brought the overall total to $290,310 of event funding for all thirteen institutions.

Respondents were asked to rank their top five exhibits from most significant to least significant. Live arthropod displays, insects as food, educational displays, and performances consistently ranked among the top three exhibits. Other significant exhibits included arts and crafts and insect specific displays. Respondents were asked if they managed live arthropod collections year-round for their events. Seventy-seven percent (10) responded "yes" and 23% (3) responded "no".

Respondents were asked to estimate the number of live insect specimens, arachnid specimens, social insect colonies, and other arthropods in their zoo. The North Carolina Museum of Natural Sciences managed 70 insect species and 20 other arthropod species for their BugFest, which were the highest numbers reported in these two categories. The Hokie BugFest at Virginia Tech managed 49 arachnid species, which was the highest number reported for this category. The Oxbow Meadows Environmental Learning Center at Columbus State University managed five social insect colonies for their Insectival, which was the highest number reported for this category.

Respondents were asked to estimate the value of their zoo (including the enclosures), and the value of the personnel, materials, and supplies needed to maintain their live collection annually. The North Carolina Museum of Natural Sciences reported a zoo value of $50,000 with a personnel value of $80,000, which were the highest amounts reported for these categories. The Insect Zoo Open House at the University of Georgia reported over $10,000 of materials and supplies necessary to maintain their live collection yearly, which was the highest amount reported for this category. The estimated zoo value for all ten institutions totaled $111,610, the zoo personnel totaled $149,430, and the zoo materials and supplies totaled $38,580. Collectively,

the estimated value for the ten institutions maintaining live collections totaled $299,620 annually.

The estimated value of monetary and in-kind event funding was previously discussed in this section. That value, combined with the estimated value of maintaining live collections, totaled $589,930. This amount characterizes how significant provisions are used to promote insects and other arthropods in communities nationwide.

Attendee demographics and information. Participants were asked to give an estimate of the ages of attendees. On average, respondents estimated 13% of attendees were ages 0 to 4, 20% were ages 5 to 8, 18% were ages 9 to 13, 8% were ages 14 to 17, 8% were college students, 22% were parents, and 11% were grandparents and senior citizens. Participants were asked to give an estimate of gender of attendees. On average, respondents estimated 48% of attendees were male and 52% were female. Participants were asked to give their best estimate of how far attendees traveled to their event. On average, respondents estimated 82% of attendees were from within a one-hour travel distance, 14% were from within a three-hour travel distance, 3% were from within a six-hour travel distance, and 1% traveled more than six hours to attend their event. Participants were asked to estimate of how many people attended their most recent event. The highest attendance reported was 40,000 at the Bug Bowl at Purdue University and the lowest attendance reported was 500 at the BugFest at the University of Florida.

Community/institutional impacts of the event. Participants were asked to respond to a series of Likert-scale questions, which totaled eight questions in this section. Respondents were asked if their event provided an educational experience to attendees. Ninety-two percent (12) of participants responded strongly agree and 8% (1) responded agree. Respondents were asked if their event had a positive economic impact on their institution. Thirty-one percent (4) of

participants responded strongly agree, 54% (7) responded agree, and 15% (2) responded disagree. Respondents were asked if their event had a positive economic impact on the community. Twenty-three percent (3) of participants responded strongly agree, 62% (8) responded agree, and 15% (2) responded disagree. Respondents were asked if their event enhanced media coverage of their institution. Seventy-seven percent (10) responded strongly agree and 23% (3) responded agree.

Respondents were asked if their event increased donations to their institution. Twenty-three percent (3) of participants responded strongly agree, 38.5% (5) responded agree, and 38.5% (5) responded disagree. Respondents were asked if their event increased recruitment to their institution. Fifteen percent (2) of participants responded strongly agree, 77% (10) responded agree, and 8% (1) responded disagree. Respondents were asked if their event had a positive impact on attendance at other outreach events. Thirty-one percent (4) of participants responded strongly agree and 69% (9) responded agree. Respondents were asked if their event increased collaborative opportunities within their institution and with other entities. Fifty-four percent (7) of participants responded strongly agree, 38% (5) responded agree, and 8% (1) responded disagree.

Attendee attitudes toward arthropods and insects. Participants were asked to respond to an additional series of Likert-scale questions, which also totaled eight sub-questions in this section. Respondents were asked if attendees showed interest in learning about arthropods and insects. Seventy-seven percent (10) of participants responded strongly agree and 23% (3) responded agree. Respondents were asked if attendees enjoyed learning about arthropods and insects. Sixty-nine percent (9) of participants responded strongly agree and 31% (4) responded agree. Respondents were asked if attendees viewed arthropods and insects as valuable. Thirty-

one percent (4) of participants responded strongly agree, 61% (8) responded agree, and 8% (1) responded disagree. Respondents were asked if attendees were generally not afraid of arthropods and insects. Fifteen percent (2) of participants responded strongly agree, 54% (7) responded agree, and 31% (4) responded disagree.

Respondents were asked if attendees liked some arthropods and insect more than others. Sixty-two percent (8) of participants responded strongly agree and 38% (5) responded agree. Respondents were asked if attendees liked arthropods and insects more after attending their event. Forty-six percent (6) of participants responded strongly agree and 54% (7) responded agree. Respondents were asked if learning about arthropods and insects made attendees more comfortable to be around these animals. Fifty-four percent (7) of participants responded strongly agree and 46% (6) responded agree. Respondents were asked if attendees showed interest in continuing to learn about arthropods and insects. Forty-six percent (6) of participants responded strongly agree, 46% (6) responded agree, and 8% (1) responded disagree.

