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Research Article

Settlement of Beetles of the Wetland of Sidi Moussa-Oualidia

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Abstract

Background: After a brief description of the study area and of the sampling methodology, the researchers present the commented list of beetles identified during the period 2013-2014 in the wetland complex of Sidi Moussa-Oualidia. **Materials and Methods:** Samples of the fauna of beetles are taken by traps barber, quadrat, sight hunting and threshing trees using the "Japanese umbrella", in order to ensure almost complete coverage of habitat types. **Results:** Surveys conducted in four stations, have culminated in the identification of 40 species distributed in 24 tribes. Amongst these species, 47% are detritivores, 28% phytophagous, 17% predatory and 8% necrophagous. The trophic organization of the species is arranged by hierarchization from the shore where the predators and the granivores are preponderant towards the interior of the cultivated lands where detritivores dominate widely. The geographical distribution of the species includes several distinct categories: Mediterranean species, North African species, Moroccan endemic species and species with large distributions. **Conclusion:** The completion of this study allowed us to identify 40 species of beetles predominantly Mediterranean and 22% of endemic species. The composition of the population reveals an ecosystem in the process of degradation. These results should alert the authorities responsible for the danger that runs the complex and the urgency of taking appropriate measures to safeguard it.

Key words: Beetles, trophic organization, wetland of Sidi Moussa-Oualidia, geographic distribution

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Constituting biological reservoirs for both animal species and plant¹, Wetlands provide excellent pedagogical support to prove the importance of diversity, dynamism and functioning of ecosystems². The favorable conditions in these environments make them populated by exceptional fauna, dominated and diversified in beetles. This order, rich in rare species, threatened or of high biological value, presents nearly 40% of the world's entomological diversity³. The Morocco has more than 160 SBEI "Sites of ecological and biological interest"⁴. The wetland of Sidi Moussa-Oualidia is part of the RAMSAR sites, classified as a site of international biological and ecological interest. Due to this fact its ecological importance and its almost unknown fauna have given rise to the reasons for this study.

Due to the richness and diversity of the species identified in the two marshes as well as at the lagoon level during the year 2013-2014, a non-exhaustive list of species is commented below, taking into account the following four parameters: Biogeographic distribution, sampling stations, trophic chain and endemism. Hydrology, geology, climatology, sedimentology and physical-chemical parameters of the complex Sidi Moussa-Oualidia were described by Maanan⁵, Oulaaross⁶, Hilmi *et al.*^{7,8}, Rassou⁹, Maanan *et al.*¹⁰ and Mehdi *et al.*¹¹.

MATERIALS AND METHODS

Description of the study area

Geographical context: The study area is a wetland, consisting of a lagoon and two marshes. It is located on the Atlantic coast, between El Jadida and Safi (Fig. 1), it is located on a length of 7 km with 0.4-0.5 km wide with a total area estimated at 4.2 km², under the direct influence of the Mediterranean climate (semi-arid or dry in summer).

Hydrological context:

- **At the level of the lagoon:** The impoundment is due to the interruption of the coastal dune cord that allows the penetration of seawater into two tidal cycles: During the flood where one observes a filling of the lagoon and the ebb tide, a submersion only at the level of the subtidal channels
- **Marsh:** The impoundment is made naturally by the rain water and increase of the water table level
- **At the level of the salt marsh (saline):** The filling is done artificially as well as by pumping of the sea water from the lagoon

