JEE Journal of Ecological Engineering

Journal of Ecological Engineering 2022, 23(1), 252–263
https://doi.org/10.12911/22998993/143907
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Received: 2021.10.22
Accepted: 2021.11.15
Published: 2021.12.01

Biological and Ecological Traits of Terrestrial Arthropods (Arthropoda: Insecta) in North-West Morocco

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ABSTRACT

In order to understand the relationship between the biological characteristics of insects and their environment, an entomological study was conducted at 5 stations (agricultural and natural) in the region of northwest Morocco (Sidi Kacem) between March 2019 and September 2020. Three sampling techniques were used (sweep nets, pitfall traps, and sight hunting). The inventory of insect species captured by these different methods in the various stations reveals the presence of 105 species distributed among 7 orders belonging to 35 families. According to the results, the presented adaptive parameters such as diet, flying ability, body size, and humidity sensitivity of the species showed that predators, macropterous, small size, and hygrophilic species are more frequent.

Keywords: bioecological traits, trophic diet, mobility, hygrophilic, fields, natural environments, Morocco

INTRODUCTION

Bio-ecological traits represent all the biological characteristics of species and their relationships with the environment (Archaimbault et al., 2010). They directly reflect the qualitative and quantitative information associated with the biology of organisms and their relationships with the ecosystem. This information is very useful for studying to identify the impact of pollution on the populations of indicator species such as macro-invertebrates (Archaimbault et al., 2010). Hence, they make it possible to assess the bio-ecological quality of the ecosystem and to predict the ecological evolution of a natural or semi-natural environment or an environment modified by human presence (anthropized) which are subjected to disturbances or detect the latter via the appearance or disappearance of one or more species (Fumanal, 2007). The organisms can then be considered as true witnesses of their environment (Usseglio, 1997). Knowledge of the composition and structure of communities (faunistic or floristic lists), as well as the bio-ecological characteristics (ecological traits) of the species, should then make it possible to obtain the indications of the mesological and functional characteristics of the ecosystem studied (Southwood, 1977, Vannote et al.,1980). This subsequently leads to the information on the nature and intensity of the changes in the habitats subject to human pressures (Charvet et al., 1998; Dolédec et al., 1999). Ecological traits are described by the variables characterizing the affinities of a taxon, such as habitat characteristics, trophic diet, and biotic or abiotic conditions that play a fundamental role in the organization of terrestrial communities. These state that the distribution of species is strongly related to the frequency of ecosystem disturbances that modify resources, habitat availability, and the environment (Archaimbault et al., 2010). The traits chosen for this study are: species dispersal power (number of species able or unable to fly) (macropterous, brachypterous, and apterous), trophic diet (predators, phytophagous, coprophagous, necrophagous, and polyphagous), body size (small, medium and large), and requirement for humidity (xerophilic, hygrophilic and mesophilic).

The study aimed to make a comparison between the cultivated and natural areas and to determine how the ecological and biological factors can influence the species assemblages. These results will provide the information on the status and ecological quality (disturbance or stability) of the ecosystems in the study area.

MATERIAL AND METHODS

Study area

The study covered 5 stations in the region of Sidi Kacem (34°13′00″ north, 5°42′00″ west) located in the north-west of Morocco (Fig. 1). The region is characterized by a semi-arid climate, the temperature in autumn goes down to 6°C while in summer it can exceed 40°C. The majority of precipitation occurs from the end of September to the end of May with a probability of daily precipitation above 13% (MERRA-2, 2016).

Station 1: 34°12’35.5”N – 5°42’31.8”W. Located at the southeast of the entrance of the city of Sidi Kacem. It is a field of *Vicia faba L*. beans (Fabaceae), characterized by silty clay soil.

Station 2: 34°14’41.5”N – 5°42’14.9”W. Located at 2.5 km from station 1; this is a field of cereal crops: soft wheat: *Triticum aestivum L*. (Poaceae), characterized by silty clay soil.

Station 3: 34°13’50.5”N – 5°42’14.7”W. Located 3 km from station 2; this is a natural steppe. The plant species that dominate the area are *Nicotiana glauca* (Solanaceae), *Ferula communis* (Apiaceae), *Cynara humilis L* (Asteraceae), and *Ammi visnaga* (Apiaceae). It is characterized by silty clayey soil.

