PARASITOID HYMENOPTERA ASSOCIATED WITH DIFFERENT CORPSES ANIMALS IN ALGERIA.

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Abstract

This study presents the results of work carried out on three biological models, that of a laboratory rat *Rattus norvegicus* (Mammalia, Muridae) and the Perdrix gambra *Alectoris barbara* (Aves, Phasianidae) in 2016 during the spring (March) in the Koléa region (Tipaza). On a wild boar *Sus scrofa* (Mammalia, Suidae) in summer 2016 (July and August) around the Djurdjura national park (Bouira). Only one trapping technique is used during this study. The yellow plates are placed around these three corpses. We captured 561 Hymenoptera in the laboratory rat, of which the family Pteromalidae comes second with 24.96% (140 individuals). Likewise for the Partridge gambra with 375 hymenoptera with 22.67% (85 individuals) for the family Pteromalidae.1595 Hymenoptera in the Wild Boar, of which the family Pteromalidae also occupies the second position with 18.93% (302 individuals).

Keywords: Yellow plates, three corpses, Parasitoid, Hymenoptera, Algeria.

INTRODUCTION

The death of an unsupervised or suspicious person results in the arrival of necrophagous insects (CATTS & GOFF, 1992; SMITH, 1986). These insects are generally the only source of information for the short and long-term determination of post-mortem interval (PMI).The sarcosaprophage fauna is divided into five ecological groups, which are accidental species whose presence is due to chance. In general, necrophages, necrophiles, and omnivores are the most medically important (ARNALDOS et al., 2005). The composition of this fauna varies depending on the nature of the body and the different stages of decomposition (SCHOENLY et al., 1996). Corpse decomposition is influenced by many factors, the most important of which are temperature, humidity, precipitation and insect abundance (TANTAWI et al., 1996). Studies on necrophagous arthropods have been conducted in several regions of the world to determine necrophagous species and succession patterns (TABOR et al., 2005). Certain hymenoptera are also associated with corpses: we occasionally observe the presence of wasps or ants. These species are most often not scavengers, but exploit this ecosystem to hunt the larvae found there (CHARABIDZE & GOSSELIN, 2014). Omnivores, which also feed on the corpse and associated fauna; we note the presence of Hymenoptera such as wasps and ants but also of Coleoptera (LECLERCQ, 1996; AMENDT et al., 2004; ARNALDOS et al., 2005; WYSS & CHERIX, 2006). Hymenoptera belonging to the Pteromalidae family are parasitoids of Dipterous Calliphoridae (Charabidze, 2008). In Algeria, work on parasitoids is fragmented and limited.

MATERIEL AND METHODES

This study presents the results of work on three biological models, that of a laboratory rat *Rattus norvegicus* (Mammalia, Muridae) and Perdrix gambra *Alectoris barbara* (Aves, Phasianidae) in 2016 during spring (March) a forest in Kolea (Tipaza). On a wild boar *Sus scrofa* (Mammalia, Suidae) in summer 2016 (July and August) around Djurdjura National Park (Bouira). Only one trapping technique is used in this study. The yellow plates are placed around these three corpses (Fig.1). The species captured in the yellow plates are brought back to the level of zoology laboratory of the national higher veterinary school in order to determine them. We rely on keys on dichotomous keys and works include those of BERLAND (1940); GOULET and HUBER (1993); PINTUREAU (2012) as well as the websites: http://www1.montpellier.inra.fr/CBGP/coleotool/parasitoides.html and http://www7.inra.fr/opie-insectes/ch-01.htm. The photos were taken by digital camera (Samsung J7pro) (Fig. 2).

Analyze data

The results of the yellow plates are used by certain ecological indices as follows: relative abundance (AR %) (DAJOZ, 1971), the Shannon diversity indices and equitability indices (RAMADE, 2003). These data were analyzed using Paleontological Statistics software version 2.17 (HAMMER et al., 2001).

Figure 1. Arrangement of yellow plates on the three corpses (a. Perdrix gambra ; b.Rat de laboratoire ;c. Sanglier sauvage in two different localities (Originale).

