Diversity and Distribution of Rodents in Northern Jordan

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Abstract:

Despite the comprehensive literature on the mammals of Jordan published in the last two decades, the rodent fauna in northern Jordan remains largely unknown. This study aims to study rodents' diversity and distribution in northern Jordan. The survey was conducted during July 2020-April 2021 using Sherman folding live traps for 360 trap nights from 18 different locations along the northern borders of Jordan with Syria extending from Saham to Um el Quttein. A total of 102 individuals representing six species of rodents representing two families (Muridae: The eastern spiny mouse, *Acomys dimidiatus*; broad-toothed field mouse, *Apodemus mystacinus*; Wagner's gerbil, *Gerbillus dasyurus*; Tristram's jird, *Meriones tristrami*; and the house mouse, *Mus musculus*; Cricetidae: Günther's vole, *Microtus guentheri*) were identified. In this study, no new records for the rodents of Jordan were added. However, the present study adds new localities for the rodent fauna of Jordan and extends the distribution range for some species. Surveys on rodents and other small mammals should be carried out every two or three years to estimate their population size and monitor changes in their composition.

Keywords:

Rodentia, Northern Jordan, Diversity, Distribution.

Introduction

Rodents make up one of the most diverse groups of mammals on the planet, accounting for nearly half of all recognized mammalian species. Rodents are divided into 33 families with over 2,287 species representing a wide range of appearance and behavior (Wilson and Reeder, 2005).

Amr (2012) reported that 26 rodent species representing seven families (Spalacidae, Hystricidae, Sciuridae, Dipodidae, Gliridae, Cricetidae, and Muridae) were recorded during the study of Jordanian mammals. The study showed that rodents are the most diverse group of mammals in Jordan. Amr *et al.* (2018) gave details on the distribution and ecology data to all rodents of Jordan as well as identification keys for families and species. Habitat preference and zoogeographic affinities of rodents in Jordan were analyzed. The authors reported 28 species of rodents with 20 genera in eight families (Cricetidae, Dipodidae, Gliridae, Hystricidae, Muridae, Myocastoridae, Sciuridae, and Spalacidae) were recorded in Jordan.

This study is the first attempt to study the rodents of northern Jordan.

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Materials and Methods
Area of study:

1. Sama as Sirhan, Raba'a Al Sarhan, Hawija, Al Kawm al Aḥmar and Um el Quttein

These regions located within the Irano-Turanian area, and they meet the Syrian border. The vegetation is dominated by *Anabasis articulata, Artemesia herba-alba, Astragulus spinosum, Retama raetam, Urginea maritima, Ziziphus lotus, Zygophyllum dumosum,* and scattered *Pistacia atlantica* trees. The altitude of these regions ranges from 400 to 700 m asl, with an average annual rainfall of 50-100 mm. Surface soil layers are thin or non-existent in certain situations, and surface rockiness is quite high. Chains of basalt rocks scattered throughout the region, as well as spots of wheat fields (Amr, 2012, Ababsa, 2013) (Figure 1).

2. Ar Ramtha, As Sarih, Ash Shajarah, Elhusn, Balad ash Shaykh, Foara, Saham, and Zubiah

These localities lie within the Mediterranean region, which is defined by mountain ranges that stretch from Irbid in the north to Ra's Al Naqb in the south. The elevation of these regions ranges from 700 to 1500 m asl, with an annual rainfall of 400-600 mm (Amr, 2012, Ababsa, 2013) (Figure 1).

A total of 18 locations along the northern borders of Jordan with Syria extending from Saham to Umm Al Quttain were visited. The sites in which the traps were set up, coordinates and number of traps are recorded (Table 1).

Table 1. List of trapping localities.

