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Morphological Identification and Geographical Distribution of Scorpions in Azilal Province (Morocco)

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ABSTRACT

Background: Scorpionism is considered as one of the health and medical problem in undeveloped tropical and subtropical countries in the world. In Morocco, Azilal province is considered among the most Moroccan regions affected by the scorpion sting and envenomation. Despite of its epidemiological status, little is known about the distribution of scorpions in Azilal province. Any strategy against these envenomation must first go through a good knowledge of the composition and distribution of scorpion fauna involved. The current study aimed to study the scorpion fauna of this province in order to manage and control scorpionism related problems.

Methods: In this field-laboratory investigation during 2014-2017, different localities of Azilal province were surveyed. 14 sampling localities were selected based on geographical situation, climate and local data. In the laboratory, the collected scorpions were determined morphologically based on the valid taxonomic keys.

Conclusion: Our investigations in the Azilal province have allowed to us to inventory seven species. Among the inventoried species some are deemed dangerous for humans. The geographical distribution of collected species was discussed. The present work will be a complementary contribution to the comprehensive study of the scorpion sting syndrome in Morocco.

Key words: Azilal province, Distribution, Inventory, Scorpions.

INTRODUCTION

People in tropical and semi-tropical areas are in danger of scorpion sting and this situation constitutes a serious health problem in the region. The annual number of scorpion stings exceeds 1.2 million leading to more than 3250 deaths (0.27%) (Chippaux and Goyffon, 2008). In Morocco, the scorpionism represents the most frequent cause of poisoning as reported by the Poison Control and Pharmacovigilance Center of Morocco (Soulaymani and El Oufir, 2009). The central regions of Morocco remain the most affected by scorpionic envenomation with many cases of death being recorded each year, particularly in the region of Beni Mellal Khenifra including Azilal province (Charrab *et al*. 2009).

Morocco by its vast geographic scope, its various climates and diverse ecosystems houses a diverse scorpion fauna. More than 61 scorpion species, belonging to 12 genera and two families (Buthidae and Scorpionidae) have been described in the country. The other particularity of this fauna is its remarkable endemicity. Indeed about 72% of these species (44 species) are endemic to Morocco (Touloun, 2019).

The objective of this study is to develop a database on the identification and mapping of the spatial ranges of the scorpionic fauna of the study area. This can aid in the development and implementation of any strategy to combat this scourge, which represents a real problem for both the local population and the health staff.

MATERIALS AND METHODS

Study Area

Azilal province constitutes one of the five provinces of the region of Beni Mellal-khenifra located in the center of Morocco (Fig 1). It covers an area of 10050 km^2. According to the general census of 2014 of the Kingdom of Morocco the province's population is 554 001 inhabitants in 2014, with urban residents accounting for 18.2% is urban. The density of the population is 55,12 per km^2 (Ministère de l'Intérieur, 2015).

The province is characterized by a wide geographical diversity with almost all types of landforms: plains, mountains and plateaus. Its climate varies from semi-arid type in the plains to continental in the mountains. Rainfall occurs mostly during the first few months of the crop year and may extend into May. The mountainous areas whose altitude exceeds 1000 m, are experiencing snowfall from October and persisting throughout the spring (Ministry of Interior, 2010).

Scorpion collection was carried out between March and June of each year during 2014-2017 period. 14 localities with climatologic and topographic gradient were selected for collection through random sampling (Fig 1; Table 1).

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Collection and identification of scorpions

The scorpions were captured from under rocks, crevices and burrows and under tree barks. The nocturnal missions in the field were carried out with ultraviolet lamps. The scorpions were then collected by the tail with long-handled tongs. The collected species were transferred to glass jars containing 70% ethanol and labeled with the collector's name, the location and the date of sampling. The collected specimens were then identified based on taxonomic descriptions according to previous works (Vachon, 1952; Vachon, 1974; Lourenço, 2003; Lourenço, 2005; Lourenço, 2009).

RESULTS AND DISCUSSION

Scorpion fauna composition

During the period between 2014 and 2017, 152 scorpion specimens were examined from studied sites of the province of Azilal and examined in the laboratory. These specimens are distributed among seven species belonging to four genera in Buthidae and Scorpionidae families. The identified species are as follows: *Androctonus mauritanicus, Butheloides slimanii, Buthus lienhardi, Buthus malhommei, Buthus paris, Scorpio fuliginosus* and *Scorpio weidholzi* (Fig 2).

