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FASES DE DECOMPOSIÇÃO DE CARCAÇAS DE PORCOS (*Sus scrofa* L.) SUBMERSAS EM UMA BARRAGEM NA AMAZÔNIA CENTRAL

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Manaus, AM

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Sinopse:

Estudou-se as fases de decomposição utilizando como modelo carcaças de suínos submersas em uma barragem na cidade de Manaus, a fim de aumentar a precisão na estimativa do intervalo pós-morte submersão (IPMS) para corpos recuperados em ambiente aquático na região amazônica.

Palavras-chave: Forense , intervalo pós-morte submersão, Amazônia

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“Cumpriu sua sentença. Encontrou-se com o único mal irremediável, aquilo que é a marca do nosso estranho destino sobre a terra, aquele fato sem explicação que iguala tudo o que é vivo num só rebanho de condenados, porque tudo o que é vivo, morre.”

Ariano Suassuna

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Resumo

A decomposição e a colonização da fauna em carcaças em ambiente terrestre têm sido bem estudadas, mas o conhecimento do processo de decomposição em ambiente aquático ainda é escasso. Esse trabalho teve como objetivo descrever as fases de decomposição utilizando como modelo carcaças de suínos submersas em uma barragem na cidade de Manaus, a fim de aumentar a precisão na estimativa do intervalo pós-morte submersão (IPMS) para corpos recuperados em ambiente aquático na região amazônica. O intervalo pós-morte submersão total foi de 20 dias e seis fases de decomposição foram descritas: fresco submerso; flutuação inicial;deterioração de flutuação; deterioração inchada; restos flutuantes e restos submersos. Estes dados serão valiosos em investigações forenses envolvendo corpos submersos, indicando o tipo de condições da água que o corpo tenha sido exposto.

Palavras-chave: Intervalo Pós- Morte de Submersão,forense, Amazônia Central

Abstract

Decomposition of submerged pig carrion (Sus scrofa L.) in **a dam in Central Amazonia**

The decomposition and fauna colonization on carcasses in the terrestrial environment have been well studied, but knowledge of the process of decomposition in water is still scarce. This article aims to describe the stages of decomposition ten pig carcasses were deployed in a dam in the city of Manaus, in order to increase the accuracy in estimating the postmortem submersion interval (IPMS) for bodies recovered in the aquatic environment in the region. Decomposition time to skeletal remains was 20 days.Six phases of decomposition were established: submerged fresh, early floating, floating decay, bloated deterioration, floating remains and sunken remains. This data will be valuable in forensic investigations involving submerged bodies, indicating the type of water conditions that the body has been exposed.

Keywords: Post-mortem submersion interval,forensic,Amazon

Introdução Geral

Os afogamentos são uma das principais causas de morte evitáveis no mundo (OMS,2014). As principais causas de encontrar corpos em ambiente aquático estão relacionadas a acidentes de trabalhos com embarcação (Giertsen e Morild, 1989; Kahana et al. 1999; Stoop,2003), acidentes de recreação (Pampín e Rodríguez, 2001; Lunetta e Modell, 2005; Papadodima et al.,2010; Stoop, 2003) , suicídio (Çetin et al., 2001 ; Avis, 1993; Kringsholm et al.,2001) e descarte de vítimas de homicídio (Giertsen e Morild,1989; Lunetta e Modell, 2005; Haupt, 2006).

No Brasil, as características do clima, a vasta rede hidrográfica e o tamanho do litoral representam fatores de risco importantes para os afogamentos. Em 2010 morreram por afogamento 6.590 brasileiros, 43,6% desses casos tiveram afogamento em águas naturais (Ministério da Saúde, 2014). Neste mesmo ano a região brasileira que apresentou o maior número casos de morte por afogamento foi a Norte com 777 mortes (Ministério da Saúde, 2014). Segundo Szpilman*et al*. (2012) nas regiões litorâneas brasileiras apesar de acontecer afogamentos a taxa de salvamento e reanimação da vítima é maior uma vez que geralmente há a presença de salva vidas na maioria das praias, o que não ocorre no interior do país. Assim quando ocorre afogamento em água doce as chances de salvamento da vítima são bem menores. Na região Norte com o aumento das temperaturas na estação menos chuvosa há o aumento de afogamentos, uma vez que aumenta a procura da população por igarapés e praias de água doce.

Um número significante de mortes relacionadas ao ambiente aquático são comumente caracterizadas por incertezas da causa da morte, da trajetória do corpo na água e a estimativa do Intervalo Pós- Morte de Submersão (IPMS) que é definido como o tempo em que o corpo fica submerso até o momento em que ele é descoberto (Arimoro, 2013; Mateus et al., 2013). Parâmetros médicos, como mortis algor, rigor mortis e livor mortis são comumente usados como indicadores de tempo de morte em ambientes terrestres (Henssge et al.,1995). No entanto, essas características são alteradas pelo ambiente aquático e há poucos trabalhos relacionando as fases de decomposição de corpos humanos ou de carcaça de animais em ambientes aquáticos (Hobischak e Anderson, 1999) dificultando a trabalho de perito em estabelecer o IPMS.

