

Checklist of terrestrial beetles (Arthropoda, Insecta, Coleoptera) associated with agroecosystems in North–West Morocco

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Abstract

Checklist of terrestrial beetles (Arthropoda, Insecta, Coleoptera) associated with agroecosystems in North–West Morocco. Beetles play an important role in agrosystems as bioindicators of quality, ecology, conservation, and soil characteristics. The Coleoptera of agrosystems in Morocco are poorly known. To contribute to the knowledge of beetles in this country we conducted a survey in a region of North–West Morocco between 2019 and 2020. The inventory was carried out using several types of traps. We identified 54 species belonging to 14 families, 20 subfamilies, and 18 tribes. The most abundant family was Carabidae, with 24 species, and the most dominant subfamily was Harpalinae, with 19 species. This work provides the first checklist of coleopteran fauna associated with agrosystems in North–West Morocco. We provide an identification key of subfamily and tribe, and update information on the distribution of the beetles identified.

Checklist dataset published through [GBIF](#) (Doi: [10.15470/ohymvn](https://doi.org/10.15470/ohymvn))

Key words: Coleoptera, Checklist, North–West Morocco

Resumen

Lista patrón de escarabajos terrestres (Arthropoda, Insecta, Coleoptera) asociados a agroecosistemas en el noroeste de Marruecos. Los escarabajos desempeñan un papel importante en los agrosistemas como bioindicadores de calidad, ecología, conservación y características del suelo. Los coleópteros de los agrosistemas de Marruecos aún no están bien estudiados. Para llenar este vacío, y a fin de contribuir al conocimiento de los escarabajos (Coleoptera), se estudió una región del noroeste de Marruecos entre 2019 y 2020. El inventario se realizó utilizando diferentes tipos de trampas. En la región se registraron un total de 54 especies, divididas en 14 familias pertenecientes a 20 subfamilias y 18 tribus. En este estudio, Carabidae fue la familia más abundante, con 24 especies, y Harpalinae la subfamilia más dominante, con 19 especies. Este trabajo proporciona la primera lista patrón de la fauna de coleópteros asociada a los agrosistemas del noroeste de Marruecos. Se incluye una clave de identificación de la subfamilia y la tribu, así como información actualizada sobre la distribución de las especies. También se indica su distribución en Marruecos.

Lista de datos publicada en [GBIF](#) (Doi: [10.15470/ohymvn](#))

Palabras clave: Coleoptera, Lista patrón, Noroeste de Marruecos

Resum

Llista patró d'escarabats terrestres (Arthropoda, Insecta, Coleoptera) associats a agroecosistemes al nord-oest del Marroc. Els escarabats exerceixen un paper important en els agrosistemes com a bioindicadors de qualitat, ecologia, conservació i característiques del sòl. Els coleòpters dels agrosistemes del Marroc encara no estan ben estudiats. Per omplir aquest buit, i per tal de contribuir al coneixement dels escarabats (Coleoptera), es va estudiar una regió del nord-oest del Marroc entre 2019 i 2020. L'inventari es va fer utilitzant diferents classes de paranys. A la regió es van registrar un total de 54 espècies, dividides en 14 famílies pertanyents a 20 subfamílies i 18 tribus. En aquest estudi, Carabidae va ser la família més abundant, amb 24 espècies, i Harpalinae la subfamília més dominant, amb 19 espècies. Aquest treball proporciona la primera llista patró de la fauna de coleòpters associada als agrosistemes del nord-oest del Marroc. S'inclou una clau d'identificació de la subfamília i la tribu, així com informació actualitzada sobre la distribució de les espècies. També se n'indica la distribució al Marroc.

Llista de dades publicada a [GBIF](#) (Doi: [10.15470/ohymvn](#))

Paraules clau: Coleoptera, Llista patró, Nord-oest del Marroc

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Introduction

About 400,000 species of beetles have been described worldwide to date and the total number is estimated to be between 850,000 and 4 million (Zhang, 2013; Bouchard et al., 2017). The largest order is Coleoptera. The evolutionary success of this order can be attributed to its diversity of habitat types (Bouchard et al., 2017). Beetles are found in almost all ecosystems and they play diverse ecological roles, ranging from ecosystem engineers to biological control agents (Myers et al., 2009; Tseng et al., 2018). Because of their high diversity, beetles are effective and reliable indicator species for monitoring environmental change. They are found in high numbers in most vegetation types and can be sampled using various techniques (Chung, 2004). Their versatility makes them a valuable group to study assemblage structure and diversity in various habitats. Studies on the distribution and survival of many beetle species in different habitats serve to consolidate our level of knowledge regarding the effects of changes in environment and climate (Vaibhao et al., 2013). Species checklists are effective tools in the domain of natural science and they are directly related to any conservation program of a species. In comparison with many other areas in the world, such as Europe, relatively few studies have been conducted to date in Morocco other than the earliest work of Antoine (1955–1963) and Kocher (1956–1969)

