A Checklist of Arthropods Associated with Pig Carrion and Human Corpses in Southeastern Brazil

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Necrophagous insects, mainly Diptera and Coleoptera, are attracted to specific stages of carcass decomposition, in a process of faunistic succession. They are very important in estimating the postmortem interval, the time interval between the death and the discovery of the body. In studies done with pig carcasses exposed to natural conditions in an urban forest (Santa Genebra Reservation), located in Campinas, State of São Paulo, southeastern Brazil, 4 out of 36 families of insects collected - Calliphoridae, Sarcophagidae, Muscidae (Diptera) and Dermestidae (Coleoptera) – were considered of forensic importance, because several species were collected in large numbers both visiting and breeding in pig carcasses. Several species were also observed and collected on human corpses at the Institute of Legal Medicine. The species belonged to 17 different families, 6 being of forensic importance because they were reared from human corpses or pig carcasses: Calliphoridae, Sarcophagidae, Muscidae, Piophilidae (Diptera), Dermestidae, Silphidae and Cleridae (Coleoptera). The most important species were: Diptera – Chrysomya albiceps, Chrysomya putoria, Hemilucilia segmentaria, Hemilucilia semidiaphana *(Calliphoridae),* Pattonella intermutans *(Sarcophagidae),* Ophyra chalcogaster *(Muscidae),* Piophila casei *(Piophilidae); Coleoptera* – Dermestes maculatus *(Dermestidae),* Oxyletrum disciolle *(Silphidae) and* Necrobia rufipes *(Cleridae).*

Key words: forensic entomology - Diptera - Coleoptera - carrion insects - decomposition - death time

The decomposition of a dead body starts firstly through the action of microorganisms such as fungi and bacteria, followed by the action of a series of arthropods, with the predominance of the sarcosaprophagous insects (Nuorteva 1977). Notable differences were noted in the decomposition process, basically related to time of disintegration, being faster in the presence than in the absence of insects (Payne 1965, Jirón & Cartín 1981).

After death, the body undergoes natural changes, going through different stages of decomposition that are attractive to necrophagous insects. According to Bornemissza (1957) the decomposer community of a carcass goes through a process of ecological succession. Therefore, the insects arrive in a determined sequence, producing an addition and/or substitution of species. Knowing this sequence as well as their preference for the different stages of decomposition, and the meteorological data, it is possible to determine the postmortem interval (PMI). Insects can also verify the cause of death and if the body was moved (Catts & Goff 1992, Anderson 1997).

The basic reason for using insects in criminal investigations, a science denominated as forensic entomology, resides in the fact that insects are the first ones to detect and to find a cadaver and are present in all stages of decomposition and, furthermore, some species are specific for certain areas and seasons. Another important point to be considered is that oviposition can occur minutes after death (Smith 1986). It is interesting to point out that insects of forensic importance are those that do not just visit the corpse or carcass in the adult form, but also breed in these substrates because, by knowing the developmental time of their larvae, it is possible to estimate the time of death.

Our objective was to determine the insects that are of importance in estimating the time of death for the study area. Samples were collected from pig carcasses exposed to a natural urban forest and from human corpses at the Institute of Legal Medicine (ILM) in the area of Campinas, State of São Paulo, Brazil.

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MATERIALS AND METHODS

The study was done in two different environments: in a natural forest area (Santa Genebra Reservation) and at the ILM, both located in the city of Campinas, State of São Paulo. The data were collected from 1994 to 1998.

In the natural area (Morellato & H Leitão-Filho 1995), 16 pig carcasses (*Sus scrofa* Linnaeus) weighting approximately 10 kg each were used as baits. They were killed mechanically with a blow to the head and by mechanical asphyxia and immediately placed inside metal frame cages to exclude large vertebrate scavengers. Underneath the cages, metal trays with sawdust were placed to collect larvae leaving the carcasses to pupate. The adult insects were captured from pigs by emergence traps, consisting of an iron frame in form of inverted funnel and covered with transparent fabric. The immature forms (maggots and pupae) were collected through daily screening of the sawdust placed under the bait and were deposited in plastic vials covered with transparent fabric, to prevent the escape of adults after emergence. Each experiment lasted until the entire carcass had been consumed. At the ILM, the adult insects that were attracted to 20 human bodies or were transported with them to the morgue, were collected with an insect net. The maggots were collected with forceps, deposited in plastic vials, transported to the laboratory, where they were kept and reared until the eclosion of the adults. The collections were made once a week, in the morning. The collected and reared insects were later counted and identified. The Calliphoridae was identified according to Dear (1985).

