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New records and check list of arthropods from two oasis ecosystems in Algeria

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Abstract. An arthropod sampling survey was performed in two palm groves from the wilaya of Biskra and Ouled Djellal. During 12 months (2020) of survey, the obtained results indicated the presence of 117 taxons divided into 2 classes (Insecta =103 species and Arachnids = 11 species). The species belonged to the orders: Coleoptera, Diptera, Orthoptera, and Hymenoptera. The Coleoptera order was the most represented in the two palm groves (32 from Ouled Djellal (OD) and 6 from Feliache (Fe)). The major trophic guild represented in the oasis ecosystems was the predator guild (OD= 39%, Fe=32%) in comparison to those of phytophagous (OD= 28%, Fe=12%) and pests (OD= 4%, Fe=15%). This indicates an ecological balance in the investigated oasis ecosystems between pests and their predators. The observation of two new species: *Scymnus frontalis* (Fabricius, 1787) and *Diomus zinon* (González and Honour, 2011), from the Coccinilidae Family increases the number of predator species of insect pests in the investigated oasis ecosystems.

Keywords: Arthropods, New record, Ziban oases, Coccinillidae, updated species list.

Introduction

With their presence on earth for more than 400 million years, insects constitute an unprecedented biological success and an essential component of life on our planet (Ring and Vincent, 2012; Lebreton *et al.,* 2013; Gilles, 2019).

They participate to natural processes essential for maintaining biological systems. Despite their ecological importance, they are still poorly understood and suffer from a lack of interest (Leraut, 1990; Leraut, 2003; Ramade, 2012; Coïc *et al.,* 2018). The known insect fraction, which is assumed to represents less than 1% of the world's species, is already in high danger of extinction (Gilles, 2019; U.I.C.N., 2019).

Insects form a cosmopolitan group, found in different ecosystems (Calatayud, 2011; Sauvion et al., 2013; Gilles, 2019). Each ecosystem gives, by its nature and its specificity, an opportunity for the appearance and maintenance of a variation of insects, which takes advantage of the typical conditions of the habitat. The structure of these habitats influences their diversity and abundance (Urban and Smith, 1989; Halaj *et al.,* 2000). Several groups of insects can be located in different biotopes and adapt to the local conditions of the region by building a mosaic of natural resources which remains favorable to the biodiversity of the entomofauna.

Climate change has effects at all levels of organization (animal or plant) (Chaupin *et al.,* 2000; Parmesan, 2006). In relation to the importance of the changes observed at the level of biodiversity, the IPBES experts gathered during the third session in January 2015, evoked its strong impact on ecosystems, their biodiversity and ecosystem services that they provide (IPBES, 2014; Belhamra *et al.,* 2014) and which are experiencing an accelerated decline (BNT, 2015). Due to the important role of biodiversity (insects) in maintaining the structure, the stability and the functioning of ecosystems and their productivity (Dajoz, 2008). The oases are ecosystems of ecological interest, for many faunal populations, due to the flora diversity that characterizes them (Belhamra *et al.,* 2014; Deghiche-Diab, 2020; Aouissi *et al.,* 2021). However, a lack of scientific knowledge on the modalities of adaptations and the evolution of the structure of insects under oasis ecosystems is induced by these disturbances (Aouissi *et al.,* 2021). This why, the legitimized and crucial question that arises; what is the state of play and the possible impact on biological diversity in our Ziban oasis ecosystems? An update list was performed at tow palm groves from Biskra and Ouled Djellal oasis ecosystem. This paper will review the list of arthropods present in oasis ecosystem especially those used in biological control or in an integrated pest management program for the maintain of its stability.

Materials and methods

Study area

In order to have an inventory of insect species, their distribution and community composition, we performed a monitoring study in two palm groves, located in the oasis of Biskra (Fig. 1) and that of Ouled Djellal (Fig. 2).

Covering an area of 2 035.978 km2, the Biskra region (34°, 48' N and 5°, 44' E) is one of the wilayats of southern Algeria. It is located in the south east of Algeria, and limited by the province of Batna in the north, to the North-West by M'Sila and Ouled Djellel, to the North east by Khenchela, to the south by El Oued and Ouargla. Its' vast expanse, combined with geological and geographic characteristics as well as climatic factors, show a series of ecosystems, sheltering a diversity of forests, mountains, plateau, steppes and oasis habitats, offering a diversity of animal and plant species (Fig. 1a).