Station 4: 34°15’19.1”N – 5°44’01.3”W. Located 3 km from station 2, this is an alfalfa *Medicago sativa L*. (Fabaceae) field and a wasteland dominated mainly by *Dittrichia viscosa L* (Asteraceae). The station is characterized by sandy clay loamy soil.

Station 5: 34°11’12.5”N – 5°42’32.8”W. Located at 2.5 km from station 1, this is a matorral, characterized by clay soil. The plant species that dominate the area are *Chamaerops humilis L*. (Arecaceae), *Eucalyptus sp* (Myrtaceae), *Olea europaea* L (Oleaceae), and *Opuntia ficus-indica L. Mill* (Cactaceae).

Insect Sampling

In order to understand the relationship between the biological characteristics of the species as well as their relations with the environment, insect sampling was carried out from March 2019 to September 2020. Three sampling techniques were used: barber traps, consisting of pots with the diameter of 10 cm diameter and height of 17 cm; each pot was buried vertically so that the opening corresponded to the ground level.

Fig. 1. Geographic location and sampling location of the study area

The soil was then packed around the opening to avoid the barrier effect on small arthropod species (Benkhellil, 1991). Sight hunting consists in searching for all the fauna that can be observed by the eye for 30 to 45 min. Finally, mowing vegetations with sweep nets allows the collection of individuals present in the vegetation with a net (Benkhellil, 1991). The data on diet, flying ability, and requirement for the humidity of the species were obtained from the following works: (Bedel, 1895), (Jeannel,1941,1942), (Antoine 1955–1961) (Larochelle, 1990) and (Larochelle and Larivière, 2003).

RESULTS AND DISCUSSION

Faunistic inventory

The study of the composition of the population revealed the existence of 105 species divided into 7 orders belonging to 35 families. According to the results, predators, macropterous, hygrophilic, and small species are more frequent. The ground beetles were the most abundant and diverse insects captured on the ground, which is consistent with the findings reported by (Kromp, 1999; Holland and Reynolds, 2003; Letourneau et al., 2011) in other crops (Table 1).

Trophic diet

Global and stationary distribution of species in the different biotopes

According to the trophic diet, insects are divided into five groups: predators, phytophagous, coprophagous, necrophagous, and polyphagous (Table 1). The number of predator species is the highest in all stations. Thus, the results showed that these species constitute 41% of the global insect population. Phytophagous species occupy the second place with 34%, polyphagous species the 3rd place with 16%, necrophagous species correspond to 6%, while coprophagous species represent only 3% of the stand (Fig. 2).

The predator species are also dominant at each station (Fig. 3). Among the predator species harvested, the following are cited: *Licinus punctatulus*, a predator of gastropods (Larochelle, 1990), and *Calathus circumseptus* which is a predator of cereal aphids, caterpillars, and ants (Cosim, 2011). This study was also able to show that at stations 1, 2, 3, and 4, the proportions of predators and phytophagous species are remarkably close, because at these four stations, herbaceous environments were chosen with a high density of plant covers.

In contrast, station 5 has a poor vegetation cover density, resulting in a low proportion of phytophagous species (Fig. 3). This is probably due to the type of soil (clay soil) which is compact, making it difficult for the circulation of air, water, and the propagation of roots, thus leading to the installation of a low plant and animal density. According to Letourneau et al., (2011) and Soliveres et al., (2016), the presence of insects is generally positively correlated with the abundance and diversity of vegetation. The polyphagous species were in 3rd place in the five stations. The coprophagous and necrophagous species are only represented by small percentages in all study stations.

The majority of species are predators, which can therefore display a significant role in biological control. Carabid beetles, in particular, are considered an ecologically important family of natural enemies of pests (Kromp, 1999) and key players in biocontrol in agroecosystems (Ågren et al., 2012). Most carabids are predators; both larval and adult forms can feed on such pests as lepidopteran larvae, aphids, and slugs. Some species can also feed on leaves, seeds, fruits, and fungi (Lövei and Sunderland, 1996). This dominance of predators can be explained by the fact that the stations (1,2,3 and 4) are herbaceous formations constituting open environments, which favor the presence of predator species (Rouabah et al., 2015). According to Melnychuck et al., 2003, predator diversity tends also to be higher under an herbaceous cover. The presence of predatory species in station 5 is probably related to the proximity of *Eucalyptus* and *Olea europaea* trees. The obtained findings share similarities with a previous work which found that arthropod predators were significantly more abundant in the proximity of trees (Dix and Baxendale, 1997; Schirmel et al., 2014). Trees provide food resources and shelter for a diverse set of species (Siitonen and Ranius, 2015) including arthropod predators (Pilskog et al., 2016).

