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First Data on Insects to Forensic Interest in the Region of Gouraya, Algeria

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***Abstract* – This study presents the results of work carried out on the corpses of cats (*Felis catus*) and a boar (*Sus scrofa*) in the region Gouraya during summer 2012 and winter 2013. Results show that the fauna insect cadavers moves in successive waves. Three insect orders dominate in his essays. These are the Diptera, Coleoptera and Hymenoptera. The experiment confirms that the Diptera are more active during the day and night. The technique of traps glu demonstrates the high activity of *Lucilia sericata* with 88.3% and the species *Musca domestica* with a rate of 11.3% during the day. Overnight dominate both species with rates of 72% and 28% respectively. *Calliphora vicina* and *Sarcophaga carnaria* operate very little during the experiment. Sampling has identified several families of the order Coleoptera such as those Dermestidae, Staphylinidae and the Silphidae. Among the Hymenoptera, two families are noted. They are Formicidae and Braconidae. This experiment showed five states cadaverous decomposition: fresh, bloated, active decay, advanced decay and dry or skeletal state.**

***Keywords* - Felis Silvestris Catus, Sus Scrofa Algira, Necrophagous Insects, Diptera, Coleoptera, Algeria.**

I. Introduction

Among the most remarkable work in the world, those [30] could be mentioned. They underline the colonization of body in the open air by eight successive waves of necrophagous arthropods. This theory associates each stage of decomposition of the body by species or group of species of arthropods [14], [7]. These insect groups in certain circumstances used to determine the post-mortem interval [46], [2]. The use of insects to solve crimes has become a common method throughout the world, Belgium [24], [25], [26], [27], Finland [32], [33], England [39], Switzerland [45], Germany [2], [3], [6] and Brazil [15], [16]. In Africa, there are studies in the same field in Cameroon [19], [20] and South Africa [41], [42]. There are limited published on forensic entomology in the north of Africa where the few work done in this field remain fragmented and limited. In Algeria, the work of Bouleknefet [12], [13], Benrima [8], Berchi [11], Bensaada [10] and Bensaada and Doumandji [9] could be mentioned. This work seeks to clarify in a region near the Mediterranean coast succession squads of insects necrophagous. It reinforces some statements made in the same site by Bensaada [10] and Bensaada and Doumandji [9].

Presentation of the study area

The region of Gouraya is 120 km west of Algiers (36 ° 32 'N, 1 ° 34' E). It is bordered to the north by the Mediterranean Sea, to the east by Wadi Sebt in the south by forests and Aghbal Messelmoun and in the west by Larhat. The terrain is mountainous with an average altitude of 800 m. The area is a juxtaposition of very heterogeneous landscapes formed mainly of forests and djebels. The zones of the Wadi, plateaus and plains are not recorded. The region is located in the subhumid bioclimatic stage with winter soft warm. The average annual temperature is 20.5 ° C, while rainfall appears irregular from one year to another (489.1 mm).

II. Materials and Methods

The experiment is carried out in the region of Gouraya, four cats *Felis silvestris catus* (Linnaeus, 1758) and a boar (*Sus scrofa Algira* Loche, 1867), found dead on the edges of roads struck by vehicles. Cats are collected in June, August 2012 and January 2013. The body of the Pig (*Sus scrofa*) is collected in the end of December 2012 and samples are transported into a garden in an urban area. Regarding the four *Felis silvestris catus*, they are placed in large containers filled with sand in order to follow the pupation of necrophagous insects and to facilitate fauna of the corpses. Containers are covered by a wire mesh with large mesh (5 cm x 5 cm) to protect each of the corpses face raptors and other scavengers. Two sampling techniques are used, the daily manual harvests around the body and catches using glue traps used mainly to quantify Diptera (Fig.1). The glue traps are changed every day in order to determine the proportions of different species of flies that frequent the corpse. For the Pig, given its mass, body is disposed outdoors. During the sampling periods, each day the carcasses are photographed. In the same time, observations related to physical changes due to degradation are made and recorded. Sampling of insects is performed manually twice a day for the first week of degradation body. The identification of species was made using the keys proposed by Carvalho et Mello-Patiu [16], Matile [28], [29] and Perrier [38] for species of Diptera. For species of Coleoptera and hymenoptera, keys of Perrier [36], [37] are used.

