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Different Response Patterns of Beetle Communities to Environmental Factors in Ramsar Wetland, West Algeria

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Abstract

An ecological study was carried out to estimate and measure the importance of environmental factors on the abundance, diversity and regularity of terrestrial beetle communities in the Ramsar wetland (Dayet El Ferd, Algeria). Samples were collected bimonthly for one year, with peripheral reference to the water point along the two transects. A micro-distribution and ecology have been tackled besides the degree of maturity of the wetland are discussed. On the basis of 432 samples and 12341 depicted diverse specimens, 221 species belonging to the Adephaga and Polyphaga equally, have been identified, grouped in 30 families, 71 subfamilies with a net dominance of Carabidae. Bagous argillaceus (Gyllenhall, 1836), Calomera lunulata (Fabricious, 1741) and Morica favieri (Lucas, 1859) were abundant, accounting for 18% of the global fauna; a large number of rare taxa (= present in at least 10 individuals) were found. The diversity and regularity of these communities generate a positive correlation of great importance according to a certain rate of organic matter present in the soil. Maximum diversity is found at the highest levels, while regularity is mainly found at intermediate levels.

Keywords: *Beetle, Ramsar wetland, biodiversity, micro-distribution, Algeria*

1. Introduction

In the northwest of Algeria, particularly the south region, Tlemcen has a wetland of 3,323 hectares. This area was classified as a Ramsar site on the 12th of December 2004 and is of significant interest as it is part of an international organization protecting such zones. It's important to protect the area's biodiversity. And we need to pay special attention to the Beetles here. They face many environmental challenges, so we need to take strict measures to preserve them.

This order of Beetles is the richest on the planet, and it's the most important part of the biodiversity (Hammond, 1992; Daly et al., 1998; Odegaard, 2000). This fauna includes many rare species whose populations are widely dispersed and/or fragmented. (Williams, 2002) whose populations are widely dispersed and/or fragmented, which makes them extremely important for biogeography and conservation (Gomez et al., 2005; Abellan et al., 2007). Beetles are often the most common species found in temporary humid habitats (Larson, 1985; Jeffries, 1994; Collinson et al., 1995). They indicate the overall characteristics and conservation quality of a region based on their distribution and ecology (Foster, 1991; Riberi and Foster, 1992). The insects in the West Algerian wetlands are relatively unknown. Recent research carried out by Boukli Hacene et al. from 2009 to 2014 has enabled us to gain a better understanding of the subject.

Research exploring factors affecting micro distribution and community structure is of fundamental interest within ecology. The initial study has several objectives, which include analyzing the composition of the Beetle communities in this protected wetland and determining the primary environmental factors

2. Materials and Methods

Study area

Dayet El Ferd is located in the north west of Algeria, it is limited to the North-West by Sidi El Djilali Mounts (Jebel Tenouchfi 1840m), the South-West by El Abed mounts (1450m), and to the South-East by El Gor mounts (Jebel Hariga, 1600m). it is located in the central part of the steppe zone of Wilaya of Tlemcen.

The study was conducted in the periphery of the pond of the wetland “Dayet El Ferd” near Belhadji Boucif Village (Tlemcen, 34°28’N and 1°15’ W). the yearly average precipitation do not exceed 200mm and there is a significant temperature variation, with minimum values ranging from minus 2.2 to 33.1. The dry period extends to six months with the drought index of 0.91 and the Emberger’s climatic stage is a of arid type with cold winter (Q = 18.13). These climatic conditions influence the water distribution, the flora, vegetal covert, edaphic factors and the assemblages of local fauna populations.

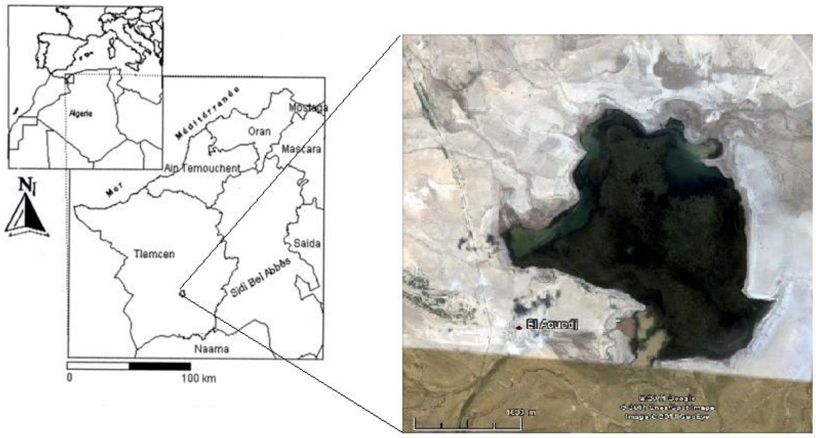

Figure 1. Geographical localization of the study site (from Google Earth)