The palm grove chosen for insect sampling is a living date palm collection created as part of the PNR1 project "Inventory, characterization and conservation of date palm cultivars in south-eastern Algeria", initiated to preserve genotypes of endangered date palms, their multiplication and the constitution of a genebank. It is located on an area of 4ha (46° 5'21.08''E 49° 34'35.24''N, 85m a.s.l) at Feliache (Fe) municipality on the national road N° 83, it include 88 cultivars from date palm trees spaced 9m between them (Fig. 1b).

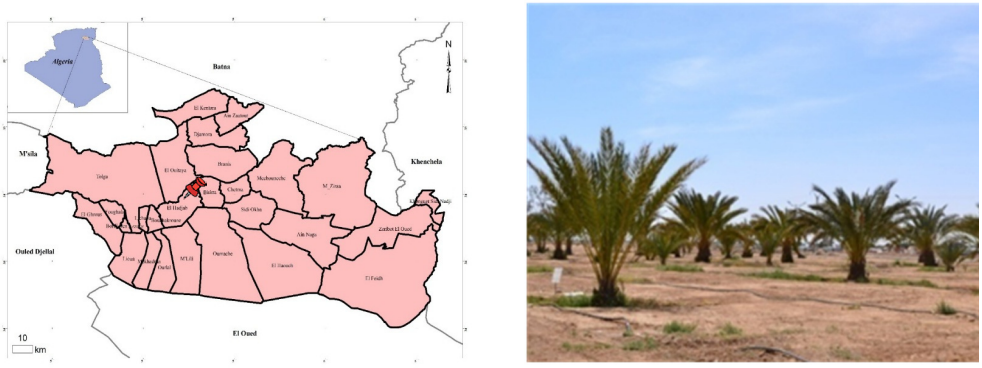

Figure1. Location of **a.** Biskra region and **b.** Chosen palm grove Feliache (Fe)

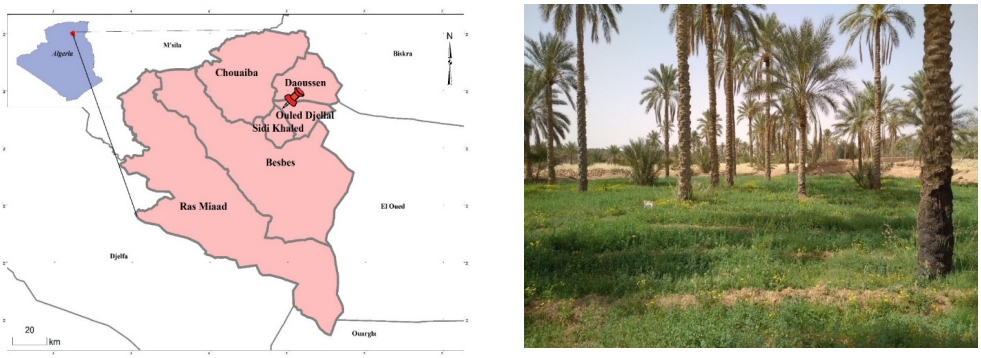

Figure 2. Location of the **a.** Wilaya of Ouled Djellal and **b.** sampling palm grove Ouled Djellal (OD)

Another palm grove (34°25'N 5°25'E, 195m a.s.l) was selected from the Oasis of the wilaya of Ouled Djellal (Figure 2b), the wilaya was created in 2019 and formalized in 2021. It is located in the Algerian Sahara with an area of 131, 220 km^2 and delimited to the north by the M'sila province, to the east by the Biskra province and El M'Ghair province, to the west by the Djelfa province and to the south by the Ouargla province (Fig. 2a).

Sampling arthropods

One of the most effective ways of collecting invertebrates during fauna surveys is by using pitfall traps (Laub *et al.,* 2008). It is designed as an inexpensive, easily made item and very effective (Deghiche-Diab, 2015), used in studies of seasonal occurrence of insects, to examine spatial distribution patterns, to compare relative abundance in different micro-habitats, to study daily activity rhythms and in community surveys.