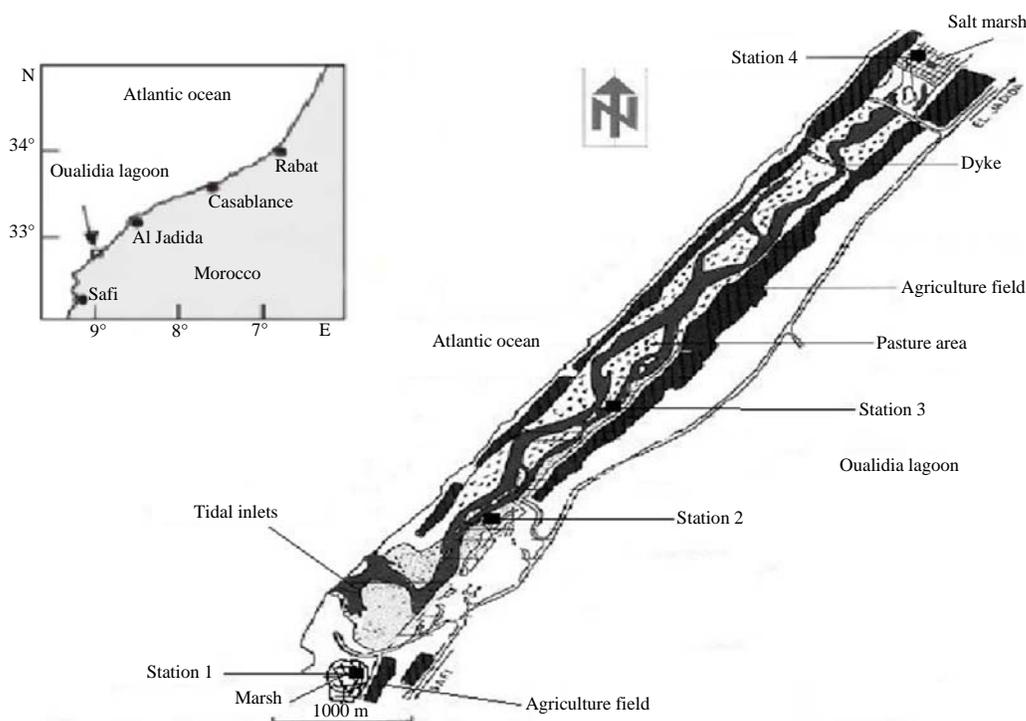


Fig. 1: Localization of the study area. Source: Hilmi *et al.*⁷

Methods: In this study, four stations have been explored and have been the subject of a systematic sampling. The surveys are carried out to ensure almost comprehensive coverage of habitat types that can be related to ecological changes of the site. For the study of the carpet plant, they get inspiration from the phytosociological surveys (Abundance, dominance and sociability) according to Quezel and Verdier¹², along the upstream-downstream profile of the complex (lagoon-marsh).

The harvesting of beetle fauna is carried out between May, 2013 and November, 2014. Several methods have been used:

- **Traps Barber:** The method consists of using plastic jars, filled to 1/3 of 70% alcohol with rotten fish as attractive bait, the pots are pushed into the ground so that its upper edge is flush with the ground surface. This method allows us to collect the fauna that moves on the ground, the traps are protected by lids raised by small supports preventing rain and small invertebrates to enter. In 2014, following weak results collected in 2013, the bait has been replaced by beer. This last bait gave us better results
- **Quadrat:** The method is to make squares of 1 m to the sandy ground, their content is then sifted at height of 10 cm. The beetles found there are harvested for processing
- **Sight hunting:** This method allows us to take the fauna of the beetles on a large surface. The underside of stones, pieces of wood and various debris found in our way are prospected

In addition to these three methods, made a threshing of the foliage of the trees (bushes) using "Japanese umbrella" the hunting ground to harvest frondicultural fauna.

RESULTS AND DISCUSSION

Vegetation cover: In this study, apart from the surveys carried out under the stones and the various debris, six categories are prospected depending on the most dominant and abundant plant species. These plants belong to the Chenopodiaceae family consisting of *Sarcocornia perennis*, *Suaeda verra*, *Atriplex portulacoides* and *Arthrocnemum macrostachyum* and to the family Solanaceae: *Lycium intricatum* Boiss and *Mandragora autumnalis*.

Under the influence of water and salinity, plant species, in each station succeed one another from the shore where dominate the Chenopodiaceae towards the inside of cultivated land passing through an area of transition corresponding to a plant cover at Solanaceae. These areas are marked by a strong trampling of passers-by and livestock. The succession of these plants has enabled us to distinguish the beetles according to the host plant or the corresponding plant refuge.

Wildlife inventory commented: The fauna of the coleoptera of the Sidi Moussa-Qualidia complex is relatively rich and fairly diversified. The whole stand is made up of 10 families, unequally distributed in 24 tribes of 40 species (Table 1).

The study of the beetles mentioned above will take account of each species:

- Biogeographic distribution
- Sampling stations
- Diet
- Endemism (If the species exists only in Morocco)

These four parameters were established according to Soldat¹³, Tovar and Ferrer^{14,15}, Arahou¹⁶, Soldati *et al.*¹⁷, Fauchoux¹⁸, Condamine *et al.*¹⁹, Chenfour *et al.*²⁰, Hacene and Hassaine²¹, Hacene²², Lillig *et al.*²³ and Jaskula²⁴.