Location	N	E	Number of Traps
1. Al Hammah	32° 41' 45.43''	35° 41' 26.68''	20
2. Al-Kawm al Aḥmar	32°22'26.79"	36°23'59.00"	20
3. Ar Ramtha	32° 34' 0.82''	36° 3' 2.74''	20
4. As Sarih 1	32°29'21.90"	35°55'15.18"	20
5. As Sarih 2	32°28'49.05"	35°57'46.97"	20
6. Ash-Shajara 1	32° 39' 22.97''	35° 58' 4.89''	40
7. Ash-Shajara 2	32° 39' 55.20''	35° 57' 20.36''	25
8. Ash-Shajara 3	32° 38' 20.63''	35° 56' 5.88''	19
9. Balad ash Shaykh	32° 40' 6.82''	35° 43' 18.74''	20
10. Elhusn	32°28'3.07"	35°56'20.34"	10
11. El-kherba	32° 39' 18.89''	35° 55' 47.72''	20
12. Fo'ara	32° 37' 9.62''	35° 46' 10.60''	20
13. Hawija	32° 25' 52.29''	36° 16' 50.80''	20
14. Raba'a Al Sarhan	32° 26' 59.65''	36° 17' 6.19''	20
15. Saham	32° 42' 45.45''	35° 45' 55.03''	16
16. Sama as-sirhan	32° 27' 54.68''	36° 15' 47.16''	20
17. Um el Quttein	32° 19' 46.31''	36° 37' 47.28''	20
18. Zubiah	32° 26' 36.07''	35° 46' 27.66''	10