The presence of the phytophagous species, which comes 2nd to predators, was certainly related to the density of the vegetation cover at stations 1, 2, 3, and 4, which includes adventitious species, serving as hosts for the phytophagous

Table 1. List of species harvested at the 5 stations in 2019 and 2020

Order	Family	Taxonomy	S1	S2	S3	S4	S5
Coleoptera	Carabidae	*Brachinus crepitans Linnaeus, 1758*	–	+	+	+	–
		Brachinus efflans Dejean, 1830	–	+	+	–	–
		Brachinus immaculicornis Dejean, 1826	–	+	+	–	–
		Brachinus angustatus Dejean, 1831	–	–	+	–	–
		Chlaenius decipien L. Dufour, 1820	–	+	+	–	–
		Pterostichus ebenus Quensel, 1806	+	+	+	+	+
		Pterostichus elongatus Duftschmid, 1812	–	+	+	–	–
		Chlaenius chrysocephalus P. Rossi, 1790	+	+	+	–	–
		Chlaenius cyaneus Brullé, 1835	–	–	+	–	–
		Chlaeniellus olivieri Crotch, 1871	–	–	+	–	–
		Carabus rugorus rugorus Fabricius, 1775	+	+	+	–	–
		Licinus punctatulus Fabricius, 1792	+	+	+	+	–
		Graniger cordicollis Audinet–Serville, 1821	+	+	+	–	–
		Calathus circumseptus Germar, 1823	+	+	+	–	–
		Scybalicus oblongiusculus Dejean, 1829	+	+	+	–	–
		laemostenus complanatus Dejean, 1828	–	–	+	–	–
		Odontocarus cephalotes Dejean, 1826	–	+	+	–	–
		Ditomus tricuspidatus Fabricius, 1792	–	+	+	–	–
		Demetrias atricapillus Linnaeus, 1758	+	–	–	–	–
		Carterus interceptus Dejean and Boisduval,1829	–	+	–	–	–
		Carterus dama P. Rossi, 1792	–	+	–	–	–
		Siagona rufipes Fabricius, 1792	–	+	–	–	–
		Siagona dejeani Rambur, 1838	–	+	–	–	–
		Parophonus hispanus Rambur, 1838	–	–	+	–	–
		Poecilus decipiens Waltl, 1835	–	+	–	–	–
		Scarites terricola Bonelli, 1813	+	+	–	–	–
		Dixus clypeatus P. Rossi, 1790	–	+	–	–	–
		Dixus sphaerocephalus Olivier, 1795	–	+	–	–	+
		Acinopus sabulosus Fabricius, 1792	–	+	+	+	+
		Harpalus neglectus Audinet–Serville, 1821	–	–	+	–	–
		Poecilus purpurascens Dejean, 1828	+	+	+	–	–
		Tschitscherinellus cordatus Dejean, 1825	+	–	+	–	–
		Distichus planus Bonelli, 1813	+	–	–	–	–
	Tenebrionidae	*Pachychila salzmanni Solier, 1835*	+	+	+	+	+
		Dendarus pectoralis Mulsant and Rey, 1854	+	+	+	+	–
		Gastrhaema rufiventris Waltl, 1835	–	+	+	+	–
	Scarabaeidae	*Oxythyrea funesta Poda, 1761*	+	+	+	+	–
		Aethiessa floralis Fabricius, 1787	–	–	+	+	+
		Gymnopleurus sturmi MacLeay, 1821	+	–	+	+	–
		Gymnopleurus flagellatuss Fabricius, 1787	+	–	+	+	+
	Coccinellidae	*Coccinella septempunctata Linnaeus, 1758*	+	+	+	+	–
		Hippodamia variegata Goeze, 1777	–	+	+	–	–
	Staphylinidae	*Ocypus aethiops Waltl, 1835*	–	+	+	–	–
		Ocypus olens O. F. Müller, 1764	–	+	+	–	–
		Philonthus laminatus Creutzer, 1799	–	–	+	–	–
	Cantharidae	*Cantharis coronata Gyllenhal, 1808*	+	+	+	–	–
		Rhagonycha fulva Scopoli, 1763	+	+	+	–	–
	Chrysomelidae	*Chrysolina bankii Fabricius, 1775*	+	+	+	+	–
		Chrysolina diluta Germar, 1823	–	–	+	–	–
		Chrysolina affinis Fabricius, 1787	–	+	+	–	–
		Lachnaia vicina Lacordaire, 1848	+	–	+	–	–
	Curculionidae	*Lixus pulverulentus Scopoli, 1763*	+	+	–	–	–
	Silphidae	*Thanatophilus ruficornis Küster, 1851*	+	+	+	+	–
		Thanatophilus sinuatus Fabricius, 1775	+	+	+	–	–
		Silpha tristis Illiger, 1798	+	+	+	+	–
		Silpha olivieri Bedel, 1887	+	+	+	–	–
		Silpha puncticollis Lucas, 1846	+	+	+	–	–
	Oedemeridae	*Oedemera simplex Linnaeus, 1767*	+	–	–	–	–
	Malachiidae	*Malachius lusitanicus Erichson, 1840*	–	+	+	–	–
		Charopus rotundatus Erichson, 1840	–	+	+	–	–
	Meloidae	*Lagorina sericea Waltl, 1835*	–	–	+	–	–
	Dermestidae	*Dermestes frischii Kugelann, 1792*	–	–	+	–	–
	Dasytidae	*Psilothrix viridicoerulae Geoffroy, 1785*	–	–	+	–	–
		Dasytes terminalis Jacquelin du Val, 1863	–	+	+	–	–
		Lobonyx aeneus Fabricius, 1787	–	+	+	–	–

