

## The Specific Richness of Forest Cockroach Communities in The Region of Aflou (Laghouat; Algeria)

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## THE SPECIFIC RICHNESS OF FOREST COCKROACH COMMUNITIES IN THE REGION OF AFLOU (LAGHOUAT; ALGERIA)

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### ABSTARCT

Forest cockroaches are among the insects that play an important and effective role in forest formations, they are insects with incomplete metamorphosis belonging to the order of Blattodea. This work is a contribution to the knowledge of Blattoptera species existing in the forest environments of Aflou's region (Laghouat; Algeria).The inventory was carried out monthly in the El-Khnegue Forest (Aflou) from February 2019 to May 2019. It revealed the presence of six species of forest Cockroaches, which belongs to 4 genera of the Blattellidae family. After identification, it was demonstrated that, these species were: *Dziriblatla nigriventris* (Chopard, 1936), *Dziriblatla stenoptera* (Chopard, 1937), *Loboptera ovobata* (Bohn, 1991), *Loboptera decipiens* (Germar, 1817), *Phyllodromica zebra* (Rhen, 1903) and *Ectobius sp.* (Stephens, 1835). Our results showed also that the soil and the thin layers of litter provide favorable habitat for the development of different species. The litters are composed mainly of leaves, which give very high organic carbon content with little humidity.

**Keywords:** Blattodea, cockroaches, forest, inventory, Laghouat.

### INTRODUCTION

The forest is seen as an ecosystem with multiple roles that should be conserved or restored, it is an excellent conservatory of biodiversity because of the presence of animal and plant species (Dajoz, 2006). Among this animal we have the insects, which are the most dominant group of organisms on earth, both in terms of taxonomic diversity (> 50 % of all species described) and ecological function (Wilson, 1992). It has long been recognized and documented those insects are the most diverse group of organisms, which means that the number of insect species is more than any other group (Hedjouli et al., 2021).

Cockroaches are an ancient form of insect, they are among the groups of insects that evolved during the first great insect radiation, and primitive or ancestral cockroaches have been around for about 350 million years or since the early Carboniferous and they appear to have achieved optimal body shape and other characteristics early in their evolutionary history (Cochran, 2009; Hedjouli et al., 2021).

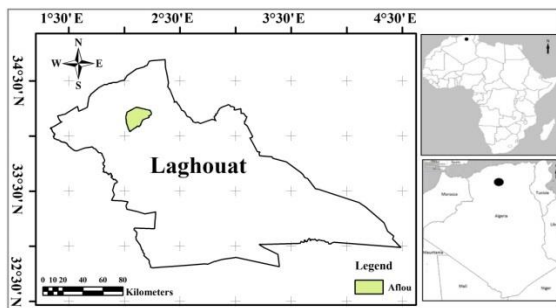
However, forest cockroaches are the best example of forest litter insects, they often exist in litter and especially at ground level, these insects feed on plant debris and which also help to decompose dead leaves (Hedjouli et al., 2021). The composition of the cockroach fauna can vary from region to another, depending on the habitat and many biotic and abiotic factors (Rust et al., 1995).

The first aim of this study is to evaluate the richness and the abundance of the different species of forest cockroaches that exist in the region of Aflou (Laghouat; Algeria), while the second part of this study, is to analyze the different components of the cockroach's natural habitat that exist in this forest for better understanding of these insects' behaviors.

## MATERIAL AND METHODS

### *Presentation of Study Area*

The area selected for harvesting forest cockroaches is that of Aflou part of the highlands of the central Algeria. It is characterized by a semi-arid climate with the existence of two seasons, one dry and hot, the other rainy and cold. The Aflou region is attached to the wilaya of Laghouat and located on the mountains of the Saharan Atlas, in the heart of Jebel Amour. This city is 1400 m above sea level and is located northwest of the capital of the Wilaya. It is bounded between 34°06'N and 2°05'E (S.A.A., 2010) (Figure 1).