RESULTS

Table I contains a compilation of all Coleoptera and Diptera collected during the decomposition studies from 1993 to 1998. They were identified by order, family and species, whenever possible, and classified as species of forensic importance to estimate the PMI and as area indicators. A species was considered of forensic relevance, if it was reared from a carcass, evidencing that an exposed body can serve both as food source for the adult insects, and as substratum for egg laying immature development.

Tables II and III present data on the frequency of the species of forensic importance that were collected in the natural forest and at the ILM.

DISCUSSION

An exposed body represents a temporary habitat and food source for a variety of organisms that extend from bacteria and fungi to vertebrates. Regarding the experiment done in the forest, the insects were the most important decomposition agents of the pig carcasses, being present during all the stages of decomposition. The Diptera had a peak during the initial stages, and the Coleoptera during the final decay process.

The diversity of insects collected in the natural environment was much larger than at the ILM and several corpses in the morgue had insects that came from natural environments. This may be due to differences in attractiveness exerted by the different species, or to the smaller sampling effort spent at the IML, or both. However, the adult flies that were attracted to the corpses at the ILM were the same species that were collected in the pig carcasses and are important forensic indicators. *Chrysomya albiceps, C. megacephala, Hemilucilia semidiaphana* and *Pattonella intermutans* were the most frequent. Most of the Coleoptera can be considered incidental visitors, and only a few species can be considered to be forensic indicators: *Dermestes maculatus*, *Oxylletrum disciolle* and *Necrobia rufipes*.

Of the 54 collected species, 28 are of forensic importance and can be used as indicators of the PMI and of the area, because they were reared from the carcasses or they occurred in just one environment or season. The insects collected in both environments can provide the initial data for additional studies to improve the knowledge of the carrion arthropod fauna in the area of Campinas.

The insects can be useful tools in investigations on causes and circumstances of death. However, the usefulness of this method depends on how the corpse has been handled before the arrival of the entomologist at the death scene. Ideally, the forensic entomologist should be part of the team of professionals that are first called to the death scene.

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REFERENCES

Anderson GS 1997. The use of insects to determine time of decapitation: a case study from British Columbia. *J Forensic Sci 42*: 947-950.

Bornemissa GF 1957. An analysis of arthropod sucession in carrion and the effect of its decomposition on the

TABLE I

Adult Diptera and Coleoptera collected in a natural forest of Santa Genebra Reservation and at the Institute of Legal Medicine (ILM) in Campinas, SP, from 1993 to 1998

Order	Family	Genus/species	Site	PMII	AI
Coleoptera	Cantharidae	sp.	ILM	-	-
	Carabidae	sp.	ILM	X	-
	Cerambycidae	sp.	ILM	-	-
	Cleridae	*Necrobia rufipes*	ILM	X	X
	Dermestidae	*Dermestes maculatus*	Forest/ILM	X	-
	Histeridae	*Euspilotus* sp.	Forest	X	-
		Omalodes sp.	Forest	X	X
	Phengodidae	sp.	ILM	-	-
	Scarabaeidae	*Deltochilum brasiliensis*	Forest/ILM	X	-
		Eurysternus parallelus	Forest/ILM	X	-
		Scybalocanthon sp.	Forest	X	X
		Canthon sp.	Forest	X	X
		Coprophanaeus ensifer	Forest	X	X
	Staphylinidae	spp.	Forest	X	-
	Silphidae	*Oxyletrum disciolle*	Forest	X	X
Diptera	Anthomyiidae	*Hylemyioide aurifacies*	Forest	-	-
		Hylemyioide brasiliensis	Forest	-	-
	Bibionidae	sp.	Forest	-	-
	Bombyliidae	sp.	Forest	-	-
	Calliphoridae	*Chrysomya albiceps*	Forest/ILM	X	-
		Chrysomya putoria	Forest/ILM	X	X
		Chrysomya megacephala	Forest/ILM	X	-
		Cochliomyia macellaria	Forest/ILM	X	-
		Hemilucilia segmentaria	Forest/ILM	X	-
		Hemilucilia semidiaphana	Forest/ILM	X	X
		Mesembrinella bellardiana	Forest	X	X
Diptera		*Lucilia eximia*	Forest/ILM	X	X
	Cloropidae	*Liohipellates* sp.	ILM	-	-
	Dolichopodidae	sp.	Forest	-	-
	Drosophilidae	sp.	Forest	-	-
	Fanniidae	*Fannia pusio*	Forest	X	-
		Fannia canicularis	Forest	X	-
	Lauxaniidae	sp.	Forest	-	-
	Micropezidae	sp.	Forest	-	X
	Muscidae	*Biopyrellia* sp.	Forest	-	-
		Morellia humeralis	Forest	-	-
		Ophyra chalcogaster	Forest/ILM	X	-
		Pseudoptilolepis sp.	Forest	-	-
	Neriidae	sp.	Forest	-	-
	Odiniidae	sp.	Forest	-	-
	Otitidae	spp.	Forest	-	-
	Phoridae	*Megaselia scalaris*	Forest/ILM	X	-
	Piophilidae	*Piophila casei*	ILM	X	X
	Richardiidae	sp.	Forest	-	-
	Ropalomeridae	sp.	Forest	-	-
	Sarcophagidae	*Pattonella intermutans*	Forest/ILM	X	-
	Sepsidae	*Sepsis* sp.	Forest	-	-
	Syrphidae	*Copesthylum larei*	Forest	-	-
	Stratiomyidae	*Hermetia illucens*	Forest/ILM	X	X
	Tabanidae	*Tabanus* sp.	Forest/ILM	-	-
		Chrysops sp.	Forest	-	-
	Tachinidae	spp.	Forest/ILM	-	-
	Tephritidae	sp.	Forest	-	-
	Tipulidae	sp.	Forest	-	-

