Does Fabric Inhibit Larval Access to Decomposing Remains?

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Abstract

Flies colonize and lay their eggs on all forms of organic matter including carcasses of animals and humans. Once colonized, the eggs will grow into larvae and begin their life cycle. Larvae, the young of the flies, are known to eat the carcass and aid in decomposition. Forensic entomologists use the larvae in criminal investigations or research in order to help determine time of colonization. Covered carcasses can make it harder for flies to colonize as the carcass is not easily accessible. Using previous knowledge of blow flies and larvae, their life cycle and colonization, this project aims to see how time of colonization is affected by different fabrics. My results show that the different fabrics still allow for colonization, but at a slower rate than an unwrapped carcass. These results can be used when determining time of colonization for carcasses wrapped in fabrics, carpets or other substances that may be used to cover a carcass.

Introduction

For centuries flies have helped investigators solve crimes and figure out what happened to a carcass before it is found. Flies are often the first responders to a crime scene and can find a carcass in different habitats and settings. Calliphoridae, commonly known as blow flies, are commonly associated with crime scenes as they can smell dead matter up to 2km away. There also are many other types of flies that can arrive at a crime scene such as Phoridae (coffin flies), Muscidae (house flies) or Sarcophagidae (flesh flies) (Carloye & Bambara, 2006). All of these flies and other insects are helpful forensically when determining time of death and time of colonization. Time of colonization is the first colonization that occurs on a carcass once it is found by a fly. Once the eggs have grown into the larval stage, the larvae then help aid in decomposition. They do this by growing and developing from feeding on the carcass. Through this feeding they break down the organic matter of the carcass which helps decompose the carcass down to the skeletal stage.

Forensic entomology is a field of forensic science which involves the application of the study of insects and other arthropods in criminal investigations and legal cases (Forensic Entomology, 2013). The field of forensic entomology is ever growing, as more and more people realize the importance of the presence of insects. Insects, especially flies and their larvae aid in forensic entomology in different ways. A few important ways in which they help are in determining the time of colonization, determining the time of death, aiding in the decomposition process, or helping determine if a carcass has been moved or disturbed (Anderson, n.d.). As the field grows, this leaves many new areas of research on anthropogenic influences on decomposition and insect activity.

Forensic textiles is the use of fabrics, such as clothing, and their distinctive patterns to help aid in criminal investigations. It is a subfield of forensic science and is still a relatively new

field, so little research is available on this topic, such as how different fabrics affect larvae. A previous study by Dautartas (2009) looked at wrapped remains in different materials. Eight cadavers were used, with two left unwrapped, as a control, and four were wrapped in a cotton blanket or a plastic tarp. The cotton blanket individuals had mummified tissue, similar to the control individuals. However the cotton blanket individuals had more prevalent mummification than the control and plastic tarp individuals. The plastic tarp individuals had the most dramatic differences in decomposition. They had no mummification and still had insect activity by the end of the experiment (Dautartas, 2009). Besides this study, unfortunately not much else is known on whether or not covering up this matter affects the colonization of flies and the life cycle of larvae and the colonization. The previous study looked more at the effects of wrapping a carcass, and less at the effect of wrapping a carcass on insects. If wrapping a carcass does affect insects and their colonization, this could change the time of colonization estimations for carcasses that are covered up.

The objective of this study is to determine if fabric inhibits a flies' attraction and colonization of a decomposing carcass. Fabric covered carcasses were hypothesized to have slower decomposition than unwrapped carcasses due to restricted larval access. It also was hypothesized that the uncovered carcasses will have more colonization and insect activity than the wrapped carcasses due to the larvae having quicker access to the carcass and the flies being able to smell the attractants quicker than the wrapped carcasses.

Materials and Methods

This experiment was conducted at the Entomology Field Operations Building (EFOB) field in Fall 2021. Nine fetal pig carcasses (1409g) were used as a proxy for decomposition, with three carcasses serving as the control. The six remaining carcasses were wrapped in 0.91m of fabric (cotton or polyester) and secured with duct tape. Each carcass was placed 18m apart, and protected from vertebrate scavengers with an aluminum cage that was secured to the ground with tent stakes.

At each observation, photographs were taken of all carcasses. Temperature and humidity were recorded hourly with a data logger (HOBO MX2300, Onset Computer Corporation, Bourne, MA).

Insect samples were collected, with live samples placed into clear plastic containers with sand and a piece of beef liver as a food source, and secured with a breathable lid. Eggs and larvae were reared until they reached the adult stage, where they were pinned and identified. Adults and live beetle samples were placed into a vial with 70% ethanol and stored until identification. Flies were identified to species using a dichotomous key (Jones et al., 2019). Beetles were identified using the key to British Silphidae (Whiffin et al., 2019).