**Figure 1: Presentation of the study area (Aflou; Laghouat; Algeria)**

### *Presentation of Study Site*

#### *i. The Forest of El-Khnegue*

This forest is located 10 km northeast of the center of Aflou, in the heart of the mountains of Jebel Amour (Zerarka, 1983). The main species of this forest is the Aleppo pine and the secondary species is the holm oak, Juniper oxyhedron and Alfa, the site of El-Khnegue covers the

two thirds of northwest of the region, it comes from Tell by the national road N ° 23 which connects the wilaya of Tiaret to Aflou, it rises quite quickly above the steppe in a rather steeply sloping and sometimes gullied glacis (Stamboul, 2004) (Fig. 2).



**Figure 2: El-Khnegue Forest (Bouaicha, Dehimi and Taibaoui, 2019)**

#### *ii. Harvesting Technique and Identification*

The individuals were captured for an hour by hands and tubes on each plot during the day, then they were conserved in plastic tubes filled with alcohol 70% and labeled according to the species and their life stage (larvae and adults). The collected species were determined later in the laboratory by using stereo-microscope and the identification keys Chopard (1943); (Chopard, 1951), then the results obtained were confirmed by Horst BOHN (Museum of Zoological Collection, Munich, Germany).

## RESULTS

### *Species Collected in the Study Region*

The forest cockroach inventory was carried out from February 2019 to May 2019, 289 individuals were collected during this period, these individuals were

mainly present in litter. 6 different species have been highlighted. 4 genera have been identified belonging to the Blattelidae family. The most abundant genus was *Dziriblatta* with two species identified as *Dziriblatta igriventris* (Chopard, 1936), and *D. stenoptera* (Chopard, 1937). Concerning the genus *Loboptera* was the

second abundant with two species: *Loboptera ovolobata* (Bohn, 1991), and *Loboptera decipiens* (Germar, 1817). Regarding the genus *Ectobuis*, the species found is *Ectobius sp* (Stephens, 1835). Finally, for the genus *Phyllodromica*, it was *Phyllodromica zebra* (Rhen, 1903) that has been identified (Figure 3).