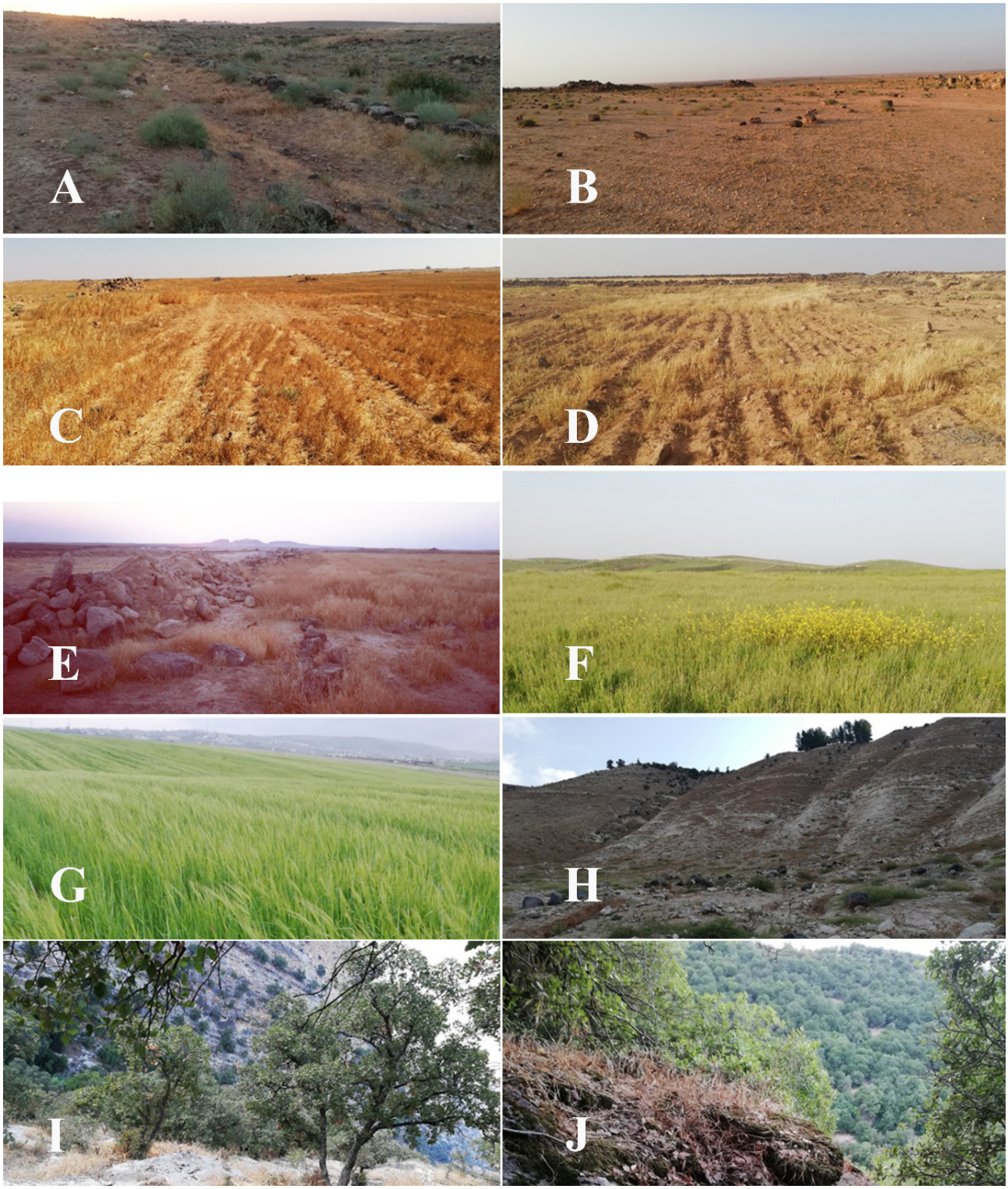

Figure 1. A. Habitat of Sama As-Sirhan area, near the Syrian border. B. Raba'a area showing desert plains with thorny plants and basalt rocks. C. Hawija area showing wheat fields and rocky accumulations. D. A wheat field with basalt rock chains in the Al Kawm al Aḥmar area. E. Habitat of Um el Quttein area, near the Syrian border. F. Wheat fields on the border with southern Syria in the Ar Ramtha area. G. Wide plains of wheat in the As Sarih area. H. Habitat of Wadi Ash Shajarah area. I. Saham area showing rocky cliffs with an abundance of oak trees. J. Dense oak forests of *Quercus calliprinos* in the Zubiah area.

Sherman folding live-traps

The survey was conducted during July 2020-April 2021. Rodents were trapped using Sherman folding live-traps (23 × 9 × 9 cm). Number of traps per location is shown in table (1). Traps were baited with mixed oatmeal and peanut butter. The traps were set in the late afternoon and checked in the early morning at sunrise the following day. Traps were aligned in longitudinal transects 20 meters apart from each other.
By using a nylon bag, the rodent species was tentatively identified based on morphological characteristics. and identified according to Amr (2012). Traps are cleaned, ventilated, and prepared for the next field trip.

Results

The 360 trap nights yielded 102 rodents' specimens belonging to six rodent species in two families (Muridae: *Acomys dimidiatus*, *Apodemus mystacinus*, *Gerbillus dasyurus*, *Meriones tristrami*, and *Mus musculus*, Cricetidae: *Microtus guentheri*) (Table 2 and 3, Figure 2 and 3).

Table 2. Relative abundance (%) of rodent species collected from 18 sites in northern Jordan.

Family	**Species**	Relative abundance (%)
Cricetidae	*Microtus guentheri*	0.06
Muridae	*Acomys dimidiatus*	0.1
	Apodemus mystacinus	0.04
	Gerbillus dasyurus	0.13
	Mus musculus	0.53
	Meriones tristrami	0.14