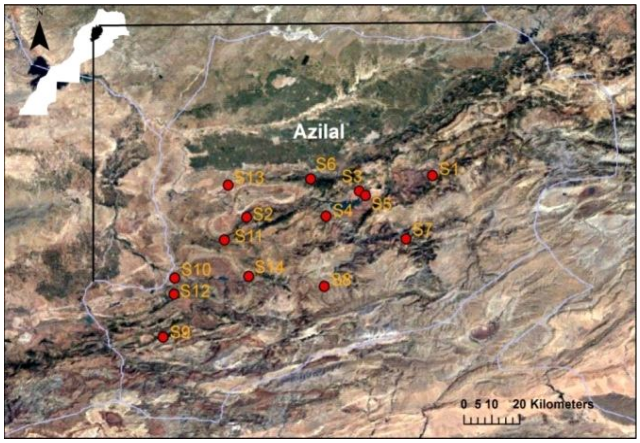


Fig 1: The study area with sampling localities surveyed.

Ecological and biogeographical characteristics of inventory scorpion fauna

Genus *Androctonus* Ehrenberg, 1828

In Morocco and*roctonus* genus is currently represented by 9 species, 7 of which are endemic to Morocco (Touloun, 2019). According to Vachon (1952) this genus was composed of several subspecies. Subsequently, a taxonomic revision of the genus allowed the elevation of certain subspecies into species (Lourenço, 2005). The two subspecies *A. mauritanicus mauritanicus* and *A. mauritanicus bourdoni* are united in the species *A. mauritanicus* (Lourenço, 2005). In the studied area, the genus is represented by *A. mauritanicus*.

Androctonus mauritanicus (Pocock, 1902)

It has a wide distribution in Morocco, where it is endemic and reputedly the most dangerous (Touloun *et al*. 2001). The presence of the species was reported by Vachon (1952) between Tiznit in the south and the region of Rabat in the north. It is found in various climates and different altitudes from the plain to highest mountains (Vachon, 1952; Touloun, 2012). It presents little preference for high altitudes where its relative abundance thus remains low. However, according to previous studies, the species still shows high frequencies (Touloun *et al*. 2001). This species was collected in all the stations studied (Table 2).

Butheloides Hirst, 1925

Morocco has the highest diversity of *Butheloides* genera with five species known (Vachon, 1952, Lourenço, 2010; Lourenço *et al.* 2011; Touloun, 2019). The discovery of all



Fig 2: Scorpion species found in the study area (A) *Androctonus mauritanicus* from Ait Attab, (B) *Butheloides slimanii* from Ait Taguella, (C) *Buthus lienhardi from* Ait Mhamed, (D) *Buthus paris* from Ouaouizeght, (E) *Scorpio fuliginous* from Tilouguite and (F) *Scorpio weidholzi* from Ouled Ayyad.

species of the genus *Butheoloides* are difficult, because of its small size and also because it often occupies rugged habitats (Touloun and Boumezzough, 2013). In the region studied, the genus is represented by *Butheoloides slimanii*.

***Butheoloides slimanii* Lourenço, 2010**

It is described from the region of Tanant in the North range of Atlas Mountains. This species has also been recorded in in November 2012 in the Grouka forest (Al Haouz Province) 43 km south-east of Marrakesh (Touloun and Boumezzough, 2013) The species was discovered in the station of Ait Taguella about 60 km from the typical station, thereby widening the known range of distribution of the species to the north (Table 2).

Genus *Buthus* Leach, 1815

The genus *Buthus* has a wide distribution in Africa, the Middle East, Asia and Europe (Fet *et al*. 2000). Lourenço (2003) revised the North African scorpions of the genus *Buthus*. He described several new species by taking up certain subspecies and varieties, which Vachon (1952) had described, according to the collections of the Museum of Natural History of Geneva. Thus among the subspecies and varieties that made up the species *B. occitanus*, six have been raised to the rank of the species.

In Morocco, during the last years, several new species have been well described and several old varieties and / or subspecies have been restored to the rank of subspecies or even species (Lourenço, 2003; Lourenço and Vachon, 2004; Touloun and Boumezzough, 2011; Lourenço *et al*. 2012).

Three species of the genus were inventoried in the study area, *B. paris*, *B. lienhardi* and *B. malhommei,* with the two latter being endemic to Morocco.

Table 1: Coordinates of the sampling localities in the study area.

