

Forensic entomology in Quebec: The first data on arthropods associated with decomposed bodies in the summer season

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INTRODUCTION

Forensic entomology, or the study of arthropods in the interaction with justice, has been developed for years in several provinces of Canada^{1,2}, with the notable exception of Quebec. The study of arthropods associated with cadavers can help to estimate the minimum post-mortem interval (PMI_{min})^{1,3,4}. The purpose of our research was to acquire the first official data regarding the arthropods associated with decomposed human bodies in Quebec and Canada.

Objectives

- Document the diversity of the necrophagous entomofauna in Quebec
- Understand the succession of arthropods on human remains throughout the decomposition process





Figure I - REST[ES] facility



Figure 2 - Insect collection using an entomological net

Figure 4 - Diptera rearing design. Eggs and larvae of Diptera were placed on a piece of pork liver on an aluminium cup, deposited on top of humidified wood chips in a Mason jar, and maintained in an environmental chamber until the emergence of adults

METHODS

Location and sampling

- REST[ES] facility, Bécancour (Québec, Canada), wooded area (Figure 1)
- 2 human donors, August 10, 2020 (Day 0), protected with mesh cages
- Observation of decomposition process and arthropods (2x/day for first 7) days, then 1x/day, 3x/week, and 1x/week) until Oct. 27.

Entomological data

- Insect collection on bodies + Entomological net (Figure 2) + Pitfall traps (3/donor, ~Im from the donor, Figure 3)
- Rearing of eggs/larvae of Diptera on pork liver, in controlled environment in the lab (23°C, Photoperiod 12:12, Humidity ~ 60%, Figure 4), and identification of adults emerged

Environmental data

- Internal and ambient data loggers (temperature + humidity)
- Weather station onsite

Table I - Succession of main arthropods (Diptera and Coleoptera) on human remains. Data came from visual observations and captures with entomological net. In grey: immature stage (i); a: adult stage

Month	Α	August												Sept												Oct													
Decomposition stages Day of decomposition	Fi	res	h	Blo	oat	t	Active										Advanced								Dry rem						ins								
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21	23	25	28	30	32	35	37	39	42	44	46	49	51	53	56	60	63	70 78
DIPTERA																																							
Calliphoridae	a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i	i, a	i, a		a		а			a	а		а							
Phormia regina		i, a	i, a	i, a	i, a	i, a	i, a	i, a	i, a	i	i, a	i	i	i	i	i	i	i	i, a	i	i	i	i	i	i	i													
Lucilia illustris or silvarum		i	i	i	i		i	i	i	i	i	i	i	i	i	i																							
Calliphora livida		i, a					i																																
Sarcophagidae		а	а	а	а	а	i						а																										
Muscidae/Fanniiidae	а	a	а	а	а	а	a	a	а	а	а	а			a	а			а		а		а		a	а	а	a						а	i, a	а	а	a i	i, a
Hydrotaea	a		i		i		a	a	а	а	a	а	a	a	i	i, a	i, a	i, a	i, a	i	i		i, a	i	i	i, a		a			а	a	i	i	i, a	а	а	а	i a
Stearibia nigriceps (Piophilidae)				а		а	а	a	а	а	а	а	а	а	а	а			а	i, a			i, a	а	i	i, a	i	i, a	i	i	i, a	i, a	i, a	i	i	i	i	i	i i
Sepsidae			а	а	а	а	a	a	а	а	а	а	a	a	a	а	а	а	а		а	а	а				a	a					a						a
Phoridae	a		а		а	а				а		а																a											
Heleomyzidae					а						а					а										а		a			а	а					i		
COLEOPTERA																																							
Silphidae		a	а	а	a	а	a	a	а	а	i, a	i, a	i, a	а	i, a	i, a	i, a	i, a	i	i	i	i, a	i	i, a	i	i, a	i, a	i	i		а		a			а			
Necrophila americana			а	а	а	а	а						a																										
Nicrophorus tomentosus		a	а		a	а																									а					а			
Oiceoptoma noveboracense						а	a	a			а																												
Necrodes surinamensis						а	a	a	а	а	a	a	a		a	а	а	а		а		а		а		a	a						а						
Nitidulidae (Omosita sp.)					а	а					a	а					а		а			а	а	а	i, a	i, a	a	i, a	i, a	i	i, a	i	i, a	а	а		i		
Dermestidae			а	а	а																		а	а														а	
Cleridae							а				a					а						а			а	а	a	a					а						
Staphylinidae			a	а	а	а	a	a	а	а	a	а	a		a	i, a	а	а	i, a			а	а	i, a	i, a	i, a	i, a	i, a	а	i, a	а	а	i, a	а	a	а	а	а	a a
Histeridae		a	а		a	а			а				a	а		a	а						а	а				a						а					

Weather

- Temperatures. Mean daily ambient temperatures ranged from 0°C (Oct. 27) to 24°C (August, 11). Daily minimum of -3°C (Oct. 27), and maximum of 33°C (August, 11)
- Precipitation. Total of 322 mm of rainfall, 33 days of rain

Decomposition

- Transition between stages was difficult to determine. Dry remains stage was reached around 18 days for the head and 39 days for the rest of the body
- Signs of desiccation/mummification were rapidly observed
- Ante-mortem injuries accelerated the decomposition process (Figure 5)



Figure 5 – Decomposition process on an arm with signs of ante-mortem injuries (Bécancour, Qc)

Diptera (Table I)

- 1st eggs laid belonged to Phormia regina and Lucilia illustris (Day 1)
- L. silvarum, Calliphora livida, L. illustris, and Sarcophigidae were associated with early decomposition stages (up to bloat stage or active decay)
- Eggs/larvae of Hydrotaea (Muscidae) and skipper fly (Piophilidae) were observed in late decomposition stages (respectively from the end of active decay, and advanced decay to dry remains)

Coleoptera (Table I)

- 1st beetles observed (Day 1) belonged to Silphidae (Nicrophorus tomentosus) and Histeridae
- Necrophila americana and Oiceotoma noveboracense were observed during the early decomposition process (until the beginning of active decay)
- Larvae of sap beetles (Nitidulidae) were associated with advanced decay and dry remains stages

This study represents the first controlled study in Canada on arthropods associated with human remains. Our results provide relevant information about the necrophagous species found in Quebec and the succession of arthropods on human cadavers. Some differences were observed between the present results and previous results obtained on pig carcasses in 2019 in Trois-Rivières (Qc)⁵. Interestingly, our results also confirm that ante-mortem injuries accelerate blow fly colonization and decomposition. Further detailed analysis of the data could help law enforcement in estimating a minimum PMI or to gain other information from insects.

Anderson GS. 2004. Determining time of death using blow fly eggs in the early postmortem interval. Int J Leg Med. 118(4):240-241.

²Sharanowski BJ, Walker EG, Anderson GS. 2008. Insect succession and decomposition patterns on shaded and sunlit carrion in Saskatchewan in three different seasons. Forensic Sci. Int. 179(2–3):219-

³Byrd JH, Tomberlin JK. 2020. Forensic entomology: the utility of arthropods in legal investigations. Third edition. Boca Raton, Florida, USA: CRC Press, Taylor & Francis, 620 p.

⁴VanLaerhoven SL and Merritt RW. 2019. 50 years later, insect evidence overturns Canada's most notorious case — Regina v. Steven Truscott. Foreensic Sci Int. 301:326-330.

⁵Maisonhaute J-É, Forbes SL. 2020. Decomposition process and arthropod succession on pig carcasses in Quebec (Canada). Can. Soc. Forensic Sci J.:1-26.