Fig.1. The device of the glue trap

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III. Results and Discussion

From 2012 to 2013, five experiments are carried out in urban areas (Table 1).

The present study shows that the decomposition of the biological models passes through five stages of decomposition (Fig. 2) during the spring and winter: fresh stage, the stage of bloating, activate decomposition, advanced decomposition and stage squelettonisation. But the rate of degradation of the body differs from one species to another in the trial period. Times in days of the different stages of decomposition of the biological models used are summarized in Table 1.

Table 1: Duration in days of the different stages of decomposition of the biological models put in experimentation

Stage / Species	Fresh	Bloating	Active decay	Advanced decay	Skeletonization
Felis silvestris catus (1)	11 VI 2012	12 VI 2012 (1 day)	13 VI 2012 (1 day)	15 VI 2012 (2 days)	20 VII 2012 (35 days)
Felis silvestris catus (2)	2 VIII 2012	4 VIII 2012 (2 days)	5 VIII 2012 (1 day)	5 VIII 2012 (a few hours)	9 VIII 2012 (4 days)
Felis silvestris catus (3)	6 VIII 2012	7 VIII 2012 (1 day)	8 VIII 2012 (1 day)	8 VIII 2012 (a few hours)	11 VIII 2012 (3 days)
Felis silvestris catus (4)	28 I 2013	1 II 2013 (4 days)	7 II 2013 (6 days)	13 II 2013 (6 days)	18 III 2013 (33 days)
Sus scrofa	29 XII 2012	10 I 2013 (12 days)	18 I 2013 (8 days)	24 I 2013 (6 days)	3 IV 2013 (69 days)

Stages of decomposition of five bodies differ from one stage to another (Table 1). It must be stressed that the time of transition from fresh to bloating stage is 24 hours in the case of cats 1 and 3 and 48 hours for Cat 2. But in the case of the Cat 4 observer notes 96 hours. Average temperatures in June (28.5 ° C), July (28 ° C) and August (31 ° C.) are relatively high (Fig. 3) and accelerate the degradation of the corpses cats 1,2 and 3. But when the average temperature falls in December (14.7 ° C) the process becomes slower in the case of Cat 4 (Fig. 3). This slowdown was more pronounced in the body of the Pig in which the decay time is greater not only because of the low temperatures (Fig.4), but also because of the greater weight of the animal and the thickness of its most important skin. These results are consistent with the work of Abd El-bar and Sawaby [1] who investigated the colonization by necrophagous of a dead rabbit killed with an organophosphate insecticide insects in Egypt. These observations confirm those made by Ozdemir and Sert [34] in the province of Ankara, Turkey on 12 pigs (Sus scrofa domesticus), the experiment was carried out during a year for four seasons. Cameroon in Central Africa, studies of dead rats (*Rattus norvegicus*) showed that there were five stages of decomposition [19]. One of the issues arising concerning the moments of great activity of Diptera during the day. In this sense, the comparison can be made between light day and night. The numbers of species of flies are counted and presented in Table 2.

Table 2: Activity of Diptera during the day and night over the degradation of the body of the cat *Felis silvestris catus* (1); use of glue traps in June 2012.

activities	0 - 24h	25-48 h	49-72h	73-96h	97-120h	121-144h	totals
effective /day	136	443	502	218	93	66	1.458
effective /night	107	238	22	27	49	-	443