Na Amazônia Central, Entomologia Forense é uma disciplina recente, e fatores relacionados ao Intervalo Pós Morte de Submersão (IPMS) ainda não foram amplamente explorados. Esse estudo representa a primeira tentativa de determinar a sucessão ecológica de artrópodes associados a diferentes estágios de decomposição de carcaça de suínos em ambiente de água doce. Contudo os dados não foram replicados, representando um ponto de partida para estimular novos estudos de decomposição em ambientes aquáticos para e estimar o IPMS.

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Artigo

Capítulo 1

Ferreira, M.C., Tourinho, A.L., Rafael, J.A. Decomposition of submerged pig carrion (Sus scrofa L.) in a dam in Central Amazonia. Submetido a Forensic Science International

Abstract

Decomposition of submerged pig carrion (*Sus scrofa* L.) in a dam in Central Amazonia

The decomposition and fauna colonization on carcasses in the terrestrial environment have been well studied, but knowledge of the process of decomposition in water is still scarce. This article aims to describe the stages of decomposition ten pig carcasses were deployed in a dam in the city of Manaus, in order to increase the accuracy in estimating the postmortem submersion interval (IPMS) for bodies recovered in the aquatic environment in the region. Decomposition time to skeletal remains was 20 days.Six phases of decomposition were established: submerged fresh, early floating, floating decay, bloated deterioration, floating remains and sunken remains. This data will be valuable in forensic investigations involving submerged bodies, indicating the type of water conditions that the body has been exposed.

Keywords: Post-mortem submersion interval,forensic,Amazon

Introduction

The decomposition of a body on land and the insect faunal succession associated with postmortem interval in this environment have been studied and described in many countries, geographic regions, habitats and seasons (ANDERSON, 2009;HOBISCHAK et al., 2006). Therefore entomological evidence is widely accepted in criminal cases involving this type of environment (HOBISCHAK; ANDERSON, 2002) This tool is often used to determine the time between death and the discovery of a body (known as Post Mortem Interval or PMI) (SMITH 1986). However, estimating PMI in an aquatic environment is still largely unexplored (HOBISCHAK; ANDERSON, 2002).

One challenge for forensic pathologists e diagnosis of the cause of death for bodies retrieved from water is considered a (PAPADODIMA et al., 2010). Actually few studies describe the stages of decomposition and the associated fauna to carcasses in freshwater environment (ARIMORO, 2013; BARRIOS; WOLFF, 2011; HOBISCHAK, 1994). Moreover the identification of organisms and an understanding of their feeding habits on submerged bodies may provide valuable information to the forensic investigator (PETRIK et al, 2004) and help determinate the Postmortem Submersion Interval (PMSI), defined as the time between corpse submersion and discovery (ARIMORO, 2013).

Another tool used to determine the MPI are modification of corpses over time such as algor mortis, rigor mortis and livor mortis. This medical parameters are commonly used as indicators of time since death in terrestrial environments, however, these traits are altered by the aquatic environment and concrete guidelines for their time of onset and dispersal are not available (PETRIK et al, 2004), especially for the Amazon region. Knowledge of the effects of submergence and the changes in the process of decomposition in body is important to determine the PMSI after all many homicide victims and a greater number of people are lost in the aquatic environment to drowning or boating accidents (AMENDENDT, et al. 2010)

The determination of Postmortem Submersion Interval (PMSI) may be crucial during legal investigation (ARIMORO, 2013), so it is important that forensic scientist and police when visiting a crime scene have an increased knowledge of the aquatic organisms that could

potentially colonize humans and non-human models (BYRD; CASTNER, 2001) and the decompositional stage of the body recoveries.

In Central Amazonian , forensic entomology is a recent discipline, where factors relating to the post-mortem submersion interval (PMSI) have not yet been fully explored. This study represents the first attempt to determine entomological succession of arthropods associated with different stages of carcass decomposition freshwater ecosystems using pig (Sus scrofa) carcasses. Although data were not replicated, the study represents a unique starting point to stimulate further studies of decomposition in aquatic environments to estimate PMSI.