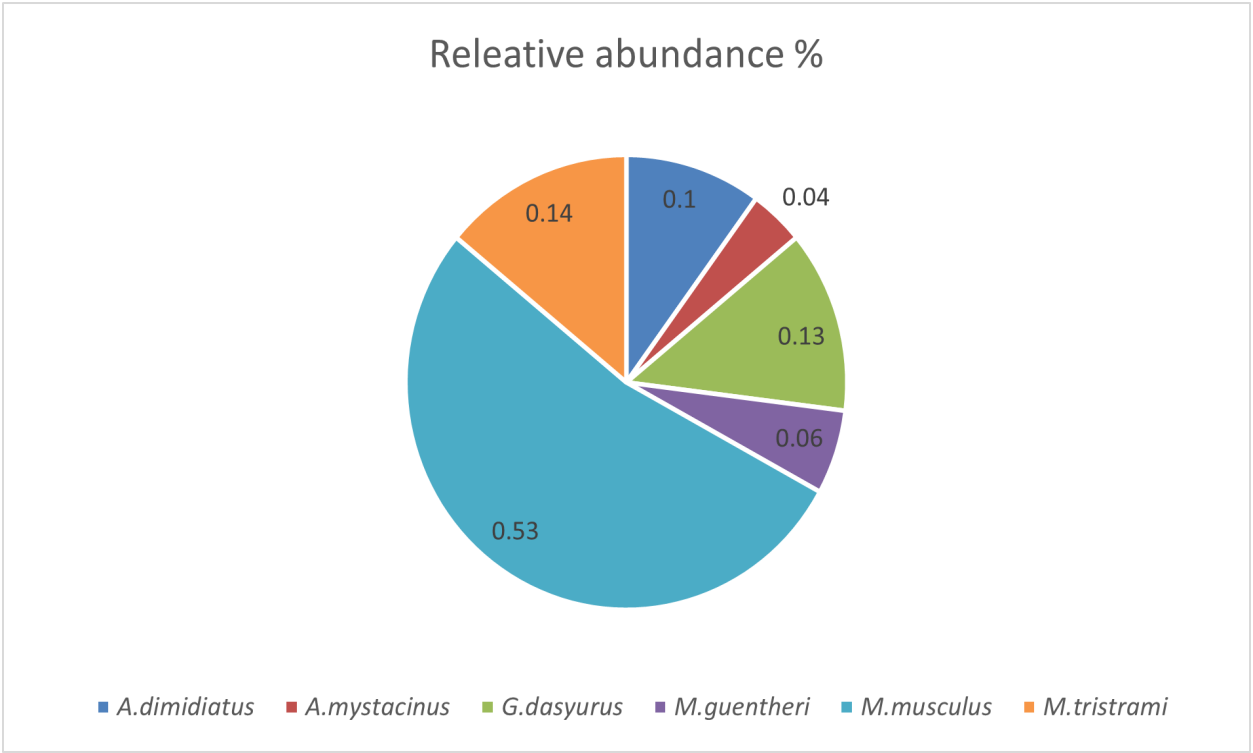

Figure 2. The relative abundance for the rodents' species that recorded at northern Jordan.

By far, *M. musculus* was the most abundant species, followed by *G. dasyurus* and *M. tristrami*. Both *A. dimidiatus* and *A. mystacinus* were the least abundant species (Figure 2).

Figure 3. Diversity of rodents in northern Jordan. A. The eastern spiny mouse (*Acomys dimidiatus*). B. Broad- toothed field mouse (*Apodemus mystacinus*). C. Wagner's gerbil (*Gerbillus dasyurus*). D. Tristram's jird (*Meriones tristrami*). E. The house mouse (*Mus musculus*). F. Günther's vole (*Microtus guentheri*).

Table 3. Number of rodents trapped per site.

Location	*A. mystacinus*	*A. dimidiatus*	*M. musculus*	*G. dasyurus*	*M. tristrami*	*M. guentheri*
Al Hammah	0	6	0	1	2	0
Al-Kawm al Aḥmar	0	0	1	0	2	0
Ar Ramtha	0	0	1	0	1	0
As Sarih	0	0	2	0	0	0
Ash-Shajara	0	3	26	0	1	6
Balad ash Shaykh	1	3	0	1	1	0
Elhusn	0	0	1	1	0	0
El-kherba	0	0	0	2	0	0
Saham	1	0	0		0	0
Sama as-sirhan	0	0	17	8	1	0
Um el Quttein	0	0	9	1	1	0
Zubiah	2	0	0	0	0	0

Family Muridae

***Acomys dimidiatus* (Cretzschmar, 1826)**
Arabian spiny mouse, Eastern spiny mouse**.**
Material Examined. 3 specimens, Ash-Shajara, 24 July 2020. 6 specimens, Al Hammah, 14 October 2020. 3 specimens, Balad ash Shaykh, 25 January 2021.

Remarks: This species was found among rocky areas in Al Hammah and Ash-shajara areas. *Acomys dimidiatus* lives in mesic and xeric biotopes and is a rock-dwelling rodent. It can be found in Jordan's entire mountain ranges, which reach from Aqaba to Al Hammah in the far north. It also encroached on Mediterranean forest ecosystems in northern Jordan, such as the Jarash and Malka forests, which have thick pine and deciduous oak vegetation, respectively. This species has never been found in rocky areas in the eastern desert of Jordan (Amr, 2012; Amr *et al.,* 2018).