Five pitfall traps were located in four opposite directions (Moulin *et al.,* 2007; Langor and Spence, 2006) in each palm grove and spaced 30m, where they were visited every week from january until décember 2020. In laboratory, the identification of species was done under binoculare magnifier and by using the references collection (Deghiche-Diab, 2009; Deghiche-Diab *et al.,* 2015a,b; Deghiche-Diab *et al.,* 2020 a,b,c) previously established. The identification of new species was done based on the articles of reviewed families, genus and species around the world (Pong and Slipinski, 2009; González and Honour, 2011; Abdolahi *et al*., 2018; Katayoun Pahlavan *et al.,* 2018; Albéryca *et al.,* 2020)

Data analysis

The collected observation and data were treated by using the following ecological indices, using PA.ST program (V. 2.17) software which is a data analysis tool that allows us to process statistical data, generate graphs and calculate different ecological and statistical indicators (Hammer, 2001; Dieumegard, 2010):

- The relative abundance AR or F = ni/ N x 100, that represents the percentage of individuals of a species (ni) compared to the total number of individuals (N) (Dajoz, 1971; Blondel, 1979).

- The constancy that is the ratio of the number of records containing the studied species to the total number of records C (%) = Pi / P x 100. (Dajoz, 1985). The species is constant if C ≥ 50%, accessory if 25% ≤ C ≤ 49%; accidental if 10% ≤ C ≤ 24% and very accidental qualified as sporadic if the C ≤ 10% (Bigot and Bodot, 1973).

Results and discussion

An arthropod inventory was assembled in the two investigated palm groves (Feliache and Ouled Djellal), during the study period. In total, 117 species and 11 orders were collected and identified. The Insecta class was the most represented with 86 species from Ouled Djellal and 31 species from Feliache palm grove. The Arachnida class was represented by 11 species where 7 species from Ouled Djellal and 5 from Feliache palm grove (Tab. 1).

Structural composition of arthropods in palm groves

In total eleven (11) orders of Arthropods were found in the two palm groves (Ouled Djellal and Feliache), eight (8) orders belonged to the class Insecta, from which Coleoptera and Diptera orders were the most represented, whereas the Arachnida class was represented by two (02) orders with seven families (Tab. 1).

Table 1. Total collected species and orders during the study period from Feliache and Ouled Djellal palm groves

		Palm groves			
		Ouled Djellal (OD)		Feliache (Fe)	
Class	Order	Family	Species	Family	Species
Insecta	Coleoptera	6	32	4	6
	Lepidoptera	4	8	2	2
	Hemiptera	4	8	2	2
	Hymenoptera	4	11	3	4
	Orthoptera	3	9	2	2
	Neuroptera	2	2	1	1
	Diptera	7	10	8	9
	Odonata	2	5	-	-
	Embiidae	1	1	1	1
Arachnida	Araneae	4	6	5	5
	Solpugida	1	1	-	-
Total	11	38	93	28	33

Total collected species by palm grove

Following the chosen method for trapping and collecting Arthropods from the chosen palm groves (Feliache and Ouled Djellal), it was noted that Ouled Djellal palm grove have the highest number of species (93 species) belonging to 38 families, in comparison to Feliache palm grove that groups only 33 species and 28 families. Fourteen species were observed in both palm groves.

In Ouled Djellal palm grove, we notice that the most represented species were from Coleoptera order with 32 species and 6 families. The second numerous orders were Hymenoptera and Diptera order, with 11 and 10 species, respectively.

Orthoptera, Lepidoptera and Hemiptera orders were represented by 9 and 8 species, respectively. Less species from Diptera order were collected from Feliache palm grove, where only 9 species belonging to 8 families were identified. The other orders were found in few numbers in our pitfall traps (Tab. 1).

The Arachnida class was well represented under Ouled Djellal palm grove conditions, where we counted 7 species, belonging to 5 families, in comparison to 5 species from the Feliache palm grove (Tab. 1).

The obtained results were analyzed using the constancy for each species (Tab. 2), under palm grove conditions we count 50 accidental species at Ouled Djellal palm grove in comparison to that of Feliache, whereas 17 accessory species were obtained from Ouled Djellal in comparison to Feliache, where no accessory species was identified. Only one constant species was obtained under Feliache palm grove in comparison to 5 from Ouled Djellal palm grove. The sporadic species were lower in Feliache palm grove (9 species) compared to those obtained from that of Ouled Djellal (14 species). The same observation was obtained for the rare species, where we counted 10 species from Feliache palm grove compared to 16 from that of Ouled Djellal.