RESULTS AND DISCUSSIONS

After a decomposition of the animal corpses which lasted 45 and 50 days for the *Perdrix gambra* and the Laboratory Rat respectively with a temperature equal to 8.8 ° c. during spring around Koléa and 53 days for wild boar in summer with a temperature varying from 21.7 ° C. at 25 ° C. at the level of the national park of Djurdjura (Bouira) and using the yellow plates, we were able to collect parasitoids which surround the corpses, we obtained the following results. We captured 561 Hymenoptera in the laboratory rat, 375 hymenoptera for the Partridge gambra and 1595 Hymenoptera in the Wild Boar (Tab.1). Our results confirm those found by AMENDT et al. (2000); DISNEY et MUNK (2004); GRASSBERGER et FRANK (2003, 2004) ; TURCHETTO et VANIN (2004) mentioning the presence of families of parasitic wasps of importance include medico-legal les Braconidae,Pteromalidae et Ichneumonidae. By cons FREDERICKX et al. (2013) have identified on pig carcasses were Ichneumonidea (one family), Chalcidoidea (two families), Cynipoidea (two families), and Proctotrupoidea (one family): Six families were identified: Braconidae, Pteromalidae, Encyrtidae, Figitidae, Eucoilidae, and Diapriidae.

We find that the Shannon diversity value ranges from 1.29 to 1.74 bits for insects found on the two bodies (bird and mammal) of the Koléa region. The population of insects necrophiliac Koléa seems little diversified. For wild boar, the Shannon index is 1.33 bits in Djurdjura National Park (Bouira). The diversity of necrophilic insects on these corpses is similar in the two regions. The values of fairness j obtained tend towards 1, which means that the insects found on the three corpses in the two regions are in equilibrium (Tab. 2). From Table 1, we noted a high relative abundance for the family of Formicidae followed by Pteromalidae. Among the parasitoid hymenoptera collected at the level of the three corpses, we obtained for the region of Koléa, 7 families recorded for *Rattus novergicus* and 5 families for *Alectoris barbara*. The Djurdjura national park region (Bouira), we noted 5 families on *Sus scrofa*. We noted the dominance of the family Pteromalidae on the three corpses with percentages ranging from 24.96% for the laboratory rat with 140 specimens, 22.67% for the partridge gambra with 85 specimens and 18.93% for the wild boar with 302 specimens. The most dominant species is *Nasonia vitripennis* (Fig.3A, B and C). The two corpses from the kola region mount the dominance of *Nasonia vitipennis* with percentages ranging from 39% for the laboratory rat and 46% for the partridge gambra. In second place comes *Alysia manducator* and *Pachyneuron* sp. with 18% each rated for *Rattus norvigecus*. 19% *Alysia manducator* for partridge gambra. The other parasitoids are poorly represented. Regarding the cadaver *Sus scofa* of Djurdjura national park (Bouira), we obtained a rate of 42% for *Nasonia vitripennis*, followed by *Pachyneuron* sp. with 31% and *Torymus* sp. with 12%. We identified the species *Alysia manducator* which belongs to the family Braconidae in the two regions on the three corpses. The presence of these parasitoids insects causes the interruption of the Calliphoridae cycle which could lead to the failure of the post-mortem inter val (IMP) calculation. The Vespidae represented by the Germanic wasp *Vespula germanica* visited the corpses in both regions at the end of the rotten stage. Our results confirm those found by AMENDT et al. (2000); DISNEY et MUNK (2004); GRASSBERGER et FRANK (2003,2004) ; TURCHETTO et VANIN (2004) et FREDRICKX et al. (2013) reported the presence of *Nasonia vitripennis* Walker (Pteromalidae) et *Alysia manducator* Panzer (Braconidae) are the most common parasitoids found on corpses. Some authors have noticed that wasps consume dead tissue and at the same time attack the insects found there. These observations therefore confirm the feeding behavior of these insects (GENNARD, 2012; FREDRICKX et al., 2013).