Table 1. Cont.

Order	Family	Taxonomy	S1	S2	S3	S4	S5
Hemiptera	Reduviidae	*Peirates stridulus Fabricius, 1787*	–	+	–	–	–
		Rhynocoris erythropus Linnaeus, 1767	–	–	+	+	+
		Oncocephalus pilicornis Reuter, 1882	–	–	+	–	–
	Pentatomidae	*Graphosoma lineatum Linnaeus, 1758*	–	–	+	–	–
		Carpocoris mediterraneus Tamanini, 1958	–	–	+	–	–
		Carpocoris fuscispinus Boheman,, 1850	–	–	+	+	–
		Piezodorus lituratus Fabricius, 1794	–	–	+	–	–
		Aelia acuminata Linnaeus, 1758	+	–	+	–	–
		Dolycoris baccarum Linneus, 1758	–	–	+	–	–
	Cercopidae	*Cercopis intermedia Kirschbaum, 1868*	+	+	–	–	–
	Scutelleridae	*Eurygaster austriaca Schrank, 1776*	–	+	+	–	–
	Alydidae	*Camptopus lateralis Germar, 1817*	–	+	–	–	–
	Lygaeidae	*Lygaeus equestris Linnaeus, 1758*	+	+	+	–	–
Orthoptera	Acrididae	*Heteracris annulosa Walker, 1870*	+	+	+	–	+
		Dociostaurus maroccanus Thunberg, 1815	+	–	+	–	+
		Aiolopus strepens Latreille, 1804	+	–	+	+	–
	Gryllidae	*Gryllus bimaculatus De Geer, 1773*	+	–	+	–	–
		Gryllus campestris Linnaeus, 1758	–	–	+	–	–
		Nemobius sylvestris Bosc, 1792	–	–	+	–	–
Lepidoptera	Nymphalidae	*Anthocharis belia Linnaeus, 1767*	–	–	+	–	–
		Danaus chrysippus Linnaeus, 1758	–	+	+	+	–
	Pieridae	*Pieris brassicae Linnaeus, 1758*	–	–	+	–	–
		Pieris rapae Linnaeus, 1758	+	+	+	–	+
		Vanessa cardui Linnaeus, 1758	–	–	+	–	–
Hymenoptera	Apidae	*Xylocopa pubescens Spinola, 1838*	+	+	+	+	+
		Apis mellifica Linnaeus, 1758	+	+	+	+	+
	Vespidae	*Polistes dominula Latreille, 1802*	+	+	+	+	–
	Andrenidae	*Andrena sp*	+	+	+	+	+
Odonata	Coenagrionidae	*Ischnura graellsii Rambur, 1842*	–	–	+	–	–
	Libellulidae	*Sympetrum fonscolombii Selys, 1840*	–	+	+	–	+
		Trithemis annulate Palisot de Beauvois, 1807	+	+	+	+	+
		Trithemis kirbyi Selys, 1891	–	+	+	–	+
		Crocothemis erythraea Brullé, 1832	+	–	+	+	–
Diptera	Muscidae	*Neomyia cornicina Fabricius, 1781*	–	–	–	+	–
	Stratiomyinae	*Stratiomys cenisia Meigen, 1822*	–	–	–	+	–
		Nemotelus pantherinus Linnaeus, 1758	–	+	–	–	–
	Tabanidae	*Tabanus eggeri Schiner, 1868*	–	–	–	+	–
	Tephritidae	*Terellia virens Loew, 1846*	–	–	+	–	–
	Syrphidae	*Eristalis arbustorum Linnaeus, 1758*	–	–	–	+	–
	Asilidae	*Choerades sp.*	–	+	–	–	–
7	35	105	43	63	83	28	16