Because insects have short generation times in comparison to plants and vertebrates, they are the most affected by climate change, it can have a direct influence on their development, reproduction, and survival (Bale *et al*., 2002). It is noted that different parameters from abiotic and biotic factors that characterize each palm grove, have an effect on the diversity on Arthropods. Different authors Armsworth *et al.* (2004) and Bonnemaison (1962), agree that the abiotic factors such as microclimate have a direct effect on the abundance of population and their distribution and fluctuation. In addition, Dajoz, (2008) and Nentwig (2007), reported that the variations in diversity of species varies with the climatic conditions (time and temperature). All these parameters can explain the difference distribution of species under each palm grove.

The effect of biotic factors on the distribution of species has been the subject of debate, as reported Barbault (1981) and Tilman (1997), the increase in plant diversity induces an increase in the diversity of phytophagous species. This can be an explanation of the presence of a large number of accidental species in the tow palm groves, where it is noted the presence of vegetative cover (weeds). The diversity of crops cultivated under oasis ecosystem can also represent a favorable microclimate (Honěk, 1998; Pan *et al.,* 2020) for the presence of prey (Bohan *et al.,* 2000) that provide food for the predator species that can explain the height number of accidental species under palm groves. As a palm grove plays a role of screen by protecting the species from desert influences and creates a microclimate favorable to their development following the various cultural practices applied (Deghiche-Diab, 2019). Human intervention under

oasis ecosystem through cultural practices can also have an effect on the diversity and number of species. It is noted that farmers at Ouled Djellal palm grove does not use pesticides or treatments. As reported Sauphanor *et al.* (1993), Bettiche, (2017), N'Goran *et al.* (2019); the massive use of pesticides can have a negative effect on several trophic levels of insects in the cultivated environment. The absence of treatments or chemicals can be another possible explanation of the high number of accidental species under Ouled Djellal palm grove in comparison to that of Feliache. The presence of constant species in the habitat maybe justified by the fact that they are favored by the presence of their host plants and their prey (Deghiche-Diab *et al.,* 2020a). The list of rare species includes species collected in the majority of cases at one time, their presence in few numbers is probably due to the probabilities of capture (type of traps used) or the ecological capacity of each species to populate biotopes (Blondel *et al.,* 1973; Deghiche-Diab, 2009; Deghiche-Diab, 2015). Another possible explanation that the species may be introduced from another ecosystem and did not yet adapt to the new conditions of the area (Deghiche-Diab, 2020; Deghiche-Diab *et al.,* 2021).

Table 2. Total number of species collected from Feliache (Fe) and Ouled Djellal (OD) palm groves

Orders	**Families**	**Species**	**C% Palm groves**		**in common**	**Trophic guild**
			Fe	**OD**		
Odonata	Libellulidae	*Sympetrum sanguineum* (Muller, 1764)	-	10.42		Pr
		Sympetrum vulgatum (Linné, 1758)	-	14.58		Pr
	Coenagrionidae	*Coenagrion* sp	-	6.25		Pr
		Ischnura pumilio (Charpentier, 1825)	-	6.25		Pr
		Enallagma cyathigerum (Charpentier, 1840)	-	4.17		Pr
Coleoptera	Tenebrionoidae	*Erodius emondi* spp. laevis (Solier, 1834)	-	20.83		Pr
		Akis lusitanica (Solier, 1836)	-	4.17		Pr
		Pimelia sp	-	22.92		Pr
		Pimelia payraudi (Latreille, 1829)	-	35.42		Pr
		Stenocara sp	-	31.25		Pr
	Cetoniidae	*Protaetia morio* (Fabricius, 1781)	-	41.67		Ph
		Tropinota squalida (Scopoli, 1783)	-	45.83		Ph
		Hoplia argentea (Poda-1761)	-	54.17		Ph
		Tropinota (epicometis) *hirta* (Poda, 1761)	-	72.92		Ph
	Meloidae	*Mylabris sp4*	2.08	2.08		Po
		Meloidae sp	-	6.25		Po
		Mylabris sp1	-	4.17		Po