- : Data absent

The number of Diptera during the day is more important than during the night. This number reaches 502 individuals during the third day of the experiment against 22 individuals during the night, knowing that the traps are placed in the morning (from 10am to 19h) and for capturing night (from 19h to 10h in the morning) (Table 2). It appears that a significant proportion of the catch occurs in the middle of the day between 11 am and 15 am according to direct observations. These results agree with those of Amendt [4], Greenberg [22] and Singh and Bharti [40] Wooldridge [44]. The low effective in the night can be explained by the fact that the night is not conducive to pontes, especially as the temperature drops. The results found invalidate those of Charabidze [17] who worked in the North of France. The last cited author notes that the proportions of insects caught during the day (10h to 17h) and night (17h to 10h) are substantially identical. But Charabidze [17] compares the catches of 7 hours diurnal with those of 17 hours nocturn. However, the author specifies that the numbers observed during the day were significantly higher than during the night. These same authors report a similar activity during the whole day (split into three periods: from 9am to 15h, 15h to 21h and 21h to 9h), although specific differences were observed. It seems probable that even if the flies do not fly at night, they remain active at dusk and dawn [5]. Diptera are active and lay their eggs only during the day light from sunrise to sunset. Green [21] reported that *C. vicina* flies and lay their pontes at night under artificial light. In the same sense, Greenberg [22] noted that *L. sericata* issues its eggs

during the night on a dead rat near a light source of low intensity. Insects Medico-legal interest are collected from carcasses of mammals in the region Gouraya are summarized in Table 3.

Table 3: List of necrophagous species recovered from the corpses of the Pig and Cat in the region of Gouraya in Algeria

Orders	Families	Species
Diptera	Calliphoridae	*Calliphora vicina* *Lucilia sericata*
	Sarcophagidae	*Sarcophaga muscaria*
	Muscidae	*Musca domestica* *Graphomyia maculta (sous F. Muscinae)*
	Anthomyidae	*Anthomyia* sp.
Coleoptera	Staphylinidae	*Creophilus maxillosus* (Linnaeus, 1758) *Philonthus* sp.
	Silphidae	*Thanatophilus sinuatus* (Fabricius, 1775)
	Dermestidae	*Dermestes frischii* (Kugelann, 1792) *Dermestes undulatus* (Brahm, 1790) *Dermestes atomarieus*
	Histeridae	*Hister sp.* *Saprinus* sp.
	Cleridae	*Necrobia rufipes* (De Geer, 1775)
	Carabidae	*Leistus* sp.
Hymenoptera	Braconidae	*Coelalysia* sp.
	Chalcidae	*Chalcis* sp.
	Formicidae	

The observations made on the ground in the region Gouraya show that the first flies to land on the corpses in summer is especially *Lucilia sericata*. For against, the Pig died in December and the corpse of the Cat 4 retrieved in January, is the *Calliphora vicina* which is first on these corpses. It should be noted that *Calliphora vicina*, very common during the cold season, decreases its action during the summer while *Lucilia sericata,* rare in winter, appears in very large numbers in summer. The work of Wolff [43] in summer on a cadaver of Boar in Medellin, Colombia are in agreement with the results of this study. They demonstrate that the Lucilia genus of the family Calliforidae is the first to put her eggs on the corpse. Similar experiments carried out in France by Charabidze [17] on the bodies of rat and rabbit and other work in England by Davies [18] on the spoils of mouse highlight a strong seasonal variability of the process of colonization insect necrophagous. The results of this study are in accord with those of Compobasso [14], who note that the blowfly *Calliphora vicina* prefers shady conditions and is active during the winter. On the contrary, the green fly (*Lucilia sericata*) preferred light and is more resistant to high summer temperatures. The observations made in the station Gouraya confirm those of Mohr and Tomberlin [31]. In fact in Texas (USA), the cited authors note that *Calliphora vicina* is the second most important species in their catch during the winter in the carcasses of *Sus scrofa domesticus* L. These authors also show that the peak catches of *Calliphora vicina* is from midday. The existence of a large temporal variations in the numbers of caught is explained firstly by climatic variations. It is actually observed a strong dependence of the number of the trapped insects in relation to the average local temperature and insolation. The gradual decline in the number of insects caught (in the winter) can be explained by the decrease in the average temperature during this season [23]. Against changes by catch species recorded during the same experiment and on the same day appear in close collaboration with insect activity, and illustrated by an increase numbers caught during peak insolation [17]. According to Payne [35] there are species that occur during several stages of decomposition and not during one. In the experiment on Cat 1 (in June), for example the presence of *Dermestes* sp. is observed on the second day of the experiment at the boatingt stage and the activity of this Coleoptera continued throughout the decomposition process. In contrast in January, the experiment on Cat 4, the *Dermestes* sp. is reported in the fifth day post-mortem. It should be noted that this same species disappears and reappears throughout the deterioration of the body.

