

Field Documentation of Unusual Post-Mortem Arthropod Activity on Human Remains

JENNIFER L. PECHAL,^{1,2,3} M. ERIC BENBOW,^{1,4} JEFFERY K. TOMBERLIN,⁵ TAWNI L. CRIPPEN,⁶ AARON M. TARONE,⁵ BANESHWAR SINGH,^{5,7} AND PAUL A. LENHART⁵

J. Med. Entomol. 52(1): 105–108 (2015); DOI: 10.1093/jme/tju012

ABSTRACT During a forensic investigation, the presence of physical marks on human remains can influence the interpretation of events related to the death of an individual. Some tissue injury on human remains can be misinterpreted as ante- or peri-mortem wounds by an investigator when in reality the markings resulted from post-mortem arthropod activity. Unusual entomological data were collected during a study examining the decomposition of a set of human remains in San Marcos, Texas. An adult female *Pediodes haldemani* (Girard) (Orthoptera: Tettigoniidae) and an *Armadillidium* cf. *vulgare* (Isopoda: Armadillidiidae) were documented feeding on the remains. Both arthropods produced physical marks or artifacts on the remains that could be misinterpreted as attack, abuse, neglect, or torture. Additionally, red imported fire ants, *Solenopsis invicta* Buren (Hymenoptera: Formicidae), were observed constructing structures in the mark produced by the *P. haldemani* feeding. These observations provide insight into the potential of post-mortem arthropod damage to human remains, which previously had not been described for these taxa, and therefore, physical artifacts on any remains found in similar circumstances may result from arthropod activity and not ante- or peri-mortem wounds.

KEY WORDS arthropod, unusual post-mortem feeding, human remains, forensic science, wound misinterpretation

Introduction

In death investigations, there can be wounds or other forms of physical trauma of questionable origin present on the decedent that can influence the interpretation of events leading to the individual's death (Denic et al. 1997, Prahlow and McClain 1997). In some instances, these areas of trauma are associated with ante-mortem activities (e.g., sharp force trauma) and are difficult to distinguish from those that occurred after death (Sauer 1998). Especially, the physical artifacts that ultimately were determined to have originated from insect, or other arthropod, activity, such as with cockroach (Blattodea) feeding activity on remains that can be misinterpreted as burn marks (Denic et al. 1997, Bright et al. 2009).

For example, authors on this paper have been consulted by law enforcement agencies to determine whether or not lesions found on human remains resulted from arthropod activity and if the physical artifacts occurred ante- or post-mortem (J.K. Tomberlin and J.L. Pechal, personal communications). Further, arthropod activity on human remains can be misidentified as sources of intravenous drug use, bite marks, defensive wounds, or other activities depending on the case and death scene circumstances (Denic et al. 1997).

There are several orders of incidental arthropod taxa associated with carrion, such as Lepidoptera, Hymenoptera, and Orthoptera, that utilize carrion resources because of availability in a habitat; however, these incidental taxa are not dependent on the carrion for further development (Smith 1986). Katydid (Orthoptera: Tettigoniidae) are commonly found in terrestrial, grassland ecoregions (Gwynne 2001). Many katydids are omnivorous, carnivorous, or scavengers and are known to feed on carrion; thus, the feeding behavior of katydids on decomposing vertebrates (i.e., carrion) may not be that unusual (Gwynne 2001). But here we present the first documentation of katydid feeding on a human cadaver. Isopoda, or pill bugs, are small non-descript crustaceans related to insects. They are common in terrestrial and aquatic habitats and often feed on decaying organic matter (Hassall et al. 1987, Gooday et al. 1990). The red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae), is a predominant ant

¹ Department of Biology, 300 College Park, University of Dayton, Dayton, OH 45469.

² Present address: Department of Entomology, 243 Natural Science Bld., Michigan State University, East Lansing, MI 48824.

³ Corresponding author, E-mail: pechalje@msu.edu.

⁴ Present address: Department of Entomology and Department of Osteopathic Medical Specialties, 243 Natural Science Bld., Michigan State University, East Lansing, MI 48824.

⁵ Department of Entomology, 2475 TAMU, Texas A&M University, College Station, TX 77843.