***Apodemus mystacinus* (Danford and Alston, 1877)** Broad- toothed field mouse**.**
Material Examined. 2 specimens, Zubiah, 12 August 2020. 1 specimen, Balad ash Shaykh, 25 January 2021. 1 specimen, Saham, 1 September 2021.

Remarks: This species was found among forested areas in Zubiah and Saham. It was discovered that *Apodemus mystacinus* prefers thick, humid oak forests with or without pistachio trees or pines (Amr *et al*., 2018). This species' burrows were found under small rocky boulders or piles of rocks, with empty oak acorns often pointed their entrances (Abu Baker and Amr, 2008; Amr *et al.,* 2018).

***Gerbillus dasyurus* (Wagner, 1842)**
Wagner's gerbil.
Material Examined. 5 specimens, Sama Al-Sarhan1, 16 August 2020. 3 specimens, Sama as-sirhan 2, 18 August 2020. 1 specimen, Um el Quttein, 23 September 2020. 2 specimens, Sama as-sirhan 3, 1 October 2020. 1 specimen, Al Hammah, 14 October 2020. 1 specimen, Balad ash Shaykh, 25 January 2021.

Remarks: This species was found among chains of basalt rocks and scattered wheat fields in Sama Al-Sarhan and Um el Quttein. Gerbillus dasyurus can be found in a variety of environments, including basalt deserts, sandstone mountains, hammada deserts, and temperate areas of the Mediterranean mountains. The Jordanian Desert is home to a large population of this gerbil. Wagner's gerbil was discovered to share burrows with Psammomys obesus (Amr and Saliba, 1986). The burrows of *Gerbillus dasyurus* were simple but deep, with one or two unplugged

emergency exits (Hatough-Bouran, 1990). According to Amr *et al.* (2018), Wagner's Gerbil is also found in sand dunes, dry wadi beds, flat gravel plains, limestone cliffs, and narrow wadis and hills. *Anabasis articulata, Atriplex halimus,* and *Artemisia sieberi* were among the stored plants in the burrows (Abu Baker and Amr, 2003a).

***Meriones tristrami* (Thomas, 1892)**
Tristram's jird.
Material Examined. 1 specimen, Ash-Shajara, 24 July 2020. 1 specimen, Elhusn, 5 Augest 2020. 2 specimens, Al Hammah, 14 October 2020. 2 specimens, El-Kherba, 10 September 2020. 1 specimen, Um el Quttein, 23 September 2020. 1 specimen, Sama as-sirhan, 1 October 2020. 1 specimen, Balad ash Shaykh, 25 January 2021. 4 specimens, Ar Ramtha, 10 Mar 2021. 2 specimens, Al Kawm al Aḥmar, 8 April 2021.

Remarks: This species was found among the steppe of scattered thorny vegetation in Sama Al-Sarhan and Um el Quttein. *Meriones tristrami* lives in the Mediterranean and steppe regions of Jordan, mostly in the humid and dry Mediterranean regions (Amr, 2012). Peter (1961) investigated Tristram Jird's burrow system, which could be small (50 cm long) or large reaching several meters in length.

***Mus musculus* (Linnaeus, 1758)** The house mouse.
Material Examined. 13 specimens, Ash-Shajara (1), 23 July 2020. 2 specimens, Ash-Shajara (2), 24 July 2020. 11 specimens, Ash-Shajara (3), 24 July 2020. 1 specimen, Elhusn, 5 Augest 2020. 9 specimens, Um el Quttein, 23 September 2020. 1 specimen, Sama as-sirhan (1), 16 August 2020. 5 specimens, Sama as-sirhan (2), 18 August 2020. 11 specimens, Sama as-sirhan (3), 1 October 2020. 1 specimen, Ar Ramtha, 10 Mar 2021. 2 specimens, As Sarih, 21 Mars 2021. 1 specimen, Al Kawm al Aḥmar, 8 April 2021.

Remarks: This species was found in all regions of this research. Mus musculus is a common species that can be found in a wide range of environments, including deserts. It can be found in both new and old homes, restaurants, hotels, and farms. Because of its close connection with humans, it has spread across much of the world. In some areas, it is confined to human dwellings and ecosystems preserved by human activity, and when introduced, it may become feral. (Amr, 2012; Amr *et al.*, 2018).