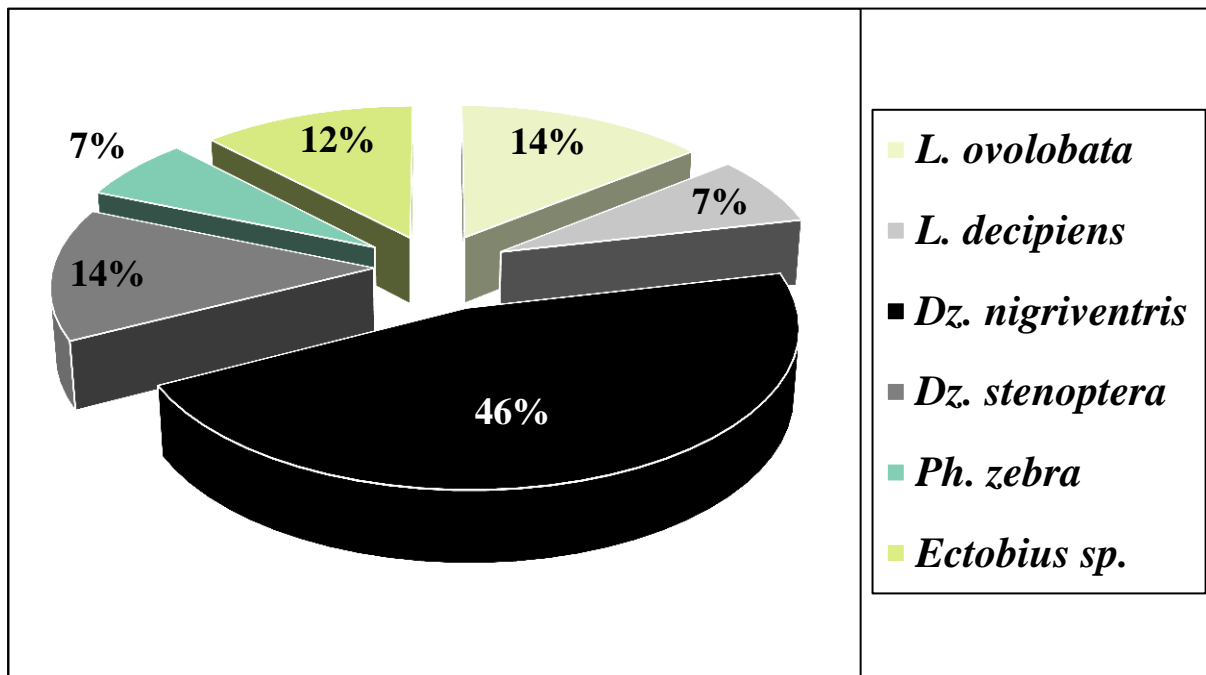


Figure 3: The abundance of different forest cockroaches collected.

### ***Abundance of Species Collected by Stage of Development and by Gender***

#### ***i. By Stage Of Development***

Figure 4 represents the percentage of cockroaches captured at different stages of development (adults & larvae). The adults appeared during all the months of the study period, while the larvae were absent during the month of February. Meanwhile, the numbers of adults collected were larger than the number of larvae during the study period except the month of April where number of larvae exceeded the adult's number.

#### ***ii. By Gender***

Regarding the studied biological complex, we also note that the activity of males and females varies from month to

month, as we said above that the adult phases are more active in the months of February and March, so that activity of male and female was higher during the month of May, where the activity of females were higher than the males' activity (Figure 5).

#### ***iii. Ecological Indices***

The results of the frequency of occurrence of the species studied in the Aflou region shows that the two species *D. nigriventris* and *D. stenoptera* were classified as omnipresent species, while, the species *L. decipiens* was considered as constant species, while the *L. ovolobata* and *Ectobius sp.* species appear as regularly species and finally the last one *Ph. zebra* was considered as rare species (Table 1).

During the study period, we made four field trips to the Aflou's region. We collected 286 individuals divided into 6 different species, so the total richness was  $S = 6$ , with an average richness of 4 species.

The Shannon-Weaver index was estimated with 2.21 bits. This value was

between  $1.5 < 2.21 < H_{max}$ . The sufficiency value (Equitability) was  $0.86 (\geq 0.5)$ . This means that the complex was rich in species, with a balanced distribution of abundance among their species, the state of the environment was complex, mature and stable (Table 2).

