NECROPHAGOUS BEETLES ASSOCIATED WITH DIFFERENT ANIMAL CORPSES IN VARIOUS ALGERIAN LOCALITIES

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Abstract. This study presents the results of a work carried out on six biological models: that of a Garenne Rabbit *Oryctolagus cuniculus* (Mammalia, Liporidae), a Mongoose Egyptian *Herpeste ichneumon* (Mammalia, Herpestidae) in the region of the Greater Kabylie (Algeria) in 2015 during the spring period (March and April), the common jackal *Canis aureus* (Mammalia, Canidae) in Tikjda during the autumn season (November and December) of the same year, Rat *Rattus norvegicus* (Mammalia, Muridae) and the Partridge gambra *Alectoris barbara* (Aves, Phasianidae) in 2016 during the winter (February and March) in the Kolea region (Tipaza), as well as on a wild boar *Sus scrofa* (Mammalia, Suidae) in summer 2016 (July and August) around the Djurdjura National Park (Bouira). Only one trapping technique was used in this study. The Barber pots were placed around these six corpses. In the Egyptian mongoose, we captured 500 beetles and 435 coleopterans in the wild rabbit. The Carabidae family are dominant with 27.40% in the Mongoose of Egypt and the Dermestidae family with 22.07% in the Garenne Rabbit. The common jackal with 190 Coleoptera whose Staphylinidae family dominates with 51.58% (98 individuals). 995 Coleoptera identified in the wild boar of which the family Staphylinidae is best represented with 38.39% (382 individuals). Regarding the laboratory rat, we identified 161 Coleoptera and 119 Coleoptera in the *Alectoris Barbara.* The Staphylinidae family dominates for the two, with 39.13% (63 individuals) and 53.78% (64 individuals) respectively.

Keywords: Great Kabylie, Bouira, Kolea, Wild Rabbit, Egyptian Mongoose, Jackal, Rat.

Rezumat. Gândaci necrofagi asociați cu diferite animale din diferite localități algeriene. Acest studiu prezintă rezultatele unei lucrări realizate pe șase modele biologice: un iepure *Oryctolagus cuniculus* (Mammalia, Liporidae), o mangustă egipteană *Herpeste ichneumon* (Mammalia, Herpestidae) în regiunea Cabylia Mare Algeria) în 2015 în perioada de primăvară (martie și aprilie).Șacal comun *Canis aureus* (Mammalia, Canidae) din Tikjda în sezonul de toamnă (noiembrie și decembrie) din același an, șobolan comun *Rattus norvegicus* (Mammalia, Muridae) și *Alectoris barbara* (Aves, Phasianidae) în anul 2016 în timpul iernii (februarie și martie) în regiunea Kolea (Tipaza). Pe un mistreț *Sus scrofa* (Mammalia, Suidae) în vara anului 2016 (iulie și august) în jurul Parcului Național Djurdjura (Bouira). S-a utilizat numai o tehnică de capturare în timpul acestui studiu. Capcanele Barber au fost plasate în jurul acestor șase cadavre. Din mangusta egipteană, au fost capturați 500 de gândaci și 435 de coleoptere din iepurele sălbatic. Familia Carabidae cu 27,40% este dominantă la mangusta egipteană și familia Dermestidae cu 22,07% la iepurele sălbatic. Șacalul comun cu 190 de coleoptere unde familia Staphylinidae domină cu 51,58% (98 de indivizi). 995 coleoptere identificate la mistreț din care familia Staphylinidae este reprezentată cel mai bine cu 38,39% (382 indivizi). În ceea ce privește șobolanul comun s-au identificat 161 coleoptere iar la *Alectoris barbara* 119 coleoptere. Familia Staphylinidae domină pentru cei doi, respectiv 39,13% (63 indivizi) și 53,78% (64 indivizi).

Cuvinte cheie: Marele Kabylie, Bouira, Kolea, iepure sălbatic, mangustă egipteană, șacal, șobolan.

INTRODUCTION

Despite more than 150 years of existence, forensic entomology is still considered a recent discipline (GAUDRY, 2007). Necrophagous insects are ubiquitous in anthropogenic ecosystems. Within our ecosystems, the most opportunistic organisms are necrophagous insects, true "recyclers" of dead organic matter (LECLERCQ & VERSTRAETEN, 1992). Coleoptera, important actors in the corpse-ecosystem, have so far been neglected by forensic entomologists for the benefit of the Diptera. Coleoptera include the largest and most diverse order of insects on earth, accounting for about 40% of all insects (SAWABY et al., 2016). Different species of beetles increase in number in advanced stages of decomposition in the open air and are absent or less represented inside (GOFF, 1991); ALMEIDA & MISE, 2009). This lack of interest in the Coleoptera of the corpse ecosystem is already described in one of the first reference books of forensic entomology of SMITH (1986), MIDGLEY et al. (2010), in Belgium of DEKEIRSSCHIETER et al. (2013), in Germany AMENDT et al. (2007), in Turkey of ÇOBAN & BEYARSLAN (2013) of AÇIKGÖZ (2016), in Athens of DIMAKI et al. (2016) and in Egypt SAWABY et al. (2016). 4 ecological groups can be associated with the corpse, a fifth category is sometimes cited, it is the “accidental” species whose presence on the body is a coincidence (DEKEIRSSCHIETER et al., 2012). This science is little known, but growing (FREDERICKX et al., 2010). Forensic entomology is implemented all over the world, in Belgium (LECLERCQ & QUINET, 1949; LECLERCQ & VERSTRAETEN, 1992; LECLERCQ, 1996, 1999), Switzerland (WYSS & CHERIX, 2006), Germany (AMENDT et al., 2000, 2004). In Africa, studies are being conducted in the same field in South Africa (VILLET & AMENDT, 2011) and in Cameroon by FUNGANG et al. (2012). In North Africa, there are few published studies on forensic or medico-legal entomology that remain fragmentary or limited. In Algeria, BOULEKNEFET et al. (2009, 2011), and of BENSAADA & DOUMANDJI (2012), of SAIFI et al. (2014), of BENSAADA et al. (2014), by BOULEKNEFET et al. (2015), and TALEB (2019) could be mentioned. Throughout this research, we provide a brief study on the necrophagous beetles of medico-legal importance that are collected on cadavers associated with different animal corpses in different Algerian localities.