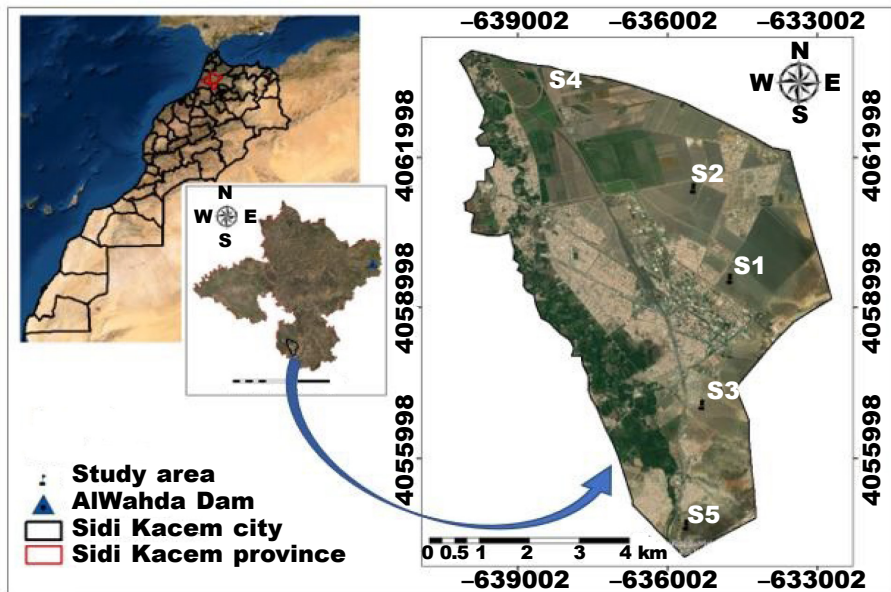


Fig. 1. Geographic location of the study area and the sampling stations.

Fig. 1. Localización geográfica del área de estudio y los puntos de muestreo.

and later studies by Chavanon et al. (1995), Zitouni and Chavanon (2000, 2005), Arahou (2008, 2010), Hajji Hour et al. (2011), Bouraada et al. (2016, 2020), Chavanon (2020), and El Harche et al. (2021a, 2021b). However, our knowledge of the beetle fauna in Morocco is incomplete, especially that of agrosystems. Most research to date has focused on insects in natural and forest ecosystems. To our knowledge, no distributional checklist of beetles in agrosystems has yet been carried out in Morocco. We are aware only of El Harche et al.'s (2021a, 2021b) research on the biodiversity of insect fauna in semi-arid agrosystems. Species checklists are crucial for any type of inquiry or analysis of biodiversity but research has not yet been performed in many regions in the country. Here we studied the composition of beetles in Sidi Kacem, in the North–West of Morocco. The aim of this paper is to provide the first checklist of Coleoptera in agrosystems in this region.

Material and methods

Study site

The study was conducted at 5 stations in the region of Sidi Kacem (34° 13' 00" N, 5° 42' 00" W) in the north–west of Morocco (fig. 1): Station 1: 34° 12' 35.5" N – 5° 42' 31.8" W: a bean field (*Vicia faba* L., Fabaceae), characterized by a silty clay soil. Station 2: 34° 14' 41.5" N – 5° 42' 14.9" W: a field of cereal crops (soft wheat: *Triticum aestivum* L., Poaceae), characterized by a silty clay soil. Station 3: 34° 13' 50.5" N – 5° 42' 14.7" W: natural steppe; the plant species that dominate the area are: *Nicotiana glauca* Graham (Solanaceae), *Ferula communis* L. (Apiaceae), *Cynara humilis* L. (Asteraceae), and *Ammi visnaga* (L.) Lam.

(Apiaceae); again, the soil here is a silty clay. Station 4: 34° 15' 19.1" N – 5° 44' 01.3" W: alfalfa field (*Medicago sativa* L., Fabaceae) and a wasteland dominated mainly by *Dittrichia viscosa* (L.) Greuter (Asteraceae); this station has sandy, clay loamy soil. Station 5: 34° 11' 12.5" N – 5° 42' 32.8" W: matorral, characterized by a 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).

Data collection

Three sampling techniques were used: Barber traps (consisting of 10 cm diameter and 17 cm high pots), sight hunting, and sweep nets. Beetles were collected between March 2019 and September 2020. The captured specimens were identified and labeled following maximum magnification of x 35 and standard identification keys, including French carabid fauna (Jeannel, 1941–1942) and Moroccan carabid beetles (Antoine, 1955–1963). For validation, we consulted Antoine's collection at the Scientific Institute of Rabat (Morocco) and the collections of the National Museum of Natural History of Paris (France). Subfamily, tribe, and species are listed. All the species are listed with their valid names, correct spelling, author, and year of description.

Results

We identified 54 species, belonging to 14 families, 20 sub-families and 18 tribes. Details are listed below (see the checklist dataset published through [GBIF](#) (Doi: [10.15470/ohymvn](#)).

Checklist of beetles

Order Coleoptera

Family Carabidae

Subfamily Harpalinae Bonelli, 1810

Tribe Chlaeniini Brullé, 1834

***Chlaenius* (*Dinodes*) *decipiens* L. Dufour, 1820**

Regional distribution: throughout Northern and Central Morocco, including the Middle and High Atlas (Machard, 2018), as far as Gada of Debdou and Oujda in the east (Chavanon, 2020).

General distribution: all over Europe, Maghreb (from Morocco to Tunisia) and Turkey (Löbl and Löbl, 2017).

***Chlaenius* (*Trichochlaenius*) *chrysocephalus* P. Rossi, 1790**

Regional distribution: sporadic in a large part of Morocco (Machard, 2018). Reported, in particular, from the lower part of Moulouya and the Gada of Debdou (Chavanon, 2020), and from Lake Dayat Aoua (Bouraada et al., 2020).