Results

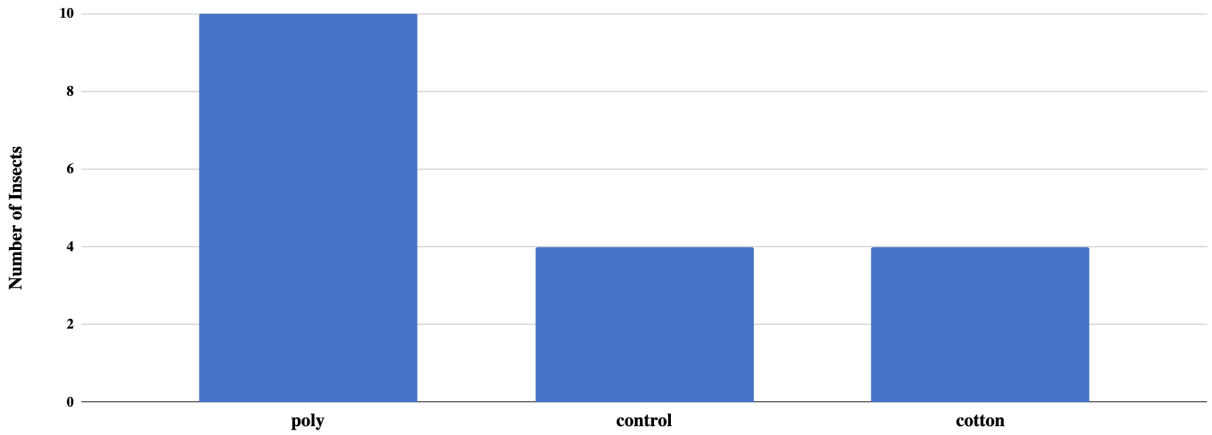

Figure 1: The type of fabric that was colonized and the number of insect samples present. This is based upon the samples that made it to adulthood and which fabric they were originally colonized on.

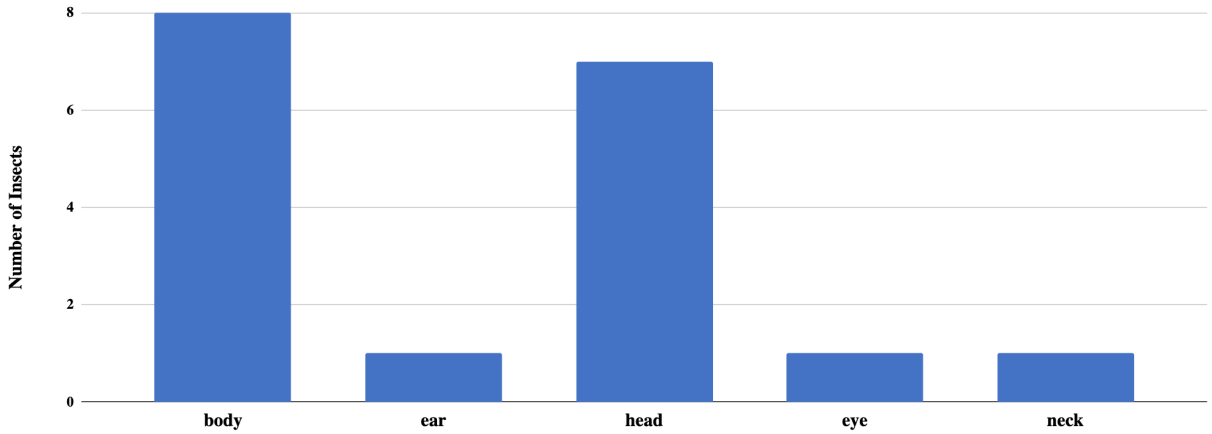

Figure 2: The location on the body that was colonized and the number of insect samples present. This is based upon the samples that made it to adulthood and what location they were collected from.

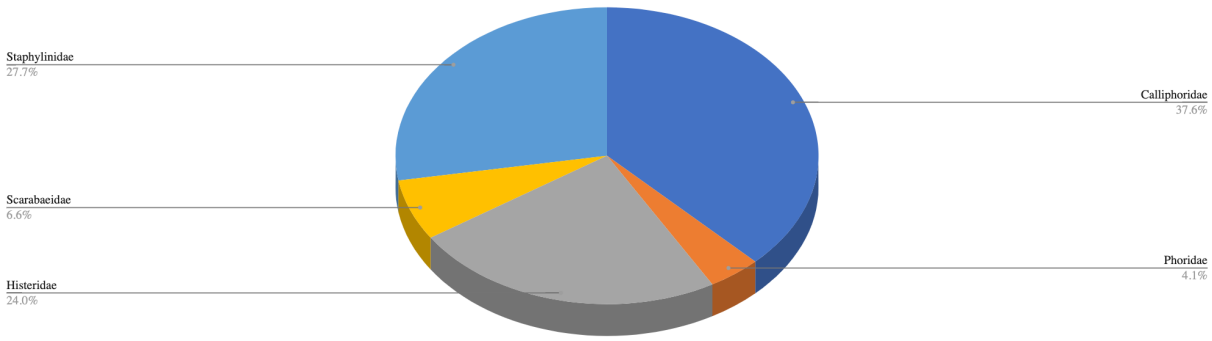

Figure 3: The percentage of different families that were collected in the insect samples. This is based upon the samples that made it to adulthood.

