Forensic Science International 182 (2008) e19–e22

Contents lists available at ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint

Short communication

Coprophanaeus lancifer (Linnaeus, 1767) (Coleoptera, Scarabaeidae) activity moves a man-size pig carcass: Relevant data for forensic taphonomy

Alexandre Ururahy-Rodrigues [a,*], José Albertino Rafael [a], Roberto Ferreira Wanderley [c], Helder Marques [d], José Roberto Pujol-Luz [b]

[a] *Instituto Nacional de Pesquisas da Amazônia, INPA, CPEN. Avenida André Araújo número 2936 Bairro Petrópolis. Caixa Postal 478, CEP: 69060-001 Manaus, Amazonas, Brazil*
[b] *Núcleo de Entomologia Urbana e Forense, Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade de Brasília, Campus Darcy Ribeiro, Asa Norte, Brasília, DF, CEP: 70910-900, Brazil*
[c] *Instituto de Medicina Legal Leonídio Ribeiro, Polícia Civil do Distrito Federal. Setor de Áreas Isoladas Sudoeste, lote 23, bloco "B", Complexo da Polícia Civil, Brasília, DF, CEP: 70610-200, Brazil*
[d] *Setor Técnico Científico da superintendência de Policia Federal em Goiás, Avenida Edmundo Pereira de Abreu,826 Goiânia, GO, CEP 74823-030, Brazil*

ARTICLE INFO

Article history:
Received 27 November 2007
Received in revised form 24 August 2008
Accepted 23 September 2008
Available online 5 November 2008

Keywords:
Forensic entomology
Forensic taphonomy
Amazon rain forest
Brazil
Sacarabaeidae (dung beetles)

ABSTRACT

Taphonomy is the study of many variables involving decomposition, preservation, dispersal, erosion, burial or exposition of dead organisms. Forensic Taphonomy examines how biotic or abiotic variables can change evidences in legal investigations. Many insects are closely associated with decomposition processes. The scavenger dung-beetle, *Coprophanaeus lancifer* (Linnaeus, 1767), may be important biotaphonomically in the decomposition process of carcasses. Man-size pig carcasses were used as models to examine the decomposition process in the Adolpho Ducke Forest Reserve in central Amazonia. The scavenger dung-beetle has great potential in decomposition and production of *post-mortem* injuries, including dismemberment and the removal of soil beneath the carcass thereby causing a change in its position.

1. Introduction

One of the main contributions to forensic entomology in death-scene investigation is to evaluate and understand the entomological evidence. Insect activity on a corpse can cause injuries to superficial soft tissues, to internal organs, and dismemberment of the skeletal extremities [1]. Insects may also promote burial or exposure of the cadaver, facilitating its consumption by other organisms [1]. The capacity to recognize such injuries and activities is important in initial analysis and observation of crime scenes [1]. Recent work shows that vertebrates can begin to feed on the carcass after immature insects (mostly dipteran larvae) abandon the corpse to pupate [2].

The study of many variables involving decomposition, preservation, dispersal, erosion, burial or exposition of dead organisms was denominated Taphonomy [3]. The more specific area of Forensic Taphonomy examines how biotic or abiotic variables can change evidences in legal investigations [4–6], and can be classified into Biotaphonomy and Geotaphonomy. While the first deals with how biotic and abiotic variables influence decomposition process, the latter investigates how the decomposition process influences or modifies the soil and surrounding environment, or how environment influences decomposition [7].

Many insect species are associated with decomposition of human corpses and animal carcasses in different stages of development (flies and beetles for the most part) and are the mainly responsible for soft tissue removal [8,9].

In Brazil many species of beetles (Coleoptera) are linked to animal decomposition. [10–13]. The necrophagous *Coprophanaeus lancifer* is particularly important due to its large size (4.0–4.6 cm in length), to its crepuscular foraging activities, and to the habit of digging oviposition chambers and tunnels under or near the carcass, were pieces of the carcass are deposited to feed the larvae [13,14]. Adults are good flyers, arriving quickly at carcass where they may remain for long periods of time [15].

In this work we present some aspects of the biotaphonomic activity of *C. lancifer* in carcasses, especially: (1) Production of *post-mortem* injuries on relatively large animals, (2) dismemberment of skeletal appendages, and (3) activities of the beetles on and under

* Corresponding author. Tel.: +55 21 2413 5184.
E-mail addresses: ururahy.rodrigues@gmail.com, ururahy@inpa.gov.br (A. Ururahy-Rodrigues).

0379-0738/$ – see front matter © 2008 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.forsciint.2008.09.009

the ground surrounding the carcass causing a movement which can roll the carcass up to 180° in 72 h.