Methods

The sampling is undertaken through two transects from its superior limits the periphery of the water spot. Each transect is subdivided into six parcels. Many potentially active factors upon this community were studied; it is about the distance from water, texture, residual humidity, salinity, pH, organic matter, vegetation strata and the flora recovering rate. The plots are is defined in six classes (10m, 30m, 60m, 90m, 120m and 150m) from the pond periphery. The pedological analyses are realized in a laboratory on the basis of 36 samples. The flora covert is visually estimated in five classes: 0%, 25%, 50%, 75%, and 100%.

The specimens are collected via interceptive traps and the direct collect by a mouth aspirator.

Three attractive traps and three Barber ones are placed in the plots of tree stratum, and only three Barber traps are set in the remaining plots. Identification was performed in accordance to the collaboration of P. PONEL from the biodiversity and ecology institute of Aix-Marseille.

Data base

The samples protocols of the Beetles are very differentiable according to the studies; the studied whereabout (forest, agro-system, etc) and the studied taxonomic rank in terms of sampled parcels, and number and types of placed traps. A special attention is highlighted concerning to the accuracy and solidity of our sampling method of the specific wealth and the sampling effort in terms of the total number of samples. Once the sampling effort has been assessed, this study will be followed by an analysis of community structures using an index study based on traditional descriptors. In addition to species richness (S), total number of individuals (N) and Simpson's index, four utility indices were used: Shannon's index (H'=-Σ(Ni/N) x log2(Ni/N)), Simpson's index, Parker's index and Hill's index. However, regularity or homogeneity was assessed using Piélou's equitability index (J=H'/log2(S)).

3. Results and Discussion

Fauna Composition and Biographical Considerations

A total of 12341 specimens dispersed in 30 families, 221 species were represented (Tab.1). The Polyphaga group dominates the Adephaga group with 77% in terms of taxonomic richness and abundance; it should also be noted that three species are ultra-dominant with 58%. Bagous argillaceus (Curculionidae) with 3232 individuals caught, i.e. 26.18% of the total number; Morica Favieri (Tenebrionidae) with 2894 individuals (23.45%), followed by Calomera Lunulata (Carabidae) with 1087 individuals (8.8%). The total abundance of the other 218 species does not exceed 41.55% and 38.46% of the total number of species are represented by 1 to 2 individuals.

In considering the works of Löbl and Smetana (2003,-2008), the captured Beetles community is essentially composed of palearctic species geographically widely scattered. However, the endemic species are represented at meager proportion (11%). There are 52 endemic Mediterranean species, including 28 that live exclusively in the Western Mediterranean, 10 from North Africa, 9 species endemic to the Maghreb and 5 from Algeria.

This work has also enriched the fauna of Algerian Coleoptera with thirteen new species reported for the first time (Table 1). *Aphodius lividus, Thanatophilus rugosus, Bembidion* (*Notaphemphanes*) *ephippium, Epuraea* (*Haptoncus*) *luteola, Carpophilus bipustulatus, Centorus* (*Centorus*) *procerus, Distichus planus* and *Sphenoptera* (*Deudora*) *rauca* are species that are found mainly in Europe and in Mediterranean bay. *Bembidion* (*Nega*) *ambiguum* and *Bembidiom* (*Peryphus*) *andreae* are essentially present in Mediterranean countries. *Zophosis errans* and *Morica Favieri* are Iberian species, and *Cymindis suturalis pseudosuturalis* are known and found only in Morocco.