MATERIAL AND METHODS

- **STUDY SITE**

We have chosen study sites at different bioclimatic stages and at different seasons. The Iboudrarene (Tizi-Ouzou) forests occupy an area of 1613 ha. They consist mainly of holm oak and cedar. The region of Fréha (Tizi-Ouzou) is populated by mixtures of cork oak and zen oak, cedar mixed with green oak, Eucalyptus and maquis trees of cork oaks, Arbutus, lentiscus maquis, Philaria, oleaster, Calycotome, Bruyère agricultural crops (National Forest Research Institute, Tizi-Ouzou, 2013)(ANONYME, 2013). The region Djurdjuran (Bouira) is characterized by variable annual precipitations (rain and snow), depending on the altitude (up to 1,500 mm), which places it among the wettest regions of Algeria. The vegetation of the Djurdjura Park is structured in tree, shrub and herbaceous strata. The sylvatic formations are oak forests and pure cedars (QUEZEL et al., 1999). Tikjda is located 1478 meters above the sea level on the southern slope of Djurdjuran in the region of Kabylia. MENARD & VALLET (1988) recognized five types of vegetation in the Tikjda zone, Cedar Forest (*Cedrus atlantica*), Green Oak Taillis (*Quercu srotundifolia*), Matorral Cedar and Holm Oak, Shrub and Chamfephy Lawns. Koléa is located northwest of Algiers,. It is occupied by large agricultural fields (CÔTE, 1996) (Fig. 1, Table 1).

Figure 1. Geographic coordinates and different bioclimatic areas of the study (original).

Table 1. Geographic Coordinates and bioclimatic different areas of study.

Study stations	Geographical coordinates	Bioclimatic stages
Iboudrarene (Tizi- ouzou)	36° 31′ 06″ N, 4° 14′ 22″ E	Sub-humid to cold winter
Fréha (Tizi-ouzou)	36.7584° N, 4.3177° E	Sub-humid to cold winter
National Park of Djurdjura (P.N.D.) (Bouira)	36° 27′ 47″ N, 4° 10′ 41″ E	Sub-humid to mild winter
Tikjda National Park (Bouira)	36° 15′ 53″ N, 4° 04′ 26″ E	humid bioclimatic stage for fresh winter
Koléa (Tipaza)	36°38′26″N 2°45′54″E	Wetatmild winter

- **BIOLOGICAL MATERIALS**

During our study, we sacrificed some corpses, except for the common jackal and the Egyptian mongoose we found already dead, belonging to two different classes of mammals and birds: that of a Garenne Rabbit *Oryctolagus cuniculus* (Mammalia, Liporidae) a Egyptian mongoose *Herpeste ichneumon* (Mammalia, Herpestidae) in the region of greater Kabylie (Algeria) in 2015 during the spring (March and April); a common jackal *Canis aureus* (Mammalia, Canidae) in Tikjda during the autumn season (November and December) of the same year; the laboratory Rat *Rattus norvegicus* (Mammalia, Muridae) and the Perdrix gambra *Alectoris barbara* (Aves, Phasianidae) in 2016 during the winter (February and March) in the Kolea region; a wild boar *Sus scrofa* (Mammalia, Suidae) in 2016 around the Djurdjura National Park (Bouira) during summer (July and August) (Fig. 2).

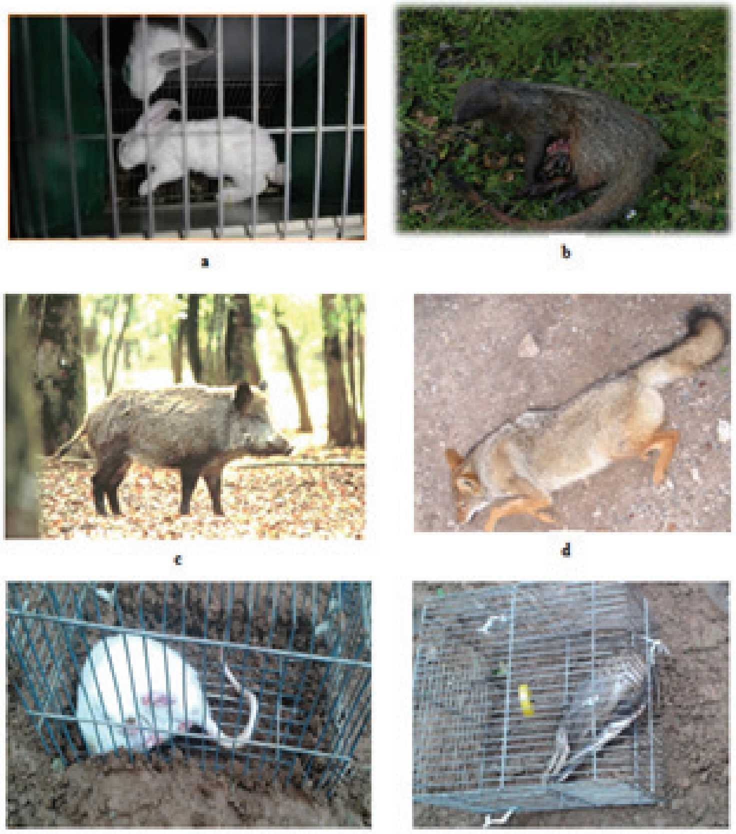

Figure 2. Biological materials used: a. Garenne rabbit *Oryctolagus cuniculus* (Mammaloia, Leporidae); b. Egyptian mongoose *Herpeste ichneumon* (Mammalia, Herpestidae); c. Wild boar *Sus scrofa* (Mammalia, Suidae); d. Common jackal *Canis aureus* (Mammalia, Canidae); e. Laboratory Rat *Rattus norvegicus* (Mammalia, Muridae); f. Partridge gambra *Alectoris barbara* (Aves, Phasianidae) (original).