The microhymenopterans are also capable of choosing their hosts by size and developmental stage (DA SILVA MELLO et al., 2010). By TOMBERLIN et al. (2011) the Complex biological processes that are climate-dependent and site specific, like decomposition and ecological succession, are subject to inherent variability. *Nasonia vitripennis* is a cosmopolitan species (WHITING, 1967; DARLING & WERREN, 1990; YODER et al., 1994). After death, a series of physical and chemical changes occur within the body as it decomposes. Decomposition begins within minutes of death, as the cessation of essential metabolic functions triggers cellular changes (CLARK et al. 1996, CARTER et al. 2007, STATHEROPOULOS et al. 2007). Ecological succession of necrophilous insects follows a predictable sequence, related to their differential attraction to changing odor profiles associated with carrion and colonizing insects. Necrophilous insect taxa arrive to a decomposing body in a predictable sequence. Several sensory cues contribute to the predictability of insect succession, but primary among these are visual stimuli and volatile organic compounds (VOCs) that are by-products of decomposition (CRUISE et al., 2019). according to CHARABIDZE & GOSSELIN (2014) found that in total the work of Dr LECLERCQ during his career in forensic entomology encountered that only one species of hymenoptera is that of the Braconidae. Otherwise CHIN et al. (2009) reported that the parasitoid *Exoristobia philippinensis* (Hymenoptera: Encyrtidae) and larvae of *Orphyra spinigera* (Diptera: Muscidae) on pupae of *Chrysomya rufifacies* were collected from carcasses of monkeys in Malaysia. MARCHIORI & MIRANDA (2011) collected dipteral synanthropes in chicken excrement and observed parasitoids of these insects. The parasitism rate was 28.4%. The following species have been identified: *Muscidifurax raptorellus*, *Nasonia vitripennis*, *Pachycrepoideus vindemmiae*, *Spalangia cameroni*, S. *drosophilae*, S.*endius*, S. *nigra*, S. *nigroaenea*, *Spalangia* sp. (Hymenoptera: Pteromalidae) and *Tachinaephagus zealandicus* (Encyrtidae), with the Species *P. vindemmiae* having the highest incidence. These data serve as the basis for future evaluations of the biological control of the family Calliphoridae by parasitoids. Despite its potential usefulness in forensic entomology, the presence of parasitoids on crime scene has been largely because of their small size (about 2 mm in length) and the paucity of biological information available (GRASSBERGER and FRANK 2004). Successful parasitism by insect parasitoids is usually divided into hierarchical requirements, consisting of habitat location, host acceptance, and evaluation and physiological regulation of the host (BRODEUR and BOIVIN 2004). The discrimination between a low and high quality host is performed by collection of a small sample of the pupae hemolymph through the parasitoid female ovipositor (KING and ELLISON, 2006).