General distribution: France, Greece, Italy, Iberian Peninsula, Yugoslavia and Maghreb (Morocco, Algeria and Tunisia) (Cosimi, 2011; Chapelin–Viscard et al., 2012; Ghannèm et al., 2017a, 2017b).

***Chlaenius* (*Chlaeniellus*) *olivieri* Crotch, 1871**

Regional distribution: throughout Morocco except for the arid Eastern and Saharan regions (Machard, 2018).

General distribution: France, Belgium, Switzerland, and Maghreb (Tronquet, 2014; Ghannèm et al., 2017a; Löbl and Löbl, 2017).

Tribe: Pterostichini Bonelli, 1810

***Pterostichus (Melanius) elongatus* Duftschmid, 1812**

Regional distribution: Northern, Western and Central Morocco (Machard, 2018), reaching the lower part of Moulouya to the east (Chavanon, 2020).

General distribution: Albania, Austria, Bosnia Herzegovina, Bulgaria, Croatia, Czech Republic, France, Greece, Hungary, Italy, Moldavia, Romania, Slovakia, Slovenia, Spain, Russia (South European Territory), Ukraine, Yugoslavia, Iran, North Africa, Afghanistan, Kazakhstan and Turkey (Guéorguiev and Guéorguiev, 1995; Namaghi et al., 2010; Löbl and Löbl, 2017).

***Poecilus (Carenostylus) purpurascens purpurascens* Dejean, 1828**

Regional distribution: Northern, Eastern, Western and Central Morocco: Rif, from Lower Moulouya to the High Atlas, southwards to Agadir and Errachidia. The ssp. *debduensis* (Antoine, 1962) occupies the Gada of Debdou and Middle Moulouya (Machard, 2018; Chavanon, 2020).

General distribution: France, Greece, Portugal, Spain and Maghreb (Cosimi, 2011; Tronquet, 2014; Löbl and Löbl, 2017).

Tribe Harpalini Bonelli, 1810

***Scybalicus oblongiusculus* Dejean, 1829**

Regional distribution: coastal regions between Casablanca, Tangier and Melilla (Machard, 2018). Also in Oujda (Chavanon, 2020).

General distribution: Spain, France, Italy, Great Britain, Bulgaria, Croatia, Malta, Iran and the Maghreb (Luff, 2007; Duff, 2008; Cosimi, 2011; Ghannèm and Boumaiza, 2017; Löbl and Löbl, 2017).

***Acinopus (Acinopus) sabulosus* Fabricius, 1792**

Regional distribution: Eastern region (Eastern Rif and between the mouth of Moulouya, Moulay Rechid, the Rekkam Plateau and Tendirara) and Central Morocco (Upper Moulouya, Middle and High Atlas) (Kataev and Wrase, 2015; Machard, 2018; Chavanon, 2020).

General distribution: North Africa (from Morocco to Libya) (Kataev and Wrase, 2015; Löbl and Löbl, 2017).

***Ditomus tricuspидatus* Fabricius, 1792**

Regional distribution: Northern, Eastern, Western and Central Morocco (between Tangier, Saïdia, Oujda, Debdou, the central Middle Atlas and the Sous Wadi) (Machard, 2018; Chavanon, 2020).

General distribution: France, Portugal, Spain, Italy, the Balkans and Maghreb (Serrano et al., 2003; Tronquet, 2014; Ghannèm et al., 2015; Löbl and Löbl, 2017; Andújar et al., 2019).

***Tschitscherinellus cordatus cordatus* Dejean, 1825**

Regional distribution: Northern, Western and Central Morocco (from Tangier to Essaouira, Taza region, Middle Atlas, reaching Asni in the south and Zaïo and Toussit in the east (Machard, 2018; Chavanon, 2020).

General distribution: Mediterranean Europe (from the Iberian Peninsula to the Balkans, including Mediterranean islands), Ukraine, Turkey, the Middle East and Maghreb (Cosimi, 2011; Poneel, 2015; Andújar et al., 2019).

***Parophonus (Parophonus) hispanus* Rambur, 1838**

Regional distribution: sporadic in Northern and Central Morocco. In the south it reaches the region of Marrakech, and to the east, it reaches Oujda (Machard, 2018; Chavanon, 2020)

General distribution: Mediterranean Europe (from Iberian Peninsula to the Balkans, including Malta), Hungary, Moldavia, Romania, Slovakia, Slovenia, Ukraine, Turkey and Maghreb (Sciaky, 1992; Ghannem and Boumaiza, 2017; Löbl and Löbl, 2017).

***Dixus clypeatus* P. Rossi, 1790**

Regional distribution: Northern and Western Morocco (from Casablanca to the north of the Middle Atlas (Machard, 2018); sporadically found in the east of the country (Chavanon, 2020).

General distribution: Mediterranean Europe (from the Iberian Peninsula to the Balkans, including Malta), Hungary, Moldavia, Romania, Slovakia, Slovenia, Ukraine, Turkey and Maghreb (Guéorguiev, 2011; Tronquet, 2014; Albouy and Richard, 2017; Löbl and Löbl, 2017; Andújar et al., 2019).

***Dixus sphaerocephalus* (A. G. Olivier, 1795)**

Regional distribution: almost all of Morocco apart from high mountain and desert regions (Machard, 2018).