Interest in collaboration. Respondents from all thirteen institutions indicated interest in a collaborative platform to share knowledge and resources for entomology outreach activities. In order to address this interest, plans to implement a community/consortium have been discussed. Potential avenues for this community/consortium include: forming a Google Group, forming a Facebook page, building a website, applying for an eXtension community of practice, or creating a formal collaborative working group through another entity such as 4-H/Cooperative Extension. Further details regarding the development of a community/consortium will be discussed in Chapter Five.

Below is a set of figures and tables displaying UEOE survey responses from 2016. Figure 12 illustrates how long each event has been hosted. Table 1 displays event information such as

estimated attendance, number of volunteers, and the most popular exhibit. Figure 13 illustrates funding sources for the events. Table 2 shows the estimated annual support for the events and the estimated value of live collections and maintaining them annually. Figure 14 displays community/institutional impacts of the events. Figure 15 displays attendee attitudes toward insects and other arthropods.

Figure 12: Number of Years of Event Existence as of 2016

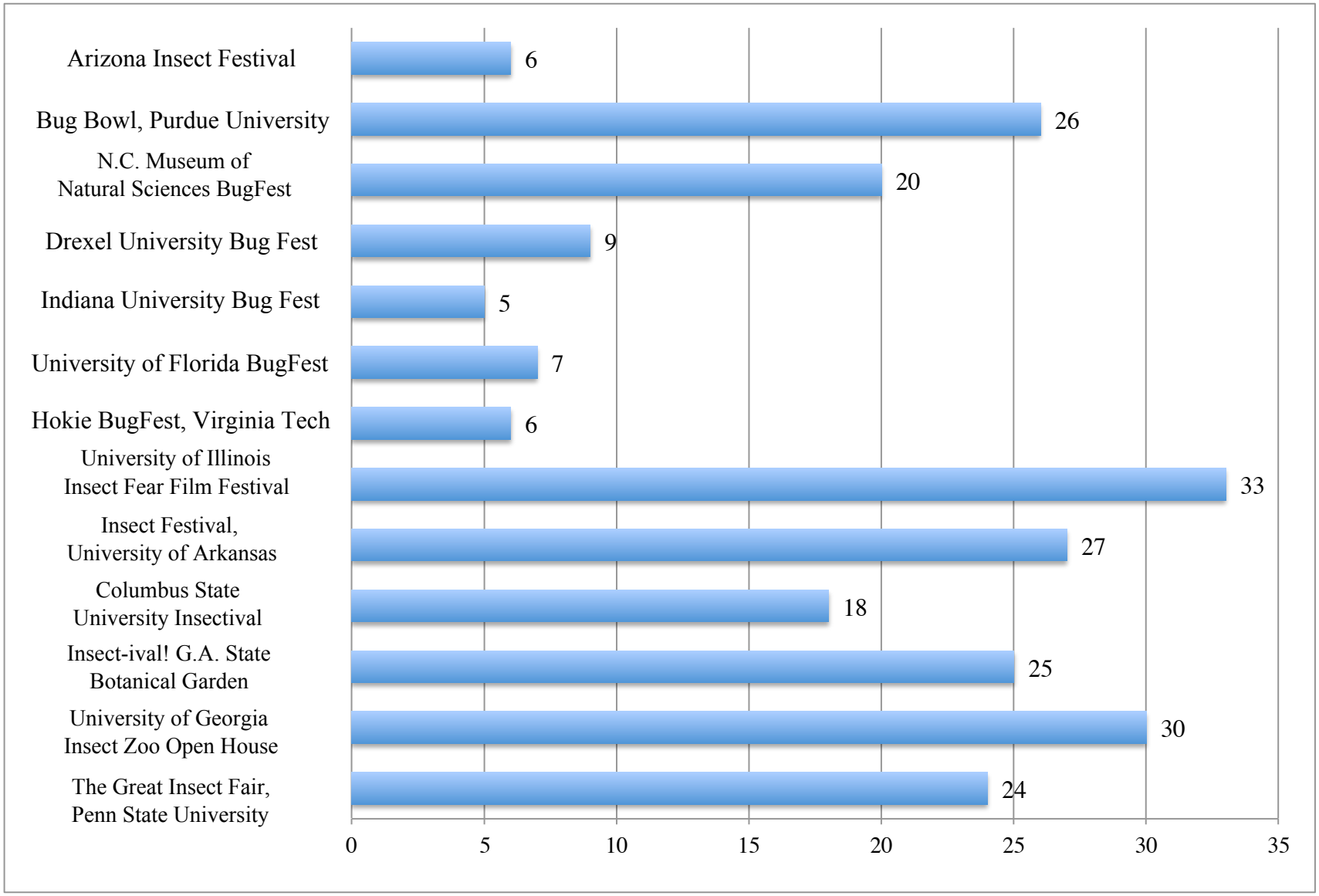


Table 1: Event Information as Reported in 2016

	Estimated Attendance	Number of Volunteers	Most Popular Exhibit
Arizona Insect Festival	6,000	150	Insects as Food
Bug Bowl, Purdue University	40,000	100	Arthropod Zoo
N.C. Museum of Natural Sciences BugFest	31,898	500	Café Insecta
Drexel University Bug Fest	2,023	12	Live Invertebrates
Indiana University Bug Fest	950	18	Live Insects
University of Florida BugFest	500	35	Arthropod Zoo
Hokie BugFest, Virginia Tech	7,020	150	Live Arthropods
University of Illinois Insect Fear Film Festival	850	30	Films and Commentary
Insect Festival, University of Arkansas	3,000	101	Arthropod Zoo
Columbus State University Insectival	1,000	30	Honey Extraction
Insect-ival! G.A. State Botanical Garden	1,100	50	Butterfly Release
University of Georgia Insect Zoo Open House	1,000	46	Insect Café
The Great Insect Fair, Penn State University	4,000	200	Butterfly Tent