PMII: forensic indicator of postmortem interval; AI: forensic indicator for the area.

TABLE II

Frequency of Coleoptera and Diptera of forensic importance collected at the Institute of Legal Medicine of Campinas, from 1993 to 1998

Order	Family	Genus/species	Frequency
Coleoptera	Carabidae	sp.	17 adults
	Cleridae	*Necrobia rufipes*	4 adults
	Dermestidae	*Dermestes maculatus*	6 adults/larvae
	Scarabaeidae	*Deltochilum brasiliensis*	10 adults
		Eurysternus parallelus	6 adults
Diptera	Calliphoridae	*Chrysomya albiceps*	2,030 adults/larvae
		Chrysomya megacephala	90 adults/larvae
		Cochliomyia macellaria	2 adults
		Hemilucilia segmentaria	5 adults
		Hemilucilia semidiaphana	1 adults
		Lucilia eximia	11 eggs
	Muscidae	*Ophyra chalcogaster*	28 adults/larvae
	Phoridae	*Megaselia scalaris*	25 adults/larvae
	Piophilidae	*Piophila casei*	8 larvae
	Sarcophagidae	*Pattonella intermutans*	3 adults
	Stratiomyidae	*Hermetia illucens*	4 larvae

TABLE III

Frequency of adults of Coleoptera and Diptera of forensic importance collected in carcasses of pigs exposed in a natural area, in the city of Campinas, in the period from 1993 to 1998

Order	Family	Genus/species	Frequency
Coleoptera	Dermestidae	*Dermestes maculatus*	71
	Histeridae	spp.	352
	Scarabaeidae	spp.	1,039
	Staphylinidae	spp.	72
	Silphidae	*Oxyletrum disciolle*	128
Diptera	Calliphoridae	*Chrysomya albiceps*	1,404
		Chrysomya putoria	849
		Chrysomya megacephala	41
		Cochliomyia macellaria	98
		Hemilucilia segmentaria	186
		Hemilucilia semidiaphana	81
		Mesembrinella bellardiana	136
		Lucilia eximia	144
	Fanniidae	*Fannia* sp.	345
	Muscidae	*Ophyra chalcogaster*	567
	Phoridae	*Megaselia scalaris*	24
	Sarcophagidae	*Pattonella intermutans*	84
	Stratiomyidae	*Hermetia illucens*	11

soil fauna. *Austr J Zool 5*: 1-12.

Catts EP, Goff ML 1992. Forensic entomology in criminal investigations. *Annu Rev Entomol 37*: 253-272.

Dear JP 1985. A revision of the New World Chrysomini (Diptera: Calliphoridae). *Revta Bras Zool 3*: 109-169.

Jirón LF, Cartín VM 1981. Insect succession in the decomposition of a mammal in Costa Rica. *J New York Entomol Soc 89:* 158-165.

Morelatto P, Leitão-Filho H 1995. *Ecologia e Preservação de uma Floresta Tropical Urbana: Reserva de Santa Genebra,* Unicamp, Campinas, 136 pp.

Nuorteva P 1977. Sarcosaprophagous insects as forensic indicators. In CG Tedeschi, WG Eckert & LG Tedeschi (eds), *Forensic Medicine: a Study in Trauma and Environmental Hazards,* Vol. II, WB Saunders, New York, p.1072-1095.

Payne JA 1965. A summer carrion study of the baby pig *Sus scrofa* Linnaeus. *Ecology 46*: 592-602.

Smith KGV 1986. *A Manual of Forensic Entomology,* Cornell University Press, Ithaca, 205 pp.