Based on the figures above, the type of fabric that had the most colonization was polyester. According to figure 1, there were ten insect samples from the polyester fabric, while there were only four from the cotton and the control. This shows that the polyester samples had the most insects that made it to adulthood from their initial colonization. This is interesting because the polyester covered bodies colonized later than the control bodies. According to figure 2, the location with the most collected samples was from the body, which was defined as the stomach and side area of the pig body. The body had eight samples collected from it with the head coming in second with seven samples collected. The rest of the samples were collected from the ear, eye and neck with each having one sample collected. This is interesting that the body had the most samples collected that made it to adulthood and the head being second since usually the eyes or the mouth are quickly colonized due to easy access. Lastly according to figure 3, the most common insect present was *Calliphoridae* with 37.6% of the samples that made it to adulthood being this insect. This is not shocking as blowflies were the most collected samples from the bodies. Figure 3 also shows that there also was a *Phoridae* present which was interesting to find since they are known to be flies that bury themselves. While there was one present, I am surprised that there were not more due to the bodies being wrapped and insects needing to chew through the fabric to get to the body.

Discussion

In the lab, about ⅔ of the specimens did not make it to adulthood. The insect samples collected died as larvae, did not emerge from their pupal cases, and if they did, they were not fully grown and were unidentifiable adults. There could be more diversity in the results if there was a higher survival rate of larvae, pupae and adults. The specimens possibly could be *Lucilia coeruleiviridis,* the green bottle fly, which is known to be difficult to rear in a lab setting. This species is common in Indiana, so it would not be alarming to find this species among the adult samples. However, this species is difficult to keep alive once taken from the natural setting and is difficult to rear to adulthood in a lab setting. While we cannot say for certain that the specimens that did not make it to adulthood is this species due to them being unidentifiable, it is a possible explanation for the low survival rate from the samples collected.

Based on the data collected, covered bodies took longer to attract flies than the uncovered bodies. Flies did not show on the covered bodies until attractants had made their way to the top layer of the fabric. When first wrapped, the covered bodies had no activity as the attractant was freshly trapped as opposed to the uncovered bodies that had activity the day they were placed. The uncovered bodies had initial colonization that day and began their decomposition process. Once the fluids and attractants from the covered bodies had seeped to the outer layers of the fabric, activity then became present as more flies could smell this attractant. After the initial colonization happened on the covered bodies, they too began their decomposition process.

Based on the data, uncovered bodies had a quicker colonization than the covered bodies. From the data sheets collected on Day 0, the control bodies had maggots that were collected. This began the colonization of the control bodies and the collection of insects as well. Insect samples were collected from the control bodies through Day 2. From the data sheets collected on Day 7, the cotton and polyester bodies had maggots that were collected. This began the colonization of the wrapped bodies, an entire week after the control bodies were colonized. Most of the insect samples of the polyester wrapped bodies were collected through Day 11 with a few other collections happening Day 1 and 2 and Day 15 and 17. Most of the insect samples of the cotton wrapped bodies were collected through Day 9 with a few other collections happening Day 1 and 2 and one on Day 17. Using this data we were able to determine that the uncovered bodies colonized quicker than the covered ones, which most likely is due to the fact that the attractants were available quicker on the uncovered bodies allowing for quicker colonization.

These results are important in forensic textiles, forensic entomology and in forensics in general as they can be used at crime scenes with wrapped or covered remains. In the future, these results can be useful when determining the time of colonization of a wrapped body. As stated previously, from the data that was collected, the covered carcasses were colonized later than the uncovered carcasses. This is important to note as these results add this new information to the field of forensics and the time of colonization estimates. Additionally, these results add new information in the context of previous studies as this study looked at fabric wrapped remains, while other studies look more at covered remains in things such as suitcases, trash bags and plastic tarps. This study adds the new information of how fabrics affect blow fly attraction and larval abilities to get to remains.

Overall, colonization happened on all of the uncovered and covered bodies, so covering a body does not inhibit colonization. It does however affect the rate at which colonization happens due to the scent of the attractant being masked in the covered bodies by the fabric until it gets to the top layer. This also means that a slower colonization will make the decomposition go slower. All of the bodies did get to the decomposed stage, so different fabrics do not inhibit this as well. Decomposition and colonization go hand in hand, so the slower one goes, most likely the other will go at the same rate. Different fabrics do not inhibit either of these from happening, but they do interfere a bit in the speed of these processes.

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