Table 1: Summary results of species based on families and tribes

Families	Tribes	Species	
Tenebrionidae	Blaptini Leach, 1815	4	
	Pimeliini Latreille, 1802	4	
	Opatrini, 1832	1	
	Akidini Billberg, 1820	2	
	Tentyriini Eschscholtz, 1831	3	
	Scaurini Billberg, 1820	1	
	Asidini Fleming, 1821	1	
	Erodiini Billberg, 1820	1	
	Scarabaeidae	Psammodiini Mulsant, 1842	1
		Cetoniini Leach, 1815	1
Scarabaeini Latreille, 1802		2	
Dermestidae		Dermestini Latreille, 1804	2
Carabidae		Scaritini Bonelli, 1810	1
	Pogonini Laporte de Castelnau, 1834	3	
	Harpalini Bonelli, 1810	3	
	Pterostichini Bonelli, 1810	1	
	Cicindelidae	Cicindelini Latreille, 1802	1
Chrysomelidae	Chrysomelini Latreille, 1802	1	
	Clytrini Kirby, 1837	1	
Nitidulidae	Carpophilini Erichson, 1842	1	
Dytiscidae	Hygrotini Portevin, 1929	1	
Staphylinidae	Blediini Adam and Hegyessy, 2001	2	
	Staphylinini Latreille, 1802	1	
Coccinellidae	Coccinellini Latreille, 1807	1	

Tribe of Blaptini Leach, 1815

***Blaps tingitana* (Allard, 1880):**

- Located in North Africa: From the coastal region of Mauritania and the Western Sahara to Southwest of Morocco (located at Magador, the valley of the Wadi Souss up to Erfoud in East of Morocco)
- Levied in the station 1, 2 and 4 during April and May
- This is a saprophagous species

***Blaps nitens* ssp. (Barbara Solier, 1848), currently named *Blaps nitens* ssp.¹⁷:**

- This is a North-African, Atlantic coastal (Essaouira, Oualidia) and Mediterranean species
- Captured in S1, S2 and S4 in May, June, July and September
- Saprophagous

***Blaps pingus* (Allard, 1880):**

- Located in the Atlantic coastal region, from Tangier to Souss (Agadir)
- Several individuals are captured in the two marshes (S1, S4) and at the lagoon (Ostrea S2) in May, June, July, September and October
- This saprophagous species feeds on fruit and leaves desiccated of *Lycium*
- It is an endemic species in Morocco

***Blaps inflata* (Allard, 1880):**

- This is a Moroccan Atlantic coastal species, found from Casablanca to Souss (Agadir and Escalera)
- Several individuals are identified from upstream to downstream of the lagoon and in the marsh. This species is active in May, June, July and September
- Saprophagous
- Endemic species in Morocco

Tribe of Pimeliini Latreille, 1802

***Pimelia (Amblytera) rugosa* (Fabricius, 1792):**

- Occupies all Occidental Morocco and Central between Tangier and Taza, the Atlas towards the Telouët region, Atlantic region to the South until the edge of the Sahara, Oualidia, Birkouat and Ackermoud
- Species of sandy land, burrowing and walker. It has been extensively captured at the lagoon (Ostréa station 2) and stations 3 and 4 from April-October

- Detritivores
- Endemic species of Morocco

***Pimelia crenata* (Fabricius, 1798):**

- Found in the Northern Africa. In Morocco, this species is located in the Atlantic coast region from Tangier to Essaouira (Mogador, Lazari, Diabat and Oualidia)
- The species is present in all the studied stations (Lagoon and the two marshes) during May, June, July and September
- Detritivores

***Pimelia cordata* (Kraatz, 1865):**

- This species is localized in the Moroccan Atlantic coast region, from Mogador to Lazari (Essaouira)
- This is a burrowing and walker species captured in S1, S3 and S4 during April, May, June, July and September
- Detritivores
- Endemic species of Morocco

***Pimelia (Amblytera) rotundipennis* (Kraatz, 1865):**

- This species is located in the Northern Africa and the Iberian Peninsula. In Morocco, the species is found from the Atlantic coast to the Southwest and mainly in Oualidia
- Present in all the considered stations from April-September
- Detritivores regime, burrowing and walker species

Tribe of Opatrini, 1832

***Clitobius ovatus* (Erichson, 1843):**

- This species is located on the African tropical coast (Angola, Senegal and Cabo Verde) and the Mediterranean (Tunisia, Sahara, Sicily, Turkey, Lampedusa and Maltese islands)
- This is a salty region species, captured only in the marshes at the foot of *Salicornia* in April, May, June and very few individuals are present in September
- Phytophagous