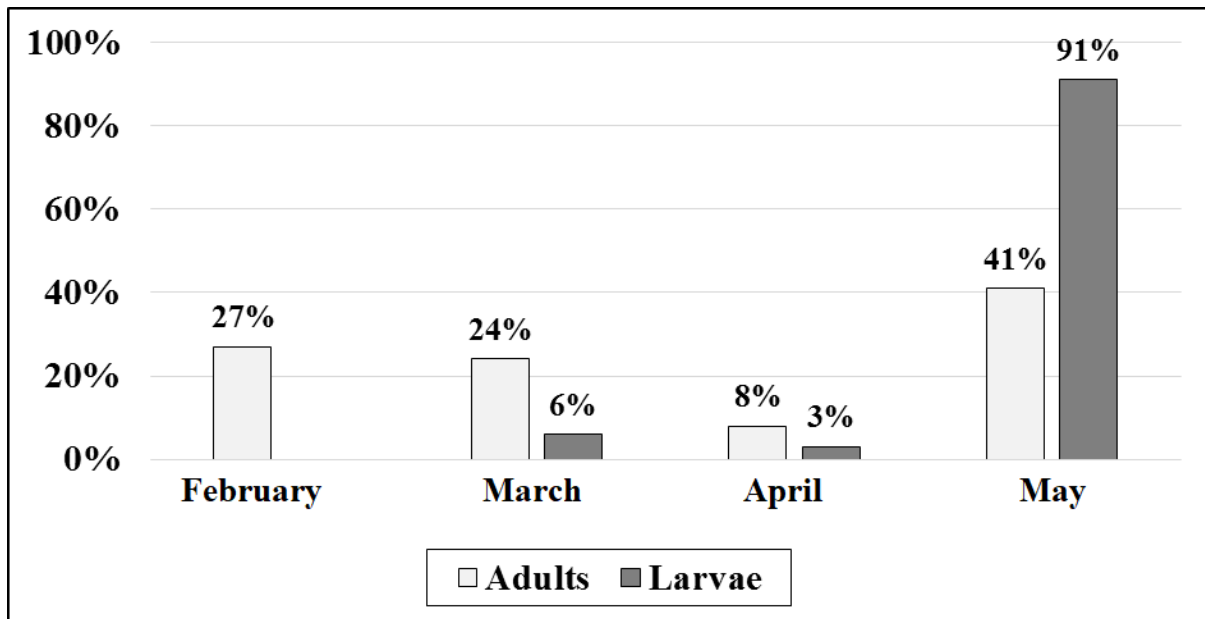


Figure 4: Abundance of forest cockroaches inventoried according to their stage of development.

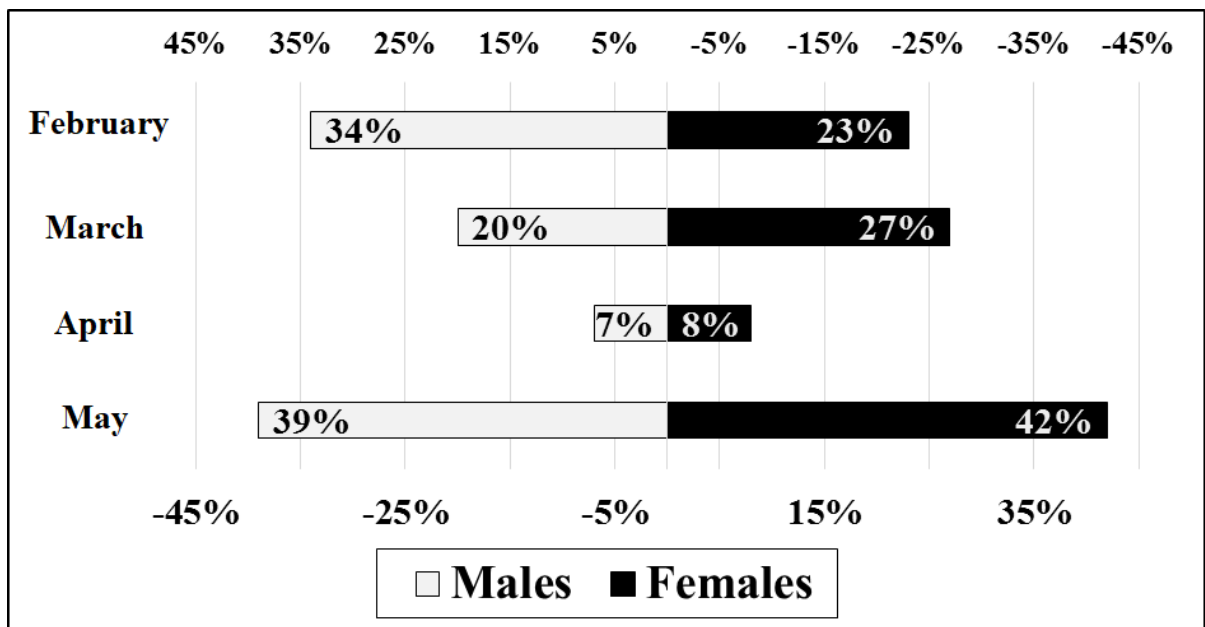


Figure 5: The abundance of forest cockroaches collected by gender.