Fig.2. Different stages of decomposition of the Cat 2 during the month of August and wild boar during the month of January in the region Gouraya

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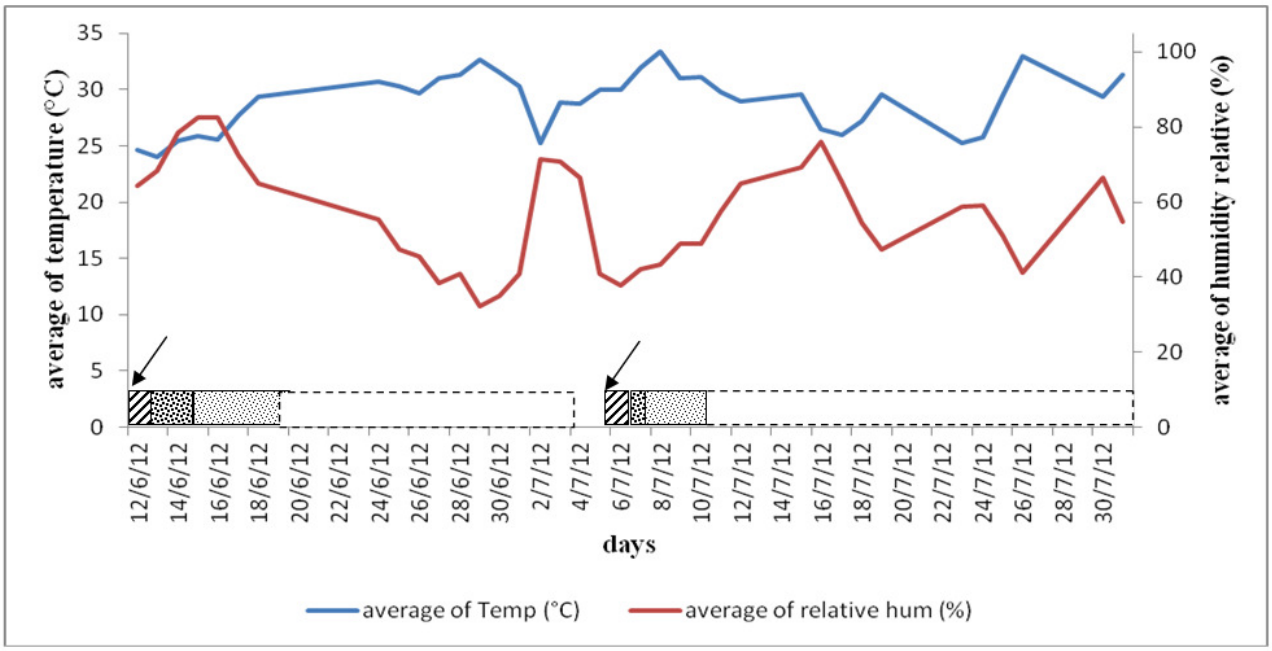

Fig.3. Variation of the daily temperature and relative humidity during the decomposition of the corpses cat 1,2 and 3 in summer

Bloating stage
Active decay stage
Advanced decay stage
Skeletonization
Fresh stage