General distribution: France, Sardinia, Sicily, Portugal, Spain and North Africa (Tronquet 2014; Löbl and Löbl, 2017; Andújar et al., 2019).

***Carterus (Carterus) interceptus* Dejean, 1830**

Regional distribution: here and there in Northern, Western and Central Morocco, as far as the Gada of Debdou and Nador in the east (Machard, 2018; Chavanon, 2020).

General distribution: Portugal, Spain and Maghreb (Löbl and Löbl, 2017)

***Carterus (Carterus) dama* (P. Rossi, 1792)**

Regional distribution: Northern, Western and Central Morocco, reaching the Gada of Debdou in the east (Machard, 2018; Chavanon, 2020).

General distribution: Mediterranean Europe (from Spain to the Balkans, including Malta), Romania, Russia (Southern European Territory), Ukraine, Maghreb and Turkey (Tronquet, 2014; Kostova and Guéorguiev, 2016; Talarico et al., 2016; Löbl and Löbl, 2017; Andújar et al., 2019).

***Odontocarus cephalotes* (Dejean, 1826)**

Regional distribution: Northern and Central Morocco (between Tangier, Casablanca, El Hajeb and Taza) (Machard, 2018) up to the Gada of Debdou (Chavanon and Zitouni, 1996; Chavanon, 2020).

General distribution: Spain, Portugal and Morocco (Andújar et al., 2019; Löbl and Löbl, 2017).

Tribe Sphodrini Laporte de Castelnau, 1834

***Calathus (Bedelinus) circumseptus* Germar, 1824**

Regional distribution: Northern, Western and Central Morocco (between Tangier, lower part of Moulouya, Oujda, Taza, the western border of Middle Atlas and High Atlas and the Sous (Machard, 2018; Chavanon, 2020).

General distribution: Albania, Croatia, France, Greece, Italy, Portugal, Spain, Algeria and Morocco (Serrano et al., 2003; Cosimi, 2011; Löbl and Löbl, 2017).

***Laemostenus (Laemostenus) complanatus* (Dejean, 1828)**

Regional distribution: almost all of Morocco (Machard, 2018).

General distribution: Great Britain, Ireland, France, Spain, Portugal, Italy, Greece, Croatia, Slovenia, Yugoslavia, Macaronesia, Maghreb, Cyprus, Lebanon, Korea and Canada (Machado and Oromi, 2000; Borges et al., 2005; Luff, 2007; Duff, 2008; Mendonça and Borges, 2009; Tronquet, 2014; Löbl and Löbl, 2017).

Tribe Licinini Bonelli, 1810

***Licinus (Licinus) punctatulus punctatulus* Fabricius, 1792**

Regional distribution: almost all of Morocco apart from the arid Eastern and Saharan regions (Chavanon et al., 1995; Machard, 2018; Bouraada et al., 2020).

General distribution: Azores, Spain, Maghreb (ssp. *punctatulus*), Croatia, Belgium, France, Great Britain, Italy, Portugal, Canary Islands (ssp. *granulatus*), Croatia, Italy (ssp. *siculus*) and Libya (ssp. *torretassoi*) (Machado and Oromi, 2000; Mendonça and Borges, 2009; Ghannèm and Boumaiza, 2017; Löbl and Löbl, 2017).

Tribe Lebiini Bonelli, 1810

***Demetrius (Demetrius) atricapillus* (Linnaeus, 1758)**

Regional distribution: Atlantic region from Tangier to Tiznit (Machard, 2018), mouth and banks of the lower Moulouya and Guerbouss Pass (Chavanon, 2020).

General distribution: West Palaearctic species ranging eastward to Siberia, in Europe known from most countries, Canary Islands, Maghreb, Turkey and Syria (Machado and Oromi, 2000; Cosimi, 2011; Tronquet, 2014; Löbl and Löbl, 2017).

Subfamily Siagoninae Bonelli, 1813

Tribe Siagonini Bonelli, 1813

***Siagona rufipes* (Fabricius, 1792)**

Regional distribution: Hassi Mahjez (Daoura valley) and Mahdar near Saïdia (Junger and Faille, 2011).

General distribution: Morocco, Algeria (La Calle, Lake El-Hout) and Tunisia (northern sector) (Löbl and Löbl, 2017; Ghannèm and Boumaiza, 2017). Also mentioned from Cartagena (Spain) (Junger and Faille, 2011).

Subfamily Brachininae Bonelli, 1810

Tribe Brachinini Bonelli, 1810

***Brachinus (Brachynolomus) immaculicornis immaculicornis* Dejean, 1826**

Regional distribution: in a large part of Morocco (Machard, 2018), it reaches the region of Bouârfa in the south-east of the country (Chavanon, 2020).

General distribution: Croatia, France, Greece, Italy, Spain, Switzerland, Maghreb (ssp. *immaculicornis*), Bulgaria, Macedonia, Romania, Turkey, and part of the Middle East (ssp. *apfelbecki*) (Cosimi, 2011; Ghannèm and Boumaiza, 2017; Löbl and Löbl, 2017).

Subfamily Scaritinae Bonelli, 1810

Tribe Scaritini Bonelli, 1810

***Scarites (Parallelomorphus) terricola terricola* Bonelli, 1813**

Regional distribution: Northern and Central Morocco, from Massa Wadi to Tangier and from Tangier to the mouth of the Moulouya, western border of the Atlas (Machard, 2018) and banks of the Mohammed V dam (Chavanon, 2020).