Orders	Families	Species	C% Palm groves		in common	Trophic guild
			Fe	OD		
		Mylabris sp2	-	8.33		Po
		Mylabris sp3	-	4.17		Po
	Chrysomelidae.	*Clytra sp,*	-	2.08		Pr
	Coccinellidae	*Adalia bipunctata* (Linné, 1758)	-	4.17		Pr
		Oenopia conglobata (Linné, 1758)	-	10.42		Pr
		Exochomus nigripennis (Erichson, 1843)	-	31.25		Pr
		Psyllobara viaintiduopunctata (Linné, 1758)	-	8.33		Ps
		Hippodamia variegata (Goeze, 1777)	-	47.92		Pr
		Coccinella algerica (Kovàr,1977)	-	72.92		Pr
		Henosepilachna elaterii (rossi,1794)	-	25.00		Ps
		Coccinella septempunctata (Linné, 1758)	87.50	77.08	x	Pr
		Diomus zinon (González and Honour, 2011)	2.08	-		Pr
		Scymnus frontalis (Fabricius, 1787)	2.08	-		Pr
	Carabidae	*Brachinus explodens* (Duftschmid, 1812)	-	25.00		Pr
		Cicindela flexuosa (Fabricius, 1787)	-	25.00		Pr
		Bembidion sp	-	10.42		Pr
		Cicindela campestris (Linné, 1758)	-	16.67		Pr
		Calosoma inquisitor (Linné, 1758)	-	12.50		Pr
		Harpalus rufipes (De Geer, 1774)	-	16.67		Ph
		Calomera littoralis (Fabricius, 1787)	-	18.75		Pr
		Chlaenius decipiens (L.Dufour, 1820)	-	31.25		Po
		Licinus punctatulus (Fabricius, 1792)	6.25	4.17		/
	Scarabaeidae	*Amphimallon solsticialis* (Linné, 1758)	-	12.50		Ph
		Scarabaeus sacer. (Linné, 1758)	-	16.67		Co
	Curculionidae	*Cleonis pigra* (Scopoli, 1763)	4.17	27.08		Ph
Lepidoptera	Nymphalidae	*Venessa cardui* (Linné, 1758)	12.50	16.67	x	Ph
		Danaus chrysippus (Linné, 1758)	-	18.75		Ph
	Peridae	*Euchloe simplonia* (Freyer, 1829).	-	22.92		Ph
		Pieris rapae (Linné, 1758)	-	25.00		Ph
		Pieris-brassicae (Linné, 1758)	14.58	25.00	*x*	Ph
		Colias crocea (Fourcroy, 1785)	-	18.75		Ph
	Arctiidae	*Utetheisa pulchella* (Linnaeus, 1758)	-	4.17		Ph
	Sphingidae	*Hyles lineate* (Fabricius, 1775)	-	12.50		Ph
Hymenoptera	Chrysididae	*Omalus biaccinctus* (R. du Buysson, 1893)	10.42	6.25		Pa
	Ichneumonidae	*Ophion luteus* (Linné, 1758)	-	10.42		Pa
		Apechthis compunctor (Linné, 1758)	12.50	12.50		Pa
	Apidae	*Bombus terrestris* (Linné, 1758)	-	8.33		Po
		Apis mellifera (Linné, 1758)	-	25.00		Po