Note: (+) Present (–) Absent.

insects. Indeed, several authors reported the beneficial effects of vegetation cover on the diversity and presence of phytophagous insects (Mullen et al., 2008; Samu, 2003).

A positive association between phytodiversity and both diversity and abundance of phytophagous arthropods has been also found in a variety of ecological experiments (Mulder et al., 1999; Scherber et al., 2010; Borer et al., 2012). It is important to note that phytophagous species can play an important role in the reduction of weeds. Among the phytophagous species, one can mention, for example, *Dixus sphaerocephalus, Aiolopus strepens,* and *Andrena sp*.

Polyphagous species are both predatory and phytophagous. They can contribute to the regulation of populations of insect pests and the reduction of weeds. However, the low percentage of polyphagous species can be considered an indication of the stability of the five biotopes, as these species are often found in the most disturbed habitats (Brandmayr et al., 2005).

Sensitivity of species to humidity

Global and stationary distribution of species in the different biotopes

Hygrophilous species represent the highest percentage (55%) of all species (Fig. 4). Xerophilic species are in 2nd place (27%), followed by mesophilic species (18%). Hygrophilous species dominate in stations 1, 2, 3, and 4 with rates

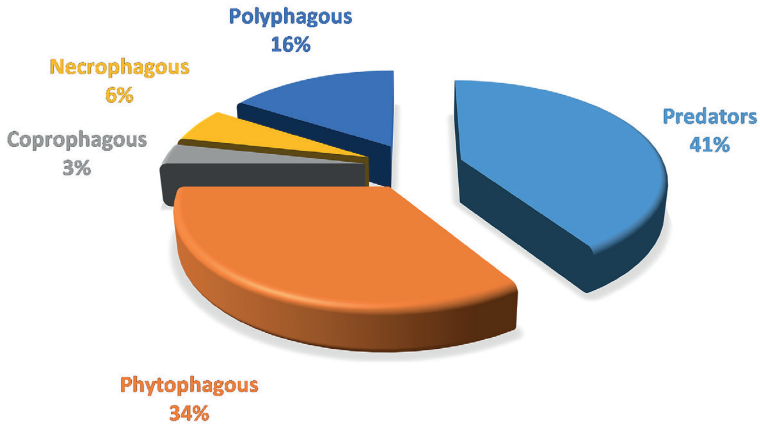

Fig. 2. Proportion global of predators,phytophagous, coprophagous, necrophagous and polyphagous species

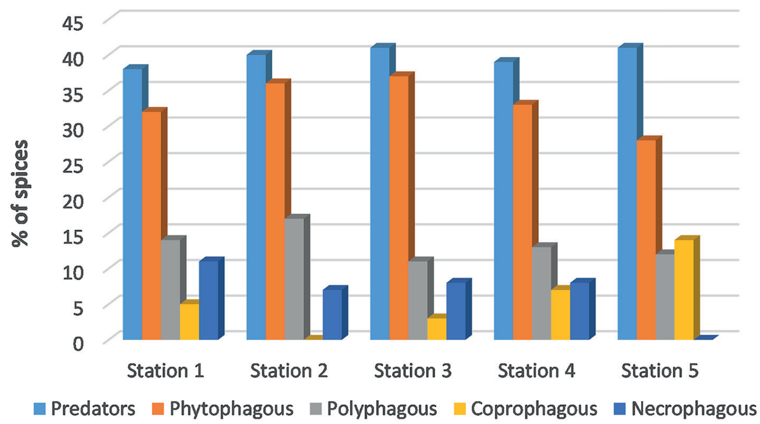

Fig. 3. Distribution of insect populations according to their diet (predators, phytophagous, coprophagous, necrophagous and polyphagous) at the five stations