General distribution: Palaearctic species: Southern Europe and part of Central Europe, Russia (European part, Far East), North Africa, Near and Middle East, Central Asia, Afghanistan, Mongolia, India, Pakistan, China, Taiwan, North Korea and Japan (Horvatovich, 1974; Wiezik, 2005; Tronquet, 2014; Albouy and Richard, 2017; Löbl and Löbl, 2017).

***Distichus (Distichus) planus* Bonelli, 1813**

Regional distribution: throughout Morocco, except in the high mountains (Machard, 2018).

General distribution: Portugal, Spain, France, Italy, Greece, Malta, Georgia, Azerbaijan,

Turkey; Middle East, Central Asia and Pakistan (Löbl and Smetana, 2003; Cosimi, 2011; Gnannem and Boumaiza, 2017; Abdel–Dayem et al., 2020).

Family Silphidae

Subfamily Silphinae Latreille, 1807

Tribe Silphini Latreille, 1805

***Thanatophilus ruficornis* Küster, 1851**

Regional distribution: Northern, Western and Central Morocco, reaching Agadir in the southwest and the Chott Tigrî in the southeast (Kocher, 1958b; Valcárcel and París, 2015; Chavanon, 2020).

General distribution: Portugal, Spain, Sardinia, Sicily and Maghreb (Löbl and Smetana, 2004; Grosso–Silva and Soares–Vieira, 2009; Baz et al., 2014; Löbl and Löbl, 2015; Valcárcel and París, 2015).

***Thanatophilus sinuatus* Fabricius, 1775**

Regional distribution: Northern, Western and Central Morocco, reaching Melilla and Berkane in the East (Kocher, 1958b; Valcárcel and París, 2015; Chavanon, 2020).

General distribution: Palaearctic species distributed throughout Europe and Maghreb to Japan (Löbl and Smetana, 2004; Löbl and Löbl, 2015; Çiftçi et al., 2018; Jarmusz et al., 2020; Egorov et al., 2020).

***Silpha tristis* Illiger, 1798**

Regional distribution: Western Rif and Middle and High Atlas (Kocher, 1958b; Valcárcel and París, 2015).

General distribution: almost all of Europe, and Morocco, Azerbaijan, Armenia, Georgia, Turkey, Iran, Russia and Nearctic Region (Prieto Piloña et al., 2002; Löbl and Smetana, 2004; Löbl and Löbl, 2015; Çiftçi et al., 2018; Egorov et al., 2020).

***Silpha olivieri* Bedel, 1887**

Regional distribution: all of Morocco except south of the High Atlas (Kocher, 1958b; Valcárcel and París, 2015; Chavanon, 2020).

General distribution: Albania, Bulgaria, Croatia, France, Greece, Italy, Malta, Macedonia, Portugal, Spain, Turkey, and Maghreb (Prieto Piloña et al., 2002; Löbl and Smetana, 2004; Löbl and Löbl, 2015; Çiftçi et al., 2018).

***Silpha puncticollis* Lucas, 1846**

Regional distribution: all of Morocco except south of the Atlas (Kocher, 1958b; Valcárcel and París, 2015; Chavanon, 2020).

General distribution: France, Italy, Portugal, Spain and Maghreb (Löbl and Smetana, 2004; Baz et al., 2014; Löbl and Löbl, 2015; Valcárcel and París, 2015). Also reported in North America (Ferreira, 2017).

Family Staphylinidae

Subfamily Staphylininae Latreille, 1802

Tribe Staphylinini Latreille, 1802

***Ocypus (Pseudocypus) aethiops* Waltl, 1835**

Regional distribution: all of Northern and Central Morocco, between Cap de l'Eau, Tangier, Casablanca and the Middle Atlas (Kocher, 1958b).

General distribution: Azores, Madeira, France, Italy, Portugal, Spain, Switzerland and Maghreb (Löbl and Smetana, 2004; Assing and Schülke, 2006; Tronquet, 2014; Löbl and Löbl, 2015; Andoujar et al., 2019; Ferreira, 2021).

***Ocypus (Ocypus) olens* O. F. Müller, 1764**

Regional distribution: almost all of Morocco, reaching the High Atlas in the south (Kocher, 1958b).

General distribution: a large part of Europe, North Africa (from Madeira and Canary Islands to Tunisia) and Mauritania. Introduced to the Nearctic Region (Löbl and Smetana, 2004; Assing and Schülke, 2006; Löbl and Löbl, 2015).

***Philonthus (Philonthus) laminatus* Creutzer, 1799**

Regional distribution: mentioned with doubt from Beni Tadjite (Eastern Morocco) by Chavanon (2020).

General distribution: a large part of Europe, Turkey, and Iran. Not reported from North Africa (Löbl and Smetana, 2004; Löbl and Löbl, 2015; Pérez–Moreno et al., 2020).

Family Scarabaeidae

Subfamily Cetoniinae Leach, 1815

Tribe Cetoniini Leach, 1815

***Oxythyrea funesta* Poda von Neuhaus, 1761**

Regional distribution: from the Mediterranean coast to the northern edge of the Sahara (Baraud, 1985; Mitter, 2011; Chavanon et al., 2015; Tamadouni and Arahou, 2017; Vondráček et al., 2018; Chavanon, 2020).