Figure 13: Sources of Event Funding as Reported in 2016

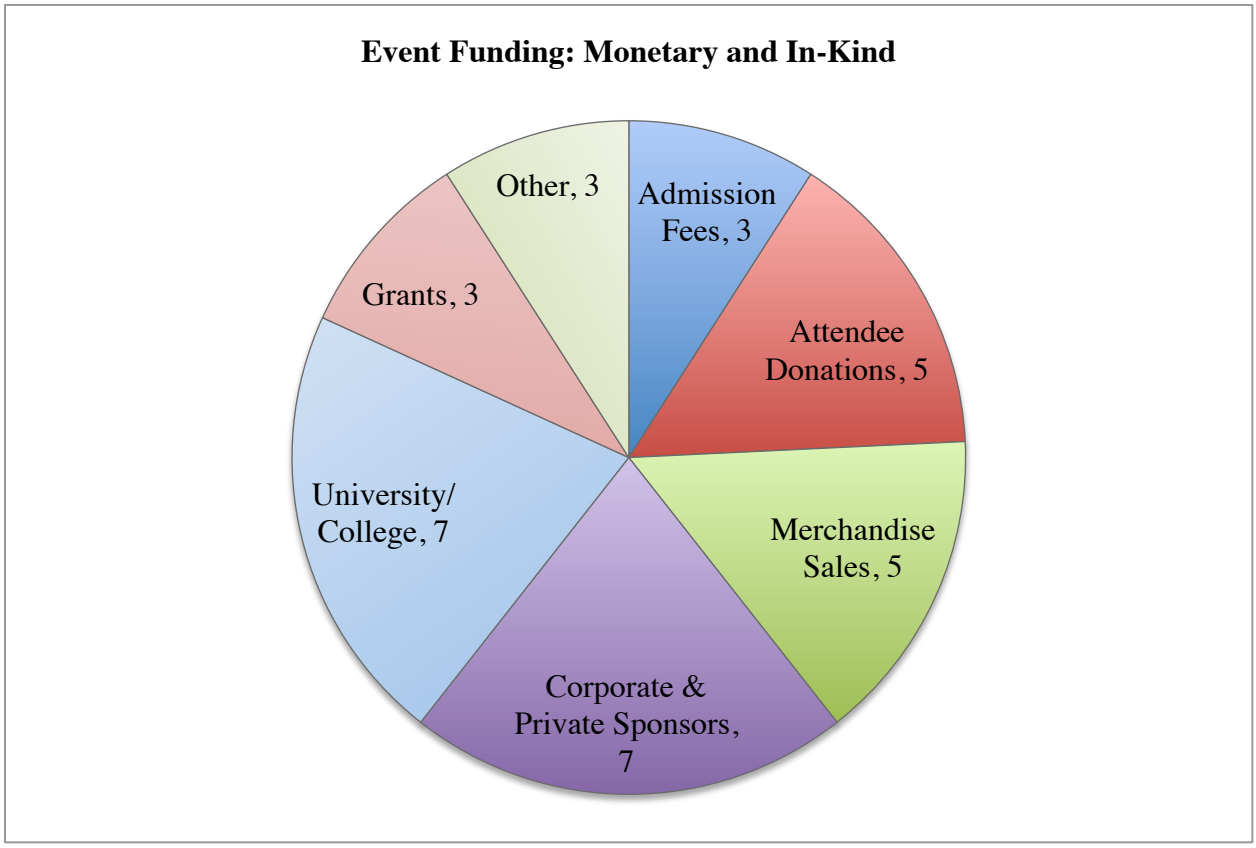


Table 2: Estimated Value of Annual Support and Live Arthropod Collections as Reported in 2016

	Estimated Annual Support		Estimated Value of Live Collections
Monetary	$172,770	**Zoo Value**	$111,610
In-Kind	$117,540	**Zoo Personnel**	$149,430
		Materials/Supplies	$38,580
Total:	$290,310	**Total:**	$299,620

Combined Total:	$589,930

Figure 14: Responses Regarding Community/Institutional Impacts of Entomology Outreach Events