⁶ Southern Plains Agricultural Research Center, USDA-ARS, 2881 F and B Rd., College Station, TX 77845.

⁷ Present address: Department of Forensic Science, 1015 Floyd Ave., Virginia Commonwealth University, VA 23284.

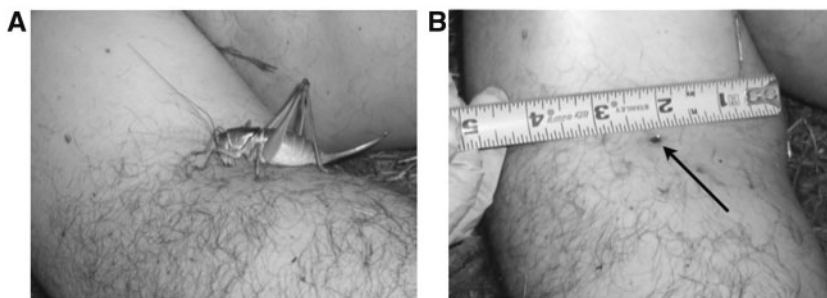


Fig. 1. A gravid, female *Pediodectes haldemani* (Girard) (Orthoptera: Tettigoniidae) feeding on the right forearm of a set of human remains (A), and the resulting physical artifact (indicated by the black arrow) on the remains by the feeding *P. haldemani* (B).

species found in grassland ecoregions (Morrison et al. 2004), and have often been associated with carrion (Wells and Greenberg 1994, Stoker et al. 1995). In terms of forensic entomology, these aforementioned arthropod taxa are infrequently associated with decomposing vertebrate carrion and are considered incidental arthropod evidence (Early and Goff 1986, Avila and Goff 1998). However, katydids and isopods could possibly be of significance when evaluating physical artifacts on human remains, as their importance in the decomposition process and frequency of utilizing decomposing remains in a natural habitat has yet to be thoroughly studied.

Material and Methods

Entomological data were collected during the decomposition of human remains over time as part of a larger study addressing decomposition ecology and applications in forensics. This study was conducted at the Forensic Anthropology Center at Texas State (FACTS) (29°55'54.98" N 98°00'00.62" W) in San Marcos, Texas, USA, in the Edwards Plateau ecoregion (Balcones Canyonlands subregion). A Caucasian male, approximately 153 kg, was placed in the field, nude and supine, on 5/22/2012 at approximately 5:00 p.m. with exposure to naturally occurring arthropods. Entomological observations were made every 8 h.

Both voucher specimens of the *Pediodectes haldemani* (Girard) (Orthoptera: Tettigoniidae) and *Armadillidium* cf. *vulgare* (Isopoda: Armadillidiidae) have been deposited in the TAMU insect collection (Texas A&M University, College Station, Texas, USA) as TAMUIC voucher number 700 and 705, respectively. Prior to submission of the voucher specimens, the abdomen of the female *P. haldemani* was dissected to assess the gravid status and the crop preserved in 80% ethanol. All parts of the *P. haldemani* were submitted to the TAMU insect collection.

Results

A gravid adult female *P. haldemani* was documented feeding on the right forearm area of the remains

(Fig. 1, Supp Video 1 [online only]) on 5/24/2012 and collected approximately 32 h after field placement of the remains; while an *A. cf. vulgare* was documented feeding on the left forearm area (Fig. 2) on 5/25/2012 and collected approximately 69 h after field placement. Both arthropods left small (<0.6 cm), round physical artifacts on the skin of the remains (Figs. 1 and 2). The *P. haldemani* crop was approximately the size of a small marble (<3 cm diameter) and was filled with a food bolus, which was presumably human flesh. Red imported fire ant activity was also observed around the remains from the placement date in the field until the conclusion of the study after five days. Soil and other surrounding organic debris were brought by the red imported fire ants and soon occupied the artifact resulting from the *P. haldemani* feeding on the remains (Fig. 3). The debris pile was re-constructed multiple times, as the structure was disturbed each time the remains were moved for sampling purposes.