Sampling localities		GPS coordinates X	GPS coordinates Y	Height (sea level m)
S1	Tagleft	6°07′18″	32°13′59″	1078
S2	Ait Attab	6°43′22″	32°06′08″	784
S3	Ait Ouarzik	6°21′31″	32°11′04″	1173
S4	Bin El Ouidane	6°27′58″	32°06′20″	1000
S5	Ouaouizeght	6°20′18″	32°10′14″	1110
S6	Afourar	6°30′57″	32°13′21″	466
S7	Tilouguite	6°12′27″	32°02′04″	1300
S8	Ait M'hamed	6°28′19″	31°53′07″	1716
S9	Demnate	6°59′35″	31°43′33″	1001
S10	Ait Oumras	6°57′21″	31°54′40″	921
S11	Tabia	6°47′41″	32°01′51″	556
S12	Tanant	6°57′28″	31°51′38″	841
S13	OuledAyyad	6°46′58″	32°12′10″	449
S14	Ait Taguella	7°04′41″	32°04′06″	547

***Buthus lienhardi* Lourenço, 2003**

This species correspond to *Buthus occitanus tunetanus* var. *lepineyi* Vachon, 1949 before regaining at the species rank by Lourenço (2003). It is one of the representatives of the Moroccan fauna of high mountains. In the High Atlas Mountains, we have found it at altitudes between 1100 m and 2600 m (Touloun, 2012). In these regions, it occupies also the asylvatic biotopes where the snow persists several months. In the study area this species has been located in two altitude stations, Demnate and Ait Mhamed (S8) (Table 2).

***Buthus malhommei* Vachon, 1949**

This species corresponds to *Buthus occitanus malhommei* Vachon, 1949 before regaining at the species rank (Lourenço, 2003). It may be found in the area that covers the Haouz plain and extends north toward the Jbilets small mountain range to occupy the Central Bahira and El Kelâa des Seraghna (Touloun, 2012). In the studied area, this species has been collected in one station in Ouled Ayyad (S13) (Table 2).

***Buthus paris* (C.L. Koch, 1839)**

It corresponded to *Buthus occitanus paris* before regaining

Table 2: Distribution of scorpion species in the studied area (* : presence).

	A. mauritanicus	*B. slimanii*	*B. lienhardi*	*B. malhommei*	*B. paris*	*S. weidholzi*	*S. fuliginosus*
1078	*				*	*	
784	*				*	*	
1173	*						
1000	*						
1110	*		*		*		
466	*						
1300	*		*				*
1716	*		*				*
1001	*	*			*		*
921	*				*		
556	*				*		
841	*				*		
449	*			*		*	
547	*	*			*		

at the species rank (Lourenço, 2003). In Morocco, this species is adjusted to the foothills north of the High Central and Western Atlas below 1300 m altitude (Touloun, 2012). It also occupies massive coasts of Tunisia and eastern Algeria to the west Algiers meridian (Arroyo, 1963). It has been located also in the eastern region of Oujda, Ain Beni Mathar and Tandrara (Touloun *et al*. 2014). In the study area, this species always remains confined to the Atlas foothills where it was inventoried in eight stations (Table 2).

Genus *Scorpio* Linnaeus, 1758

Vachon (1952) had already reported the complexity of this monospecific genus. This led to a revision of this genus in which several subspecies have been elevated to the species rank (Lourenço, 2009). The species of this genus are strictly ground-dwelling. Its burrows which sometimes exceed a meter deep are built preferably under or near clumps of vegetation where the substrate is soft and easy to widen. Two species endemic to Morocco, were surveyed in the study area *S. fuliginosus* and *S. weidholzi.*

***S. fuliginosus* (Pallary, 1928)**

It is known from pre-forest and forest areas of the High Atlas from 900 m of altitude (Vachon, 1952; Touloun, 2012). In our study it was collected in three stations all located at altitudes exceeding 1000m, in Demnate, Tilouguite and Ait Mhamed (Table 2).

***S. weidholzi* Werner, 1929**

It is the most common species of the genera in the Haouz plain in the center of Morocco (Touloun, 2012). In this study, it was discovered in three low altitude stations in Tagleft, Ait Abbas and Ouled Ayyad (Table 2).

Distribution of specimens collected according to biotopes

In Beni Mellal-Khenifra region, including Azilal province, scorpions have great medical importance and scorpionism remains a serious public health problem for local populations (Soulaymani *et al*. 2002; Charrab *et al*. 2009).

Among inventoried species some show a tendency to territorial expansion often caused by human activities and their adaptation to anthropized environments, particularly *A mauritanicus* and certain species of the *Buthus* genus, increasing the risk of stings inside dwellings and their neighborhoods (Fig 3).