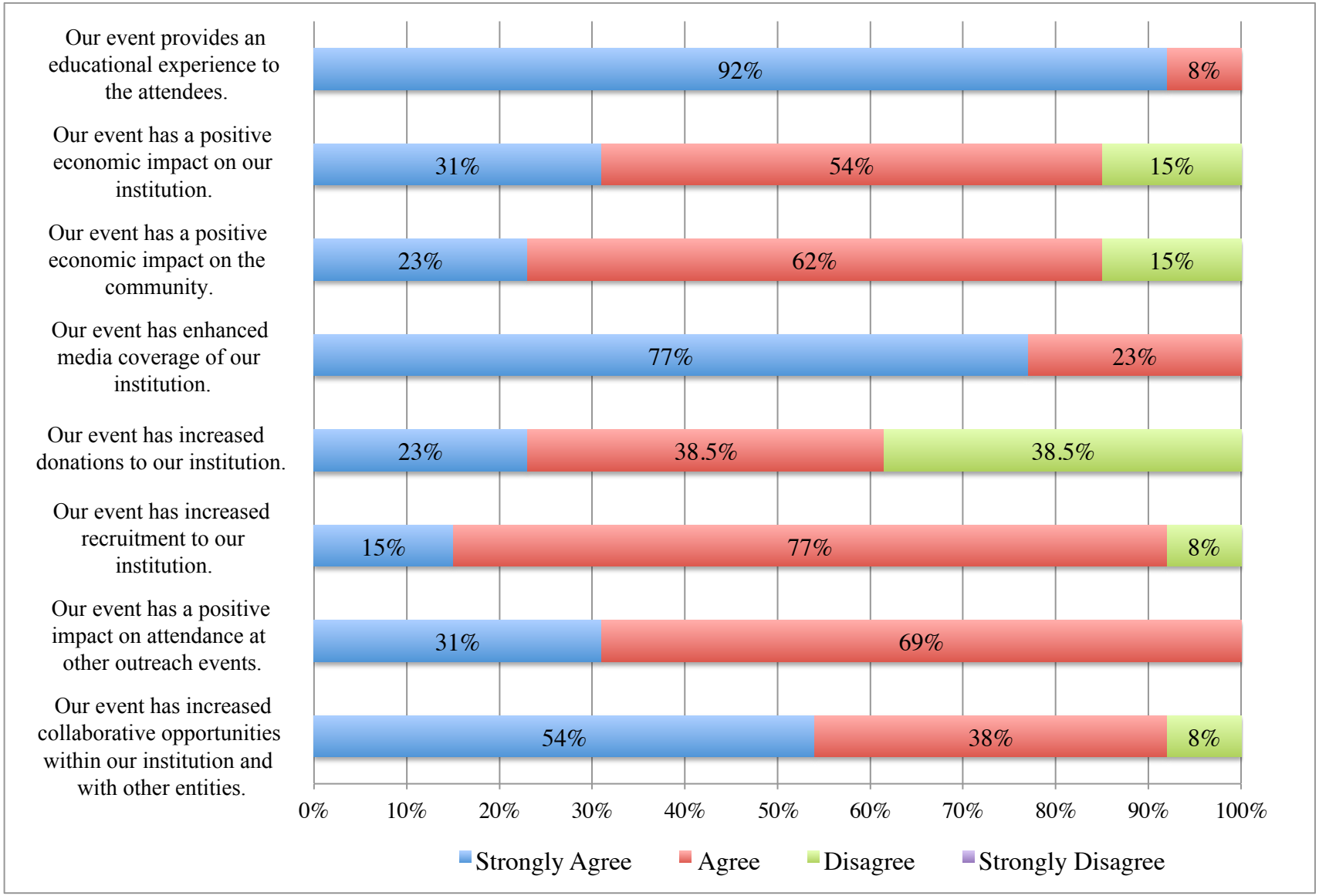
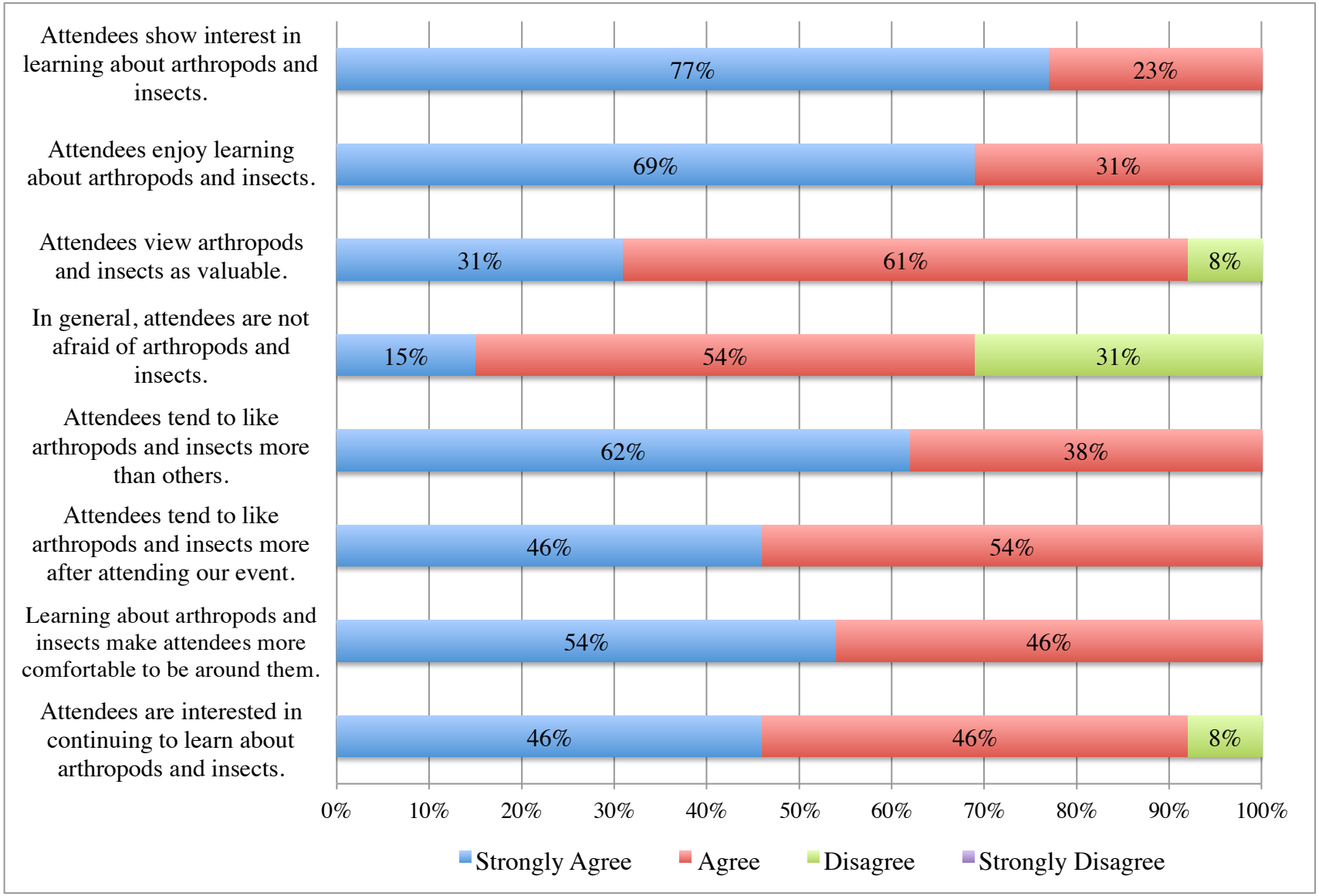


