The Effects of Scavenging on Blow Fly Colonization
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Introduction

Forensic entomology is the application of the study of insects to the practice of law. One of the most common insects applied in forensic entomology is flies (Amendt, et al., 2004). When an animal dies because they release volatiles that are attractants to flies (Flint et al., 2022). Flies also have an incredible sense of smell, so strong they are able to detect the smallest milliliter of volatile in the air within a several mile radii.

The period of time when blow fly oviposition and the following feeding and discovery is known as time of colonization, this may be calculated using data on the development of flies (Bagsby & Hans, 2024). Adult flies are attracted to the body and then lay eggs in crevices and wounds. Those eggs then hatch into maggots, and they start to eat the body and go through the different instars in the maggot life stage. When they reach the final instar, they will pupate and turn into an adult, and thus the cycle continues (Shah et al., 2015).

Forensic entomologists use the flies' lifecycle to measure the approximate time of colonization by using the temperature in the area in tandem with rearing maggots collected and identifying the fly species. It is important to identify the species, due to individual fly species needing differing amounts of growing degree days. With the temperature and fly identified, it is possible to calculate the approximate time of colonization.

Normal oviposition sites for flies are the body's orifices, since the eggs are vulnerable, adults prefer to their eggs in these sites as they provide easy access for the maggots to get to softer and nutritious tissue and provide cover (Amendt et al., 2004). So, when there are other openings on a corpse or carcass, like a cut, it creates a new potential oviposition site for a fly (Amendt et al., 2004; Amendt et al., 2011; Flint et al., 2022, Munro et al., 2019). Flies prefer to oviposit on resources that have cover like an animal with fur rather than a piece of meat (Amendt et al., 2011).

One question that has not been adequately addressed in this field is the influence of scavenging on blow fly colonization. A study that supports that scavenging affects colonization was examined with rodent scavenging on swine carcass. The study specifically looked at rodent scavenging increasing oviposition sites for primary colonizers (Flint et al., 2022). The study found that the rodent feeding increased the oviposition sites for primary colonizers by opening a new wound that colonizers could use to access more tissue. Their study relates to this study in the scavenging aspect, however, we aimed to see whether the amount of scavenging has effects on colonization, and what those effects are not whether scavenging in general increases colonization. When vertebrate scavengers interact with remains, they can interact with remains by scattering pieces when eating and degrading the remains (Indra et al., 2023). Vertebrate scavengers target the most nutritious parts of the remains and do whatever to get to it, which includes scattering pieces. Vultures, the most common vertebrate scavengers do this as they are

obligate scavengers. Almost all other vertebrate scavengers are facultative and do not need to eat carrion as a primary food source but will still scatter remains (Selva, et al., 2019).

My hypothesis is that with an increase percentage of scavenging, there will be an increased blow fly colonization. The significance of this research is to expand upon forensic entomology in relation to death investigation. Time of colonization is an estimation of insect age to determine when colonization occurred (Amendt et al., 2011). Since scavenging removes mass from the resource, this would affect the timing of the decomposition and may also affect the time and patterns of colonization. I looked for any difference in species present and in what abundance. The goal of this project was to determine the effects of scavenging on blow fly colonization.

Methods

The experiment was conducted at Purdue University's EFOB (Entomology Field Operation Building), the replicates' locations were randomized with a computer to assign the replicates' number to the position. The replicates were at least 15 meters apart from each other. There were three replicates per treatment, with three treatments representing a different amount of scavenging. A control (to allow for natural vertebrate scavenging), uncaged, 25%, and 75% mass removed treatments were used to simulate scavenging. For the treatments, 25% or 75% of biomass was removed until the desired percentages were reached. When the carcasses were placed in the field, they had steel wire chicken cages (30 x 61 x 45cm) to stop any vertebrate scavenger activity. Observations were made every 48 hours for 7 days totaling 5 observations. During observation periods, documentation included decomposition stage with photos using a DSLR camera, the location of colonization and insect activity. A subsample of insect eggs was collected on the first observation day averaging 150 eggs per replicate, and then reared the eggs to adults to identify the species present. The eggs were reared in jars that contained pine shavings and beef liver for food and moisture. If the liver dried or started to mold it was replaced. Photographs were taken at every observation time. Temperature and humidity data was collected via a HOBO data collector (MX2300, Onset Computer Corporation, Bourne, Massachusetts). The trail camera used to collect footage was a Vikeri 4k 32MP trail camera. I collected and reared adults, and identified the flies to species using Jones et al., 2019.