General distribution: Palaearctic species: most of Europe up to the Ural Mountains and the Caucase, North Africa, Cyprus, Iran, Kazakhstan, Turkey and West Siberia (Bunalski, 1999; Silfverberg, 2004; Šablevičius, 2004, 2007; Bukejs et al., 2006; Horak et al., 2009, 2013; Pivotti et al., 2011; Barclay and Notton, 2013; Tamutis and Dapkus, 2014; Daas et al., 2016; Thomaes et al., 2016; Löbl and Löbl, 2016; Vondráček et al., 2018; Zemouri et al., 2021).

***Aethiessa floralis* Fabricius, 1787**

Regional distribution: everywhere except in desert regions (Baraud, 1985).

General distribution: Spain, Malta, Italy (Calabria and Sicily), North Africa and Sinai (Sparacio, 2009; Pivotti et al., 2011; Löbl and Löbl, 2016).

Subfamily Scarabaeinae Latreille, 1802

Tribe Gymnopleurini Streubel, 1846

***Gymnopleurus (Gymnopleurus) sturmii* W. S. MacLeay, 1821**

Regional distribution: throughout Morocco (Baraud, 1985).

General distribution: Western, Southern and Central Europe, North Africa, Turkey, Jordan and Syria (Marniche et al., 2007; El Aichar et al., 2013; Löbl and Löbl, 2016; Tonelli et al., 2016; Sonnevile et al., 2017).

***Gymnopleurus (Gymnopleurus) flagellatus flagellatus* Fabricius, 1787**

Regional distribution: all of Morocco (Baraud, 1985).

General distribution: Azerbaijan, Armenia, France, Georgia, Greece, Italy, Portugal, Spain, Russia (South European Territory), Turkey, Ukraine and North Africa (ssp. *flagellatus*); Georgia, Iran, Syria and Turkey (ssp. *asperatus*); Lebanon and Syria (ssp. *calignosus*); Afghanistan, Pakistan and North West India (ssp. *hornei*); Azerbaijan, Russia (South European Territory), Iran, Central Asia, Mongolia, China (Xinjiang) (ssp. *serratus*) (Gharakhloo and Ziani, 2010; Dortel et al., 2013; Siddiqui et al., 2014; Tonelli et al., 2016; Löbl and Löbl, 2016; Sobhi et al., 2017; Seyedein et al., 2019).

Family Cantharidae

Subfamily Cantharinae Imhoff, 1856

Tribe Cantharini Imhoff, 1856

***Cantharis (Cantharis) coronata* Gyllenhal, 1808**

Regional distribution: Northern and Central Morocco, between Tangier, Taza and Rabat, reaching Tadla in the south (Kocher, 1956c).

General distribution: Portugal, Spain and Morocco (Löbl and Smetana, 2007; Diéguez Fernández et al., 2017).

***Rhagonycha (Rhagonycha) fulva* Scopoli, 1763**

Regional distribution: all of Morocco, except sub-Saharan regions (Kocher, 1956c).

General distribution: a large part of Europe, Azerbaijan, Georgia, Turkmenistan, Turkey, Iran, Syria and Morocco (Löbl and Löbl, 2007; Kazantsev, 2011; Yildirim et al., 2011; Fanti, 2014; Kerimova and Huseynova, 2014; Samin et al., 2015; Fanti and Ghahari, 2016).

Family Dermestidae

Subfamily Dermestinae Latreille, 1804

Tribe Dermestini Latreille, 1804

***Dermestes (Dermestinus) frischii* Kugelann, 1792**

Regional distribution: except for the mountains, all of Morocco including the Saharan regions (Kocher, 1956b).

General distribution: cosmopolitan species (Löbl and Smetana, 2007).

Family Prionoceridae

Tribe Lobonychini Majer, 1987

***Lobonyx aeneus* Fabricius, 1787**

Regional distribution: all of Northern and Central Morocco, between Oujda, Tangier, Oulmès and the Middle Atlas (Kocher, 1956c; Arahou, 2008, 2010; Bocakova et al., 2012).

General distribution: Portugal, Spain, France (Eastern Pyrenees), Sardinia, Sicily and North Africa (Löbl and Smetana, 2007; Molina, 2013).

Family Dasytidae

Subfamily Dasytinae Laporte de Castelnau, 1840

Tribe Dasytini Laporte de Castelnau, 1840

***Psilothrix (Psilothrix) viridicoerulea* Geoffroy, 1785**

Regional distribution: all of Morocco except sub-Saharan regions (Kocher, 1956c).

General distribution: most of Europe (Belgium, Netherlands, Denmark, Italy, Spain, Portugal, Greece, Croatia, France, Germany, Ireland, Latvia, Malta, Macedonia, Slovenia, Sweden, Poland, Romania, Great Britain, Yugoslavia and Switzerland), Turkey and North Africa (from Canary Islands to Libya) (Löbl and Smetana, 2007; Baviera and Liberti, 2010; Amokrane et al., 2020).

***Dasytes (Anthoxenus) terminalis* Jacquelin du Val, 1863**

Regional distribution: Northern, Central and Western Morocco, reaching the Sous in the south (Kocher, 1956c; Villemant and Andrei–Ruiz, 1999; Villemant and Fraval, 2002; Arahou, 2008, 2010).