Figure 15: Responses Regarding Attendee Attitudes Toward Insects and Other Arthropods



Discussion of Research Questions

The previous sections of this chapter provided detailed description of the results of each survey. The following sections will correlate those findings with the three overarching research questions of the study.

Research question one. How does Hokie BugFest impact attitudes of youth attendees toward insects and other arthropods?

Not surprisingly, the majority of youth (usually around 70%) who participated in the JEC survey held positive attitudes toward insects and other arthropods before attending the event. On average, 30% of youth participants possessed negative feelings toward insects and other arthropods before attending Hokie BugFest. Of those 30%, an average of 60% reported feeling less afraid of insects and other arthropods after visiting exhibits. Additionally, an average of 44% of youth who did not report fear indicated visiting exhibits had positively impacted their attitudes. These findings suggest that Hokie BugFest has an overall positive impact on youth who attend the event.

Research question two. How does Hokie BugFest impact attitudes of adult attendees toward insects, other arthropods, and pesticides?

The majority of adults (usually around 75%) who participated in the SAP survey also held positive attitudes toward insects and other arthropods coming into the event. On average, 25% of adult participants possessed negative attitudes towards insects and other arthropods before attending Hokie BugFest. Of those 25%, an average of 25% strongly agreed and 72% agreed that the event had positively impacted their attitude toward insects and other arthropods. Overall, of all adult participants who did not report negative feelings an average of 49% strongly agreed and 50% agreed that Hokie BugFest had still positively impacted their attitudes. An

average of 46% of adult participants strongly agreed and 47% agreed that learning about insects and other arthropods made them more comfortable to be around these creatures. Further, an average of 42% of adult participants strongly agreed and 53% agreed that they planned to continue learning about insects and other arthropods in the future. In general, these findings suggest that Hokie BugFest has had a positive impact on adult perceptions of insects and other arthropods.

When adult participants were questioned about pesticides and arthropods in relation to their home, an array of perceptions were reported. On average, 59% of adults possessed negative attitudes toward insects and other arthropods found in and around the home. Participants were open to removal of these creatures from the home, or killing them using non-chemical means, but less comfortable with the idea of pesticide use. On average, 39% of adult participants disagreed and 36% strongly disagreed that they would use a pesticide to kill an insect or other arthropod that entered their home. Interestingly, an average of 8% of adult participants strongly agreed and 40% agreed they would use a pesticide as a preventative measure to keep insects and other arthropods from entering their home.

When adult participants were asked to respond to the statement, “I am not afraid of pesticides,” an average of 44% disagreed and 20% strongly disagreed. When participants were asked to respond to the statement, “Pesticides are not harmful to my health,” an average of 42% disagreed and 40% strongly disagreed. However, an average of 24% of adult participants strongly agreed and 51% agreed that exhibits at Hokie BugFest had positively impacted their attitudes toward pesticides. Although adult participants appeared to possess negative attitudes toward pesticides, findings indicated their willingness to learn about pesticides at the event, where exhibits offered information on safe use and pest management strategies.

Research question three. How do similar events of other institutions compare and contrast with Hokie BugFest?

This study identified fourteen events held at other institutions that are similar to Hokie BugFest. Like Hokie BugFest, most of the events are hosted by departments of entomology at universities as annual, single day events. They focused on many orders of insects and other arthropods, like spiders, scorpions, and millipedes, instead of focusing solely on one type of insect. Similar to Hokie BugFest, most of the institutions kept a live arthropod zoo year round to support their events. Live arthropod exhibits ranked consistently among the top displays at the majority of events.

Also comparable to Hokie BugFest, respondents estimated over 80% of people traveled within a one-hour distance to attend their event. Fifteen percent of respondents strongly agreed and 54% agreed that attendees are not afraid of insects and other arthropods. This finding corresponds highly to the percentages that were reported by Hokie BugFest attendees. Forty-six percent of respondents strongly agreed and 46% agreed that attendees were interested in continuing to learn about insects and other arthropods in the future. This finding is also highly comparable to the percentages that were observed with Hokie BugFest participants. Respondents were agreeable that attendees enjoyed learning about insects and other arthropods and felt more comfortable with these creatures after learning about them.

Several differences were reported between Hokie BugFest and other events. Some events had been ongoing for five or six years and some had been in existence for upwards of 30 years. Event funding was variable, as some events relied on university or corporate support, and others relied on donations or merchandise sales. Attendance was also varied, with some events reporting as few as 500 visitors, and others reporting up to 40,000 visitors. Two of the events, the

BugFest at the North Carolina Museum of Natural Sciences and the Bug Bowl at Purdue University, are two-day events. This likely contributed to the very large attendance numbers reported by these institutions.

This chapter discussed the findings from the three surveys used to assess Hokie BugFest attendees and to assess similar outreach events of other science instituions. Chapter Five will discuss the conclusions of the study and advice for future researchers.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This chapter provides a summary of the study and research objectives, limitations of the study, as well as contributions of the study and recommendations for further research.