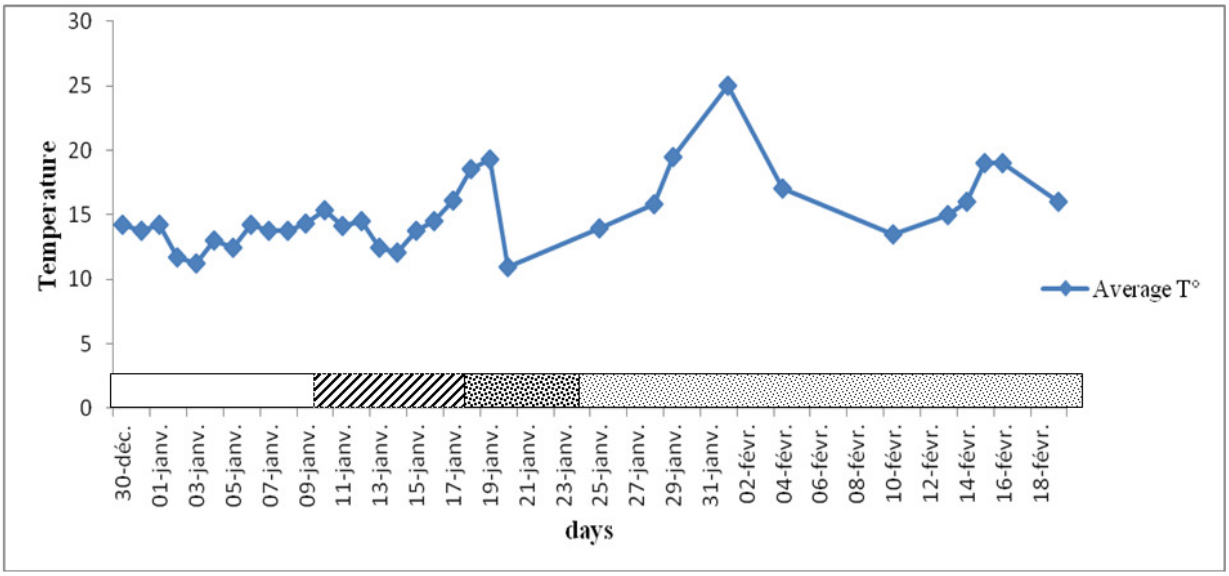

Fig.4. Variation of the daily temperature in Gouraya during the decomposition of corpse wild boar (Sus scrofa) in winter

Fresh stage
Bloating stage
Active decay
Advanced decay

The results obtained in the present study are agree with those of several authors especially as regards the influence of temperature on the process of degradation of the corpses. In effect, Campobasso [14] write that among the factors, two are predominant in the decomposition of a body. This is the ambient temperature and the accessibility of insect body. The development of insects, is a function of time and temperature. Larvae for their development depend on the species but also on the temperature. These authors note that the development is more rapid when the temperature is high and slowed with decreasing temperature. The temperature controls the speed and the process of decomposition of the body, but it also influences the activity of the insect populations. It also intervenes at a local level.

The temperature created by the larvae present in the body is very important and has an impact in the biological process. She plays the role of the main factors of variation of the speed of the development [17]. According to Campobasso [14] and Wolff [43] after the deposit of the corpse colonization of Diptera is quite fast considering the presence of oviposition on the first day of the data collection, or 1 or 2 days post-mortem. All depends on the ambient temperature. The results obtained in this study confirm those of Compobasso [14] and Wolff [43] about the rapid appearance of Diptera. Two groups are important in forensic entomology, Diptera and Coleoptera [3], [43]. In this study, it is found that the flies *Lucilia sericata* and *Musca domestica* intervene quickly on the corpses. Effectively, upon deposit of the body, the Calliphoridae intervene quickly to colonize [15], [17], [43]. The appearance of necrophile species done from the stage of' Bloating [45] during which the egg laying of the Calliphoridae and the Muscidae become very frequent on the carcasses. Massive emissions of eggs by flies preceding the arrival of the necrophile species that colonize the body to feed mainly on eggs and larvae of Diptera. In this study plan chronologically *Lucilia sericata* is installed on the corpse before Musca domestica. This results are in agreement with the remarks made by Bouleknefet [13], and Bensaada and Doumandji [9]. As regards the duration of the decomposition of Cat 1, it is of six days in the present work, while Bensaada [10] reported 40 days. This difference must be put down to a difference in microclimates occurring during experiments. The increase in the number of species intervenes from the initial stage to the active stage decay followed by a decrease in Advanced decay stage [3]. A Gouraya, the emergence of Coleoptera necrophile and predators coincides with the abundance of eggs laid by flies and maggots hatched. This observation is similar to those of Feugang [19], [20]. It should be noted general headcount reduction of necrophagous and necrophile species during the Advanced decay stage. This stage is characterized by the absence of larvae and a high activity of adult and larvae of Coleoptera the family of Dermestidae and mites of the family Gamisidae.