Tribe of Akidini Billberg, 1820

***Akis tingitana cordicollis* (Fairmaire, 1884):**

- This species is located Moroccan Atlantic coast, from Casablanca to Essaouira (Lazzari and Diabat)
- The species is present in May and June and found in all the considered stations

- This is a necrophagous species that eats tracks, dying or dead pupae and clutches of Lepidoptera (*Lymantria dispar*)
- Endemic species of Morocco

***Morica favieri* (Lucas, 1859):**

- The species is located in France, Iberian Peninsula, Spain. In Morocco, the species is found in the Eastern, Western and in the centre (Rabat, Guercif, Meadde Moulouya, Sahara and behind the Atlas and Ifni). It is also found in Lazzari (Essaouira) and Oualidia
- This species is abundantly captured in the upstream and the downstream of the lagoon and in the marsh. The species is active in May, June, September and October
- It is an anthropophilic species with a detritivorous diet

Tribe of Tentyriini Eschscholtz, 1831

***Pachychila foveipennis* (Kraatz, 1865):**

- Located in the Northern Atlantic region, the species is found in Morocco from Tangier to Oued Ykem, between Oued Mellah and Oued Neffik
- Beach species and coastal dunes, this species is captured it at the level of the beach (S3) and the saline sands (S4) in June, July, September and October
- Detritivores
- Endemic species of Morocco

***Pachychila (Pachychila) intermedia* (Haag, 1875):**

- In Morocco, the species is located in the Atlantic coastal region, from Rabat to Safi and Oualidia
- Harvested on the sand as well as under stones throughout the lagoon (S2, S3 and S4). It is present in April, May, June, July, September and October
- Detritivores
- Endemic species of Morocco

***Pachychila (Pachychila) impunctata* (Fairmaire, 1860):**

- Located in Spain, Tunisia, Senegal and Morocco. In Morocco, it is found in the coastal region, from Oued Tensift to Oued Noun (Goulimine) and in Lazzari and Diabat (Essaouira)
- The species is captured in S3 and S4 under stones, dung of cows and under the sand. It is active in June and poorly present in May, September and October
- Detritivores

Tribe of Scaurini Billberg, 1820

***Scaurus gigas* (Waltl, 1835) = *Scaurus hespericus* (Solier, 1838):**

- The species is located in the Western Mediterranean (South Spain and Portugal), Western Algeria and the Atlantic and Mediterranean regions of Morocco
- The species is captured in stations S1, S2 and S3 in May, June and September
- Detritivores
- Species whose male is reported as originating in Tangier

Tribe of Erodiini Billberg, 1820

***Erodius externus* (Fairmaire, 1875):**

- The species is located along the Moroccan Atlantic coast, from Essaouira (Diabat and Lazzari), Oualidia to Agadir
- Species of the dunes, it is captured in S2, S3 and S4 during April, May, June, July and September
- Detritivores
- Endemic species of Morocco

Tribe of Asidini Fleming, 1821

***Alphasida (Glabrasida) mazaganica* (Escalera, 1929):**

- The species is located only in Moroccan Atlantic coast from Casablanca to Safi
- The species is captured in S3 and S4 under stones and under weeds during April, May and June
- Detritivores
- Endemic species of Morocco

Tribe of Psammodiini Mulsant, 1842

***Psammodius porricollis* (Illiger, 1803), synonyms *Brindalus porricollis* (Illiger, 1803):**

- The species is located in the Atlantic and Mediterranean coasts. It is found in the Western Palearctic region (Portugal, Spain, Azores, France, Corse, Albania, Greece, Turkey, Lebanon, Libya, Tunisia, Algeria, Morocco, Syria, Chypre, Malta and United Kingdom)
- Captured in S2, the species is quasi-present throughout the year (April, May, June, July, September, October and November)
- Burrowing species, nocturnal and psammophile detritivores

Tribe of Scarabaeini Latreille, 1802

***Scarabeus sacer* (Linnaeus, 1758):**

- This species is located on the Mediterranean coast, Southern Europe (Corse, Chypre, France, Italy, Sardinia and Sicily), Northern Africa, Ethiopia, Soudan and certain Asian regions (Afghanistan, Iran, Israel and Syria). In Morocco, the species is found in the Eastern coast (Melilla, Saïdia and Berkane)
- Coastal sand species, coastal dunes and marshes. It is active in May and June and presents in S2 and S3
- Coprophagous (found under excrements)

***Scarabeus laticollis* (Linnaeus, 1767):**

- The species is located in Mediterranean region, in Corse, Iberia peninsula, Maghreb (Morocco and Algeria), Italy (Sicily and Sardinia Islands), France and Spain
- This species observes a diurnal and nocturnal activities. It is active during April, May and June and found in all the studied stations
- Coprophagous, feeds on various feces including sheep and oxen

This beetle plays an important ecological role thanks to the recycling of manure.