**Table 1: Frequency of occurrence (F %) of harvested species**

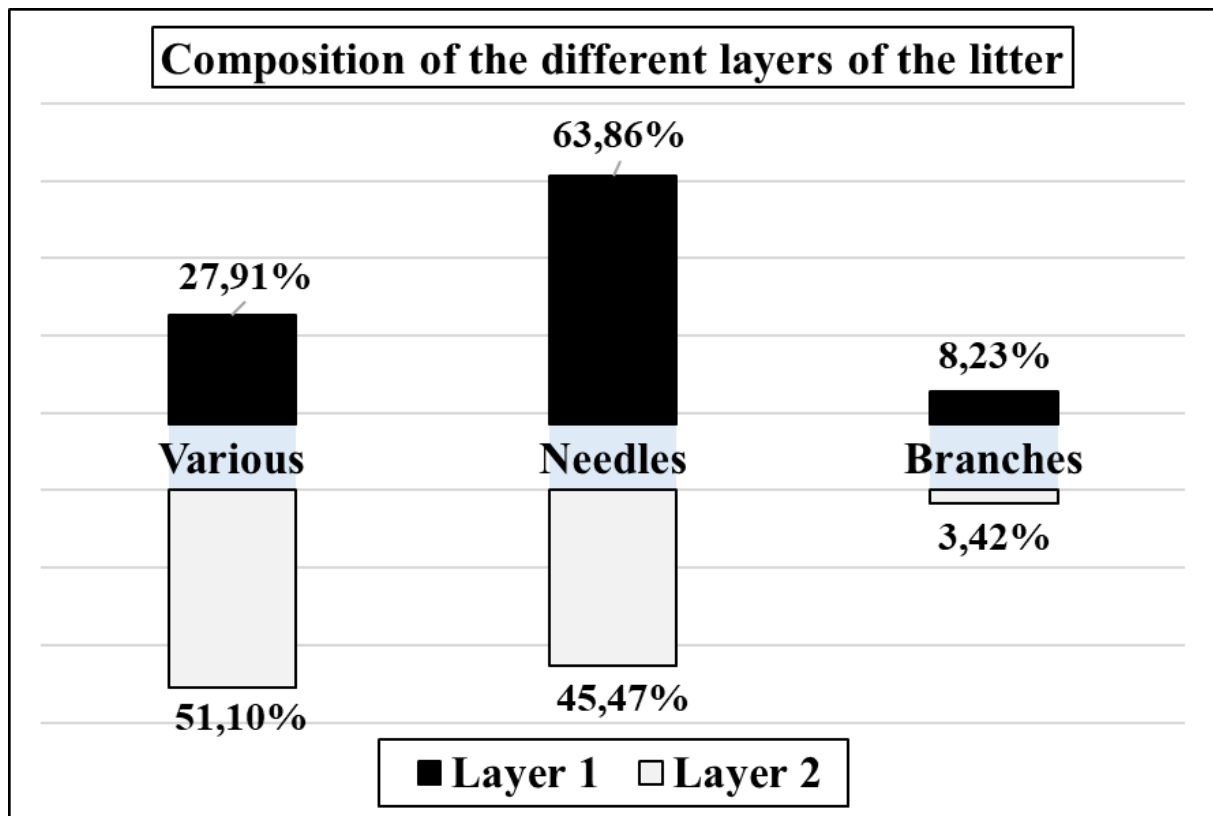
Species	Occurrence %	Categories
<i>L. ovolobata</i>	50	Regular
<i>L. decipiens</i>	75	Constant
<i>Dz. nigriventris</i>	100	omnipresent
<i>Dz. stenoptera</i>	100	omnipresent
<i>Ph. Zebra</i>	25	Accidental
<i>Ectobius sp.</i>	50	Regular

**Table 2: Diversity parameters of the study region**

Parameters of diversity	
Species richness	6
Average richness	4,25
$H_{max}$	2,58
Shannon-weaver	2,21
Equitability	0,86

*i. Physical Separation of Residues*

Figure 6 summarizes the results obtained by physical analysis of leaf debris in Aleppo pine forests (Aflou).



**Figure 6: Composition of the different classes of residues.**

**The Study of the Natural Habitat of Forest Cockroaches**

The four sites from which different samples were taken showed that the outer layer represents the largest proportion of needles 63.86%, while the inner layer contains 45.47 % of needles. The branches

are present in greater proportion in the outer layer than in the inner layer, unlike the various whose percentage is higher in the inner layer and represents 51.18 % of the total leaf residue.