2. Methods

This work was carried out in the Adolpho Ducke Forest Reserve (100 km^2) of the National Research Institute of Amazonia (INPA), Manaus, Brazil, in *terra firme* primary forest (2°55′51″ S, 59°58′59″ W). Six large domestic pigs (~60 kg) were killed by a shot with .38 caliber in the frontal region of the head and placed undressed in metal cages of 4 m^2 with 2″ mesh. Three repetitions of two pigs each were also set and observed for 30 days—two pigs were observed from 30 June 2005 to 30 July 2005 (low rainfall), from 18 October 2005 to 17 November 2005 (mid rainy season) and from 14 March 2006 to 13 April 2006, during the most rainy time of the year. Daily visits to the site for observation were carried out between 17:00 and 18:30 h. Seven voucher specimens of *C. lancifer* were collected and are deposited at the Invertebrate Collection at the National Research Institute of Amazonia (INPA).

3. Results

C. lancifer had colonized the pig carcass (Fig. 1) by the first day after death in all cases. Colonization was crepuscular occurring between 17:00 and 18:30 h. Flying beetles arrived and landed on the ground near the carcass and soon burrowed under and near the carcasses. After landing, the beetles began to make elongate, irregular-edged openings in the tissues of the pigs (lesions, ~35–60 mm of diameter; Fig. 2). These injuries allowed evisceration and

Fig. 1. *Coprophanaeus lancifer* (larger, greenish black beetles) and flies on the foreleg of a pig carcass.

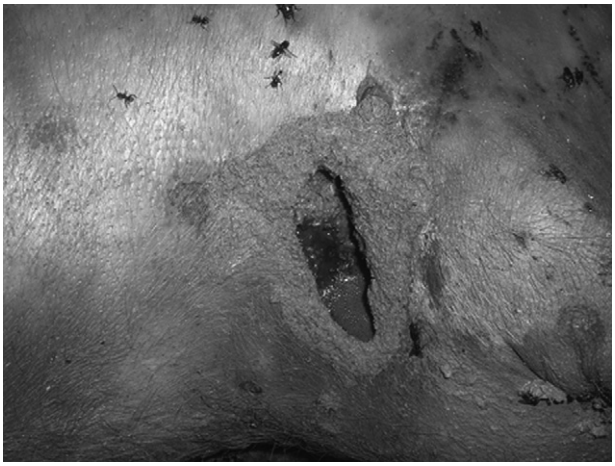

Fig. 2. Lesion caused by *C. lancifer* surrounded by a mass of fly (Calliphoridae) larvae, at approximately 48 h *post-mortem*.

Fig. 3. One minute *post-mortem*.

Fig. 4. The same carcass after 26 h *post-mortem*, showing the soil removed by the beetle from beneath the carcass on the left side of the photo.

Fig. 5. Gas-filled carcass 48 h *post-mortem*; the carcass had rolled onto its back.

Fig. 6. The same carcass in more advanced stage of decay at 72 h *post-mortem*; the rolling had continued to nearly 180° from its initial position.

the elimination of gases in the abdominal region, and were subsequently enlarged by fly larvae (Diptera: Calliphoridae) that used them to enter the carcasses.

At one carcass in the early stages of decomposition, during the rainiest time of the year, a large number (more than in the others 2 experiments conduced) of *C. lancifer* removed a considerable quantity of argyles from soil from beneath the carcass, while preparing for oviposition. The soil removed formed two mounds near the carcass, and the left limbs anchored against these mounds performing a lever action. This activity rolled the carcass over onto its other side (Figs. 3 and 4). By this time the carcass was in the bloated stage, which facilitated its rolling over the back (~48 h) (Fig. 5). By 72 h, the carcass had rolled approximately 180°, from the left to the right side (Fig. 6). Later, in the skeletal reduction stage, the beetles' movement surrounding the carcass dismembered small hoof bones and dislocated them as far as 30 cm from the carcasses.

4. Discussion

Insect activity on decomposing corpses should be an important factor to consider at crime scenes. Insects may cause a variety of alterations of the original crime scene and so it is important to recognize those alterations for a correct analysis of the scene. For example, certain kinds of lesions, removal of particular tissues as well as removal and dislocation of tissues and bones may all be attributed to certain insect species [1]. In a forensic context, the reconstruction of the crime scene must take these activities into consideration to separate *peri-mortem* and *post-mortem* events in the analysis of the crime [16].

In this work all the models were studied without clothes what could maximized the potential of injuries. However, the biotaphonomic activities of *C. lancifer* illustrates the importance of this species as the cause of *post-mortem* injuries to the cadaver, by modifying the surroundings where it is located through excavating the soil under the cadaver, thereby changing the position of the latter from its original position either at the time of death or of placement at the scene. Thus, *post-mortem* events and alterations caused by *C. lancifer* may be confused with lesions or other artifact that may have caused death, with important and misleading consequences for the criminal or forensic investigation. In past 2004, on the Núcleo de Entomologia Urbana e Forense of the Universidade de Brasília, during the analyses of data, photos and videos, colleted by the fourth junior author, from incident with *Cinta larga* Indians, in Rondonia state, Brazilian Amazonian rain forest [17], similar lesions were observed and could be produced by this dung beetle or other kind of biotaphonomical agent. During the course of investigations, such injuries were, in principle, confused with injuries *post-mortem* caused by aggressors. Considering his crepuscular foraging [14] and the fact that in the tree experiments conduced, *C. lancifer* had colonized the models in the crepuscular hours in the day of death, complementary studies about biology of this beetle must be conduced, to be used in the *post-mortem* intervals estimative, in eventual real cases in the studied area.