Table 1: List of coleopteran species (Adephaga)

CARABIDAE (Latreille, 1802)
Calomera lunulata (Fabricius, 1781)
Lophyra flexuosa flexuosa (Fabricius, 1787)
Calosoma inquisitor (Linnaeus, 1758)
Siagona europaea europaea (Dejean, 1826)
Dyschirius chalybeus chalybeus (Putzeys, 1846)
Distichus planus (Bonelli, 1813)*
Apotomus rufithorax (Pecchioli, 1837)
Amara metallescens (Dejean, 1831)
Amara simplex (Dejean, 1828)
Amara sp
Zabrus distinctus (Lucas, 1842) ***
Bembidion andreae (Fabricius, 1787) *
Bembidion ambiguum (Dejean, 1831) *
Bembidion latiplaga mateui (Antoine, 1953) ***
Bembidion minimum (Fabricius, 1792)
Bembidion ephippium (Marsham, 1802) *
Bembidion varium (Olivier, 1795)
Pogonus chalceus viridanus (Dejean, 1828)
Pogonus luridipennis (Germar, 1823)
Acinopus megacephalus (P. Rossi, 1794)
Daptus vittatus (Fischer von Waldheim, 1823)
Harpalus tenebrosus (Dejean, 1829)
Harpalus lethierryi (Reiche, 1860) ***

Harpalus microthorax (Motschulsky, 1849)
Harpalus oblitus patruelis (Dejean, 1829)
Harpalus sp
Acupalpus elegans (Dejean, 1829)
Acupalpus maculatus (Schaum, 1860)
Anisodactylus virens winthemi (Dejean, 1831)
Ditomus sp
Ditomus sphaerocephalus (Olivier, 1795)
Calathus fuscipes algericus (Gautier des cottes, 1866) ***
Calathus mollis atticus (Gautier des cottes, 1867) •
Laemostenus algerinus algerinus (Gory, 1833)
Agonum marginatum (Linnaeus, 1758)
Chlaenius chrysocephalus (P. Rossi, 1790)
Chlaenius velutinus (Duftschmid, 1812)
Cymindis suturalis pseudosuturalis (Bedel, 1906) *
Cymindis setifeensis brevitarsis (Normand, 1933) **
Lebia trimaculata (Villers, 1789)
Microlestes corticalis (L. Dufour, 1820)
Microlestes sp
Philorhizus sp
Syntomus fuscomaculatus (Motschulsky, 1844)
Graphipterus exclamationis exclamationis (Fabricius, 1792) ***
Orthomus sp
Poecilus purpurascens purpurascens (Dejean, 1828)
Poecilus sp
Poecilus nitidus (Dejean, 1828)
Zuphium olens olens (P. Rossi, 1790)
CARABIDAE (Latreille, 1802)

New species, *Endemic of the western mediterranea, ** Endemic of North Africa, ***Endemic of Algeria

Table 1: List of coleopteran species (Polyphaga)

Helophoridae (Leach, 1815)	Scarabaeidae (Latreille, 1802)
Helophorus rufipes (Bosc, 1791) [203]	*Aphodius nanus* (Fairmaire, 1860)
Hydrophilidae (Latreille, 1802)	*Aphodius castaneus* (Illiger, 1803)
Berosus guttalis (Rey, 1883)	*Aphodius lividus* (Walckenaer, 1802)
Enochrus bicolor (Fabricius, 1792)	*Aphodius melanostictus* (Schmidt, 1840)
Histeridae (Gyllenhal, 1808)	*Aphodius sp*
Saprinus figuratus (Marseul, 1855)	*Pleurophorus caesus* (Creutzer, 1796)
Saprinus ornatus osiris (Marseul, 1862) •	*Gymnopleurus flagellatus* (Fabricius, 1787)
Saprinus semipunctatus (Fabricius, 1792)	*Gymnopleurus sturmii* (MacLeay, 1821)
Saprinus sp	*Bubas bubaloides* (janssens, 1938) •
Histeridae	*Onitis numida* (Laporte, 1840) •
Hydraenidae (Mulsant, 1844)	*Onthophagus andalusicus* (Waltl, 1835)
Ochthebius sp	*Onthophagus maki* (Illiger, 1803)
Silphidae (Latreille, 1807)	*Onthophagus aerarius* (Reitter, 1892) •
Silpha olivieri (Bedel, 1887)	*Onthophagus crocatus* (Mulsant & Godart, 1870)
Thanatophilus rugosus (Linnaeus, 1758)	*Onthophagus nebulosus* (Reiche, 1864) •
Thanatophilus sinuatus (Fabricius, 1775)	*Onthophagus taurus* (Schreber, 1759)
Staphylinidae (Latreille, 1802)	*Scarabaeus sacer* (Linnaeus, 1758)
Sepedophilus nigripennis (Stephens, 1832)	*Anthoplia floricola* (Fabricius, 1787)
Tachyporus sp	*Pentodon variolopunctatum* (Fairmaire, 1879) ***
Aleochara bipustulata (Linnaeus, 1760)	