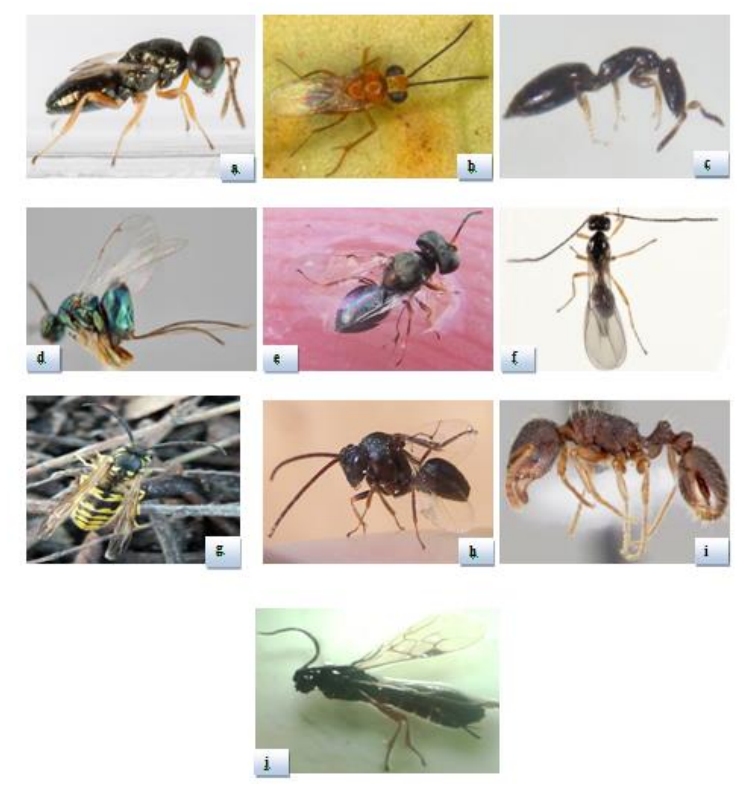

Figure 2. Different parasitoids identified in the yellow pots around the three corpses (Originale) (a: Pteromalidae (*Nasonia vitripenis*), b: Encyrtidae (*Leptomastix* sp.),c: Bethylidae (*Cephalonomia* sp.), d: Torymidae (*Torymus sp.*), e: Pteromalidae (*Pachyneuron* sp.), f: Braconidae (*Aphereta* sp.), g. Vespidae (*Vespula germanica*), h: Figitidae (*Granotoma* sp.), i: Foumicidae (*Tetramorium semilaeve*) , j: Braconidae (*Alysia manducator*).

Table 1. Families of parasitoids found in the three corpses.

Regions	Djurdjura National Park (Bouira)		Koléa			
Corpses	Wild boar		Partridge gambra		Laboratory rat	
Familles	ni	AR (%)	ni	AR (%)	ni	AR (%)
Fourmicidae	958	60,06	189	50,40	226	40,29
Halictidae	48	3,01	-	-	11	1,96
Ichneumonidae	36	2,26	-	-	12	2,14
Braconidae	12	0,75	65	17,33	44	7,84
Encyrtidae	-	-	-	-	22	3,92
Trichogrammatidae	-	-	-	-	20	3,57
Anthaphoridae	31	1,94	-	-	-	-
Aphidae	120	7,52	-	-	55	9,80
Vespidae	25	1,57	-	-	25	4,46
Bethylidae	-	-	12	3,20	-	-
Figitidae	-	-	22	5,87	-	-
Torymidae	51	3,20	-	-	5	0,89
Pteromalidae	302	18,93	85	22,67	140	24,96
Tiphiidae	12	0,75	2	0,53	1	0,18
Totales (N)	1595	100	375	100	561	100

- : no value

Table 2. Composition and structure indices applied for the hymenoptera listed at the level of the three corpses

Parameters	Wild boar	Partridge gambra	Laboratory rat
Taxa_S	10	6	11
Individuals	1595	375	561
Dominance_D	0,41	0,34	0,25
Simpson_1-D	0,59	0,66	0,75
Shannon_H	1,33	1,29	1,74
Equitability_J	0,58	0,72	0,72

The discrimination between a low and high quality host is performed by collection of a small sample of the pupae hemolymph through the parasitoid female ovipositor (KING and ELLISON, 2006). The females that neglect the host quality and ovipose in an old or cryoconserved hosts (KING and SKINNER, 1991; MILWARD-DE-AZEVEDO and CARDOSO, 1996) and already parasitized puparium, usually suffer a reduction in the quantity and quality of their progeny.

In Algeria, they are mainly represented by predatory wasps of the genus Vespoidae. Parasitoid wasps are also found in the family Pteromalidae, including *Nasonia vitripenis* , which lay their eggs in the calliphoridae diphtheria pupae. Some species of ants (Formicidae) are also necrophagous and may leave characteristic lesions on the corpses. In general, there has been very little study performed in the area of the cadaveric volatile compounds that influence the behavior of parasitoid.