Acknowledgements

We thank the Conselho Nacional de Desenvolvimento Científico e Tecnológico-CNPq processes 141747/2004-8 (AUR), 52.1239/95-8 (JAR) and 308636/2007-4; 474081/2007-9 (JRPL). We also thank the Instituto Nacional de Pesquisas da Amazônia (INPA) for academic support, the Divisão de Apoio e Suporte às Estações e Reservas do INPA-DSER for the help of Valzenir Antonio de Albuquerque and Anastácio Ribeiro Moreira, Carlos José Einicker Lamas (São Paulo Museum of Zoology) and Raimundo Henriques

(University of Brasília), who helped with finding related literature, Hélio Ricardo da Silva, Francisco Racca Filho and Roberto de Xerez of the (UFRRJ) and Adriana Oliva (Laboratorio de Entomologia Forense do Museo Argentino de Ciencias Naturales) for the comments on early versions of the manuscript.

References

[1] N.H. Haskell, R.D. Hall, V.J. Cervenka, M.A. Clark, On the body: insects' life stage presence and their postmortem artifacts, in: W.D. Haglung, M.H. Sorg (Eds.), Forensic Taphonomy: The Post Mortem Fate of Human Remains, CRC Press, 1997, pp. 415–448, xxvi + 636 p..

[2] R.J. Morton, W.D. Lord, Taphonomy of child-sized remains: a study of scattering and scavenging in Virginia, USA, J. Forensic Sci. 51 (3) (2006) 475–479.

[3] E.A. Efremov, Taphonomy: new branch of paleontology, Pan-Am. Geol. 74 (1940) 81–93.

[4] D.O. Carter, D. Yellowlees, M. Tibbett, Cadaver decomposition in terrestrial ecosystems, Naturwissenschaften 94 (2007) 12–24.

[5] W.D. Haglung, M.H. Sorg, Introduction to forensic taphonomy, in: W.D. Haglung, M.H. Sorg (Eds.), Forensic Taphonomy: The Post Mortem Fate Of Human Remains, CRC Press, 1997, pp. 1–26, xxvi + 636 p..

[6] M.H. Sorg, W.D. Haglund, Advancing forensic taphonomy: purpose, theory, and process, in: W.D. Haglung, M.H. Sorg (Eds.), Advances in Forensic Taphonomy. Method, Theory, and Archeological Perspectives, CRC Press, 2002 , pp. 3–29, XXXII + 507 p..

[7] S. Nawrocki, Taphonomic processes in historic cemteries, in: M. Grauer (Ed.), Bodies of Evidence, John Wiley & Sons, 1995, pp. 49–66.

[8] E.P. Catts, N.H. Haskel (Eds.), Entomology and Death, A Procedural Guide, Joyce's Print Shop, Inc. Clemsom, SC EUA, 1990, 182 p..

[9] E.P. Catts, M.L. Goff, Forensic Entomology in criminal investigations, Ann. Rev. Entomol. 37 (1992) 253–272.

[10] G. Luederwaldt, Os insetos necrófagos paulistas, Revista do Museu paulista 8 (1911) 414–433.

[11] M.O. Moura, C.J.B. Carvalho, E.L.A. Monteiro-Filho, A preliminary analysis of insects of medico-legal importance in Curitiba, State of Paraná. Memórias do Instituto Oswaldo Cruz 92 (2) (1995) 269–274.

[12] S.B. Pessôa, F. Lane, Coleópteros de interesse médico-legal, Arquivos de Zoologia do Estado de São Paulo 2 (1941) 389–504.

[13] K. Vulvinec, Dung beetles (Coleoptera: Scarabeinae), monkeys, and conservation in Amazonia, FL Entomologyst 83 (3) (2000) 229–241.

[14] C.A. Medina, A. Lopera-Toro, A. Vítolo, B. Gill, Escarabajos coprófagos (Coleoptera: Scarabaeidae: Scarabaeinae) de Colombia, Biota Colombiana 2 (2) (2001) 131–144.

[15] F. Feer, S. Pincebourde, Diel flight and ecological segregation within an assemblage of tropical forest dung and carrion beetles, J. Tropical Ecol. 21 (2005) 21–30.

[16] D.H. Ubelaker, Taphonomic Applications in Forensic Anthropology, in: W.D. Haglung, M.H. Sorg (Eds.), Forensic Taphonomy: The Post Mortem Fate of Human Remains, CRC Press, 1997, pp. 77–90, xxvi + 636 p.

[17] J.R. Pujol-Luz, H. Marques, A. Ururahy-Rodrigues, J.A. Rafael, F.H.A. Santana, L.C. Arantes, R. Constantino, A forensic entomology case from the Amazon rain forest of Brazil, J. Forensic Sci. 51 (5) (2006) 1151–1153.