Materials and Methods

The experiments were carried out in Manaus, in the less rainy season (August 2014), at Instituto Federal do Amazonas, Campus Zona Leste (3° 4'40.97"S 59°55'39.74"W). Was used for carrying out such experiment, a dam ,200 m long and 4 m deep, although the dam was situated in an urban area, the riparian vegetation at all sites consists of Symphonia*Cecropia glaziovi*, *Virola surinamensis*, *Carapa guianensis*, among other typical species of the region. The animal model with standard closest to the decomposition of the human being is the domestic pig (*Sus scrofa*) due to similarities such as the size of the thoracic cavity, adipose tissue, protein composition, internal organs, diet and amount of the coating the skin (CATTS ; GOFF, 1992). For this experiment we used 10 individuals of Sus scrofa, weighing on average 20 kg. Initially the models were subjected to electrical stunning in accordance to Brazilian regulations for humane slaughter of pigs (BRAZIL, 2000) followed by drowning at the study site. This procedure was approved by the Ethics Committee on Animal Use (CEUA/ INPA) protocol number 006/2014.

After slaughter, the models were arranged in individual cages placed every 20 meters along the dam. The cages were made of galvanized iron with dimensions of 75 cm x 60 cm x 80 cm, covered with aluminum screen with a mesh of 2 cm^2 which allowed the entry of water, and prevented that the animal model was carried by the current or attacked by large vertebrates. In order to reduce the loss of material, a mesh of 1 mm was placed at the bottom of the cage. Subsequently the cages were fixed in tree branches, keeping the distance of 1 m from the edge and 2 meters of depth, so the cages floating or sinking in accordance with the phase of decomposition who the carcass showed (Figure 1).

A metal structure of 1.80 m by 1.00 m containing two pulleys was fixed on the boat side to lift cages. This structure helped in the release of the hands during sampling, facilitating visual inspection and collection of specimens that were retained in the mesh of 1mm. (Figura 2)

Every 48 hours, the temperature (digital thermometer) and pH (digital pH meter 55 YSI) of each point of water were measured. Then the cage was lifted, the state of decomposition of each carcass was photo-documented and subsequently classified according to the phases described in the literature (ARIMORO, 2013; BARRIOS; WOLFF, 2011; HOBISCHAK; ANDERSON, 2002; PAYNE; KING, 1972). The carcass and the fine mesh were analyzed for

the presence of invertebrates, specimens were found preserved in 80% alcohol and identified as proposed by Hamada e Ferreira-Keppler (2012) .

Results and Discussion

The water temperature and the pH did not vary between the collection points near each model. The dam water showed an average temperature of 28.4 ° C and a characteristic pH from acid waters, with an average value of 5.32. Probably these water characteristics contributed to the total PMSI, from sacrifice until skeletal remains, was so fast, only 20 days.

It is expected that the ambient temperature has a strong influence on aquatic systems, given that organisms in this environment respond to temperature changes. In environments with standing water, the temperature is generally higher (SORG et. al., 2007) while the force of water becomes a mechanism of disarticulation of soft tissues and bones (WIPFLI et al. 1998), these two factors increase the rate of decomposition.

This rapid decomposition may explain the low number of invertebrates present in this study, through the stages of decomposition only 8 specimens of Chironomidae, 6 Odononata were collected from models and fine mesh.

The temperature is an important factor that controls the distribution of shredders, studies suggest that the richness of this group decreased with decreasing latitude, increasing temperature and microbial activity (IRONS et al. 1994). However, the published works concerning the importance of microbial activity in streams of the Amazon are still scarce, leaving speculations about the importance and availability of fungi in this environment (WALKER,1986).

Both Chironomidae family and the Odonata order were not related to any specific stage of decomposition, in other words, they are not good indicators of IPMS for this area. Althoug Chironomidae larvae can be used to determine when the body is moved, knowing that these are specific waters with high primary productivity (BARRIOS; WOLFF, 2011).

Six stages of decomposition were observed: Submerged Fresh, Early Floating, Floating decay, Bloated deterioration, Floating remains, Sunken remains. All models have gone through all stages.

Submerged Fresh (days 0 - 2): Sacrifice until floating. (Figure 3)

Early Floating (days 2 – 6): The smell of decay was evident. Presence of abdominal lividity with greenish black color. The carcasses showed a swollen abdomen, increase in body volume and began to float. Formation of epidermal bubbles of liquid hemoglobinic. (Figure 4)

Floating decay (days 8 – 10): Carcass deflation, exit gases by natural orifices. Muscle weakness, hair and nails fell off easily. (Figure 5)

Bloated deterioration (days 10 – 14): Most soft tissues have been consumed, the odor of putrefaction decreased. Disarticulation of the head, shoulders, abdomen and hind limbs at the end of this phase. (Figure 6)

Floating remains (days 14 – 18): Parts of the bones, skin and tissue remained suspended. (Figure 7)

Sunken remains (days 18 – 20): Only the bones, were at the bottom of the cages. (Figure 8)

Despite the time of decomposition have been faster compared to other studies (BARRIOS; WOLFF, 2011; HOBISCHAK, 1994), the characteristics of decomposition phases were the same as already described in the literature, being different from the duration of each phase (ARIMORO, 2013; BARRIOS; WOLFF, 2011; HOBISCHAK; ANDERSON, 2002; PAYNE; KING, 1972).