Discussion

Pediodectes haldemani is distributed throughout the Great Plains and can be quite common in the ecoregion where the samples were collected in this study (Isely 1941, Gwynne 2001). Most katydids are omnivorous, but the species of katydid collected during this study is almost completely carnivorous (Isely 1941). Yet, there has been no previous record of this katydid species feeding on decomposing human remains. The feeding behavior of the female could result from her gravid status and seeking an extra source of protein. The common woodlouse, *A. vulgare* Latr. (Crustacea: Isopoda), is an omnivorous and ubiquitous species found in Texas (Paris 1963). While this species has been documented feeding on vertebrate remains, such as a rat carcass (Pierce 1907), feeding activity on human remains had not been previously recorded. The opening left by the katydid feeding was exploited by the fire ants presumably for a protective shelter, which ants commonly construct using surrounding small woody debris and soil (Anderson and McShea 2001). The post-mortem artifacts made by the aforementioned



Fig. 2. *Armadillidium* cf. *vulgare* (Isopoda: Armadillidiidae) feeding on the left forearm of a human set of remains and indicated by a white arrow (A), with an up close image of the feeding isopod (B), and the resulting artifact (indicated by the black arrow) on the remains from the isopod activity (C).

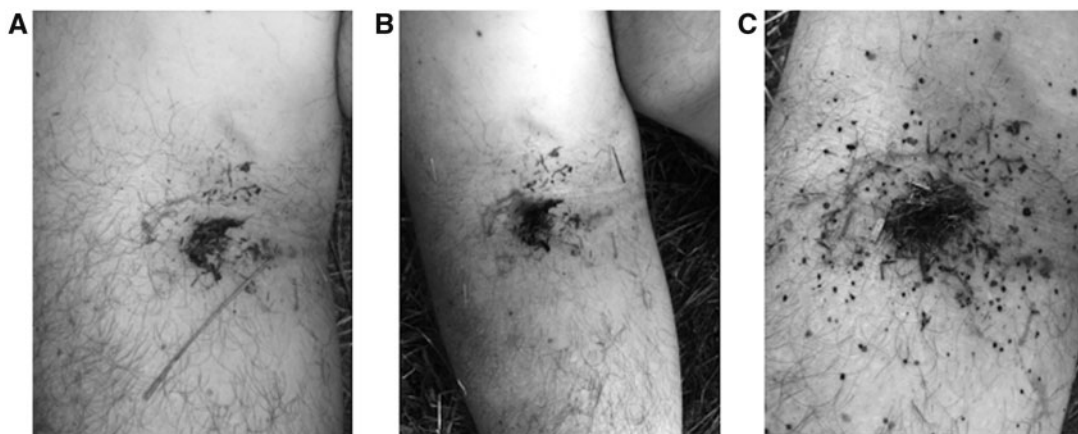


Fig. 3. A structure consisting of soil, small organic woody debris, and other organic material by red imported fire ants, *Solenopsis invicta* Burden (Hymenoptera: Formicidae), in the artifact resulting from *P. haldemani* feeding activity on the left forearm of the decedent. The structure was re-constructed each time the remains were disturbed for sampling purposes (A–C). The small dots surrounding the debris pile are fly artifacts or speck (C).

arthropod feeding activity were small in size (<0.6 cm) and may have provided an access point to the soft tissue for the red imported fire ants. The artifact resulting from the katydid feeding could be similar to artifacts produced by other insects, such as ants, that also cause small openings in the skin's surface (Campobasso et al. 2009); however, the opening made by the katydid feeding appears to be larger in diameter than those openings resulting from ant feeding.

These observations provide insight to arthropod damage on human remains that had not been previously described. These results indicate that unlikely arthropod taxa present during the decomposition process can be responsible for post-mortem activity resulting in physical artifacts on the remains. A limitation to the results presented is the arthropod activity was documented on a single set of decomposing remains. However, documentation of such infrequently witnessed information is critical to prevent the misinterpretation of similar artifacts as criminal or other activity. Therefore, investigators should note the presence of such incidental arthropods near the decedent, as they could be the source of physical artifacts present on human remains.

Acknowledgments

We would like to thank the Forensic Anthropology Center at Texas State (FACTS) in San Marcos, TX for use of their facilities and support by their staff. We would like to thank the donors to the FACTS facility without whose generous gifts we could not perform this type of research. A posthumous acknowledgment and thanks to P. Flanagan for space and hospitality during the writing of this manuscript. JKT and AMT are funded by the Department of Entomology at Texas A&M University and Texas A&M University AgriLife Research. This project was also funded (TLC, AMT, MEB, JKT), in part, by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice through Grant 2010-DN-BX-K243. Points of view in this document are those of the authors and do not necessarily represent the official position or policies of the U.S. Department of Justice.

