New records of carrion feeding insects collected on human remains

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Scientific Note

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Abstract. Arthropod species diversity was compared between two human corpses confined to a small geographic area during the winter and summer of 2004 in Santa Clara County, California. One of the primary flies collected from the corpse in the summer (*Compsomyiops callipes*) as well as two silphid species (*Nicrophorus nigritus* and *Necrophilus hydrophiloides*) in the winter appear to be new collection records on human remains. Different arthropod species were collected from both corpses and, in general, arthropods were more numerous on the corpse found in the summer. These differences can most likely be attributed to seasonal variation. This comparison demonstrates how seasonality impacts arthropod succession, often an important indicator of postmortem interval.

Key Words. forensic entomology, postmortem interval, arthropods of forensic importance.

The area of medicocriminal entomology relies on the correct identification of forensically important arthropod species. With this information, the approximate age of the insects can be determined, thus providing an estimation time of initial insect colonization. This estimation, coupled with known arrival patters of the adult species, can produce an estimation of a portion of the post mortem interval (PMI). However, arthropod succession is impacted by a number of circumstances. The literature contains a number of examples that impact succession and diversity including seasonality, geographical distance, urban vs. rural habitats, and amount of body exposure (Anderson 2001). Unfortunately, a number of these studies perform experiments using baited traps or pig carcasses that may affect their results.

During 2004 two human corpses were examined for arthropods that occurred close to each other at the base of the east foothills of Santa Clara County. Driving distance between the two crime scenes was 6.12 km and 2.8 km using GPS tracking coordinates. Both corpses were found just off rural roads in dry grass habitat. However, there are some significant differences when the cases were reviewed:

Case One: In February 2004, officers were informed of a body dumped in a rural area of San Jose, California. Responding officers observed the wrapped corpse approximately fifty feet down the southern facing slope of the roadway. Scene examination revealed that the body was wrapped tightly in two separate sheets which were secured at the torso and ankle areas with torn fabric. Seventy days had elapsed from the time the victim was reported missing to the time that her body was discovered. Post mortem putrefactive changes were consistent with this time interval, but arthropod evaluation was requested for additional confirmation. Samples of arthropods including fly larvae, a single dead mature fly, a recently ecclosed fly which died before wing expansion, and predatory insects were collected at the scene as well as on the following day during postmortem examination. Local weather station temperature readings for the period ranged from 0.0°–19.4°C with periods of fog and rain. Ground temperature readings at the scene a few days after the body was removed recorded over a 24 h period ranged from 1.0°–26.0°C with 20%–26% RH at 155 m elevation. The cause of death was determined to be an acute intoxication due to the combined effects of morphine, methamphetamine and codeine.

Case Two: In June 2004, the fully clothed body of a female was found in an advanced state of decay. The decedent was discovered in brush on the edge of a pasture just off of a rural area of San Jose, California. Large maggot masses were observed on the clothing and at the

head, neck and chest regions, with associated punctate holes of probable insect origin, which would be differentiated from ante-mortem trauma. The cause of death was determined to be two gunshot wounds to the head. Postmortem interval estimation by the medical examiner based on the degree of putrefactive changes was approximately 4–6 days but arthropod evaluation was requested for additional confirmation. Crime scene investigators collected a sample of larvae on the body at the morgue the following day and preserved them in 80% ethanol. No puparial cases were found either at the morgue or crime scene. Using the methods of Byrd (2001), larvae were also collected and reared to the adult stage, proving to be *Compsomyiops callipes*. All insects were identified (JYH), and placed in the J. Gordon Edwards Entomology Museum at San Jose State University for reference. Subsequent adult flies reared from the evidence collected at the autopsy were caged and allowed to lay eggs. Developing larvae were then reared at a constant temperature of 32°C. Every 24 h a larval sample was preserved in 80% ethanol and compared to the largest larval specimens preserved at the autopsy through measurements using a microscope. Our choice of using 32°C was predicated on the hypothesis that this temperature approaches the upper developmental threshold for this species (Higley & Haskell 2001). Also, we felt that developing larvae were constantly exposed to this optimal temperature either through ambient ground temperatures that averaged about 33.0°C over a five day period, or by developing in a maggot mass that can exceed temperatures of 45°C (Higley & Haskell 2001).

Unfortunately a good minimum PMI estimate for Case One could not be determined as there were not enough samples taken and the few maggots collected had deteriorated. In Case Two, laboratory reared larvae reached a size similar to the preserved larval evidence after 5 days. Thus, our results support a PMI estimate of 4–6 days. However we must caution that the entomological evidence was not properly collected. In our opinion, a random sample of larvae collected in the autopsy room 24 h removed from the crime scene is not as reliable as material collected at the crime scene by either a trained entomologist or investigator. These examples only illustrate the importance of training crime scene specialists in the recovery of entomological evidence.