Summary of the Study and Research Objectives

The study had two main purposes. The first purpose was to gain an understanding of how Hokie BugFest impacts attendee perceptions of insects, other arthropods, and pesticides. The second purpose was to compare and contrast Hokie BugFest with similar outreach events of other science institutions. Three research objectives were developed in order to achieve both goals. Each will be discussed in a numbered fashion below.

Research objective one. Compare and contrast Hokie BugFest with similar outreach events of other institutions and develop a community/consortium where event organizers can collaborate and share ideas.

To evaluate how Hokie BugFest compared with similar outreach events of other institutions, a Qualtrics survey was developed. Before developing the survey, events and their coordinators were identified. One difficulty of this process was that limited information existed concerning entomology outreach events. Incomplete literature justified the need for the study. In order to address this deficit, the researcher had to rely on information found on websites, many supported by the event's institution and some from local news entities. This could be considered rather unorthodox, however, it was necessary to supply enough information to begin the study. Once the information was gathered, the survey was created and distributed to these event coordinators.

The survey received a strong response rate of 93%. Hokie BugFest was found to have many similarities with events of other science institutions. Variations in attendance, event funding, and how long the events had been in existence were the main differences observed. All event coordinators indicated interest in forming a community/consortium where they could collaborate and share ideas.

Initially, the researcher planned to form this community/consortium as part of the study. Potential avenues for the community/consortium were investigated, such as forming a Google Group, forming a Facebook page, building a website, applying for an eXtension community of practice, or creating a formal collaborative working group through another entity such as 4-H/Cooperative Extension. However, it was concluded that forming the community/consortium would require extensive time and effort beyond the means of the researcher, and would be more appropriate as a professional endeavor.

Contributions of the study – objective one. The information gathered from this study will hopefully provide a base of literature should one choose to research this area further. As stated previously, information on these events was difficult to obtain. Making this study available will contribute to a body of literature that is lacking on university, entomology outreach events.

This study has also provided a foundation for the collaborators at each institution to connect, as they all indicated interest in forming a community/consortium to share entomology outreach resources. Implementing this community/consortium is a potential project for future efforts. The community/consortium would help collaborators at each institution develop professional relationships and allow them to maintain communication for years to come.

Recommendations for future research. The research of comparable outreach events at other universities and institutions could be continued. Events identified by this study can

continue to be tracked, and new events could be added to the body of work as they emerge. Since the UEOE survey was conducted, many of these universities and institutions have held their events again. Therefore, the information surrounding these events could be updated.

Research objectives two and three. The last two research objectives are part of the research that was conducted at Hokie BugFest. Due to their similar nature, the following objectives will be discussed as one.

- Evaluate how Hokie BugFest impacts attitudes of youth attendees toward insects and other arthropods.
- Evaluate how Hokie BugFest impacts attitudes of adult attendees toward insects and other arthropods, and how the event impacts perceptions of pesticides.

In order to achieve both goals, separate surveys were developed and distributed to youth and adult audiences at Hokie BugFest. One limitation of the survey population was the narrow amount of time the researcher had to collect data on attendees at Hokie BugFest. The event allowed for seven contact hours once a year; however, there were many exhibits for which attendees had to divide their attention. Therefore, survey questions had to be kept minimal for both youth and adults.

Another limitation of the survey population was that many participants coming into the event were already personally invested, meaning the majority possessed positive attitudes toward insects and other arthropods. Thus, the findings would not necessarily be easily generalized to a broader population. Further, due to the anonymous nature of the study, participants were not tracked longitudinally. Therefore, individual attitudes toward insects and other arthropods were not followed over time.

Despite these limitations, Hokie BugFest was found to positively impact youth and adult attitudes toward insects and other arthropods. When adults were questioned about pesticides, they reported a wide range of perceptions, many of which were negative. Regardless of these largely reported negative perceptions, adults reported positive event impacts on their attitudes toward pesticides.

Contributions of the study – objectives two and three. One contribution of this study is to the limited literature that exists on these entomology outreach events. Based on this study, few institutions have researched their events, or have simply not formally disseminated their findings. This study provides a basis of information on how this event was studied and how attendees perceived the event. Should another institution choose to study their event, this work will be available for their use.

Another contribution of this study is to the body of work that exists in other states concerning public perceptions of pesticide use in and around the home. Although this study focused on Hokie BugFest attendees, most of which were from southwest Virginia, the findings provide a sample of perceptions of pesticide use in and around the home for this region of the state. The findings offer a foundation that could be built upon through further research.

Recommendations for future research. There are several avenues for future research based on the findings of this study. Continuing this research at Hokie BugFest would allow for additional data collection, therefore permitting further insight into this event. It would also allow for further refinement of the survey instruments, to obtain higher quality data or to obtain additional data that was not collected in the past.

A possibility for future researchers would be to convert the JEC survey and the SAP survey into an electronic form. This would allow for swift and smooth data collection. An

electronic survey would also permit faster data tabulation. This process would have to be well executed to be successful at large events, since crowd control can sometimes be an issue. The use of iPad stations is a possibility to prevent people from waiting in line to take the survey.

Portions of this study could also be replicated at other institutions to allow for data collection at those entomology outreach events. This would permit other entities to contribute to this body of work. As mentioned previously, the results of this study would be difficult to generalize to a broader audience. However, should the research take place at other institutions, the results of this study could be compared with those of other similar outreach events.