IV. Conclusion

In the context of forensic entomology, necrophagous species, mainly species of the family of Calliphoridae, begin to lay in the carcass right from the Fresh stage. The *Calliphora vicina* species is most represented during the winter but in the summer *Lucilia sericata* arises first on the bodies with very large numbers. The numbers of necrophagous species, mainly Calliphoridae and necrophile including Staphylinidae increase as soon as the spawning and larval Diptera increase during the Bloating stage. During the active decay stage, species necrophagous especially Histeridae, Staphylinidae are the most common. It should be noted a decrease in the number of necrophile and necrophagous species in the stage of advanced decay. In fact this stage is characterized by carcasses consisting of bone and skin flaps, and in the presence of adults and larvae Dermestidae and mites of the family Gamasidae. The duration of the degradation and the different stages differs between summer and winter that has a direct relationship with the temperature. According to the observations, the insolation has an impact on the activity of Diptera. The activity of Diptera decreases from 17h to 10h, but a significant number are trapped during this interval. This discipline is very advanced in Algeria despite some fragmentary study, our work gives a little insight of species that colonize corpses in Algeria in a biotope near the sea. The forensic entomology and the study of the succession of necrophagous insects is new and needs more attention of researchers and scientists. It has been shown that species and levels of succession can vary between geographical areas, habitat types or between seasons and years. These data highlight the importance of local studies repeated and the risk of errors associated with the use of standard succession.

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References

[1] M.M. Abd El Bar and R.F. Sawaby "A preliminary investigation of insect colonization and succession on remains of rabbits treated with an organophosphate insecticide in El-Qalyubiya Governorate of Egypt" *Forensic Science International*, Vol. 208, 2011, pp. e26–e30.

[2] J. Amendt, R. Krettek, C. Niess, R. Zehner, Bratzke H "Forensic entomology in Germany" *Forensic Science International*, Vol. 113, 2000, pp. 309-314.

[3] J. Amendt, R. Krettek and R. Zehner "Forensic entomology" *Naturwissenchaftenn,* Vol. 91 2004, pp. 51-65.

[4] J. Amendt, R. Zehner and F. Reckel "The noctural oviposition behaviour of blowflies (Diptera: Calliphoridae) in Central Europe and its forensic implications" *Forensic Science International,* Vol. 175 ,2008,pp. 61–64.

[5] M. I. Arnaldos, E. Lopez-Gallego, J.J. Presa et M.D. Garcia "Daily activity pattern of sarcosaprophagous diptera on pig carcasses in southeastern Iberian Peninsula" *European Association for forensic Entomology (EAFE),*20-24 *Mai, Kolymbari/Crete, 2008, p.* 40.

[6] M. Benecke "A brief history of forensic entomology" *Forensic Science International*, Vol. 120 ,2001, pp. 2–14.

[7] M. Benecke M. "Les insectes judiciaires", *Forensic biology*, 2002, pp. 76–83.

[8] B. Benmira, A. Aouati, S. Berchi, A. Ramdane et K. Louadi "Contribution à l'étude de la colonisation post-mortem par les insectes nécrophages sur un organisme animal", 3ème *Séminaire internati. biol. anim. (SIBA),* 9-11 *mai* 2011*, Dép. Biol. anim., Constantine,2011, p.* 79.

[9] F. Bensaâda et S. Doumandji "Notes préliminaires sur la nécro-entomofaune de cadavre de quelques mammifères de la région de Gouraya(Tipaza), Algérie" *Journée Restitution du Projet Tassili*, 21-22 *novembre* 2012, *Départ. Zool. agri. for., Ecole nati. sup. agro.*, 2012, *p* 40.

[10] F. Bensaâda, A. Guerzou et S. Doumandji "Biodiversité faunistique des insectes des cadavres dans le Nord de l'Algérie" 3ème *Congrès franco-maghrébin de Zool. Ichtyol.,* 6 – 10 *novembre* 2012, *Marrakech*, 2012, *p* 134.