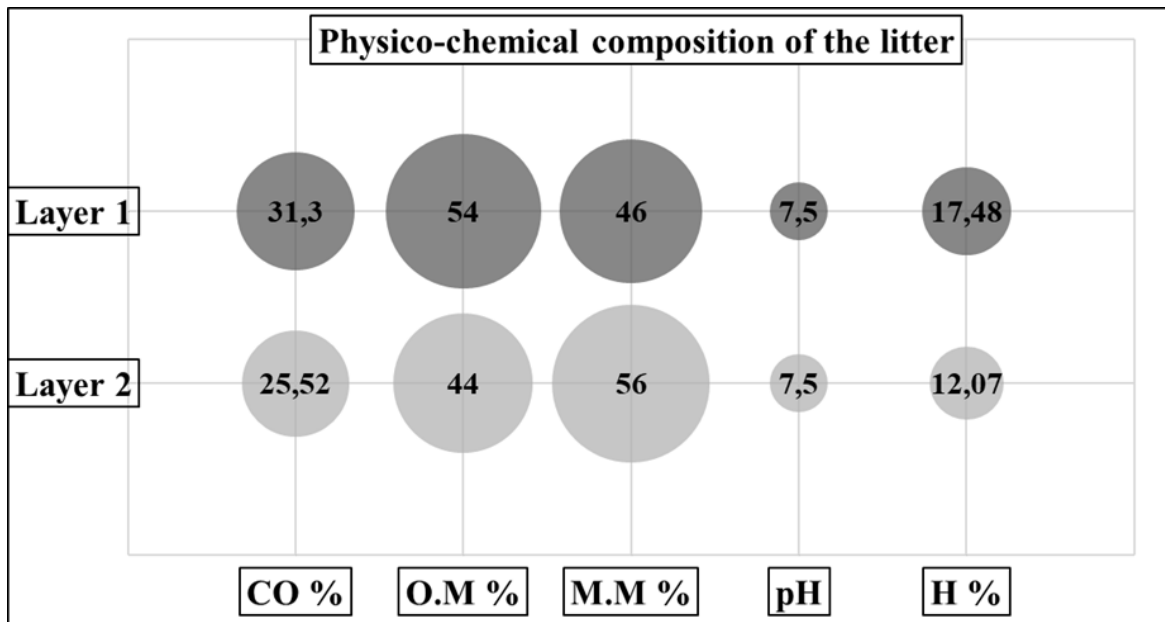


Figure 7. The physicochemical composition of the residues [H%: humidity; pH: potential hydrogen; M.M%: Mineral Matter; M.O%: Organic Matter; CO%: Organic Carbon].