- **SCHEDULE OF DIFFERENT METHODS USED IN THE FIELD**

The six corpses are put in cages. The latter are covered with an iron fence with small meshes to protect the corpses from predators (Table 2). To quantify the colonization of arthropods on the carcass of six corpses we filled the turn of every animal traps called traps or traps Barber. These are plastic pots filled with water, vinegar and powder detergent, 10 for each animal with a distribution as follows: 2 pots near the head 2 near the tail, 3 falconer abdomen and 3 pots at the back (Fig. 3). Thanatomorphosis is the set of post mortem morphological changes experienced by a body (CAMPOBASSO et al., 2001). The decomposition process is divided into different stages: active decomposition and swelling, decomposition and skeletisation of remains (VASS et al., 1992; DENT et al., 2004, SWANN et al., 2010) (Fig. 4). The species caught in the buried traps are returned to the zoology laboratory of the higher veterinary national school for determinations. On the basis of dichotomous keys and works, by taxonomic order we mention those of DU CHATENET, (1986), BAJERLEIN et al. (2012) as well as the websites www.kerbtier.de and www. Koleopterologie.de). The photos were taken by digital camera (Samsung J7pro) (Fig. 5).

Table 2. Duration in days of decomposition of the different biological models used in different Algerian localities.

Biological specimen	Systematic	Localities	Date of discovery of body	Weight	Date of deposit of body	Date of harvest	Days	Temperatures	Type of harvest
Rabbit	Mammalia - Leporidae	Iboudrarene (Tiziouzou)	15/04/2015	2 kg	17/04/2015	22/05/2015	36	14°c.	PB
Egyptian mongoose	Mammalia Herpestidae	Freha (Tiziouzou)	01/03/2015	2.6 kg	02/03/2015	13/04/2015	42	13°c.	PB
Commun Jackal	Mammalia - Canidae	Bouira (PNT)	15/11/2015	14 kg	15/11/2015	23/01/2016	53	11°c.	PB
Wild boar	Mammalia -Suidae	Bouira (PND)	23/07/2016	50 kg	24/07/2016	04/10/2016	53	25°c.	PB
Laboratory Rat	Mammalia -Muridae	Kolea (Tipaza)	08/02/2016	3.50kg	08/02/2016	28/04/2016	50	8.8°c.	PB
Partridge gambra	Aves - Phasianidae	Kolea (Tipaza)	08/02/2016	4.20kg	08/02/2016	23/04/2016	45	8.8°c.	PB

PND: National Park of Djurdjura; PNT: National Park of Tikjda; PB: Pots Barber

Figure 3. Arrangement of Barber pots near a bird corpse (original).

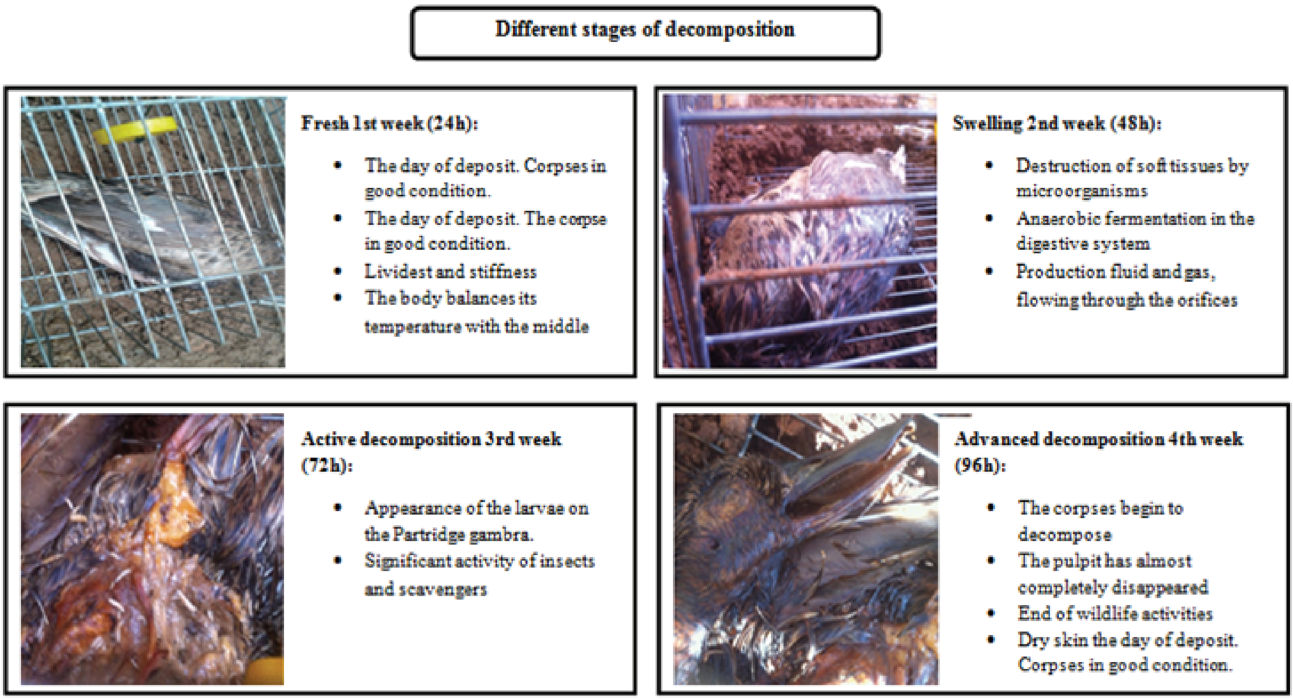

Figure 4. The composition process for the bird Partridge gambra *Alectoris barbata* (Aves – Phasianidae) in the forest biotope (DEKEIRSSCHIERTER, 2012, as amended).

Figure 5. Some necrophagous beetles harvested from six corpses (original).
a. *Anotylus rugosus* (Staphylinidae), **b.** *Creophilus maxilosus* (Staphylinidae), **c.** *Ocypus olens* (Staphylinidae), **d.** *Philonthus* sp. (Staphylinidae), **e.** *Aleochara* sp. (Staphylinidae), **f.** *Thanatophiluss inuata* (Silphidae), **g**. *Dermestes frischii* (Dermestidae, ventral view), **h.** *Dermestes frischii* (Dermestidae, dorsal view), **i.** *Saprinussem istriatus* (Histeridae), **j.** *Sisyphus schaefferi* (Scarabaeidae), **k.** *Trypocopris vernalis* (Geotrupidae), **l.** *Necrobia rufipes* (Cleridae), **m.** *Necrobia violacea* (Cleridae), **n.** *Trox fabricii* (Trogidae), **o.** *Nitidula flavomaculata* (Nitidulae).