General distribution: France, Portugal, Spain, Morocco and Algeria (Löbl and Smetana, 2007; Tronquet, 2014; Belhoucine and Bouhraoua, 2015; Bellifa and Rousset, 2021).

Family Malachiidae

Subfamily Malachiinae Fleming, 1821

Tribe Malachiini Fleming, 1821

***Malachius lusitanicus* Erichson, 1840**

Regional distribution: Rif, High and Middle Atlas (Kocher, 1956c; Arahou, 2008, 2010).

General distribution: France, Italy, Malta, Portugal, Spain, Turkey and Morocco (Audisio et al., 1995; Švihla and Mifsud, 2006; Löbl and Smetana, 2007; Plata–Negrache, 2010; Gil et al., 2021).

***Charopus rotundatus* Erichson, 1840**

Regional distribution: Mount Gourougou and North–West Morocco between Tangier, Larache and the central pre–Rif (Kocher, 1956c).

General distribution: Albania, Corsica, Sardinia, Sicily, Greece, Portugal, Spain and Maghreb (Löbl and Smetana, 2007; Plata–Negrache, 2010; Franzini, 2021).

Family Coccinellidae

Subfamily Coccinellinae Latreille, 1807

Tribe Coccinellini Latreille, 1807

***Coccinella (Coccinella) septempunctata algerica* Kovář, 1977**

Regional distribution: all of Morocco including the Saharan regions (Kocher, 1956b).

General distribution: species with Palaearctic, Nearctic, Afrotropical, and Oriental distribution (with subspecies *algerica* in North Africa and subspecies *brucki* in China, Hawaii, India, Japan and Sakalin Island) (Krafsur et al., 2005; Löbl and Smetana, 2007; Nikitsky and Ukrainsky, 2016; Tamadouni and Arahou, 2017; Saharaoui, 2017; Abu El–Ghiet, 2019; Bakroune et al., 2020; Gharbi, 2020; Mahbob, 2021).

***Hippodamia (Hippodamia) variegata* Goeze, 1777**

Regional distribution: all of Morocco including the Saharan regions (Kocher, 1956b).

General distribution: species with Palaearctic, Nearctic, Afrotropical, and Oriental distribution (Löbl and Smetana, 2007; Guesmi et al., 2011; Nikitsky and Ukrainsky, 2016; Bakroune et al., 2020; El–Saeedy et al., 2020).

Family Tenebrionidae

Subfamily Pimeliinae Latreille, 1802

Tribe Tentyriini Eschscholtz, 1831

***Pachychila (Pachychila) salzmanni* Solier, 1835**

Regional distribution: Western side of the Mediterranean coast (Español, 1944; Idrissi, 1984), north Atlantic Morocco and south Rifain Corridor (Kocher, 1958a).

General distribution: Southern Spain and Northwest Morocco (Löbl and Smetana, 2008; Hagstrum and Subramanyam, 2016).

Subfamily Blaptinae Leach, 1815

Tribe Dendarini Mulsant and Rey, 1854

***Dendarus pectoralis* Mulsant and Rey, 1854**

Regional distribution: Northern Rif, Atlantic coast from Ceuta to South West Rabat (Kocher, 1958a), Bab Taza and Talassemtane National Park (Western Rif) (Benyahia, 2015).

General distribution: Northwest Morocco and Iberian Peninsula (Löbl and Smetana, 2008).

Subfamily Alleculinae Laporte, 1840

Tribe Cteniopodini Solier, 1835

***Gastrhaema rufiventris* Waltl, 1835**

Regional distribution: between Tangier, Boulhaut and the Middle and High Atlas (Kocher, 1956a). Also, mentioned from Talassemrane National Park (Benyahia et al., 2015).

General distribution: extreme south of Spain, Northwest Morocco and Northeast Algeria (Benyahia et al., 2015).

Family Oedemeridae

Subfamily Oedemerinae Latreille, 1810

Tribe Oedemerini Latreille, 1810

***Oedemera (Oedemera) simplex* Linnaeus, 1767**

Regional distribution: Northern, Central and Western Morocco, reaching the Sous in the south and Oujda in the east (Kocher, 1956a).

General distribution: Portugal, Spain, France (including Corsica), Italy (including Sardinia and Sicily), Malta and North Africa (from Morocco to Libya) (Löbl and Smetana, 2008; Bolaño et al., 2012; Fadda, 2016; López-Pérez and Vázquez, 2016).

Family Chrysomelidae

Subfamily Chrysomelinae Latreille, 1802

Tribe Doryphorini Motschulsky, 1860

***Chrysolina (Chrysolina) bankii* Fabricius, 1775**

Regional distribution: All of Morocco, except the arid eastern and southern regions (Kocher, 1958c; Maican and Serafim, 2015; Chavanon, 2020).

General distribution: France, Great Britain, Italy, Malta, Madeira Archipelago, Portugal, Spain, Switzerland, Canary Islands and Maghreb (Löbl and Smetana, 2010; Petitpierre, 2019).

***Chrysolina (Maenadochrysa) affinis* Fabricius, 1787 (ssp. s. lat.)**

Regional distribution: Northern and Central Morocco, from the lower part of Moulouya and Oujda to the Atlantic coast, to the south of the region of Marrakech and Sidi Ifni (Kocher, 1958c; Chavanon, 2020).