Orders	Families	Species	C% Palm groves		in common	Trophic guild
			Fe	OD		
	Formicidae	*Monomorium subopacum* (Smith, 1858)	14.58	54.17		Pl
		Pheidole pallidula (Nylander, 1849)	18.75	22.92		Pr
		Tetramorium biskrensis kahenae (Menozzi 1934)	-	35.42		Pl
		Tapinoma sp	-	16.67		Pl
		Messor capitatus (Latreille, 1798)	-	20.83		Pl
		Messor barbara (Linné, 1767)	6.25	22.92	x	Pl
		Tapinoma nigerrimum (Nylander, 1856)	-	31.25		Pl
		Cataglyphis bicolor (Fabricius, 1793)	-	6.25		Pl
		Cataglyphis bombycinus ((Roger, 1859)	10.42	4.17	x	Pl
	Vespidae	*Polistes dominula* (Christ, 1791)	-	29.17		Pl
		Polistes gallicus (Linné, 1767)	-	22.92		Pl
Orthoptera	Gryllidae	*Brachytrupes megacephalus* (Lefèvre, 1827)	-	12.50		Pl
		Acheta domesticus (Linné, 1758)	2.08	4.17	x	Pl
	Gryllotalpidae	*Gryllus campestris* (Linné, 1758)	-	2.08		Pl
		Gryllotalpa gryllotalpa (Linné, 1758)	-	2.08		Ph
	Acrididae	*Sphingonotus rubescens* (Walker, 1870)	-	14.58		Ph
		Chorthippus sp	-	18.75		Ph
		Chorthippus biguttulus (Linné, 1758).	-	22.92		Ph
		Melanoplus bivittatus (Say, 1825)	-	20.83		Pr
		Acrida pellucida algeriana (Dirsh, 1949)	-	10.42		Ph
		Aiolopus strepens (Latreille, 1804)	-	12.50		Ph
	Pyrgomorphidae	*Pyrgomorpha agarena (Bolívar, 1894)*	4.17	-		Ph
Hemiptera	Pantatomodae	*Eurydema dominullus* (Scopoli, 1763)	-	22.92		Ph
		Codophila varia (Fabricius, 1787)	-	20.83		Ph
		Graphosoma italicum (Müller,1766)	-	10.42		Ph
		Dolycoris baccarum (Linné, 1758)	-	10.42		Ph
	Miridae	*Stenotus binotatus* (Fabricius 1794)	8.33	12.50	x	Pr
		Lygus Lygocoris pabulinus (Linné, 1760)	-	8.33		Ph
	Anthocoridae	*Orius laevigatus* (Fieber, 1860)	-	10.42		Pr
	Cicadellidae)	*Psammotettix alienus* (Dahlbom 1850)	-	16.67		Ph
	Aphididae	*Myzus percecae (Sulzer, 1776)*	10.42	-		Ps
		Rhopalosiphum padi (Linnaeus, 1758)	12.50	-		Ps
		Aphis craccivora (Koch, 1854)	2.08	-		Ps
Diptera	Torymida	*Torymus flavipes* (Walker, 1833)	6.25	-		Pa
	Dictyopharidae	*Dictyophora europaea (Linné, 1767)*	-	-		Ph
	Drosophilidae	*Drosophila* sp	14.58	-		Ph
	Tachinidae	*Peleteria varia* (Fabricius, 1794)	10.42	-		Sa

Orders	Families	Species	C% Palm groves		in common	Trophic guild
			Fe	OD		
	Calliphoridae	Lucilia sp.	4.17	12.50	x	Sa
	Syrphidae	*Sphaerophoria scripta* (Linné 1758)	20.83	-		Pl
		Syrphus vitripennis (Meigen, 1822)	-	6.25		Pl
		Melanostoma mellinum (Linné, 1758).	-	10.42		Pl
	Muscidae	*Musca domestica* (Linné, 1758)	6.25	22.92	x	Sa
	Tephritidae	*Ceratitis capitata* (Wiedemann, 1824)	8.33	20.83	x	Ps
		Bactrocera oleae (Gmelin, 1788)	10.42	14.58	x	Ps
	Bombyliidae	*Systoechus vulgaris* (Loew, 1863)	4.17	12.50	x	Pa
	Asilidae	*Neoitamus* sp.	-	10.42		He
	Culicidae	*Culiseta* sp	-	4.17		He
		Anopheles sp	-	6.25		He
Embiidea	Oligotomidae	*Oligotoma nigra* (Hagen, 1885)	10.42	4.17		Pr
Neuroptera	Myrmeleontidae	*Myrmeleon formicarius* (Linné, 1767)	-	8.33		Pr
	Chrysopidae	*Chrysoperla* carnae (Stephens, 1836)	12.50	6.25	x	Pl
Solpugida	Daesiidae	*Syndaesia* sp	-	10.42		Pr
Araneae	Lycocidae	*Trochosa terricola* (Thorell, 1856)	-	12.50		Pr
	Dysderidae	*Dysdera westringi (*Cambridge, 1872)	8.33	14.58	x	Pr
	Thomisidae	*Tomisus onustus* (Walckenaer, 1805)	4.17	-		Pr
		Thomisus sp.	-	4.17		Pr
	Araneidae	*Agalenatea redii* (Scopoli, 1763)	-	6.25		Pr
		Argiope bruennichi (Scopoli, 1772)	-	10.42		Pr
		Argyope lobata (Pallas, 1772)	-	14.58		Pr
	Lycosidae	*Alopecosa pulverulenta (Clerck, 1757*	8.33	-		Pr
	Philodromidae	*Philodromus* sp	10.42	-		Pr
	Sicariidae	*Loxosceles* sp.	4.17	-		Pr
11	53	118	36	96	14	Pr