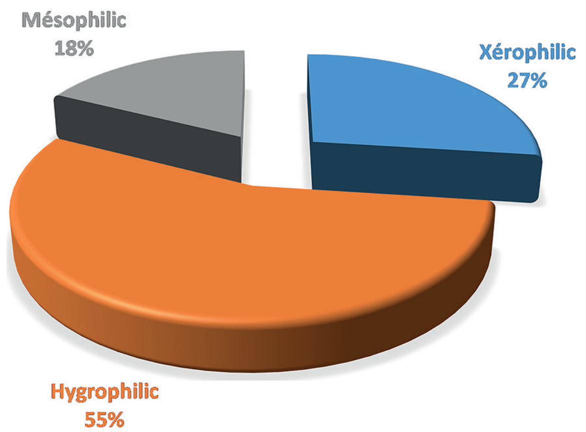

Fig. 4. Proportion global of xerophilic, hygrophilic and mesophilic species

of 54%, 57%, 58%, and 56% of the total population, respectively. Among these, there are *Poecilus purpurascens, Distichus planus* and *Trichochlaenius chrysocephalus.* Figure 5 shows that a low presence of hygroplilic species was noted in station 5. This can be explained by poor vegetation density, this loss of vegetation causes a change in hygrothermal conditions at ground level, leading to the segmentation of xerophilic species with a rate of 56% (Petremand, 2015). According to Nagumanova (2007), xerophilous species are dominant in the dry steppes with a low density of vegetation.

The dominance of hygrophilic species in the biotopes (stations 1, 2, 3, and 4) is linked with dense vegetation cover and weather conditions (rainfall at the order of 500 mm), which favor the establishment of rich and abundant vegetation (Lessel et al., 2011; Magura et al., 2003). Several studies have shown that the distribution of hygrophilic species, especially beetles, is strongly linked to the density of the vegetation cover (Kotze et al., 2011; Lessel et al., 2011). When vegetation density is high, the soil humidity content remains high for a long period which contributes to the abundance of these species (Cardwell et al., 1994; Rouabah et al., 2015). Nagumanova (2007), has made the same observation while studying invertebrates in the Ural steppe, it has found that the abundance of hygrophilic

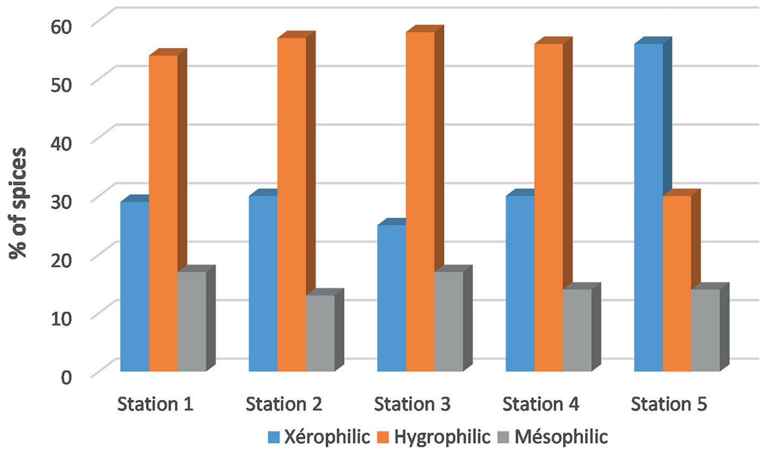

Fig. 5. Proportion of xerophilic, hygrophilic and mesophilic species at the five stations

invertebrates is greatly reduced by the decrease in humidity. The amount of humidity is an important factor for invertebrates at all stages of their development (Nepstad et al., 2002). According to Andrew et al. (2013), humidity is one of the main factors to be measured when studying the effect of climate change on insects.