Tribe of Cetoniini Leach, 1815

***Oxythyrea funesta* (Poda, 1761):**

- The species is found in the Western Mediterranean, Europe, Russia, Asia and Northern African. In Morocco, it is found from North to the Sahara regions
- This species is sampled in S1, S2 and S4 in May and June
- Phytophagous species

Tribe of Dermestini Latreille, 1804

***Dermestes (Dermestinus) frischi* (Kugelann, 1792):**

- This Western Palearctic species is located in widely distributed over the World. It is found in particular in Europe, Tropical Africa, Middle East, Nearctic, Northern Africa and Eastern Asia
- The species is captured in S1, S3 (More than 100 individuals on a Hedgehog Corpse and on oyster shells) and in S4. The species is active in April, May, June, July, September and October

- Necrophagous species (Living at the expense of corpses of insects or vertebrates "Fresh or dried")

***Dermestes (Dermestinus) maculatus* (DeGeer, 1774):**

- The species is widely distributed over the World. It is found on all continents except the Antarctic
- The species is captured in S1, S3 (More than 100 individuals on a Hedgehog Corpse and on oyster shells) and S4. This species is active in April, May, June, July, September and October
- Necrophagous species (Living at the expense of corpses of insects or vertebrates "Fresh or dried")

Tribe of Scaritini Bonelli, 1810

***Scarites buparius (Scallophorites)* (Forster J.R., 1771):**

- This species is settled in sanding coastlines of the Mediterranean (France, Corse, the Western basin of the Mediterranean, Greece, Algeria, Morocco and Tunisia)
- Species of the dune environment is captured in S2 and S3 and is active from April-September
- Predator of larvae and adults of other insects

Tribe of Pogonini Laporte de Castelnau, 1834

***Pogonus chalceus* (Marsham, 1802):**

- This is a Euro-Mediterranean species. In Morocco, it is found in Meddle Atlas, Dayas and Merjas (Moroccan Atlantic coastline), lower Moulouya (Eastern Morocco) and species mentioned for the first time in Oualidia "New species"
- Halophilic species, captured in S1 and S4 during April, May and June
- Predatory

***Pogonistes gracillis* (Dejean, 1828):**

- The species is located in the Atlantic and Mediterranean coastline (Algeria, France, Greece, Italy, Malta, Morocco, Spain and Tunisia). In Morocco, the species is found in Dayas, Douiete near Fes, in lower Moulouya (Eastern Morocco) and in the Bou-Areg Beach. Species mentioned for the first time in Oualidia "New species"
- The species is captured in S1 and S4 during spring (April, May and June)
- Predatory

Pogonus littoralis

- The species is located in the Atlantic and Mediterranean coastline and in the English Channel. In Morocco, it is located at the mouth of the faeces up to Tensift
- Species enfeoffed of salt marsh. It is captured in S4 during April
- Predator

The tribe of Harpalini Bonelli, 1810

***Daptus* (Fischer von Waldheim, 1824) *Vittatus* (Fischer von Waldheim, 1824) *labiatus* (Motschoulsky, 1849):**

- The species is widely distributed in the Mediterranean coastline, Southern Europe and Northern Africa. In Morocco, the species is rarely found in Mogador and Douiete (near Fes) and Lower Moulouya (Eastern Morocco). Species mentioned for the first time in Oualidia "New species"
- The species is found in salty areas and captured in S1 and S4 during April
- Granivorous

***Harpalus distinguendus* (Duftschmid, 1812):**

- This is a Euro-Mediterranean species found in Spain and the Northern Africa
- Present in S1, S3 and S4, this hygrophilic species is captured in April, May and June
- This is an omnivorous and phytophagous species

***Dichirotrichus obselatus* (Dejean, 1829):**

- This Euro-Mediterranean species is found in Maghreb, Canary Islands, Egypt and Morocco
- The species is captured in S1, S4 during April and May
- Granivorous