(x): Present; (-): not present: (/): unknown C%: Constancy; Ph: Phytophagous; Pr: Predator; Pl: Polyphagous; Po: Pollinator; Ps: Pest; Co: Coprophagous, Sa: Saprophagous; He: Hematophagous.

Trophic guilds

Under oasis ecosystem different species categories were identified where we counted, the most important category was represented by predators with 36% of the total collected species, the second numerous category was represented by the phytophagous species that represented 27% of the total collected species, the polyphagous were in the third position, with 15% of all collected species.

The specialization of species under Ouled Djellal palm grove indicated that the most important category was represented by predator species with 39% of all collected species. Phytophagous species were also well represented with 28% and 17% were polyphagous species (Fig. 3a).

From Feliache palm grove, that groups 33 species, the important category was represented by predators with 32% of all collected species, the category of polyphagous species were in the second position with 17% and 15% were pest species. 12% represent the phytophagous and parasitoids species (Fig. 3b). Each of these trophic groups includes insects that play various functional roles, thus constituting key organisms at different trophic levels (Koricheva *et al.,* 2000; Haddad *et al.,* 2009). This distribution takes into consideration the diet type of adult states although it is important to note that in nature there is no absolute trophic specialization (Beaumont and Cassier, 1983).

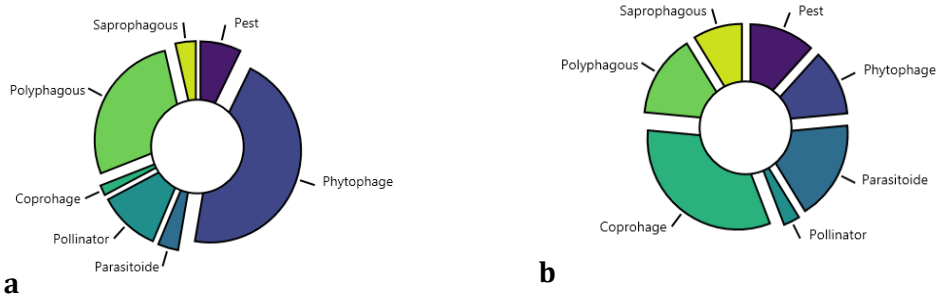

Figure 3. Trophic guild of collected species under **a.** Ouled Djellel and **b.** Feliache palm grove

We have to notice that the rate of predatory species exceeds that of pest and phytophagous species under palm groves (Ouled Djellal, Feliache), that shows a certain ecological balance and indicated that pest species are well controlled.

Contrary to the results obtained during our study, the importance of phytophagous group has always been pointed out by the authors who have worked under oasis ecosystem (Benameur-Saggou, 2009; Achoura and Belhamra, 2010; Deghiche Diab, 2015; Deghiche-Diab, 2020).

Indication of new recorded species

In general, because insect species have relatively short life cycles, high reproductive capacity and high degree of mobility, the physiological responses to warming temperatures can produce large and rapid effects on species population dynamics. We see a clear link between warm climate conditions and some recent large-scale insect outbreak events.

The Coleoptera order may contain the largest number of described species of any insect (Aberlenc, 2021). Their species play an important ecological role (Deghiche-Diab and Belhamra, 2019). They are characterized by a diversified way of life (Leraut, 2003; Leraut, 2008; Bardgett and Van Der Putten, 2014) and perform important functions in different ecosystem (Yamada *et al.,* 2007; Almeida and Louzada, 2009; Lee and Albajes, 2016). Species belonging to this order are well adapted to the conditions of oasis ecosystem (Deghiche-Diab, 2020). Ladybirds beetles belonging to the family Coccinellidae, Order Coleoptera, play an important role in pest control (Omkar and Pervez, 2016). In addition to the list of species established by authors working under oasis ecosystem (Saharaoui and Gourreau, 1998; Saharaoui *et al*., 2014; Saharaoui, 2017; Boukhlouf, 2018; Deghiche-Diab and Belhamra, 2019) we added two new records belonging to the Coccinellidae family.