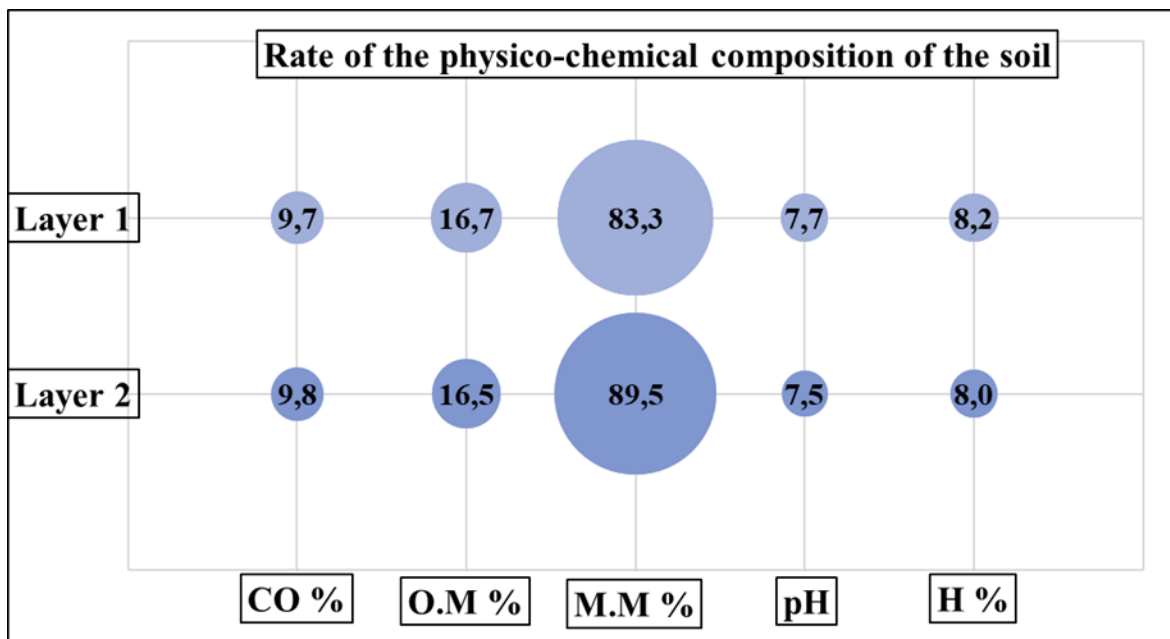


Figure 8. Measurement of the physicochemical composition of the soil [H%: humidity; pH: potential hydrogen; M.M%: Mineral Matter; M.O%: Organic Matter; CO%: Organic Carbon].

*i. Physicochemical Analysis of Residues and Soil*

The recording of the average leaf residue of the outer layer was more humid with 17.48 %. The pH readings indicated that the residue in this region was basic (pH = 7.55). The inner layer was richer in

mineral matter with 56 %, unlike the outer layer which was richer in organic matter and organic carbon (54 % and 31.30 % respectively) (Figure 7).

The results of the physicochemical analysis of the soil in the Aflou region (Figure 8) showed that the humidity level was close between the outer and inner layers (16.50 % and 24.21 % respectively). In addition, the soil in this area was rich in mineral matter and shows high levels of it



(over 80 % in both layers). The proportions of organic matter and organic carbons were similar in both layers.

## DISCUSSION

Cockroaches are one of the oldest orders of insects with a fossil history dating back over 300 million years. There are 4000 known species worldwide belonging to six families, Blattidae, Cryptoceridae, Polyphagidae, Nocticolidae, Blattellidae and Blaberidae (Roth, 2003). According to different classification criteria, cockroaches are divided into several families, including the Blattellidae, which includes small cockroaches (Gordon, 1996; Guillaumin et al., 1969).

The inventory of African cockroach species is far from complete. In North Africa for example, very little research has been carried out on the fauna of Blattodea (Chopard, 1929, 1943). Indeed, studies on these insects in Algeria remain punctual and fragmentary.

The analysis of the results of the forest studied during the period from February 2019 to May 2019 in the Aflou region, showed that the Blattodea fauna is represented by 6 species, these latter belong to 4 different genera: *Loboptera*, *Ectobius*, *Dziriblatia* and *Phyllodromica*. Over 289 individuals of different stages were captured including *L. ovolobata*, *L. decipiens*, *Ectobius sp.*, *Dz. nigriventris*, *Dz. stenoptera* and *P. zebra*.

*L. decipiens* was reported in northern Africa by Chopard (1943), in Tunisia, Morocco and Algeria, where it is common almost everywhere, especially in coastal regions (Oran, Tlemcen, Blida, Biskra and in Annaba). The species has also been reported in the work of Cherairia (2004), Bouachria (2005), Habbachi (2013), Masna (2016) and Hedjouli et al. (2021).

*L. ovolobata* is a small species which closely resembles *L. decipiens*. This species is identified for the first time in Algeria by Masna (2016) in the Djelfa

forest. It is characterized by a shiny black body, devoid of a white border and its short, lobiform, black elytra. This species was also recently reported by Hedjouli et al. (2021) in different forest (Djelfa, Annaba and El Taref).