Another recommendation would be to pilot new survey instruments as was done in this study. Testing the survey instrument allows the researcher to make corrections with the gathered feedback. For example, when the JEC survey was first piloted, categories for gender were listed as “Male” and “Female”. Many children questioned their parents about what this meant. Therefore, the researcher changed the gender categories to say “Boy” and “Girl” to reflect the needs of the youth audience.

Hokie BugFest Update, Conclusions, and Perspectives

Since the UEOE survey was conducted, Hokie BugFest has continued to progress. In the fall of 2016, the event entered its sixth year. An estimated 7,700 people attended the event, 200 of which were volunteers. In 2017, Hokie BugFest entered its seventh year. An estimated 8,400 people attended the event, 250 of which were volunteers. A bug-eating contest was added to the event in 2017 and proved to be very popular. Nevertheless, the most popular exhibits have remained live arthropod displays.

Although this study is completed, the professional work that surrounds it will continue. Hokie BugFest is one of many 4-H entomology activities at Virginia Tech that occurs and grows

year after year. This and other activities manifested through the Virginia Cooperative Extension plan of work for 4-H entomology. The 4-H entomology plan of work is a new venture and the findings from this study will help build it and encourage participation from Extension faculty across the state.

It is likely this work will continue to thrive and be expanded upon by the 4-H entomology plan of work committee. This study has provided a path to collaborate with other universities and institutions and to share ideas that encourage STEM and STEAM activities within many localities. By participating in the community/consortium, collaborators will be able to enrich their programming and other 4-H entomology activities.

This study has also allowed for insight into public perceptions of insects, other arthropods, and pesticides. Understanding this audience is key in knowing how to properly convey scientific information on insects and other arthropods, pest management strategies, and pesticide safety. The findings will assist those hosting entomology outreach events in recognizing the needs of their audience.

Plans to publish these findings have been examined. There are several opportunities for journal articles that emerged during the course of the study. The results from the UEOE survey, the JEC survey, and the SAP survey all have potential to be published as individual articles in appropriately selected journals.

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Appendix A

Internal Review Board Approval Letter

VirginiaTech

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: June 10, 2016

TO: Michael John Weaver, Stephanie Lynn Blevins

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)

PROTOCOL TITLE: Thesis: Comparing University Entomology Outreach Events to Gauge Public Opinion of Arthropods

IRB NUMBER: **16-587**

Effective June 10, 2016, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Exempt, under 45 CFR 46.110 category(ies) 2,4**
Protocol Approval Date:	**June 10, 2016**
Protocol Expiration Date:	**N/A**
Continuing Review Due Date*:	**N/A**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
An equal opportunity, affirmative action institution

Date*	OSP Number	Sponsor	Grant Comparison Conducted?

* Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.

Appendix B

Participation Solicitation Email

My name is Stephanie Blevins. I am a master's candidate in the Virginia Tech Department of Entomology in Blacksburg.

Our department hosts an annual event called Hokie BugFest. It is an outreach (STEM/STEAM) event that promotes the science of entomology by showcasing our research and educational programs. This will be our sixth year hosting the event.

Through literature review and web searches, I have learned your institution hosts a similar event. As part of my research study I am seeking collaborators and collecting information about these events. I have prepared a 10-15 minute survey to collect information.

The planned outcome of this work will be to share the findings through publication. I also hope to encourage further collaboration among those who participated in the survey by organizing a formal consortium.

If there is another person at your institution who is better suited to participate, please let me know so I may contact them. If you have difficulty completing the survey, please feel free to contact me with questions.

Thank you very much for your time.

Stephanie Blevins

Follow this link to the Survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
https://virginiatech.qualtrics.com/SE?SID=SV_26ucSWMm4L2tqn3&Q_CHL=preview&Preview=Survey

Follow the link to opt out of future emails:
Click here to unsubscribe

Stephanie Blevins
Department of Entomology
VTPP – 302 Agnew Hall (MC0409)
460 West Campus Drive
Blacksburg, VA 24061
(540) 231-6543
slblevin@vt.edu

Appendix C

University Entomology Outreach Events Survey

VirginiaTech
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University, Entomology Outreach Events Survey

My name is Stephanie Blevins. I am a master's candidate in the Virginia Tech Department of Entomology in Blacksburg.

Our department hosts an annual event called Hokie BugFest. It is an outreach (STEM/STEAM) event that promotes the science of entomology by showcasing our research and educational programs. This will be our sixth year hosting the event.

Through literature review and web searches, I have learned your institution hosts a similar event. As part of my research study I am seeking collaborators and collecting information about these events. I have prepared a 10-15 minute survey to collect information.

The planned outcome of this work will be to share the findings through publication. I also hope to encourage further collaboration among those who participated in the survey by organizing a formal consortium.

If there is another person at your institution who is better suited to participate, please let me know so I may contact them. If you have difficulty completing the survey, please feel free to contact me with questions.

Thank you very much for your time.

Stephanie Blevins

VT IRB Number 16-587, Exempt

The purpose of this study is to collect information about university entomology outreach events. Please know that your participation is voluntary and that you may stop at any time. The data will be kept confidential, and the results may be published.

0% 100%

>>

Q1) Please indicate which event is being surveyed:

- o Arizona Insect Festiva, University of Arizona
- o BugFest, North Carolina Museum of Natural Sciences
- o Bug Fest, Drexel University
- o Bug Fest, Indiana University
- o BugFest, University of Florida
- o Bug Bowl, Purdue University
- o Hokie BugFest, Virginia Tech
- o Insectapalooza, Cornell University
- o Insect Fear Film Festival, University of Illinois
- o Insect Festival, University of Arkansas
- o Insectival, Oxbow Meadows Environmental Learning Center at Columbus State University
- o Insect-ival! Family Festival, University of Georgia State Botanical Garden
- o Insect Zoo Open House at the University of Georgia
- o The Great Insect Fair, The Penn State University
- o Other

Q2) Is the event hosted by a:
(Check all that apply.)