Scymnus frontalis (Fabricius, 1787)

A single individual of beetle Scymnus frontalis (Fig. 4a) was collected from a trap set at Feliache palm grove (46 ° 5'21.08''E 49 ° 34'35.24''N, 85m a.s.l), a modern cultivation of date palm that groups over 80 cultivars of dattes planted sing 1995. It is a predatory species, that feeds on Aphids in oasis ecosystems. From Iran, the genus was reviewed by Katayoun Pahlavan *et al.* (2018) and indicated a description of new species that was also confirmed later by Abdolahi *et al*. (2018). In Algeria, the genus was listed by Saharaoui and Gourreau (1998); Saharaoui (2017) and Saharaoui *et al.* (2014) in their study on the Coccinillidae family, but without indication of the presence of the same species. It should be noted that this species does not appear also in the most complete recent list established for Algerian wild and domestic fauna (Belhamra *et al.,* 2020, Aouissi *et al.,* 2021).

Diomus zinon (González and Honour, 2011)

During winter season (February) another Coccinellidae, Diomus zinon (Fig. 4b) species was also observed at the Feliache palm grove (46 ° 5'21.08''E 49 ° 34'35.24''N, 85m a.s.l) where three specimens were collected from pitfall traps. The genus was first described as a subgenus of Scymnus (Mulsant, 1850) than Weise (1895) described it as separate genus. Their prey include aphids, mealybugs, scale insects, and whiteflies, with a distinct feeding preference for the family Pseudococcidae (Albéryca *et al.,* 2020).

From Austria, it was described for the first time by Pang and Slipinski (2009); from South America, later by González and Honour (2011) and recently from Spain by Albéryca *et al.* (2020). In Algeria, the species have not been listed before in any work from the same region (Saharaoui, 2017 and Saharaoui *et al.*, 2014) or from other ecosystems.

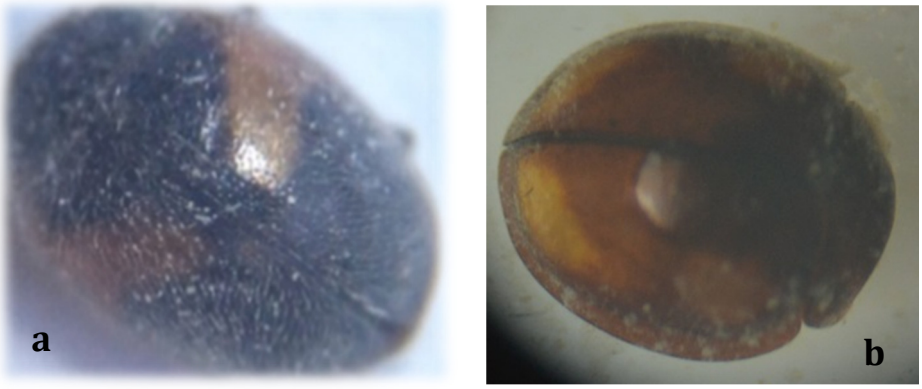

Figure 4. **a.** Adults of *Scymnus frontalis* and **b.** *Diomus zinon*

Conclusions

In order to have an updated state of arthropods species present in oasis ecosystems, an inventory was carried out at two palm groves. The first palm grove was chose in the wilaya of Biskra represented by the living collection at Feliache municipality. The second one is an old palm grove from the wilaya of Ouled Djellel at the Ouled Djellal oasis. The established list indicated the importance of insects' species mainly represented by the Coleoptera order that their species are well adapted to the arid areas conditions.

Two new species; *Scymnus frontalis* and *Diomus zenon* were observed for the first time in oasis ecosystems, by this observation the number of predatory species increase the list of biological agents that can help to maintain the stability of oasis ecosystem and the application of an Integrated Pest Managment program (IPM).

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