Regarding the genus *Ectobius*, only a few species have been reported from North Africa. The species of the genus *Ectobius* have already been reported in the forests of northeast Algeria and it is mainly present by the species of: *E. pallidus* in the region of Guelma (Cherairia, 2004), *Ectobius sp.* in the region of Djelfa (Masna et al., 2014), and finally, *E. kerveilli* was identified by (Habbachi, 2013) in the region of Annaba, and recently in both regions of Annaba and El-tarf by Hedjouli et al. (2021).

The genus *Dziriblatia* is found mainly in Morocco, Spain and Portugal. It is characterized by reduced elytra in the form of small lateral lobes in both sexes. We found two species of this genus, *D. nigriventris* and *D. stenoptera*, the latter were reported for the first time by Masna (2016) in the region of Laghouat, after that by in the region batna, and recently by (Hedjouli et al., 2021) in the forest of Djelfa.

The genus *Phyllodromica* is encountered for the first time in the forests of the Algerian Sahara, the small cockroaches of the genus *Phyllodromica* are distributed in the eastern Mediterranean and in North Africa (Chopard, 1943). The species *Ph. Zebra* was identified by the Museum of Hurst Bohn. The species has been reported in Morocco and Algeria (Saïda) by Chopard (1943), in the region of Batna by Azoui (2017) and in the region of Djelfa (Hedjouli et al., 2021; Masna et al., 2014).

The habitat variability and the adaptation to eco-climatic factors also cause cockroach sexes and individuals from different regions to vary considerably (Cornwell, 1968). Thus, the composition of the Blattodea fauna can vary from one region to another of the globe and the

suitability of the habitat depends on many biotic and abiotic factors (Rust et al., 1995).

The ground was covered with a significant amount of plant material such as leaves, twigs, fruits and seeds. All of these materials constitute the litter (Rapp, 1971; Tissaux, 1996). The decomposition of organic matter contained in litter represents a potential energy source for the species that consume them (Gobat et al., 2010).

The physical analysis of the litter at our study site indicates that pine needles and various debris were the main components and that the variance between layers is not significant. In all layers of the litter, the moisture content is less than 50%, indicating a low water retention capacity (Rapp, 1971). The water content is related to the rate of organic carbon in the soil, we have noticed that the soil is less humid than the litter as well as the rate of organic carbon which is very important in the litter than in the soil; this improves soil quality and its ability to regulate water (Lal et al., 1998).

The amount of organic carbon in forest soil depends largely on the amount and quality of litter produced by forest vegetation (Anderson, 1991; Van Cleve & Powers, 1995). The pH was relatively alkaline, this explains the proliferation of cockroaches, this result is confirmed by Habbachi (2013) who showed that cockroaches prefer eucalyptus litter of an alkaline nature than that of cork berries of an acidic nature.

The diversity and amount of organic matter present in the soil are also factors that determine the activity and diversity of insects (Burghouts et al., 1992). The two layers of litter on the site were rich in organic matter and organic carbon, on the other hand the soil was rich in mineral matter. Organic matter and mineral matter are essential for the proper functioning and sustainability of the forest ecosystem, they are the food of living soil organisms, micro-organisms and fauna

(Masna, 2016). A soil rich in organic matter and mineral matter promotes the abundance and variation of animals and plants, and therefore biodiversity (Mousset, 2014).

## CONCLUSION

In the region of Aflou (wilaya of Laghouat; Algeria) where the forest of El-Khnegue exist, we were able to demonstrate the existence of six species of forest cockroaches: *Loboptera decipiens*, *Loboptera ovobata*, *Dziriblatla nigriventris*, *Dziriblatla stenoptera*, *Phyllodromica zebra* and *Ectobius sp.* The most abundant species during the study time was *Dz. nigriventris* and classified as omnipresent species. We showed also that the El-khnegue Forest is very rich in species, and well balanced since these cockroaches are present in forest litter during all the study period.

## CONFLICT OF INTEREST

The authors declare that they have no competing interests.

## AUTHORS CONTRIBUTION

All authors have participated in the development and implementation of the reviewing plan and subsequently written it.

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