Conclusion

In this study, no classic succession of insect species was observed. Nevertheless, the fauna on the remains and the decomposition patterns do suggest that a better understanding of decomposition in the aquatic environment will be valuable in estimating elapsed time since submergence, identifying the environment in which the body has decomposed

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Figure

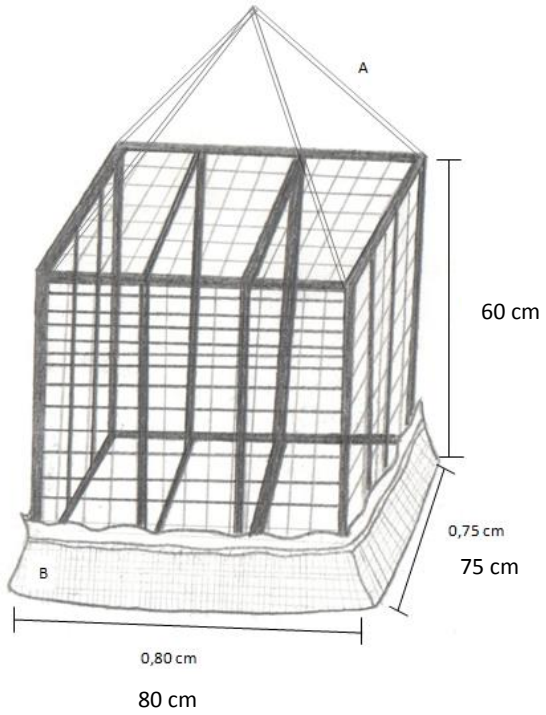

Figure 1: Galvanized iron cage model where each carcass was placed. (A) nylon rope for fixing the cage and (B) fine mesh of 1 mm

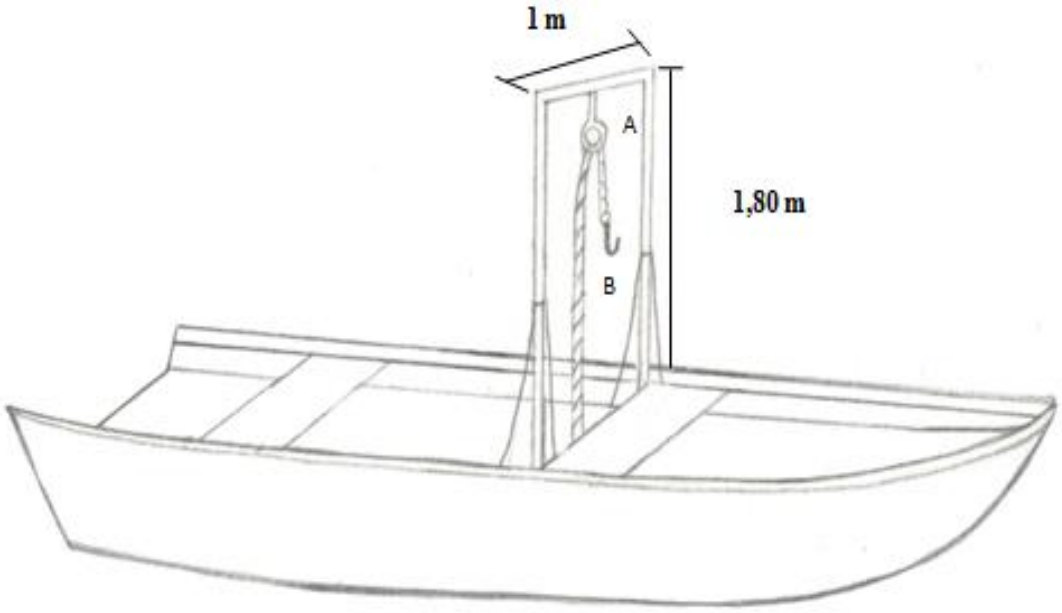

Figure 2: Metal structure containing two pulleys (A, B) fixed to the ship for suspending the cages

Figura 3: Submerged Fresh (days 0- 2).

Figura 4: Early Floating (days 2- 6). Formation of epidermal bubbles of liquid hemoglobinic

Figura 5: Bloated deterioration (days 8 -10).

Figura 6: Bloated deterioration (days 10 – 14).

Figura 7: Floating remains (days 14 – 18)

Figura 8: Floating remains (days 14 – 18)

Conclusão

Apesar nenhum inseto aquático ter sido identificado como bom indicador forense para o local, a descrição das fases de decomposição e suas durações podem subsidiar investigações forenses em ambientes aquáticos, auxiliando na determinação do Intervalo Pós Morte de Submersão em locais com características semelhantes ao local de estudo.