Aleochara sp
Platystethus capito (Heer, 1839)
Platystethus cornutus (Gravenhorst, 1802)
Platystethus nitens (C.R.Sahlberg, 1832)
Anotylus inustus (Gravenhorst, 1806)
Bledius unicornis (Germar, 1825)
Carpelimus sp
Leptobium haemorrhoum (Erichson, 1840)
Achenium depressum haemorrhoidale (lucas, 1846) **
Stilicus sp
Paederinae
Philonthus sp1
Philonthus sp2
Quedius sp
Ocypus olens (O. M³ller, 1764)
Ocypus fortunatarum (Wollaston, 1871)
Xantholinus sp

Chrysomelidae (Latreille, 1802)
Bruchus sp
Cassida rubiginosa (O.F. Müller, 1776)
Cassida sp
Chrysomela luteocincta (Fairmaire, 1864) **
Chrysomela suturata (Fairmaire, 1873) •
Chrysolina lucidicollis (Küster, 1845)
Chrysolina bicolor (Fabricius, 1775)
Timarcha sp
Diorhabda elongata (Brullé, 1836)
Galeruca sp
Luperus flavipennis flavipennis (Lucas, 1849) ***
Longitarsus sp
Phyllotreta sp
Psylliodes sp
Chaetocnema sp1
Chaetocnema sp2
Lachnaia variolosa
Lachnaia vicina (Lacordaire, 1848)
Cryptocephalus sp
Stylosomus bipartitus (Fairmaire, 1867) **

Aethiessa floralis (Fabricius, 1787)
Tropinota squalida (Scopoli, 1783) •

Buprestidae (Leach, 1815)
Acmaeodera discoidea (Olivier, 1790)
Sphenoptera rauca (Fabricius, 1787)

Cerambycidae (Latreille, 1802)
Purpuricenus desfontainii (Fabricius, 1792)

Meloidae (Gyllenhal, 1810)
Berberomeloe majalis (Linnaeus, 1758)
Mylabris sp
Mylabris sp3
Meloe cavensis (Petagna, 1819)

Anthicidae (Latreille, 1819)
Anthicus tristis (W. L. E. Schmidt, 1842)
Anthicus sp
Anthicidae 1
Anthicidae 2
Anthicidae 3
Anthicidae 4
Anthicidae 5
Cordicollis instabilis (W. L. E. Schmidt, 1842)
Hirticollis quadriguttatus (Rossi, 1792)

Scraptiidae (Mulsant, 1856)
Anaspis sp

Throscidae (Laporte, 1840)
Trixagus sp

Elateridae (Leach, 1815)
Aeoloderma crucifer (Rossi, 1790)
Drasterius bimaculatus (Rossi, 1790)
Agriotes sp
Elateridae

Table 1: List of coleopteran species (Polyphaga) (continued)

Tenebrionidae (Latreille, 1802)
Centorus procerus (Mulsant, 1854)
Lagria sp
Adesmia sp
Morica favieri (Lucas, 1859)
Erodius sp
Pimelia sp
Sepidium Tricuspidatum multispinosum (Solier, 1844) ***
Pachychila sp
Tentyria sp

Latridiidae (Erichson, 1842)
Dienerella sp
Corticaria sp

Nanophyidae (Gistel, 1848)
Nanophyes sp

Ermestidae (Latreille, 1804)
Anthrenus sp
Attagenus sp
Dermestes undulatus (Brahm, 1790)
Dermestidae 1

Zophosis errans (Solier, 1834)
Alphitobius sp
Dilamus planicollis (Fairmaire, 1883) **
Gonocephalum sp
Hoplarion sp
Scaurus puncticollis (Solier, 1838)•
Crypticus sp
Phtora crenata (Germar, 1836)
Heliotaurus ruficollis (Fabricius, 1781)
Heliotaurus sp
Blaps sp1
Blaps sp2

Malachiidae (Fleming, 1821)
Attalus sp
Clanoptilus rufus (Olivier, 1790)

Nitidulidae (Latreille, 1802)
Carpophilus bipustulatus (Heer, 1841)
Carpophilus hemipterus (Linnaeus, 1758)
Carpophilus quadrisignatus (Erichson, 1843)
Urophorus humeralis (Fabricius, 1798)
Epuraea fuscicollis (Stephens, 1835)
Epuraea luteola (Erichson, 1843)
Meligethes sp

Phalacridae (Leach, 1815)
Olibrus sp

Cryptophagidae (Kirby, 1837)
Cryptophagus sp
Atomaria sp

Coccinellidae (Latreille, 1807)
Rhyzobius sp
Scymnini
Exochomus quadripustulata ericae (Crotch, 1874) ***
Adalia decempunctata (Linnaeus, 1758)
Coccinella algerica (Kovàr, 1977)