Results

The larvae that were reared out and survived to adulthood (n = 58) were collected from the control carcasses and identified as *Lucilia sericata* (Diptera: Calliphoridae) (Meigen, 1826). The 75% replicates did not skeletonize and only mummified without much maggot activity. The 25% replicates skeletonized faster than the controls. No live maggots were collected from the replicates. The mean temperature during the experiment was 18.76 +/- 6.05°C.

A red-shouldered hawk (*Buteo lineatus*) (Accipitriformes: Accipitridae) (Gmelin, 1788) was observed scavenging on one of the control carcasses (figure 1) on the third day. In figures 2

and 3, there is a difference in the amount of egg masses laid between the 25% and 75% treatment after 24 hours, where the 25% had more than the 75%. At the end of the experiment, the 25% treatments had fully skeletonized while the 75% treatments had mummified instead.

Discussion

The data collected in this study, was to mainly determine a relationship between blow fly colonization and scavenging, while making note of the species diversity present. This study was intended to be useful for forensic investigators as it could assist with the determination of the effects of scavenging on carrion.

Due to a lack of data, the hypothesis was not supported. I hypothesized that blow fly colonization would increase with scavenging, but the data for the replicates across the treatments did not reflect this.

While my hypothesis was not supported, there were interesting points of note. One being that the 25% replicates skeletonized faster than the controls while the 75% replicates mummified. This would indicate that there must be a certain limit to when blow flies will colonize and fully decompose the carcass. In Flint et al., 2022, they noted that rodent scavenging increased the oviposition sites on the hogs that they were using. This led to me inquiring whether there was a correlation with how much was scavenged with blow fly colonization.

The limitations of this study were the low number of replicates per treatment, due to eggs only being collected after the first 24 hours and at no other time. This would limit the possibility for more flies to visit and deposit more eggs for rearing.

If this experiment were to be redone, I would suggest having more than one collection event so that more flies can be reared out and see the different species that were in the area.

For future experiments in this line of thinking, I hope that they will look to our efforts and modify it to have a better chance of success with their data and cracking the code of scavengers and the scavenged. This would be a huge benefit for forensic investigators and push forensic entomology even farther as the field still has so much research to be done.

References

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Figures

Figure 1: A red-shouldered hawk that was caught scavenging on the trail camera on uncaged treatment pig 9.

Figure 2: 75% treatment with blow flies and a wasp. There are blow fly eggs laid around the head. The eggs from this replicate were sampled from the around the head, the mouth, and the underside.

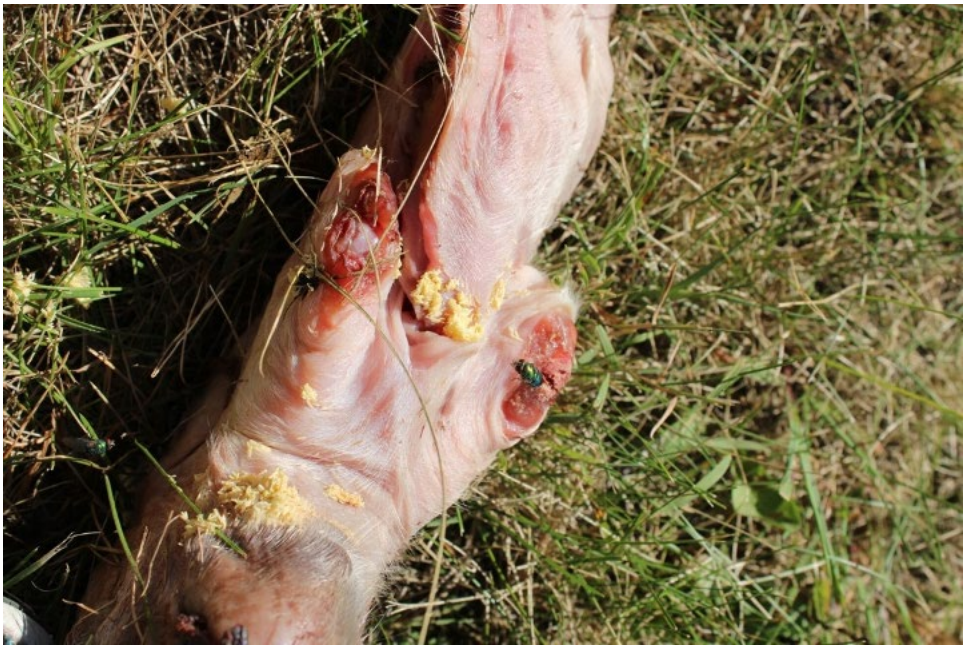

Figure 3: 25% treatment with large egg masses that were laid on the neck, “arm pits,” natural orifices, and inside the artificial scavenging. The eggs collected from this replicate were from the chin area, “arm pits,” and wound.