[11] S. Berchi, K. Louadi, A. Aouati et B. Benmira "Premier pas dans l'entomologie forensique" 3ème *Séminaire internati. biol. anim. (SIBA),* 9-11 *mai* 2011*, Dép. Biol. anim., Constantine,2011, p.*16.

[12] F. Bouleknefet, S. Berchi et K. Louadi "Caractérisation des insectes nécrophages sur un cadavre de chien" *Colloque Biol. Environnement.,* 8-10 novembre 2009, Skikda.

[13] F. Bouleknefet, S. Berchi, B. Benmira, A. Ramdane et K. Louadi "Contribution à la connaissance des insectes nécrophages colonisant un cadavre animal" 3*ème séminaire internati. biol. anim. (SIBA),* 9-11 *mai* 2011*, Dép. Biol. Anim., Constantine, p.* 20.

[14] C.P. Campobasso, G. Di Vella and F. Introna "Factors affecting decomposition and Diptera colonization" *Forensic Science International*, Vol. 120, 2001, pp. 18-27.

[15] L.M.L. Carvalho, P.J. Thyssen, M.L. Goff and A.X. Linhares "Observation on the succession patterns of necrophagous insects on a pig carcass in an urban area of Southeastern Brasil" *J. forensic med. toxicol.Vol 51. ,2004, pp.* 33–39.

[16] C.G.B. Carvalho et C.A. Mello-Patiu "Key of the adults of the most common forensic species of Diptera in South America" *Revista Brasileira de Entomologia*, Vol. 52 ,n° 3 ,2008, pp. 390–406.

[17] D. Charabidze "*Etude de la biologie des insectes nécrophages et application à l'expertise en entomologie médico-léga*" Thèse Doc., 2008, 205 p.

[18] L. Davies "Seasonal and spatial changes in blowfly production from small and large carcasses at Durham in lowland northeast England. *Med. Vet. Entomol.*, Vol. 13 ,1999, pp. 245-251.

[19] F.D. Feugang Youmessi, C.F. Bilong Bilong, D. Cherix and C. Djieto-Lordon "Biodiversity of arthropods collected on rat carrion in Yaounde,, Cameroon: Fist study on forensic entomology in Central Africa" *Int. J. Biosci*., Vol. 2, n° 1, 2012a , pp. 1–8.

[20] F.D. Feugang Youmessi, E. De Coninck, F Hubrecht, L. Bourguignon., C.F. Bilong Bilong, J.C. Ateba Awona and C. Djieto-Lordon "First records on five species of Calliphoridae (Diptera) reared from maggot collected on rat carion corpse during a forensic entomology experiment in the campus of the University of Yaounde I-Cameroon" *Int. J. Biosci*.,Vol. 2 ,n°3 ,2012b ,pp. 75–80.

[21] A.A. Green "The control of blowflies infesting slaughter-houses. I. Field observations on habits of blowflies" *Ann. Appl. Biol.,* Vol. 38, 1951, pp. 475–494.

[22] B. Greenberg "Nocturnal oviposition behavior of blowflies (Diptera, Calliphoridae)" *Journal of Med. Entomol, Vol.* 27 ,1990, pp. 807–810.

[23] S. V. Gruner, D. H. Slone, and J. L. Capinera J. L. "Forensically important Calliphoridae (Diptera) associated with pig carrion in rural north-central florida" *Journal Med. Entomol.*, Vol. 44, 2007, pp. 509-515.

[24] M. Leclercq et L. Quinet "Quelques cas d'application de l'entomologie de l'époque de mort" *Ann. Med. Lég.*, Vol. 29 ,1949, pp. 324-326.

[25] M. Leclercq et C. Verstraeten "Eboueurs entomologiques bénévoles dans les écosystèmes terrestres : observation inédite" *Note faunique de Gembloux*,Vol. 25, 1992, pp. 17–22.

[26] M. Leclercq "A propos de l'entomofaune d'un cadavre de sanglier" *Bulletin et Annales de la Société Belge d'Entomologie*, Vol. 132 , 1996, pp. 417–422.

[27] M. Leclercq "Entomologie et Medecine Légale : Importance des Phorides (Diptera) sur Cadavre Humain. *Ann. Soc. Entomol. Fr.*, Vol. 35, 1999, pp. 566–568.