- **DATA ANALYSIS**

In order to evaluate the abundance and diversity of species in the study area, we used the results of Barber pots. These data were analysed with the PAST software (Paleontological Statistics) Version 2.17 (HAMMER et al., 2001) and use of the SPSS 8.0 statistical software. As a result, the species that colonize corpses are exploited by some ecological indices such as:

- The centesimal frequency (CF) is the percentage of individuals of a species or of the total of N individuals, all species combined (DAJOZ, 1975). It is calculated by the following formula: FC% = ni * 100 / N.
- Shannon's diversity index is calculated from the following formula: H '= - Σ Pi log 2 Pi ; H ': diversity index, expressed in bits (RAMADE, 1984). Pi is the probability of meeting species i, it is calculated by the following formula: Pi = ni / N: is the number of individuals of species i. N: the total number of individuals.
- The index of equitability (E) corresponds to the ratio of the observed diversity H'to the maximum diversity H'max. are expressed in terms. It is calculated based on the following formula: E = H '/ H'max. (PIELOU, 1969 & RAMADE, 1984).

RESULTS

The identification of specimens revealed the presence of 2400 species belonging to 23 families. The list of these species is shown in the table below (Table 3). The results cited in this table reveal that the summer season (2016) was the most abundant with 995 individuals in the wild boar corpses in the Djurdjura National Park. Then, on the second position, the spring season (2015) with two bodies of mammals in two different regions of the Great Kabylia, the Egyptian mongoose (500 individuals) and the Rabbit Garenne (435 individuals). In the autumn of 2015, we collected 190 individuals from the corpse of a common jackal in the forests of the Tikjda National Park. In the region of Kolea (Tipaza), we collected from two different corpses, 161 individuals on a mammal, the laboratory Rat and 119 individuals on a bird - the Partridge gambra - during the winter season (2016). In terms of dominance of the families recorded for the spring season, we find 14 families for the Rabbit of Garenne with a richness of 23 species and 13 families for the Mongoose of Egypt (29 species). 12 families (23 species) are noted for wild boar in summer, followed by 6 families with 16 species marked for the Common Jackal. Finally, in winter, 5 families are recorded for the two corpses with 7 species for the Partridge gambra and 8 species for the laboratory rat. In Greater Kabylia (Tiziouzou), the Carabidae family dominates with 137 individuals (FC% = 27.4%), followed by the Staphylinidae family with 123 individuals (FC% = 24.6%) in the Egyptian mongoose during the spring season (2015). On the other hand, in the Garenne rabbit, the Dermestidae family dominates with 96 individuals (FC% = 22.07%), then Staphylinidae with 91 individuals (FC% = 20.92%). In Autumn 2016 in Tikjda (Bouia), the Staphylinidae family is best represented with 98 individuals (FC% = 51.58%), followed by Trogidae with 56 individuals (FC% = 29.47%) in the common Jackal. In the winter season at Kolea (Tipaza) in 2016, we report that the Staphylinidae family dominates for the two corpses, the laboratory rat with 63 individuals (FC% = 39.13%) and Partridge gambra with 64 individuals (FC% = 53.78%) respectively. Finally, in the Djurdjura National Park in the summer of 2016, we also noticed the dominance of the Staphylnidae family in wild boar with a rate of 38.39% (382 individuals) (Fig. 6). This confirms the significant correlation between the six corpses in different environments (Fig. 8).

Table 3. List of necrophagous Coleoptera colonizing six corpses in different seasons during 2015 and 2016.

Stations	**Freha (Tiziouzou)**		**Iboudrarene(Tiziouzou)**		**Tikjda (Bouira)**		**Kolea (Tipaza)**				**Bouira (PND)**	
Seasons	**Spring (2015)**				**Autumn (2015)**		**Winter (2016)**				**Summer (2016)**	
Corpses	**Egyptianmongoose**		**Rabbit of Garenne**		**Common jackal**		**Rat of Laboratory**		**Partridge gambra**		**Wild boar**	
Species	**ni**	**FC (%)**	**ni**	**FC (%)**	**ni**	**FC (%)**	**ni**	**FC (%)**	**ni**	**FC (%)**	**ni**	**FC (%)**
Carabus morbilosus	23	4,60	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
*Nebria*sp.	21	4,20	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Nebria salina	19	3,80	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Amara eurynota	23	4,60	5	1,15	0	0,00	0	0,00	0	0,00	0	0,00
*Calathus*sp.	51	10,20	0	0,00	3	1,58	0	0,00	0	0,00	31	3,12
Staphylinidae ind	1	0,20	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Staphylinidae ind. (Larve)	0	0,00	0	0,00	0	0,00	15	9,32	20	16,81	0	0,00
Creophilus maxillosus	42	8,40	20	4,60	5	2,63	0	0,00	0	0,00	85	8,54
Anotylus sp.	20	4,00	31	7,13	40	21,05	34	21,12	36	30,25	22	2,21
Ontholestes sp.	10	2,00	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Phloeopora sp.	0	0,00	0	0,00	4	2,11	0	0,00	0	0,00	0	0,00
Proteinus sp.	0	0,00	0	0,00	3	1,58	1	0,62	0	0,00	0	0,00
Philonthus sp.	0	0,00	0	0,00	1	0,53	0	0,00	0	0,00	21	2,11
Oxytelus sp.	0	0,00	0	0,00	1	0,53	0	0,00	0	0,00	0	0,00
Tachinus sp.	0	0,00	0	0,00	4	2,11	0	0,00	0	0,00	0	0,00
Atheta sp.	30	6,00	25	5,75	36	18,95	13	8,07	8	6,72	35	3,52
Anthophagus sp.	0	0,00	0	0,00	1	0,53	0	0,00	0	0,00	0	0,00
Omalium sp.	0	0,00	0	0,00	3	1,58	0	0,00	0	0,00	0	0,00
Aleochara sp.	20	4,00	15	3,45	0	0,00	0	0,00	0	0,00	163	16,38
Staphylinu sp.	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	11	1,11
Ocypusolens	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	45	4,52
Altica sp.	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	2	0,20
Cryptocephalus sexpustulatus	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	6	0,60
Aphtona sp.	3	0,60	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Podagrica sp.	4	0,80	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Longitarssus sp.	1	0,20	0	0,00	10	5,26	0	0,00	0	0,00	13	1,31
Donacia sp.	0	0,00	12	2,76	0	0,00	0	0,00	0	0,00	0	0,00
Crioceris asparagi	0	0,00	6	1,38	0	0,00	0	0,00	0	0,00	0	0,00
Luperus sp.	0	0,00	0	0,00	2	1,05	0	0,00	0	0,00	0	0,00