References Cited

- Anderson, C., and D. W. McShea. 2001. Intermediate-level parts in insect societies: adaptive structures that ants build away from the nest. *Insectes Soc.* 48: 291–301.
- Avila, F. W., and M. L. Goff. 1998. Arthropod succession patterns onto burnt carrion in two contrasting habitats in the Hawaiian Islands. *J. Forensic Sci.* 43: 581–586.

- Bright, L. A., J. K. Tomberlin, and R. Gold. 2009. Feeding patterns of American (*Periplaneta americana*) and German (*Blattella germanica*) cockroaches on pig skin, pp. 270-271. American Academy of Forensic Sciences. American Academy of Forensic Sciences, Denver, CO.
- Campobasso, C. P., D. Marchetti, F. Introna, and M. F. Colonn. 2009. Postmortem artifacts made by ants and the effect of ant activity on decomposition rates. *Am. J. Forensic Med. Pathol.* 30: 84-87.
- Denic, N., D. W. Huyer, S. H. Sinal, P. E. Lantz, C. R. Smith, and M. M. Silver. 1997. Cockroach: the omnivorous scavenger: potential misinterpretation of postmortem injuries. *Am. J. Forensic Med. Pathol.* 18: 177-180.
- Early, M., and M. L. Goff. 1986. Arthropod succession patterns in exposed carrion on the island of O'ahu, Hawaiian Islands, USA. *J. Med. Entomol.* 23: 520-531.
- Gooday, A., C. M. Turley, and J. Allen. 1990. Responses by benthic organisms to inputs of organic material to the ocean floor: a review [and discussion]. *Philos. Trans. R. Soc. Lond. A331*: 119-138.
- Gwynne, D. T. 2001. Katydid and bush-crickets: reproductive behavior and evolution of the Tettigoniidae. Cornell University Press, Ithaca, NY.
- Hassall, M., J. Turner, and M. R. Rands. 1987. Effects of terrestrial isopods on the decomposition of woodland leaf litter. *Oecologia* 72: 597-604.
- Isely, F. 1941. Researches concerning Texas Tettigoniidae. *Ecol. Monogr.* 11: 457-475.
- Morrison, L. W., S. D. Porter, E. Daniels, and M. D. Korzhukhin. 2004. Potential global range expansion of the invasive fire ant, *Solenopsis invicta*. *Biol. Invasions* 6: 183-191.
- Paris, O. H. 1963. The ecology of *Armadillidium vulgare* (Isopoda: Oniscoidea) in California grassland: food, enemies, and weather. *Ecol. Monogr.* 33: 1-22.
- Pierce, W. D. 1907. Notes on the economic importance of sowbugs. *Bull. US Bur. Entomol.* 64, pt 2: 15-22.
- Prahlw, J. A., and J. McClain. 1997. Lesions that simulate gunshot wounds. *J. Clin. Forensic Med.* 4: 121-125.
- Sauer, N. J. 1998. The timing of injuries and manner of death: distinguishing among antemortem, perimortem and postmortem trauma, pp. 321-332. In K. J. Reichs (ed.), *Forensic osteology: advances in the identification of human remains*. 2nd ed. Charles C Thomas, Springfield, IL.
- Smith, K.G.V. 1986. A manual of forensic entomology. The British Museum (Natural History) and Cornell University Press, Ithaca, NY.
- Stoker, R. L., W. E. Grant, and B. S. Vinson. 1995. *Solenopsis invicta* (Hymenoptera: Formicidae) effect on invertebrate decomposers of carrion in central Texas. *Environ. Entomol.* 24: 817-822.
- Wells, J. D., and B. Greenberg. 1994. Effect of the red imported fire ant (Hymenoptera: Formicidae) and carcass type on the daily occurrence of postfeeding carrion-fly larvae (Diptera: Calliphoridae, Sarcophagidae). *J. Med. Entomol.* 31: 171-174.

Received 26 February 2014; accepted 18 October 2014.