A Comparison of Insect Succession on Burned and Unburned Porcine Cadavers

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Introduction

Entomological data has been shown to assist in determining time of death (TOD) by determining the minimum postmortem interval (minPMI) via time of colonization (TOC) (Mahat, Zainol-Abidin and Nordin). Necrophagous arthropods have a life cycle that is split into predictable and distinct stages, each of which leave physical evidence on or near the body or where a body has been (Cruise, Watson and Schal). Arthropod evidence is then collected and preserved so that identification of the species can be performed. This data is combined with environmental data, information about arthropod eating preferences, and determination of larval stage. This information is then analyzed to determine the TOC.

Insect succession on carrion is highly variable because geographical location, local ambient temperature, stage of decomposition, endemic species, access to the carrion matter, and excess perimortem or postmortem damage to the carcass can affect the initial time of colonization. As arthropods are ectothermic, the rate of development from egg to adult is temperature-dependent; therefore, tracking the local temperature by using the nearest weather station information is critical to the determination of time of colonization (Cruise, Watson and Schal). Arthropods are attracted to carrion and other decaying matter via detection of volatile organic compounds (VOCs). Upon discovery, adults will oviposit in any available orifice or wound. As the eggs hatch, the larval stage will feed continuously as it matures. Although the pupal stage is largely stationary, pupal evidence is frequently missed during crime scene investigation (Malainey and Anderson).

Since fire is an effective method for concealing evidence, burning is one of the most prevalent methods for cadaver disposal. This method can obscure the identity of the decedent, the manner and cause of death, and the location and time of death (Fairgrieve). Despite this, few entomological studies on the subject are available (Mahat, Zainol-Abidin and Nordin). In the following sections, we analyze the growth and development of blowflies on burned and unburned pig cadavers to determine if burning a cadaver affects insect succession and oviposition.

Methodology

Three porcine feet were obtained from a local butcher shop to serve as cadavers. The fresh porcine remained covered, while the other two were burned to simulate arson victims using levels two (CGS-2) and three (CGS-3) of the Crow-Glassman Scale (CGS). The cadavers were placed in a tinfoil “boat” inside of a 12ft. x 12ft. covered, outdoor enclosure simultaneously, which served as time of death (TOD). The enclosure was lined with chicken wire to allow access for the insects, but also served as protection from local wildlife and other scavengers (Figure X). The accelerant for the arson simulation was approximately 237 mL of Publix QuickLight Lighter fluid.

All cadavers were observed via a Youtube livestream for insect activity. Direct observations were also performed daily. Adult insect and larval samples were collected for preservation and rearing throughout the observation period (13 days). The larvae selected for rearing observations were placed in an indoor, temperature-controlled enclosure with raw beef liver until pupation and hatching occurred. Other larval specimens were killed in hot water and preserved in 70% reagent-grade alcohol. Larvae and caught adult specimens were examined microscopically for identification to assist in the completion of three comparative succession charts (image x).

After identifying the necrophagous species and comparing their growth to existing data which utilizes the temperature and stage of larvae, a numeric range will demonstrate the difference in succession between a fresh, CGS-2, and CGS-3 cadaver.

Results

Table 1.

FRESH	Days Postmortem					
	0	1	2	3	4	5
Number of Flies Observed	1	30+	50+	0	0	0
Number of Beetles Observed	0	0	0	0	0	0
Number of Earwigs Observed	0	0	0	0	0	0
Maggot Masses Observed?	N	N	Y	Y	Y	Y

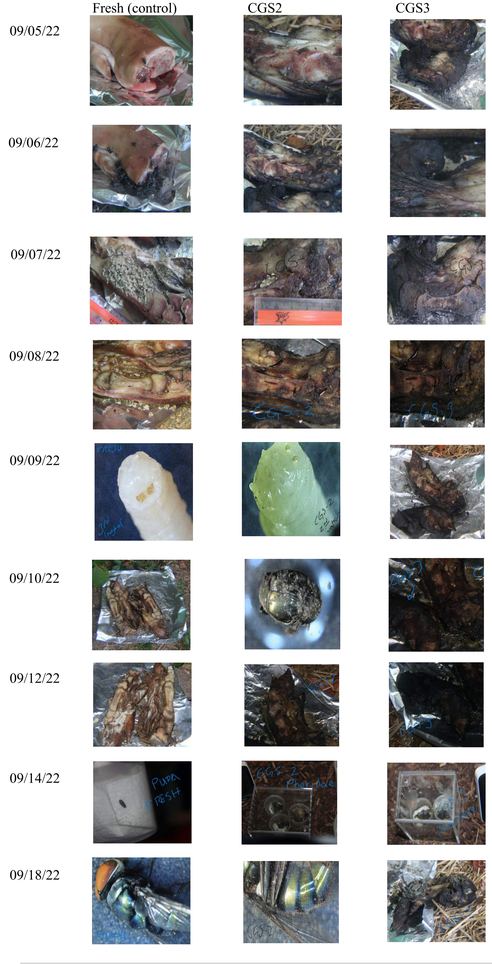
Table 2.

CGS-2	Days Postmortem					
	0	1	2	3	4	5
Number of Flies Observed	0	13	20+	20+	0	0
Number of Beetles Observed	0	0	0	3	3	3
Number of Earwigs Observed	0	0	0	10	10	10
Maggot Masses Observed?	N	N	Y	N	N	N

Table 3.

CGS-3	Days Postmortem					
	0	1	2	3	4	5
Number of Flies Observed	1	2	0	0	0	0
Number of Beetles Observed	0	0	1	3	3	3
Number of Earwigs Observed	0	0	1	10	10	10
Maggot Masses Observed?	N	N	N	N	N	N

Images of insect succession on burned and unburned porcine cadavers



Discussion and Conclusion

It was found that the unburned control cadaver had visible egg masses by day one and large maggot masses developing within two days post mortem. Flies and other insects were attracted to the cadaver within minutes of placing it in the outdoor enclosure. For cadavers CGS-2 and CGS-3, the flies mostly overlooked them and went to the control. Within three days there was one small maggot mass present on CGS-2, and no maggot activity on CGS-3. By day five, there was very little maggot activity visible on the dorsal surface of the fresh porcine, but CGS-2 and CGS-3 had beetle activity including earwigs and a few Histeridae. Between the three cadavers, the fresh control was more favored by the flies because it still contained the moisture and soft fats that the fire destroyed in CGS-2 and CGS-3. CGS-3 was the most severely burned and therefore did not attract many flies and never developed maggot masses.

Insect succession and oviposition are highly affected by arson. The act of burning a corpse severely inhibits the development of insects on the corpse and the severity of the burns delays the development of the larvae. Furthermore, Diptera did not oviposit on CGS-3, causing insect succession to be non-conforming with the predictable succession on the fresh carcas. This would increase the TOC calculation, as general oviposition was inhibited or negated all together, possibly giving the impression that the carcass had been exposed for much longer. If TOC is used to determine TOD, entomological analysis would provide a TOD that was much earlier. This would impede forensic investigations due to the remaining question of TOD. With this delay in insect succession and oviposition, and colonization by late-stage decomposition feeders, further study is required to determine the minimum post-mortem interval based on entomological evidence in found arson cases, possibly utilizing the Crow-Glassman scale on succession studies to standardize the difference in minimum post-mortem interval between burned and unburned cadavers.

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