Stations	**Freha (Tiziouzou)**		**Iboudrarene(Tiziouzou)**		**Tikjda (Bouira)**		**Kolea (Tipaza)**				**Bouira (PND)**	
Seasons	**Spring (2015)**				**Autumn (2015)**		**Winter (2016)**				**Summer (2016)**	
Corpses	**Egyptian mongoose**		**Rabbit of Garenne**		**Common jackal**		**Laboratory rat**		**Partridge gambra**		**Wild boar**	
Species	**ni**	**FC (%)**	**ni**	**FC (%)**	**ni**	**FC (%)**	**ni**	**FC (%)**	**ni**	**FC (%)**	**ni**	**FC (%)**
Dytiscidae ind.	2	0,40	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Curculionidae ind.	1	0,20	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Bothynoderes brevicornis	2	0,40	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Smicronyx sp.	5	1,00	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Othiorrynchus sp.	0	0,00	0	0,00	11	5,79	0	0,00	0	0,00	0	0,00
Meligethes sp.	11	2,20	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Nitidula flavomaculata	5	1,00	10	2,30	0	0,00	15	9,32	0	0,00	41	4,12
Apionidae ind	5	1,00	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Onthophagus sp.	11	2,20	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00
Aphodius sp.	0	0,00	0	0,00	10	5,26	0	0,00	0	0,00	0	0,00
Sisphusschaefferi	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	164	16,48
Onthophagus sp.	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	32	3,22
Onthophagus taurus	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	12	1,21
Psyllobora vigintiduopunctata	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	4	0,40
Oxythyrea sp.	5	1,00	11	2,53	0	0,00	0	0,00	0	0,00	0	0,00
Troxfabricii	41	8,20	33	7,59	56	29,47	0	0,00	0	0,00	0	0,00
Pseudocistela sp.	0	0,00	2	0,46	0	0,00	0	0,00	0	0,00	0	0,00
Heliotaurum ruficollis	0	0,00	3	0,69	0	0,00	0	0,00	0	0,00	0	0,00
Lobonyxaeneus	0	0,00	13	2,99	0	0,00	0	0,00	0	0,00	0	0,00
Thanatophiluss inuata	0	0,00	41	9,43	0	0,00	0	0,00	0	0,00	0	0,00
Saprinus semistriatus	32	6,40	22	5,06	0	0,00	0	0,00	0	0,00	61	6,13
Saprinus planiusculus	20	4,00	17	3,91	0	0,00	0	0,00	0	0,00	55	5,53
Acritus sp.	0	0,00	1	0,23	0	0,00	0	0,00	0	0,00	0	0,00
Dermestes frischii	70	14,00	96	22,07	0	0,00	0	0,00	0	0,00	92	9,25
Dermestidae ind. (Larve)	0	0,00	0	0,00	0	0,00	51	31,68	33	27,73	0	0,00
Buprestis sp.	0	0,00	1	0,23	0	0,00	0	0,00	0	0,00	0	0,00
Anthaxia sp.	0	0,00	6	1,38	0	0,00	0	0,00	0	0,00	11	1,11
Tricodes sp.	0	0,00	10	2,30	0	0,00	0	0,00	0	0,00	0	0,00
Necrobia violacea	12	2,40	44	10,11	0	0,00	0	0,00	0	0,00	0	0,00
Necrobia rufipes	10	2,00	0	0,00	0	0,00	0	0,00	0	0,00	51	5,13
Elateridae ind.	0	0,00	11	2,53	0	0,00	0	0,00	0	0,00	11	1,11
Cryptophagus sp.	0	0,00	0	0,00	0	0,00	11	6,83	0	0,00	0	0,00
Sericoderus sp.	0	0,00	0	0,00	0	0,00	0	0,00	1	0,84	0	0,00
Omonadus bifaciatus	0	0,00	0	0,00	0	0,00	0	0,00	6	5,04	27	2,71
Coleoptera sp. (larve)	0	0,00	0	0,00	0	0,00	21	13,04	15	12,61	0	0,00
N (Totals)	500	100,00	435	100,00	190	100,00	161	100,00	119	100,00	995	100,00
Total wealth (S)	**S = 29**		**S = 23**		**S = 16**		**S = 8**		**S = 7**		**S = 23**	
Number of families	**13**		**14**		**06**		**06**		**05**		**12**	

ni: number of individuals; FC (%) : Centesimal frequency (%); PND : National park of Djurdjura; S: is the total wealth of species.