Of greater importance is that these two cases afforded a rare opportunity to compare two corpses found geographically very close to each other but at different times of the year (winter and summer). Furthermore, most of the information concerning forensically important insect fauna centers on areas such as Canada, Hawaii, and the eastern U.S. Very little information exists on insects associated with human remains in California. Therefore, we decided to identify and catalog as many of the arthropods as possible to look for any noticeable differences in species richness and abundance.

In cataloging the insects found on these bodies (Table 1), two important pieces of information were apparent. First, the primary flies collected in both cases have either not been previously reported to feed on human corpses, or their occurrence on bodies has been rare. Very little information exists on carrion feeding flies in the western U.S., particularly in California. James (1955) states that *Calliphora latifrons* (Hough) is one of the most common flies in the western U.S. but it is often found on the bodies of small birds and rodents. However, it was found to occur on human corpses (Anderson 1995) and pig carrion (VanLaerhoven & Anderson 1999) in British Columbia and in Case One of this study. The collection of *Compsomyiops callipes* (Bigot) to our knowledge has not been documented in the literature as being associated with human remains, although it is also a very common fly associated

Table 1. List of arthropods collected from bodies from two Santa Clara county cases in 2004.

Case One	Case Two
Flies	**Flies**
Calliphoridae	Calliphoridae
Calliphora latifrons (Hough) (2 adults)	*Compsomyiops callipes* (Bigot) (many maggots and dead flies)
Other insects/arthropods	*Phormia regina* (Meigen) (many maggots and dead flies)
Silphidae (Coleoptera)	*Phaenicia sericata* (Meigen) (1 dead fly)
Nicrophorus nigritus Mannerheim (1 adult)	Sarcophagidae
Necrophilus hydrophiloides	*Sarcophaga sp.* (few maggots)
Guérin-Méneville (5 adults, ca. 50 larvae)	**Other insects/arthropods:**
Carabidae (Coleoptera)	Acari
Pristonychus (*complanatus*?) Dejean	*Ixodes sp.* ungorged (2 adults)
(1 adult 1 possible larva)	Histeridae (Coleoptera)
Forficulidae (Dermaptera)	*Saprinus sp.* (3 adults)
Forficula (*auricularia*?) (L.) (1 adult)	Staphylinidae (Coleoptera)
	Staphylinus maxillosus (L.) (3)
	Dermestidae (Coleoptera)
	Dermestes (marmoratus?) Say (2 adults)

with carrion (James 1955). Moreover, we have found it to be the most numerous fly species on at least three other bodies found in Santa Clara county (personal observation). In Case One, collections of the silphids *Nicrophorus nigritus* Mannerheim and *Necrophilus hydrophiloides* Guérin-Méneville appear to be new human remains records.

Second, although the location of these bodies is very close with respect to distance and habitat, there is a marked difference in arthropod diversity and abundance as there is no species overlap between the two bodies. Admittedly, the sample size is small and represented by only two bodies, but the discrepancy in differing insect fauna between the two may be due to seasonality. Both cases have representative necrophages such as calliphorid/sarcophagid flies and silphids in addition to necrophage predators (carabid, staphylinid, and histerid beetles), and incidental arthropods such as ticks (*Ixodes*) and dermapterans that probably use bodies for shelter. However, it was obvious that fly abundance was low during the winter months vs. summer months and is supported in the literature (Anderson 2001). Moreover, a recently completed fly trapping study in the area supports this observation and indicates definite trends in fly species abundance and distribution with respect not only with seasons, but disturbed and undisturbed habitats (unpublished data). Thus, the result that seasonality has on colonizing arthropod abundance and diversity may have far reaching consequences on arthropod succession in these cases. For example, low fly numbers in Case One may have enabled silphid beetles to become the prominent necrophages, and it is possible that by the time calliphorid numbers increase in spring, the body would no longer be attractive to this group and may in turn impact subsequent colonizers. In contrast, the high numbers of maggot masses in Case Two may not allow silphids to successfully colonize and compete with the flies. However, an abundance of maggots also brings predators such as histerids and stapylinids that were absent in Case One.

Studying local arthropod seasonality and their potentially differing colonization times on bodies are critical to forensic investigation. As demonstrated here, different species may possibly colonize bodies at differing times of the year and it is critical to identify the local insect fauna on remains. Moreover, Anderson (2001) states that this type of information may also prove valuable in determining season of death when remains are found several years after death.

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