[28] L. Matile "*Diptères d'Europe occidentale*. Ed. Boubée" Paris, T. I, 1993, 439 p.

[29] L. Matile "*Diptères d'Europe occidentale*. Ed. Boubée", Paris, T. II,1995, 380 p.

[30] J.P. Mégnin "*La faune des cadavres : application de l'entomologie à la médecine légale. Encyclopédie scientifique des Aides-Memoires*" Ed. Masson et Gauthier-Villars, Paris, 1894, 214 p.

[31] R.M. Mohr et J.K. Tomberlin, 2014 – Environmental Factors Affecting Early Carcass Attendance by Four Species of Blow Flies (Diptera, Calliphoridae) in Texas. *Journal of Med. Entomol.*, Vol. 51, n° 3, 2014, pp. 702–708.

[32] P. Nuorteva, M. Isokoski et K. Laiho "Studies on the possibilities of using blowflies (Diptera) as medicolegal indicators in Finland. I. Report of four indoor cases from the city of Helsinki" *Ann. Enomol. Fenn*, Vol. 33, 1967, pp. 217–225.

[33] P. Nuorteva, H. Schumann, M. Isokoski M. et K. Laiho K. "Studies on the possibilities of using blowflies (Diptera, Calliphoridae) as medicolegal indicators in Finland. II. Four cases where species identification was performed from larvae. *Ann. Entomol. Fenn.*, Vol. 40, 1974, pp. 70–74.

[34] S. Ozdemir et O. Sert "Determination of Coleoptera fauna on carcasses in Ankara province, Turkey. *Forensic Science International,* Vol. 183 ,2009, pp. 24-32.

[35] J.A. Payne "A summer carrion study of the baby pig *Sus scrofa* Linnaeus" *Ecology*, Vol. 46, 1965, pp. 592–602.

[36] R. Perrier "*La faune de la France - Coléoptères (Deuxième partie)* " Ed. Librairie Delagrave, Paris, Fasc. 6, 1927, 229 p.

[37] R. Perrier "*La faune de la France, Hyménoptères*. Ed. Delagrave, Paris, T. 8, 1940, 211 p.

[38] R. Perrier "*La faune de la France, les Diptères, Aphaniptères*" Ed. Delagrave Paris, T. 7, 1983, 216 p.

[39] K.G.V. Smith "*A manual of forensice entomology.* British Museum natural history, Ed. London and Cornell University Press, 1986, 205 p.

[40] D. Singh et M. Bharti "Further observations on the nocturnal oviposition behaviour of blow flies (Diptera: Calliphoridae)" *Forensic Science International,Vol.* 120, 2001, pp. 124-126.

[41] M.H. Villet "African carrion ecosystems and thier insect communities in relation to forensic entomology" *Pest technology,Vol.* 5,n° 1, 2011, pp. 1-15.

[42] M.H. Villet et J. Amendt, J., 2011 – Advances in entomological methods for death time estimation" *Forensic Pathol. Rev.,* Vol. 6, 2011, pp. 213– 237.

[43] M. Wolff, A. Uribe, A. Ortiz et P. Duque "A preliminary study of forensic entomology in Medellin, Colombia" *Forensic Science International,* Vol. 120, 2001, pp. 53-59.

[44] J. Wooldridge, L. Scrase et R. Wall "Flight activity of the blowflies, *Calliphora vomitoria* and *Lucilia sericata*, in the dark" *Forensic Science International,* Vol. 172, 2007, pp. 94-97.

[45] C. Wyss et D. Cherix "*Traité d'entomologie forensique, les insectes sur la scène de crime*" Ed. Presses polytech. Univ. romande, Lausanne, 2006, 317 p.

[46] C. Wyss, D. Cherix, K. Michaud et N. Romain N. "Ponte de *Calliphora vicina*, Robineau-Desvoidy et de *Calliphora vomitoria*, (Linné) (Diptère, Calliphoriade) sur un cadavre humain enseveli dans la neige" *Revue Internationale de Criminologie et de police technique et scientifique, Vol.* LVI, n° 1 ,2003, pp. 112–116.