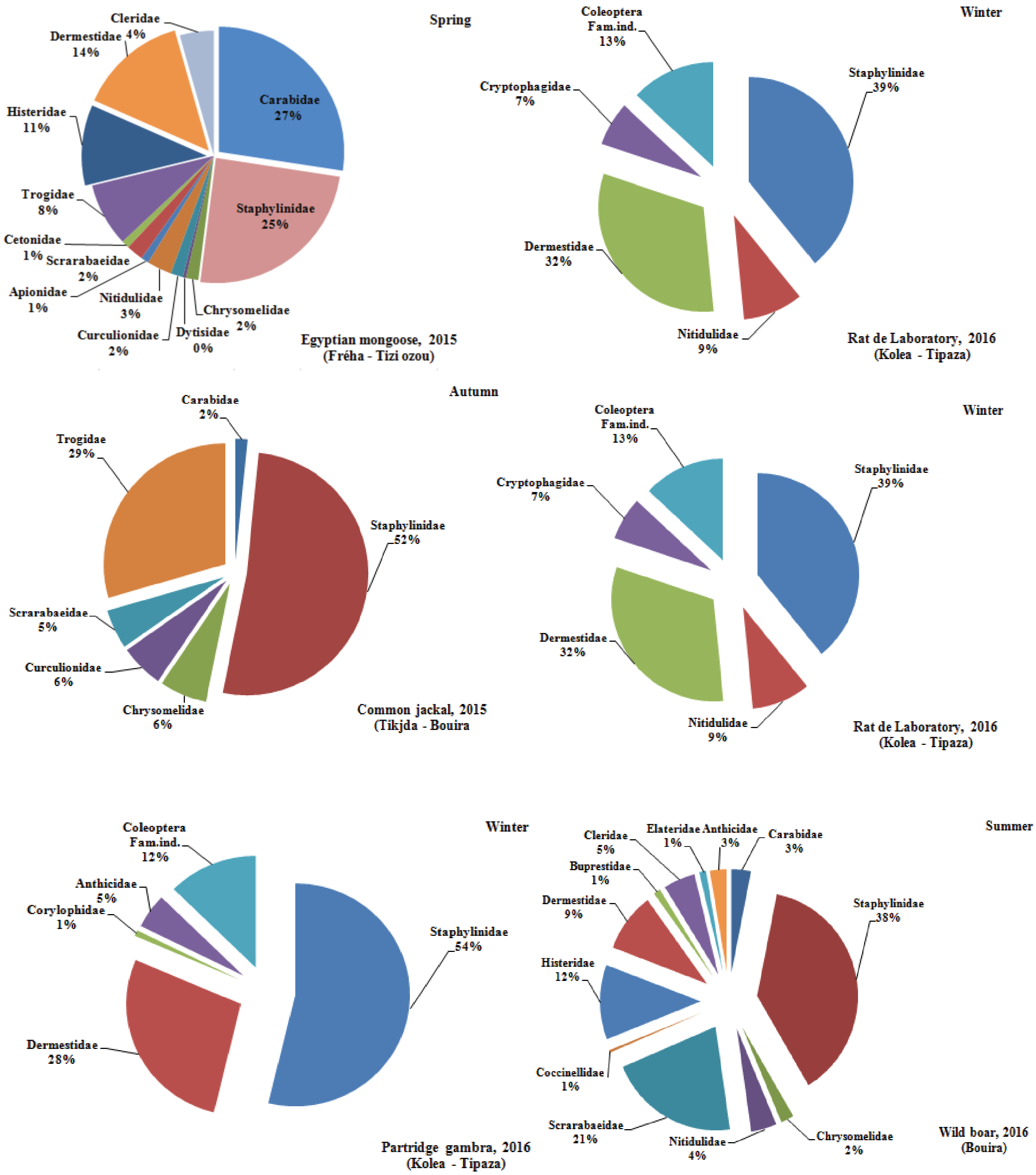

Figure 6. Centesimal frequency FC (%) families scored nearly six bodies in different stations.

Arbre hierarchique utilisant la Distance de Ward. Distance de combination des classes redimensionnee.

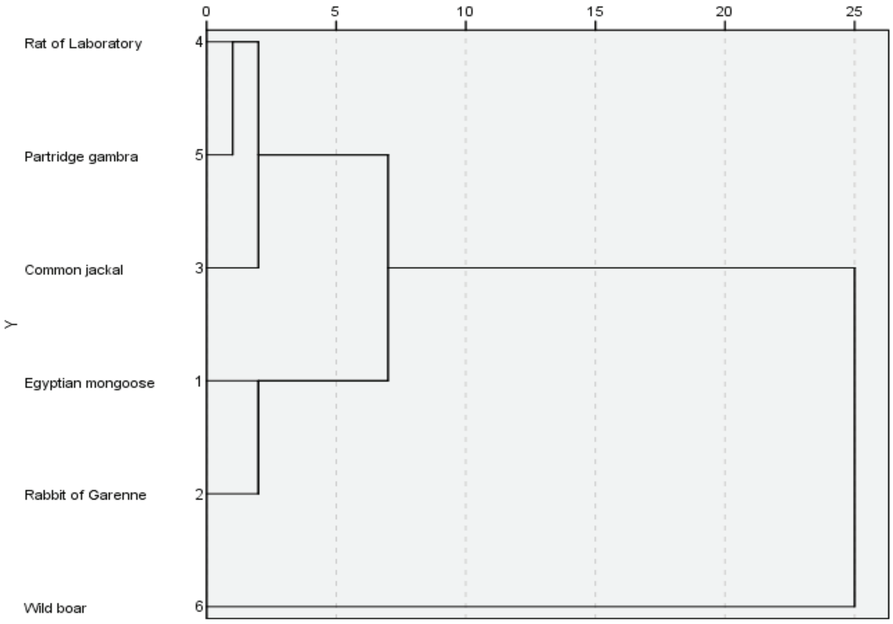

Figure 8. Correlation diagram of necrophagous beetles present on the six corpses in different media and seasons.

- **INFLUENCE OF TEMPERATURE ON THE ARRIVAL OF A SCAVENGER BEETLES IN THE FOUR SEASONS**

The influence of temperature on the collection of necrophagous beetles was evaluated during four seasons on six different corpses and different sites. In this study we calculated the average temperature of the sampling period for each season (Fig.7). According to Fig. 7, the hottest summer season (mean T ° C = 25.0 ° C) was rated as the richest in number with only 995 samples collected from the corpse - wild boar at the Djurdjura National Park (Bouira) of spring 2016 (T°C. Avg. = 13°C. to 14°C). With a total of 435 samples for the rabbit and 500 samples for Mangouste of Egypt in the large region Kabylia (Algeria) in 2015, lower than in autumn (T°C. avg. = 11°C) to 2015 Tikjda with 190 samples and low in winter (T ° C. Avg. = 8.8 ° C) with 161 samples in the Laboratory rat and 119 specimens of *Partridge gambra*.