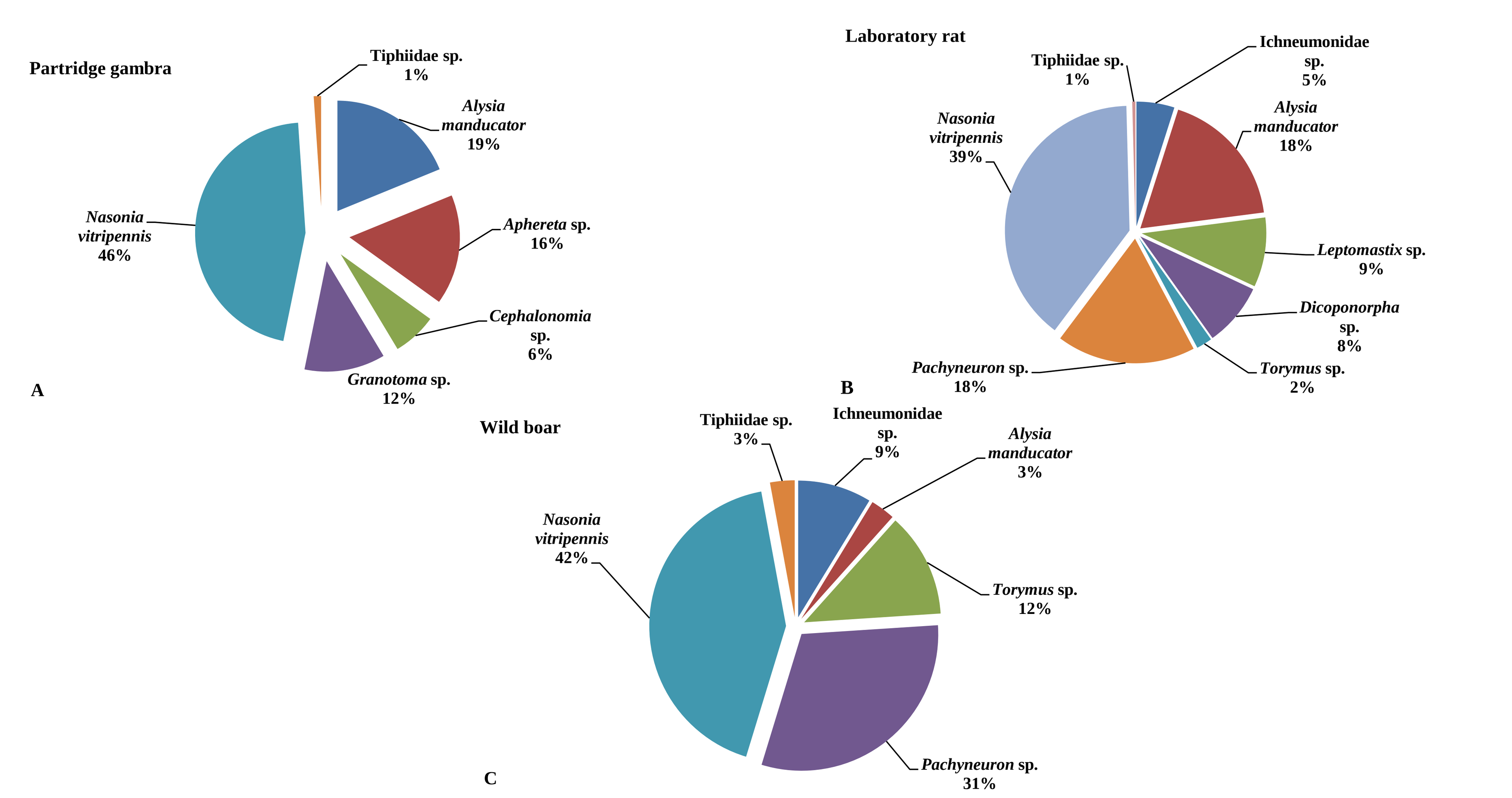

Figure 3. Different species encountered of parasitoids on the three corpses in two different localities (A, B: Koléa; C: Djurdjura National Park (Bouira).

CONCLUSION

Some species of beetles, hymenoptera and lepidoptera are also associated with decaying bodies, but they occur later and are therefore less common. In addition, although the diptera larvae of Calliphoridae are necrophages stricto sensu, that is to say that they feed on decaying animal tissue, the majority of beetles and hymenoptera are necrophiles. They are predators attracted to bodies by the presence of many potential preys. The presence of parasitoid hymenoptera, which lays their eggs inside the larvae or pupae of Diptera (genus *Nasonia*), is also observed. Forensic entomology and the study of the succession of scavenging insects are new and require more attention from researchers and scientists. It has been shown that species and succession levels can vary between geographic areas, habitat types or between seasons and years. These data highlight the importance of repeated local studies and the risk of errors associated with the use of standard succession.

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