Henosepilachna argus (Geoffroy, 1785)

Dermestidae 2

Cleridae (Latreille, 1802)
Necrobinus defunctorum (Waltl, 1835)

Dasytidae (Laporte, 1840)
Psilothrix viridicoerulea (Geoffroy, 1785)
Psilothrix lustris (Wollaston, 1854)

Dryophthoridae (Schoenherr, 1825)
Sphenophorus meridionalis (Gyllenhal, 1838)

Apionidae (Schoenherr, 1823)
Apion longithorax (Debrochers des Loges, 1889)

Curculionidae (Latreille, 1802)
Baris sp
Baris spoliata (Dejean, 1821)
Bagous argillaceus (Gyllenhal, 1836)•
Bagous sp2
Coniocleonus excoriatus (Gyllenhal, 1834)
Coniocleonus nigrosuturatus (Goeze, 1777)
Conorhynchus conicirostris (Olivier, 1807)
Conorhynchus mendicus (Gyllenhal, 1834)
Lixus anguinus (Linnaeus, 1767)
Lixus ascanni (Linnaeus, 1767)
Gronops lunatus (Fabricius, 1775)
Gronops sp
Hypera fuscocinerea (Marsham, 1802)
Hypera sp
Pachytychius sp
Sibinia primita (Herbst, 1795)
Tychius sp
Smicronyx sp
Rhytidoderes plicatus (Olivier 1790)
Sitona intermedius (Küster, 1847)
Sitona sp1
Sitona sp2
Sitona sp3

Stenocarus fuliginosus (Marsham 1802)

New species, * Endemic of the Western Mediterranean, ** Endemic of North Africa, ***Endemic of Algeria

Environmental Variables

Table 2 illustrates the variations in the fifteen physical, physicochemical, and floristic factors examined on a plot-by-plot basis. The ANOVAs conducted emphasize the significance of changes in these parameters within and among plots. Generally, the ground surrounding the pond consists of sandy-silty to silty-sandy soil, with a neutral to slightly alkaline pH.

The humidity increases gradually throughout the different levels. Maximum conductivity and salinity are found in the intermediate levels P3 and P4, which represent the area where the water table tilts and saltwater rises by capillary action.

Vegetation cover occupies less than 50% of the total surface area, with Tamarix and a Poaceae dominating in the highest levels and a Caryophyllaceae in the intermediate levels.

The clay content values, with low proportions, show a gradual increase. Significant differences in PH were observed from one sample to another, with values ranging from 7.98 to 7.09. moisture showed a significant difference between the lowest and highest points. The organic matter values recorded were comparable along the moisture and salinity gradient, ranging from 3.06 to 1.93g/kg.

Table 2: General characteristics of 36 soil samples

S=Sands, L=Loams, A=tree stratum, H=grass stratum, Sn=sol nu, *T. gallica* =*Tamaris gallica*, *A.tenella*=*Airopsis tenella*, *H. hirsuta* = *Herniaria hirsuta*, *ns* =*p*>0,5=non significant