- o University or College (as a whole)
- o College within a University
- o Department within a University or College
- o Cooperative Extension – Ag & Natural Resources
- o Cooperative Extension – 4-H
- o Local Museum
- o Other Entity

Q3) How often do you hold the event?

- o Twice a Year
- o Annually

- Every Other Year
- Every Three Years
- Every Four Years
- Every Five Years

Q4) Which days of the week did you hold your most recent event?
(Check all that apply.)

- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Saturday
- Sunday

Q5) How many total hours did you run your most recent event?

	0 5 10 15 20 25 30 35 40 45 50
Hours	

Q6) Including this year, how many years have you been hosting the event?

	0 5 10 15 20 25 30 35 40 45 50
Years	

Q7) Approximately how many people did it take to operate the most recent event?

	0 50 100 150 200 250 300 350 400 450 500
Volunteers	
Paid Event Staff	

Q8) What types of funding (monetary and in-kind) support the event?
(Check all that apply.)

- o Admission Fees (mandatory)
- o Exhibit Fees
- o Voluntary Donations (from attendees)
- o Merchandise Sales
- o Corporate & Private Sponsors/Donors
- o University/College Funding
- o Grants (Private & Public)
- o Other Funding

Q9) What is the cost of admission to the public?
(If admission is free, you still must move the slider forward and back to zero to proceed.)

Dollars

	0 3 6 9 12 15 18 21 24 27 30
Admission Fee	

Q10) What is the approximate value of your annual support (monetary vs. in-kind)?

Dollars

	0 10000 20000 30000 40000 50000 60000 70000 80000
Monetary	
In-Kind	

Q11) Please list five exhibits/activities that make your event attractive to the public:

1. [ ] Most Significant
2. [ ]
3. [ ]
4. [ ]
5. [ ] Least Significant

Q12) Do you keep a live arthropod collection year round to support outreach and educational efforts?

- Yes
- No

Q12a) Approximately how large is your live collection?

	0 20 40 60 80 100 120 140 160 180 200
Insects (# of species)	
Arachnids (# of species)	
Social Insects (# of colonies)	
Other Arthropods – myriapods, isopods, crustaceans, etc. (# of species)	

Q12b) What is the approximate value of your live arthropod collection (including their enclosures)?

	Dollars 0 10000 20000 30000 40000 50000
Value	

Q12c) What is the approximate cost to maintain your live arthropod collection annually?

	Dollars 0 20000 40000 60000 80000 100000
Personnel	
Materials & Supplies	

Q13) On a scale of 0 to 100, estimate the percentage of attendees that fall into these categories:
(Percentages indicated in each category should equal 100 when added.)

Age 0 – 4: ☐
Age 5 – 8: ☐
Age 9 – 13: ☐
Age 14 – 17: ☐
College Students: ☐
Parents: ☐
Grandparents & Senior Citizens: ☐

Total: ☐

Q14) On a scale of 0 to 100, estimate the percentage of attendees as male or female:
(Percentages indicated in each category should equal 100 when added.)

Male: ☐
Female: ☐

Total: ☐

Q15) On a scale of 0 to 100, estimate the time/effort attendees take to travel to your event:
(Percentages indicated in each category should equal 100 when added.)

Within 1 Hour Travel Distance: ☐
Within 3 Hours Travel Distance: ☐
Within 6 Hours Travel Distance: ☐
More than 6 Hours Travel Distance: ☐

Total: ☐

Q16) Please give your best estimate of how many people attended your most recent event:

_____

Q17) Please indicate your opinion of the following statements.

	Strongly Agree	Agree	Disagree	Strongly Disagree
Our event provides an educational experience to the attendees.	○	○	○	○
Our event has a positive economic impact on our institution.	○	○	○	○
Our event has a positive economic impact on the community.	○	○	○	○
Our event has enhanced media coverage of our institution.	○	○	○	○
Our event has increased donations to our institution.	○	○	○	○
Our event has increased recruitment to our institution.	○	○	○	○
Our event has a positive impact on attendance at other outreach events.	○	○	○	○
Our event has increased collaborative opportunities within our institution and with other entities.	○	○	○	○

Q17a) Please share any positive or negative aspects of your event that has been conveyed to you by your participants:

_____

_____

_____

_____

_____

Q18) Please indicate your opinion of the following statements.

	Strongly Agree	Agree	Disagree	Strongly Disagree
Attendees show interest in learning about arthropods and insects.	○	○	○	○
Attendees enjoy learning about arthropods and insects.	○	○	○	○
Attendees view arthropods and insects as valuable.	○	○	○	○
In general, attendees are not afraid of arthropods and insects.	○	○	○	○
Attendees tend to like some arthropods and insects more than others.	○	○	○	○
Attendees tend to like arthropods and insects more after attending our event.	○	○	○	○
Learning about arthropods and insects makes attendees more comfortable to be around them.	○	○	○	○
Attendees are interested in continuing to learn about arthropods and insects.	○	○	○	○

Q19) Would you be interested in participating in a consortium that shares knowledge and resources for entomology outreach activities? (i.e. festivals, camps, youth education, STEM/STEAM activities, bug zoos, etc.)

- o Yes
- o No

Q19a) Please provide your contact information:

Name: _____

Address: _____

Address 2: _____

City: _____

State: _____

Postal Code: _____

Country: _____

Phone #: _____

E-mail: _____