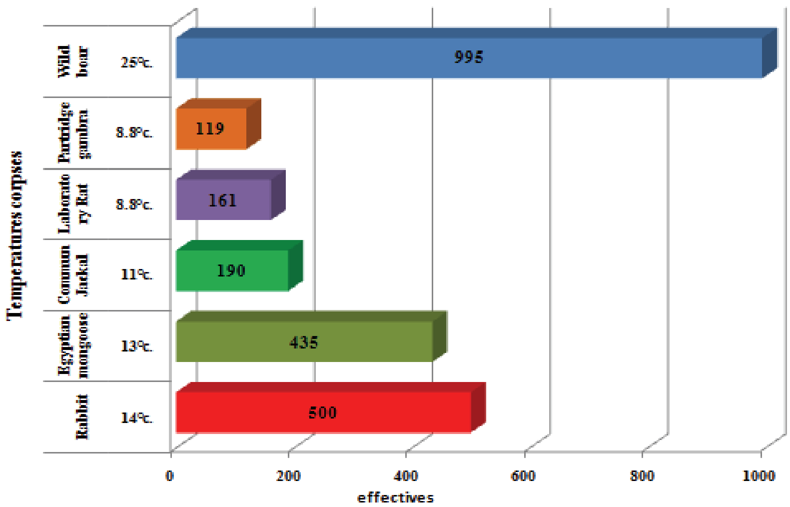

Figure 7. Temperature influence on the number of necrophagous fauna collected during the for investigation seasons on the six cadavers.

- **Analysis of the results by ecological indices of structure**

The results presented in Table 4 were studied using ecological structure indices showing the quantitative aspect of the necrofauna, namely the Shannon H 'diversity index, the maximum diversity (H' max) and the equitability E between species. The Shannon index of captured species showed that H'values record 2.38-bit information at 4.24 bits (Table 4). These approximate values of the maximum diversity of H'max; in other words, the population constituting the captured necrophagous beetles is diversified, especially in the spring, in the Egyptian mongoose, in the Fréha region. It should be noted that the values of the Equirepartition index fluctuate between 0.75 and 0.87 (Table 2). These values tend towards 1 for the four seasons reflecting a tendency towards a balance between the numbers of the present species.

- According to the diagram, we note a significant correlation ($P < 0.0001$) between the necrophagous beetles present on the two corpses - the Mongoose of Egypt and the rabbit of Garenne, between the common jackal and the laboratory rat as well as for the Mongoose Egypt and wild boar although these four corpses were found in the different environments and season (Fig. 8, Table 5).

Table 4. Ecological indices of structure H ', H'max.and E for the four seasons of prospection.

Stations	**Freha (Tiziouzou)**	**Iboudrarene (Tiziouzou)**	**Tikjda (Bouira)**	**Kolea (Tipaza)**		**Bouira (PND)**
Seasons	Spring (2015)		Autumn (2015)	Winter (2016)		Summer (2016)
Parameters	Egyptian _mongoose	Rabbit_ of_Garenne_	Common_jackal	Rat_ of_Laboratory	Partridge_gambra_	Wild_boar
Taxa_S	29	23	16	8	7	23
Individuals	500	435	190	161	119	995
Shannon_H' (bits)	4,24	3,88	2,98	2,62	2,38	3,9
Shannon_H' max.(bits)	4,86	4,52	4,00	3,00	2,81	4,52
Equitability_E	0,87	0,86	0,75	0,87	0,85	0,86

H ': Shannon diversity index; H 'max: maximum diversity; E: Equirepartition.

Table 5. Necrophagous beetles present on the six corpses in different media and seasons.

Corrélations

		Egyptian mongoose	Rabbit of Garenne	Common jackal	Rat of Laboratory	Partridge gambra	Wild boar
Egyptian mongoose	Corrélation de Pearson	1	,653**	,354**	-,015	,005	,407**
	Sig. (bilatérale)		,000	,004	,907	,969	,001
	N	64	64	64	64	64	64
Rabbit of Garenne	Corrélation de Pearson	,653**	1	,300*	,053	,078	,325**
	Sig. (bilatérale)	,0000		,016	,677	,543	,009
	N	64	64	64	64	64	64
Common jackal	Corrélation de Pearson	,354**	,300*	1	,262*	,334**	-,007
	Sig.	,004	,016		,036	,007	,956
	N	64	64	64	64	64	64
Rat of Laboratory	Corrélation de Pearson	-,015	,053	,262*	1	,919**	-,038
	Sig. (bilatérale)	,907	,677	,036		,000	,767
	N	64	64	64	64	64	64
Partridge gambra	Corrélation de Pearson	,005	,078	,334**	,919**	1	-,043
	Sig. (bilatérale)	,969	,543	,007	,000		,738
	N	64	64	64	64	64	64
Wild boar	Corrélation de Pearson	,407**	,325**	-,007	-,038	-,043	1
	Sig. (bilatérale)	,001	,009	,956	,767	,738	
	N	64	64	64	64	64	64

**. La corrélation est significative au niveau 0.01 (bilatéral).

*. La corrélation est significative au niveau 0.05 (bilatéral).

DISCUSSIONS AND CONCLUSIONS

The decomposition of a body causes significant physical and biochemical changes, the corpse will emit odours that are attractive for some species and less attractive for others. In temperate terrestrial ecosystems, insects are generally the main organisms that colonize a body in a more or less predictive sequence. These necrophagous or necrophilous insects, mainly Diptera and Coleoptera, use the micro-habitat created by the cadaver as a nutritive substrate, a breeding site, a refuge or even a hunting territory (DEKEIRSSCHIETER et al., 2012).

The Coleoptera that can be found in the corpse ecosystem were still, until very recently, little studied by forensic entomologists. According to WELLS & LAMOTTE, 1995, CAMPOBASSO et al., 2001 found that the degradation of a body and its colonization by insects are two interrelated phenomena and are influenced by many intrinsic and extrinsic factors to the corpse. However, it should be noted that many of these species can only be present on a dead body at certain times of the year. The development time of the insects and the decomposition time of the body vary greatly depending on the climatic conditions. The study of necrophagous insects is therefore not a totally reliable technique and should not be used alone. The body undergoes a thanatomorphosis. After death, decomposition processes start more or less rapidly depending on the surrounding conditions (mainly temperature and humidity) (ANDERSON, 2001).