Characteristics	P1 n=6	P2 n=6	P3 n=6	P4 n=6	P5 n=6	P6 n=6	Aire d'étude n=36
Distanc of water spot (m)	0-20	21-50	51-70	71-100	101-130	> 130	/
Vertical drop (cm)	70	50	40	30	20	<10	0-70
Clays (%) p-value	7,33±4,22 ns	7,16±5,38 0,049	14,33±6,97 ns	16,17±6,55 ns	21±8,27 ns	22,83±7,49 ns	15,58±8,28 0,033
Loams (%) p-value	32,00±9,70 ns	28±9,61 ns	34,17±7,30 ns	37±9,50 ns	39,83±6,14 ns	48±4,64 ns	36,36±9,85 ns
Sands (%) p-value	53,33±4,80 ns	52,67±7,63 ns	47,17±11,50 ns	44,83±14,61 0,020	38,17±0,36 ns	28,83±8,20 ns	44,17±12,94 ns
Coarse sands (%) p-value	7,17±5,38 0,042	8,33±10,25 0,036	4,16±2,23 0,029	1,33±1,03 ns	0,83±0,75 ns	0,33±0,51 0,005	3,69±5,49 0,005
Texture	S-l	S-l	S-l	S-L	L-S	L-S	L-S
Humidity (%) p-value	1,14±0,54 ns	0,68±0,33 ns	1,53±0,78 ns	1,67±0,94 ns	2,12±0,63 0,019	1,92±0,39 ns	1,51±0,76 0,000
pH p-value	7,09±0,41 0,041	7,98±0,42 0,045	7,36±0,29 0,009	7,19±0,39 ns	7,38±0,21 0,018	7,13±0,30 ns	7,21±0,21 0,003
Conductivity ($mS.cm^{-1}$) p-value	0,02±0,007 ns	6,57±1,88 ns	6,49±1,13± 0,010	13,80±3,60 0,026	10,96±1,69 0,042	6,38±2,16 0,049	7,37±4,75 0,000
Salinity (g/l) p-value	0,15±0,04 0,049	4,12±1,26 ns	4,06±0,74 0,003	9,15±2,60 0,048	7,12±1,19 0,049	4,00±1,46 0,05	4,77±3,15 0,000
Organic matter (g/kg) p-value	2,74±0,62 ns	1,93±0,40 ns	1,95±0,29 ns	2,25±0,27 ns	2,86±0,46 ns	3,06±0,32 ns	2,47±0,59 0,03
Vegetation stratum	A	AH	H	H	Sn	Sn	AH
Vegetation cover (%)	90	80	40	25	0	0	45
Floristic richness	26	13	12	4	0	0	32
Dominant vegetal species	*T. gallica* *A. tenella*	*T. gallica*	*H. hirsuta*	*T.gallica nain* *H. hirsuta*	/	/	*T. gallica* *H. hirsuta*

Diversity and Spatial Structure

Calculation of the sampling effort, taking into account the number of samples on the cumulative species richness measurement, results in a curve whose model obeys a logarithmic equation y =

57.729 ln (x) - 104.4 (fig. 2). This equation indicates that the frequent species were well sampled and that few additional species would have been caught by increasing the number of samples. In addition, Chao's formula evaluates the expected total species richness at 260 species compared with 221 species observed. The sampling method used was therefore satisfactory, since it captured 85% of the community in terms of estimated total richness.

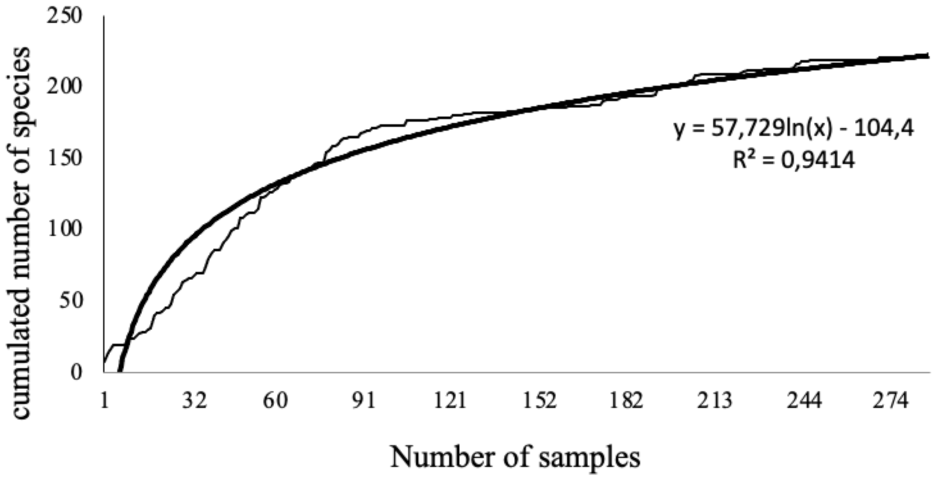

Figure 2: Species accumulation and rarefaction curve

Differences regarding species numbers and overall abundance percentages were noticed among the six plots (Tab. 3). Plot 1 contained the highest number of individuals, with 3164 catches, followed by plot 4 which had 2417 catches and surpassed the other four plots by a wide margin. The species richness shows a general downward trend with 139 species on plot 1, compared with plot 6, which appears to be specifically the poorest with 50 species caught (table 3). The high number of captures in plots 1 and 4 is certainly related to the presence of dominant species, whereas the species richness is justified by the heterogeneity of the station in terms of plant cover; the highest level P1 is mainly dominated by Tamarix and a dense, thick layer composed exclusively of Tamarix in levels 3 and 4, draining and thus reinforcing microclimatic conditions (temperature, hygrometry, etc.) favourable to the presence and activity of a large number of species. On the other hand, The plots 5 and 6, characterised as bare soils, recorded the lowest species richness.