Dispersal power of the beetle fauna

Global and stationary distribution of species in the different biotopes

The global beetle population is dominated by macropterous species (74% of total species), the apterous species are represented by 15%. In turn, brachypterous species correspond to only 11% (Fig. 6). The study focused only on the order of the beetles. Most species in other orders are macropterous. The five stations are characterized by a strong dominance of macropterous species, with a rate between 78% and 67%. Among these there are: *Pterostichus elongatus, Licinus punctatulus* and *Poecilus purpurascens*. Concerning apterous species, they are between 16% (station 1) & 13% (station 2) e.g., *Pterostichus ebenus, Graniger cordicollis, Calathus circumseptus,* and *Siagona rufipes*. Brachypterous species are least common with 9% (stations 1,2 & 4), 19% (station 3) & 18% (station 5) e.g., *Carabus rugosus rugosus, Poecilus decipiens* and *Chrysolina bankii.*

In terms of dispersal power, macropterous species dominate in all five biotopes, with lower percentages of macropterous species in stations 3 and 5 compared to the cultivated stations. This is probably because these two biotopes are the least disturbed. Macropterous species are often associated with open habitats such as certain natural environments or field edges (Dajoz, 2002; Döring and Kromp, 2003). It is often found in disturbed habitats (Gerisch, 2011; Ribera et al., 2001). These species can migrate between crops and border areas and exploit their temporarily abundant resources which take refuge during disturbances in these biotopes (Hedde et al., 2015). According to Ribera et al., (2001), Gobbi and Fontaneto, (2008), the species in perturbed habitats face an elevated risk of local extinction and the ability to relocate by flight to new favorable patches when resource availability suddenly changes is essential to survival (Fig. 7).

The relatively low rate of brachypterous species at the stations may be related to environmental disturbances. The stability of a habitat promotes the presence of brachypterous species (Gutierrez and Menendez, 1997; Šeric and Durbešic, 2009). These species are found in particular in closed environments, which are considered stable habitats (Gobbi and Fontaneto, 2008). However, the presence of these species in cultivated stations confirms that agricultural habitats could contribute to the persistence of individuals with low dispersal ability in intensive agroecosystems (Brandmayr et al., 2005; Cardarelli and Bogliani, 2014).

Variation of the size of species

Global and stationary distribution of species in the different biotopes

Concerning body size, it was found that small size is the most presented 57% (Fig. 8). Medium size species are in the 2nd place (27%), while the larger species represented 16%. Figure 9 shows

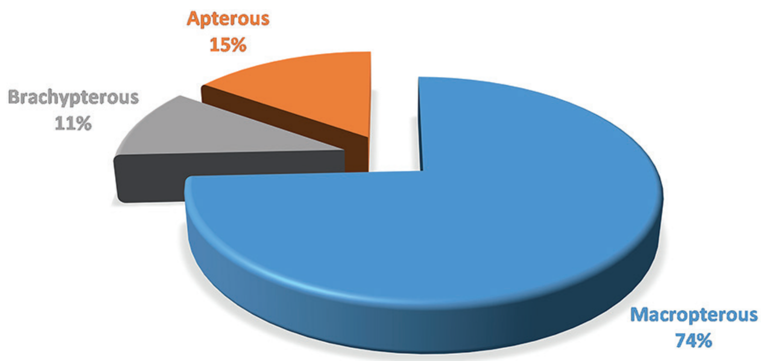

Fig. 6. Proportion global of macropterous, brachypterous and apterous species

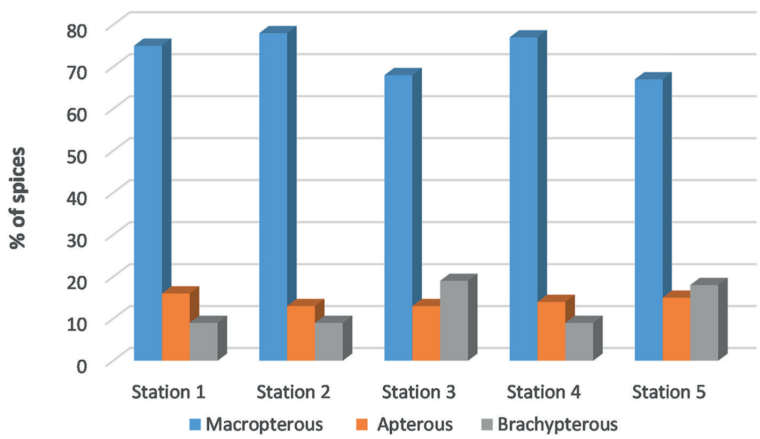

Fig. 7. Proportion of macropterous, brachypterous and apterous beetles at the five stations