The decomposition of a body involves a series of dynamic processes that lead to physical, chemical and biological changes in the corpse (MARCHENKO, 2001). The body in degradation is a micro-habitat and a food source for many living organisms (CARTER et al., 2007). Forensic entomologists divide the decomposition process into several phases. Traditionally speaking, five phases of decomposition are noted (AMENDT et al., 2004, WYSS & CHERIX 2006, DOROTHY 2007). The present study started right after the six corpses were sacrificed which allowed regular monitoring of the scavenging fauna immediately after their death. 2400 species belonging to 23 families of necrophagous beetles were collected during the four seasons. The obtained resulst are similar to those of CHARABIDZE et al. (2012), who captured a significant number of samples during the spring-summer period, as opposed to autumn and winter.

These authors explain this by the typical seasonality variations that indicate that the necrophagous insects remain at a very low level in autumn / winter compared to the warm period (spring / summer).The identification of the captured individuals reveals that the most abundant species of the six cadavers studied belong to the family Staphylinidae with 821 individuals of *Creophilus maxillosus, Anothylus* sp., *Aleochara* sp., *Atheta* sp. et *Philonthus* sp. We assume that it is the hatching of eggs deposited on the corpse that gives birth to this species during the first days of trapping that results in this abundance. We find that climatic conditions play a very important role in the colonization of a corpse by the necrophagous fauna. The forensic families of beetles are Silphidae (scavenger beetles), Dermestidae (pantry, skin or skin dermis), Staphylinidae, Histeridae, Cleridae and Nitidulidae (HASKELL et al., 1997; BYRD & CASTNER, 2000; WYSS & CHERIX, 2006). Among them, scavengers can provide information on post-mortem colonization of the remains and the time elapsed since death (HASKELL et al., 1997; SMITH, 1986; WATSON & CARLTON, 2005). A strong dependence between the number of trapped beetles is actually seen compared to the average local temperature and insulations. According to PAYNE (1965) there are species that intervene during several stages of decomposition and not on one. For Coleoptera, the first wave includes the species *Dermestes frischii* and *Creophilus maxillosus* that were reported from the beginning of the 2^{nd} stage and were present throughout the decomposition period, which confirms the work of DEKEIRSSCHIETER et al. (2012), as well as BOULEKNEFET (2016) and GUERROUDJ (2017).

In the wild boar experiment (in July), for example, the presence of *Dermestes frishii* is noticed from the second day of the swelling stage experiment and the activity of this Coleoptera continued throughout the decomposition process. According to CHARABIDZE & BOUREL (2007), Coleoptera are also frequently found associated with decaying bodies, some are true necrophages such as Silphids and Dermestidae, while others exploit the presence of many preys on the corpse as that of Histeridae, Staphylinids and Cleridae. Silphinae can be necrophages and necrophiles, predators of caterpillars and snails or phytophages (Aclypea). However, only one of the two subfamilies, the Silphinae, is of potential interest in forensic entomology because of their ecological preference for large carcasses. In contrast to Nicrophorinae, rodent and bird carcasses are preferred (DEKEIRSSCHIETER et al., 2012).

In our study sites, the appearance of necrophilous and predatory Coleoptera coincides with the abundance of eggs deposited by flies and hatched maggots. This remark is similar to FEUGANG et al (2012). A decrease in the numbers of necrophiles and necrophiles should be noted during the advanced decay stage. This stage is characterized by the absence of larvae and a strong activity of adult Coleoptera and larvae of the family Dermestidae and mites. Temperature, especially at high levels, plays an important role in insect activity, but this does not appear to be the only physical parameter determining their arrival (CHARABIDZE et al., 2012). Indeed, in spring, the present study showed great temperature variations during the 36 days to 42 days of prospecting (T°C moy. = 13°C. to 14°C.). Based on the number of collected beetles which was 2,400 of the total fauna of the four seasons, conditions seem favourable to the arrival of beetles' necrophages during this season. Autumn was low in number because the temperature decreased; this indicates unfavourable conditions for the arrival and activity of necrophagous insects. In summer, temperatures are higher (average T°C. = 25°C.); this encourages the activity of insects given their speed component. They become faster and therefore more difficult to catch mainly by the active method we have adopted. According to Hall (1995) in CHARABIDZE et al. (2012), there is no ideal solution that would allow the optimal capture of all species. The results obtained in the framework of the present work are consistent with those of several authors in particular concerning the influence of the temperature on the process of the degradation of the corpses. Indeed, CAMPOBASSO et al. (2001) write that of all the factors, two are predominant in the decomposition of a body. These are the ambient temperature and the accessibility of the body to insects. Insect development is a function of time and temperature. Thus, for their development, larvae depend on the species, as well as temperature.

This author notes that the hotter it is, the faster the development; and the colder it is, the slower the evolution of the corpse. Not only does temperature control the speed and process of corpse decomposition, but it also influences the activity of insect populations. It is also involved at a local level. Temperature is increased by the larvae present on the body, between stages in the biological process. It plays the role of the main factor of variation in their development speed (CHARABIDZE, 2012). Conversely, a local temperature favourable to insects does not necessarily presuppose the presence of a necrofauna (FARIA et al., 2004). Finally, we find that cadaveric decomposition also depends on temperature; the more favorable conditions are, the faster the decomposition and the more diversified fauna in 2004, Wyss revealed that the diversity of insect's scavengers varies with the seasons. To conclude, this is the first entomo-forensic study conducted on vertebrate carcasses used in different region of Algiers a temperate biogeo-climatic country, during four seasons. The aim of this study was to identify the carrion rove beetle communities that are understudied from a forensic point of view and the insect trapping method (Barber traps) is adapted to sampling carrion visiting insects, except for very small species. One should combine these traps with the use of netting to collect small flying insects in the present experiment, and it could be interesting to study the entomo-forensic communities in various kinds of habitats (i.e., meadows, urban, suburban, different kinds of forestation areas, etc.).

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