The values of the two indexes of diversity of Shannon (H') and of Simpson (1-D) are respectively 2,88 and 0,861. The spatial evolution of the specific diversity shows a climax at the level of parcel (P3). The diversity index of Shannon oscillates between 1,56 and 3,025 bits, Simpson index (1-D) varies between 0,59 and 0,89, this witness for the bad structuring of the Beetles communities. The meager value of the observed diversity at the level of P1 and P2 is due to the dominance of one sole species (*Morica favieri* with more than 45%). The spatial evolution of the specific diversity has a shape similar to the one of equitability. These two parameters do not show a gradient but their spatial evolution is the same.

The Piélou index has a value of 0.53 for the overall population, yet there is variability between plots with values ranging from 0.4 (P6) to 0.65 (P3) (Table3).

The abundance of *Bagous argillaceus* and *Morica favieri* explains the communities' irregularity in the richest plots (P1 & P2). The abundance of individuals is best scattered for each species in the lawn plots with (*Tamarix*) compared to those without vegetation cover, endowed with high humidity and for plots at dominant tree stratum.

Table 3: Diversity Indicators

Specific richness S	139	108	105	88	80	50
Indicators	P1	P2	P3	P4	P5	P6
Number of individuals	3164	1582	1994	2417	1917	1267
Dominance D Simpson	0,27	0,16	0,10	0,20	0,33	0,40
Shannon index H'	2,35	2,88	3,02	2,37	2,00	1,56
Margalef index	17,12	14,53	13,69	11,17	10,45	6,85
Pielou Evenness index J'	0,477	0,61	0,65	0,5309	0,45	0,40

Highly significant positive correlations ($p<0.001$) were found between organic matter and diversity index: Shannon index ($r^2=0,88$), Simpson index (($r^2=0,93$) and Piélou eveness ($r^2=0,95$). The diversity of Beetles increases in the plots where the organic matter content exceeds 2,5g/kg (figure 3).

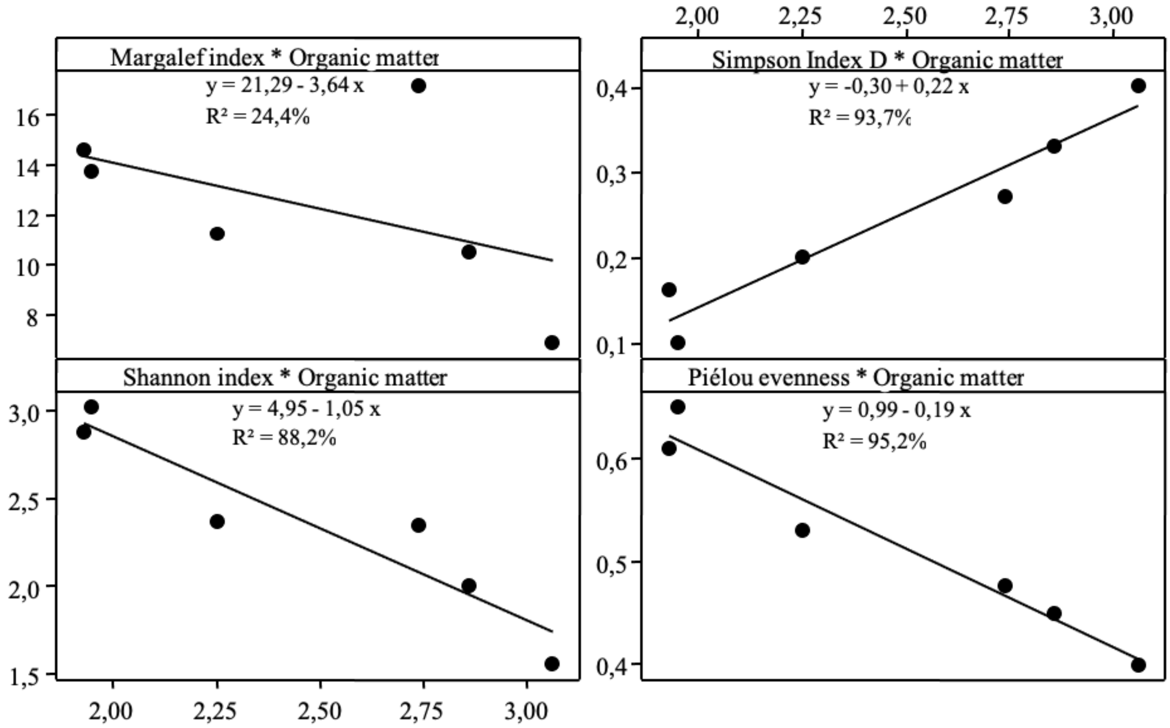

Figure 3: Regression relationships between indicators of diversity and organic matter.