A. mauritanicus is the most dangerous species in Morocco and has been reported to be responsible for the highest number of serious, often deadly envenomings, especially in children (Touloun *et al*. 2001, Oukkache *et al*. 2014). Moreover, in the fields, far from human dwellings, agricultural work poses a major risk of envenomation by species of genus *Buthus* (Touloun, 2019).

Species of *Scorpio* genera are strictly burrowing that spends most of its time hidden in deep galleries (Fig 3). It has almost no contact with man. All sting cases caused by *Scorpio sp*. were recorded in children who had been intentionally manipulating the scorpion after dislodging it from its burrow. Bites from species of the genus are not dangerous and only cause simple local pain (Goyffon and Heurtault, 1995, Touloun 2012).

Scorpion fauna in the Azilal province are little explored, except some general contributions on scorpions such as Vachon (1952), Lourenço (2010) and Touloun (2012). The specific richness at the level of the sampling localities is between one and four species. The majority of them contain at least 3 species.

Our study revealed that *A. mauritanicus* has a fairly wide ecological niche since it occupies habitats with different environmental features (various climates and different altitudes in all stations). The wide distribution of this species is due also to its adaptation to the areas modified by human activities and their neighbourhood.

The discovery of *B. slimanii*, like the other species of the genus *Butheloides,* is difficult, due to its small size and its cryptic form. It is likely that future surveys might reveal other localities for this species as well as other species of the genus whose distribution remains unclear.

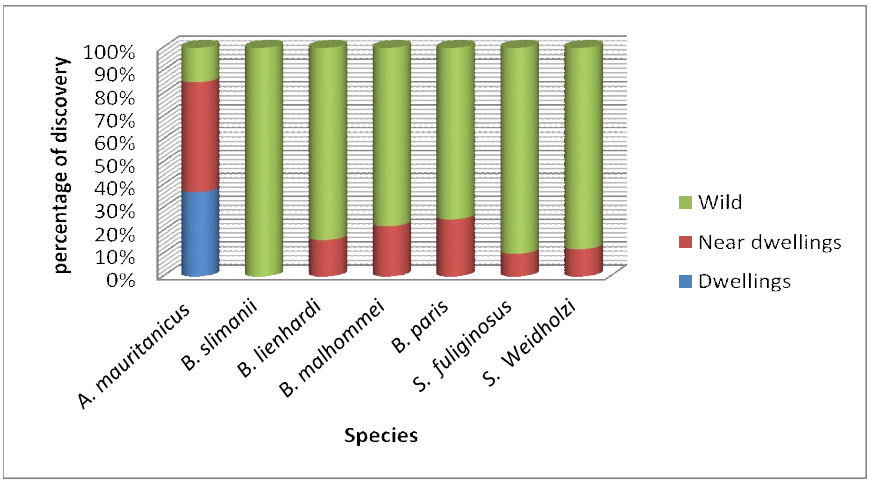


Fig 3: Distribution of scorpion species according to biotopes.

The distribution of *Buthus* species follows an altitudinal gradient. *Buthus malhommei* which is the typical species of the Haouz plain of Marrakech region (Touloun, 2012) was inventoried in Ouled Ayyad which is also a plain station. It represents so far the most northerly collection site for the distribution of this species according to our research work.

In the center of western Morocco, *B. paris* occupies the stations of the north Atlas mountains under 1300 m altitude (Touloun, 2012). In the present study, this species started to be found from low altitudes (556 m in Tabia).

B. lienhadri that represents the most alticolous species of the genus in Morocco remains limited to stations located at altitudes between 1100 m in Ouaouizeght and 1716 m in Ait Mhamed.

Since all the species of the genus *Scorpio* are all burrowing, it is very likely that the study area contains other species of the genus. Another species of the genus, *S. maurus stemmleri,* was described from Demnate in Azilal province (Schenkel, 1949) but it has been reported "*nomina dubia*" by Kovarik (2009).

CONCLUSION

The present work is the first one to highlight the composition of scorpion community in the province of Azilal. The specific richness of scorpion fauna in our study area can be explained by the diversity of habitats. However, it should be noted that this inventory is not exhaustive and needs to be completed by further other investigations in order to update the distribution of this scorpion fauna.

In addition to its ecological and biogeographical importance, this fauna is of importance in the biomedical field. Indeed, certain species are upstream of several cases of serious poisonings, sometimes fatal, especially in young children. This work could constitute a complementary contribution to the comprehensive study of the scorpion sting syndrome in Morocco.

Conflict of Interest

There is no conflict of interest to be declared.

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