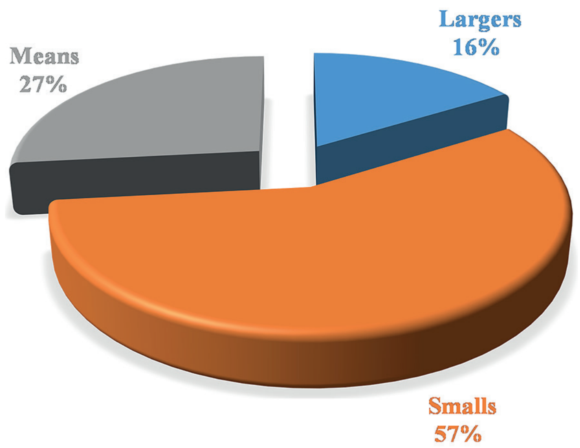

Fig. 8. Proportion global of smalls, means and larger species

the variation in the size, in station 1, small species are represented by (53% of total species), large species (17%). In turn, medium species represent (26%). In station 2, the small species presented by (54%), large species (19%), and medium species are represented by (27%). At station 3, large species represent the highest percentage (30%) compared to the other four biotopes, small species (45%) and medium species (25%). station 4, the presence of small species was noted by (53%), large species represent (18%) and medium species (25%). In station 5, small species represent (44%), larger species, (29%) and finally medium species (23%).

Concerning body size, large species are more common in less disturbed areas (station 3 and 5) and small species are more abundant in disturbed and open areas (station 1,2 and 4) (Aviron et al., 2005; Burel et al., 2004; Mullen et al., 2008). According to (Luff, 2002), larger body size can be

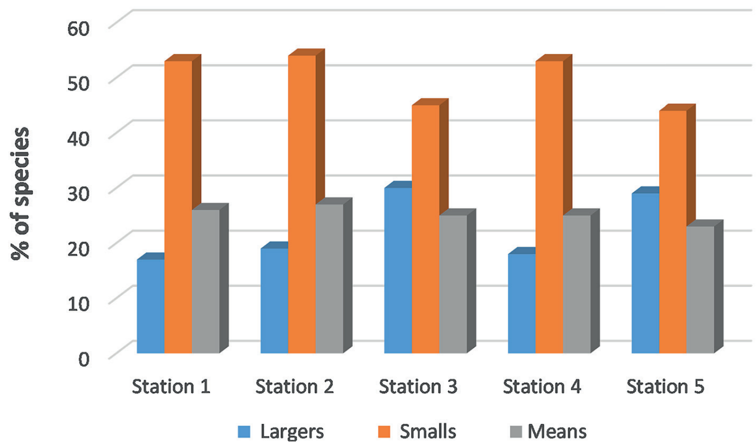

Fig. 9. Proportion of smalls, means and larger species at the five stations

considered an indicator of environmental quality. Some authors suggested that larger species are negatively associated with disturbed habitats (Ribera et al., 2001; Cole et al., 2002; Purtauf et al., 2005; Lövei and Magura, 2006).

The proportion of small species in stations (1, 2, and 4), can be related to the disturbance and anthropogenic factors (agricultural practices, fertilizer use, etc) in this biotope. These species are relatively tolerant of agricultural disturbance and maintain themselves well in open and intensively managed landscapes. In turn, large species probably have higher requirements than small species (Reiss et al., 2011). The relatively high percentages of large species recorded at stations 3 and 5 are explained by the fact that these two biotopes are the least disturbed of the five study stations. According to (Michael, 2011; Pakeman and Stockan, 2014), the body size is related to certain environmental stresses or disturbances. Large species are rare in disturbed environments, while small species are abandoned in disturbed environments (Schirmel et al., 2012). However, the abundance of some (large species) in the cultivated stations, is potential because this species can tolerate a wide range of environments (Lindroth and Bangsholt, 1985).

CONCLUSION

The study of the biological and ecological traits of species is significant in diagnosing the impact of environmental disturbances on species. The obtained results suggest that the analysis of terrestrial insect assemblages could be useful in landscape ecology studies to determine habitat stability or disturbance. It was shown that the diversity of predators (insects), particularly beetles, is an important component in cultivated fields. The approaches based on biological and ecological traits provide a general vision for assessing the risk of a disturbance at the ecosystem level. It is therefore important to continue the research in this direction to be able to identify the different types of disturbance present in ecosystems. New studies expanding the scope of terrestrial arthropod trait-based research will advance the knowledge in ecology. In conclusion, the authors propose that trait-based research will pave the way for a more robust understanding of the mechanisms structuring arthropod diversity across space and time.

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