The citation of a great number of identified species in this study dates back more than 100 years ago (Lucas, 1848; Fairemaire & Coquerel, 1866; Bedel, 1885).

The edaphic factors of wetlands located within the Algerian steppes consist of sandy and loamy-sandy textures (Ghezlaoui et al., 2011 and 2013). Salinity variations, PH, conductivity and humidity of the soil are signaled in the chott Zehrez de Djelfa (Algeria). The PH is neutral and slightly alkaline, does not exceed the value of 8 (Ghezlaoui et al., 2011 and 2013).

The humidity of the soil is relatively weak going from 7.66% in summer to 21.45% in winter. The rate of the organic matter is very feeble and does not exceed 1.2%. This is certainly explained by the meager vegetal covert (Merzouk et al, 2009). The floristic richness registered is slightly different from the one cited by Khaznadar et al., 2009 with 39 species and Ghezlaoui et al., 2013 with 43 species.

Compared to the depicted coleopteran fauna in the estuarian lagoon of Rechgoun (Boukli et al., 2011), the wetland of Dayet El Ferd seems to be richer in species with 221 taxons. The wet whereabouts are entomologically seen as being in very variable states (Borges, Meriguet and Zagatti, 2008). Many studies are interested has only one family seen the great diversity of this zoological group. The family of Carabidae is richest in terms of species, wherein Tenebrionidae the most numerous and directly outnumber the Curculionidae, which is known and common in steppic and presaharan zone, and the results are confirmed by the reference works (Turin et al, 2003).

Eyre and Lott (1996), count 441 terrestrial invertebrate species that reproduction is specific to the wet British habitats. Most of these species belong to two family Beetle predators; Carabidae and Staphylinidae and their percentage or frequency in the Beetle assemblages, is repeated in a wide range of tempered wetlands type (Kohler 1996; Lott 2001; Boukli Hacene et al., 2012). The study of six macro-intervertebrates group sampled in 30 ponds in the Leicestershire (UK), in 1999 has shown the existence of 93 species of Beetles (Carabidae and Staphylinidae) (Lott, 2001). Almost 640 specimens of Carabidae Beetle of 35 wetlands of south Scandinavia, have been collected since the end of September to the end of October (Andersen, 2011).

A study upon the Beetles settlement has been realized between October 2009 and September 2010 in the salty Marsh of the mouth of Tafna (Western Algeria) presented 3833 specimens discriminated in 140 species (Boukli Hacene et al., 2012) against 157 identified species in the mouth of Moulouya, Morocco during the numerous fragmented studies led by Chavanon and Mahboub (1998) and which is the most adjacent result of our prospection in terms of abundance and global richness of the settlement. The assemblages and structure of the Beetles communities in the wetlands are affected by a multitude of factors, enhanced by numerous implicated interactions (Murkin and Barr, 1987).

The great majority of species is represented by a minimal number of individuals. This same diagnosis has been done by Boukli Hacene (2012); Soldati (2000) and Menet (1996). According to Hengeveld & Hogeweg (1979), edaphic factors determine the distribution patterns of beetles and above all the degree of substrate moisture, which explains the distribution of species between different habitats. This assertion was later refuted by Hengeveld, 1985. The fact that organic matter is more abundant in the study area may explain the presence of Scarabeidae, which are essentially detritus feeders at the larval stage. However, some of their species appear to be native to the steppe, such as *Scarabaeus sacer* and *Pentodon algerinum* (Brose, 2003). The diversity of wetlands is highly dependent on the average duration of flooding and this can be explained by the generally high number of niches available for hygrophilous species in these landscapes (Brose, 2003).

The wetlands shelter many vulnerable or threatened species; 39% of the Carabidae species of the Sweden red list, live in proximity of potable waters including marshes and bogs (Gardenfors, 2005).

It is clear to us that the Dayet El Ferd site has real entomological potential, at least from the point of view of Coleoptera, and that this faunistic study is only a small-scale study. The results obtained are aimed at the rational use of wetlands. To counter the rapid disappearance of wetlands in Algeria, it has become urgent to put in place a comprehensive conservation policy as part of sustainable development.

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