Tribe of Pterostichini Bonelli, 1810

***Omaseus pterostichus* (Melanius) *aterrimus* (Herbst, 1978) = *Pterostichus* (Melanius) *aterrimus* (Herbst, 1978):**

- This Mediterranean species can be located in Albania, Australia, Azores, Belgium, Bosnia, Bulgaria, Belarus, Croatia, Denmark, Spain Estonia, Finland, France, Great Britain, Germany, Hungrier, Ireland, Italy, Leetonia, Lithuania, Moldavia, Morocco, Madera Islands, Norway, Poland, Russia, Slovakia, Slovenia, Sweden, Suisse and Western Siberia

- The species is captured in S1 and S4 and mentioned for the first time in Oualidia "New species"
- Granivorous

Tribe of Cicindelini Latreille, 1802

***Cicindela littoralis* (Fabricius, 1787) = *Calomera littoralis* (Fabricius, 1787):**

- The species is located on the Atlantic coastline, the English Channel, Iberia Peninsula, Maghreb (settled in sanded areas, near beaches)
- This psammophile species is captured in S1 and S4 during May (only two corpses of dead individuals are found)
- Predatory: The adults are excellent sailboats and the larvae hunt on the lookout

Tribe of Chrysomelini Latreille, 1802

***Timarcha rugosa* (Linnaeus, 1767):**

- The species is located in Maghreb (Morocco, Algeria and Tunisia) from the Moroccan Atlantic coastline to Tunisia
- Captured on the ground under stones, on sand, on different steppe vegetation, on the Mandragora autumnalis, almost all year
- Phytophagous

Tribe of Clytrini Kirby, 1837

***Antipa sexmaculata* = *Tituboea sexmaculata* (Fabricius, 1781):**

- The species is located in Languedoc Roussillon region, Iberia Peninsula, Northern-Western Africa, Anatolia, Syria and Iran
- The species is captured in all the studied station and present throughout the year
- Phytophagous: Myrmecophile larva/adult polyphagous

Tribe of Carpophilini Erichson, 1842

***Carpophilus hemipterus* (Linnaeus, 1758):**

- This species of warm and temperate regions is widely located in the World. It can be found in Europe, Asia, Africa and Northern America
- The species is captured By threshing trees especially lycium boiss on the edges of cereal fields, active during the months of April, May and June
- This is a phytophagous species (eats decomposed vegetable materials)

Tribe of Hygrotini Portevin, 1929

Hygrotus (Coelambus) parallelogrammus (Ahrens, 1812):

- The species is located on the Atlantic coastline, in Europe, Siberia and Middle East
- Species Aquatic, halophilic, able of withstanding short exudation and low intensity²⁵. The species is active in April, May and June and present in S1 and S4
- Sporadic species/predatory

Tribe of Blediini Adam and Hegyessy, 2001

Bledius (Euceratobledius) furcatus (Olivier, 1811):

- The species is found in the Euro-Mediterranean and the tropical Africa regions
- This is a halophilic species (living in salty areas), captured abundantly in S1 and active during spring (April, May and June)
- Burrowing species, phytophagous, it feeds on micro-algae

Bledius (Bledius) graellsii (Fauvel, 1865):

- This is a Euro-Mediterranean species (Western Mediterranean)
- Captured in stations S1 and S3 during April and May, the species is found in salty areas accompanied with *Bledius furcatus*
- Phytophagous

Tribe of Staphylinini Latreille, 1802

***Ocyopus planipennis* (synonym: *Tasgius (Tasgius) ater* (Gravenhorst, 1802), *Tasgius (Tasgius) planipennis* (Aube, 1842):**

- Located in Europe, Turkey, Syria, Israel, Egypt, Northern Africa and Canaries Islands. This is a palearctic species. In Morocco, The species seems localized as a relic in the Grand central Atlas
- The species is captured during spring in S1, S3 and S4
- Predatory

Tribe of Coccinellini Latreille, 1807

***Coccinella septempunctata* (Linné, 1758):**

- This is a palearctic species located in Europe, Asia and Nearctic regions
- The species is captured in all the studied stations during the spring (April and May)
- Predator of other insects (Aphidiphage)

Diet: The analysis of the trophic categories of the species identified, reveals the predominance of the detritivores with 47% consisting of 19 species, among the latter, 4 species are saprophagous, formed of *Blaps* (*B. nitens*, *B. pinguis*, *B. tingitana* and *B. inflata*) and 2 coprophagous species, *Scarabaeus sacer* and *Scarabaeus laticollis* caught in deposits of stercoral matter:

- The phytophages are presented with a portion of 28% of which 7% are granivores
- Predators with 17%
- Necrophages represent 8% (Fig. 2)

These trophic categories are divided into three groupings plants and it is possible to distinguish as:

- A plant cover halo hygrophilic, consisting of *Sarcocornia perennis*, *Atriplex portulacoides* and *Arthrocnemum macrostachyum*. In the two marshes, this vegetative association, cohabit two main trophic categories:
 - Predators, formed of Trechidae (*Pogonus chalceus*, *Pogonistes gracillis* and *Pogonus littoralis*), *Calomera littoralis*, as well as Dytiscidae (*Hygrotus parallelogrammus*)
 - Phytophages: *Dichirotrichus obselatus*, *Bledius furcatus*, *Bledius graellsii* and whose three granivores represented by *Daptus vittatus*, *Harpalus distinguendus* and *Omaseus Pterostichus*
- A halo-hygrophilic vegetal cover of *Suaeda vera*, prospected only at the level of the station 3 (Ostréa). It is represented by two granivorous species *Harpalus distinguendus* and *Omaseus Pterostichus* and two phytophagous species *Bledius furcatus* and *Bledius graellsii*
- Vegetation cover at *Lycium intricatum* Boiss, constituting an area of transition between the halo-hygrophilic medium and that of the cultivated land. The detritivores are more predominant in this area, they constitute all the species of tenebrionids identified

Necrophages (dermatitis) and coprophagous (Scarabeidae) appear only in a small percentage.

The trophic study of this stand shows an evolution of the three main trophic categories:

Detritivores, phytophagous and predatory. This evolution appears to follow a halo-hygrophilic hierarchy, increasing in order from the shore where predators (17%) and

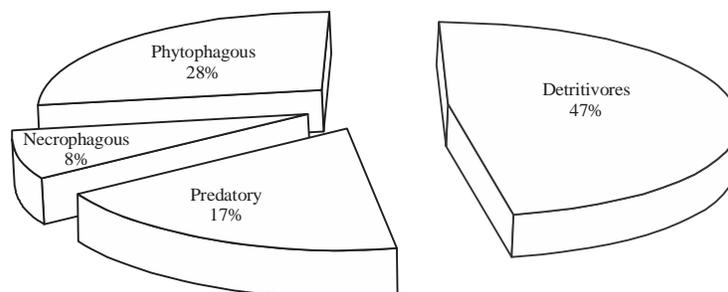


Fig. 2: Dietetic composition of all collected species

phytophagous species (28%) coexist, towards the inside of drylands where detritivores (47%) dominate.

Among these categories of consumers, phytophagous and predators are less represented than the detritivores in all the studied stations. The abundance of detritivores presented in large parts by the Tenebrionidae is due in part to deposits of detritus of plant as well as grain-rich deposits of *Lycium intricatum* Boiss, plant refuge of these beetles, it is the case of the *Blaps* and *Akis* which, in this environment are active in daylight. The studies done in wetlands by Soldati²⁶ and by Hacene *et al.*²⁷, show that Carabidae are the most representative in these environments. In our study area, these with their feeding method based essentially on predation, represent a small percentage in the overall results obtained, these are probably due to the harmful action of man (urbanisation, culture, overgrazing, tourist flows and pollution of the ground). Several studies have shown that carabids are good bioindicators of habitat disturbance^{28,29} due to their sensitivity to stress factors, including anthropization. Gasper³⁰ showed that the use of pesticides by farmers is due to the modification of the trophic chain, namely, losses of hosts, predators.

Biogeographic distribution: In all the species, four different groups are distinguished:

- Mediterranean species bringing together all species with Mediterranean characters, namely, the Euro-Mediterranean, Atlanto-Mediterranean and Western Mediterranean species
- North African species located on the periphery of North Africa
- Widespread species, distributed across the five continents
- Moroccan endemic species
- On a global scale (Fig. 3), biogeographic analysis reveals a clear presentation of species with Mediterranean characters, with a 34% portion, corresponding to 14 species. Among these species, one can cite:

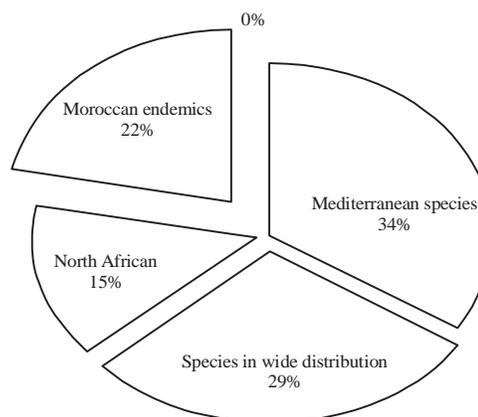


Fig. 3: Repartition of species in term their biogeographical distribution

- Atlanto-Mediterranean species: *Psammodytes porricollis*, *Pogonistes gracillis*, *Pogonus littoralis* and *Calomera littoralis*
- Three Mediterranean-Western species: *Scarites buparius*, *Scaurus gigas* and *Bledius (Bledius) graellsii*
- Euro-Mediterranean species gathering: *Pogonus chalceus*, *Harpalus distinguendus*, *Dichirotrichus obselatus*, *Omaseus Pterostichus*, *Scarabeus laticollis*, *Morica favieri* and *Pachychila impunctata*
- The wide distribution species come in second place with a portion of 29%: *Clitobius ovatus*, *Scarabeus sacer*, *Dermestes (Dermestinus) frischi*, *Dermestes (Dermestinus) maculatus*, *Daptus vittatus*, *Tituboea sexmaculata*, *Carpophilus hemipterus*, *Hygrotrus (Coelambus) parallelogrammus*, *Bledius (Euceratobledius) furcatus*, *Ocyopus planipennis* and *Coccinella septempunctata*
- The Moroccan endemic species come in third place. They represent 22% of all the species identified until now: *Blaps pinguis*, *Blaps inflata*, *Pimelia rugosa*, *Pimelia cordata*, *Akis tingitana*, *Akis cordicollis*, *Alphasida (Glabrasida) mazaganica*, *Pachychila foveipennis*

- *Pachychila (Pachychila) intermedia* and *Erodium externus*
- The North African species occupy the last position with a portion of 15%: *Blaps tingitana*, *Blaps nitens*, *Pimelia crenata*, *Pimelia rotundipennis* and *Timarcha rugosa*

The Mediterranean taxa are clearly represented in the global stand, this shows the influence of the geographical position of Morocco which is located in the Northern Africa, only 8 miles (14 km) from Europe. This proves that the region studied is essentially influenced by the Mediterranean. The presence of 22% of Moroccan endemic species proves the importance of the site as natural heritage. Depending on the extent of distribution, these endemic species consist exclusively of Atlantic coastal taxa; the influence of the studied region on the coastal Atlantic coast of Morocco is felt in the stand.

CONCLUSION

The study of the faunistic composition of the complex Sidi Moussa-Oualidia, allowed us for the first time to draw up a commented list of beetles identified until now. Ten families constitute the settlement, divided into 24 tribes belonging to 40 species. In this stand, tenebrionids dominate both in number of individuals and in number of species. Ripicoles species composed in majority by Staphylinidae and Carabidae (*Pogonus chalceus*, *Pogonistes gracillis*, *Daptus vittatus*, *Harpalus distinguendus*, *Dichirotrichus obselatus*, *Omasus pterostichus*, *Bledius furcatus* and *Bledius graellsii*) as well as an aquatic species *Hygrotus parallelogrammus* are confined to the vegetation cover at *Sarcocornia perennis*, *Atriplex portulacoides* and *Arthrocnemum macrostachyum* and the other remaining families where tenebrionids predominate are confined to the vegetation cover at *Lycium intricatum*. If referring generally to the trophic organization of the beetles, these are the detritivores species that occupy the first place. The low representation of predators in relation to the detritivores and phytophagous, is related to excessive use of pesticides, causing a change in the trophic chain by the disappearance of predators.

As for biogeographic analysis of the settlement of beetles, it reveals a dominance of the Mediterranean species.

SIGNIFICANCE STATEMENTS

The Sidi Moussa-Oualidia complex is part of the Ramsar sites, classified as a site of natural importance of biological and ecological interest, the importance of insects in the ecosystem

as an essential element of biodiversity and as a bio-indicator of the state of conservation of the environment is no longer to be demonstrated. The entomological population of Sidi Moussa-Oualidia has never been studied seriously, its entomological fauna required a thorough search.

Thus the inventory, biodiversity and ecology of beetles of the ripicoles in this wetland are necessary in order to understand the spatial organization of species associated with groups defined by the vegetation cover and the trophic chain.

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