General distribution: Italy (Calabria and Sicily) and Maghreb (with different subspecies) (Löbl and Smetana, 2010).

***Chrysolina (Palaeosticta) numida* Reiche, 1864**

Regional distribution: all of Morocco except the arid regions of the east and south where it does not exceed the Sous (Kocher, 1958c; Maican and Serafim, 2009; Chavanon, 2020).

General distribution: North Africa (from Morocco to Libya) (Bienkowski, 2001; Löbl and Smetana, 2010; Rozner and Rozner, 2013).

Subfamily Cryptocephalinae Gyllenhal, 1813

Tribu Clytrini Kirby, 1837

***Lachnaia (Lachnaia) paradoxa* G. A. Olivier, 1808**

Regional distribution: all of Morocco except the southern desert regions (Kocher, 1958c; Maican and Serafim, 2009; Chavanon, 2020).

General distribution: France (Pyrénées Orientales), Sicily, Portugal, Spain, and North Africa (from Morocco to Egypt) (Löbl and Smetana, 2010; Rozner and Rozner, 2013).

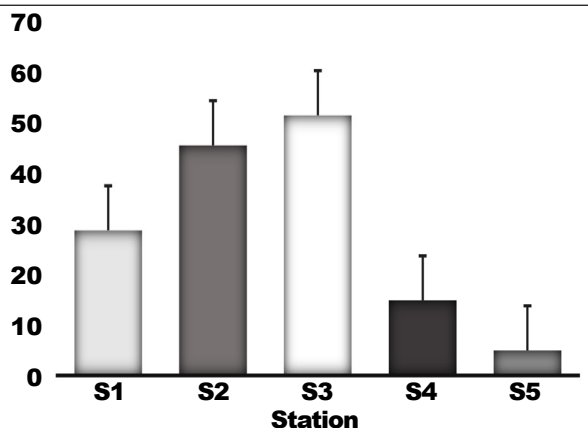


Fig. 2. Species richness at sampling sites: S1, station 1; S2, station 2; S3, station 3; S4, station 4; S5, station 5.

Fig. 2. Riqueza de especies en los distintos puntos de muestreo.

Family Curculionidae

Subfamily Lixinae Schönherr, 1823

Tribu Lixini Schönherr, 1823

Lixus (Dilixellus) pulverulentus Scopoli, 1763

Regional distribution: Northern and Central Morocco, reaching Casablanca and Marrakech to the west, the central High Atlas to the south and the Beni Snassen Mountains and Guefaït to the east (Kocher, 1961; Arahou, 2008, 2010; Stüben et al., 2015; Chavanon, 2020).

General distribution: Western and Central Palaearctic: a large part of Europe, North Africa (from Madeira and Canary Islands to Tunisia), Cyprus, Turkey, Syria, Iran, Afghanistan, Tadjikistan and West Siberia (Löbl and Smetana, 2013; Boukhris–Bouhachem et al., 2016; Sanaei and Seidy, 2017).

Discussion

Our study of beetle species in the region of Sidi Kacem allowed us to draw up a first list of beetles encountered in the north west of Morocco. The findings from five different localities show that fauna of Coleoptera is highly diverse in the region, with 54 species from 14 families, classified further into 20 sub-families and 18 tribes. The most subfamily abundant was Harpalinae with 19 species. According to Ober (2002) and Avgin and Emri (2007), the carabid subfamily Harpalinae contains the most species of carabid beetles, with over 19,000 species worldwide.

The diversity of ground beetle species varied between survey sites (fig. 2). Species richness and abundance was greatest at Station 3, followed, in order, by stations 2, 1, 4, and 5 (fig. 2). This variation could be related to factors such as vegetation type, soil humidity, or availability of trophic resources, particularly at station 3 where specific richness was high. According to Boivin and Hance (2002), Jukes et al. (2001), and Thomas et al. (2006), beetle fauna is related to environmental variables and biotic factors such as characteristics of the vegetation. In general, the greater the vegetation, the higher the

numbers of arthropods –and carabids in particular– due to more food resources (Schaffers et al., 2008; Harvey et al., 2008; Zou et al., 2013). Human activity, particularly agricultural practices, can alter beetle abundance and population structure (Pena, 2001). In stations 2, 3, and 4, the abundance of beetle species has likely decreased due to anthropological activity and human expansion disturbing the ecosystem. Numbers of many species have decreased in some areas as a result of intensified human activity (Di Marco and Santini, 2015; Laanisto et al., 2015). Station 5 showed the lowest species richness (fig. 2). This is probably because the texture of the soil (clay) at this station makes root propagation and circulation of air and water difficult, resulting in low plant density. Many studies have shown that changes in plant diversity alter not only herbivore diversity but also insect predator and parasitoid diversity, and that plant diversity contributes to insect diversity (Siemann et al., 1998; Knops et al., 1999; Koricheva et al., 2000; Perner et al., 2003). Our findings are in accordance with such findings.

This work highlights the exceptional heritage value of beetles in North–West Morocco and, particularly, in the agroecosystems of the Sidi Kacem area. It will only be possible to maintain this remarkable biodiversity in this region if specific conservative measures are adopted. The findings from this study constitute a guide for future taxonomic and ecological research regarding species of beetles in Morocco. This checklist of Coleoptera can be updated with new findings in the future.

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