Family Cricetidae
***Microtus guentheri* (Danford & Alston, 1880)** Levant vole.
Material Examined. 6 specimens, Ash-Shajara, 23 July 2020.

Remarks: This species was found only among the wheat plains in the Al-Shajara area on the border with Syria. According to Amr (2012), *Microtus guentheri* is only found in the Mediterranean biome. In the areas between Irbid and Al Mafraq, some colonies were discovered. This is a colonial species, with colonies ranging from 40 to 100 burrow systems per 1000 m^2. Gray hamster (*Cricetulus migratorius*) and Tristram's jird (*Meriones tristrami*) share burrows with it. *Microtus guentheri* is a favorite of the Barn owl, *Tyto alba* (Rifai *et al.*, 1998).

Discussion

The rodent fauna of northern Jordan follows two patterns: those found near plains and rocky valleys in the Ash-Shajarah, as well as Mediterranean forests in the Zubiah and Saham areas, have Palearctic affinities (*Apodemus mystacinus*, and *Microtus guentheri*), while those found in arid regions have mesic affinities (*Meriones tristrami* and *Gerbillus dasyrus*).

New sites within the distribution range for each species of rodents were recorded in northern Jordan, which are as follows: *Acomys dimidiatus* (Ash-Shajara), *Apodemus mystacinus* (Saham), *Gerbillus dasyurus*

(Sama as Sirhan, Al Hammah, and Balad ash-Shaykh), *Meriones tristrami* (Al Kawm al Aḥmar, Sama as Sirhan, Al Hammah, Harta, Amrawah, and Balad ash-Shaykh), *Microtus guentheri* (Ash-Shajara).

The Balad ash-Shaykh mountains, covered in deciduous oak and punctuated by narrow valleys, have the highest diversity, whereas four species were collected: *Meriones tristrami*, *Acomys dimidiatus*, *Apodemus mystacinus*, and *Gerbillus dasyurus*). The lowest diversity was recorded in several localities with different habitats where only one species was recorded as follow: Zubiah (*Apodemus mystacinus*), El-kherba (*Meriones tristrami*), and As Sarih (*Mus musculus*). In addition, the highest trappbility (0.59) was recorded in the Um el Quttein and Ash Shajarah areas.

The most frequently trapped species was the house mouse (*Mus musculus*), accounting for 0.53 % of all traps (Figure 2). This species is a common species of northern Jordan, as was recorded in almost all regions, especially wherever there are human habitations. It is a common species found around plantations and inhabited areas. *Mus musculus* populations are increasing in northern Jordan due to their ability to adapt to a variety of conditions and ability to construct nests everywhere. Moreover, the growing human presence for grazing and farming in many places led to the introduction and extensive reproduction of this species.

Despite intensive trapping in northern Jordan, particularly in the Sama as Sirhan and Ash-Shajarah areas, the gray hamster (*Cricetulus migratorius cinerascens*) was neither captured nor recovered from owl pellets. Rifai *et al.* (1998) found this species in Barn owl pellets collected in the As Sarih region.

The distribution range of *Acomys dimidiatus* fits very well with its current distribution that extending from northern parts of Jordan until its most southern edges (Amr *et al.,* 2018). This species was only found near the northern border of Jordan with Syria in the Ash-Shajarah and the Al Hammah areas, where it inhabited rockslides and the pilling up of large basalt rocks in wadis.

According to Amr (2012), the habitat of northern Jordan is appropriate for *Apodemus mystacinus*, it has a rocky Mediterranean habitat with an abundance of evergreen oak forests. *Apodemus mystacinus* is a widespread and abundant species in the forested areas within its distribution range in Jordan and still fits very well with its current distribution (Amr, 2012). In current study, *Apodemus mystacinus* was only found in the Zubiah and Saham areas with the same habitats. On the other hand, Wagner's gerbil (*Gerbillus dasyurus*) was only found in rocky areas. Hatough-Ouran (1990) stated that *Gerbillus dasyurus* prefers the runoff wadis rather than another habitat. This gerbil prefers rocky areas with little vegetation and avoids sandy soil (Amr, 2012). In this study, *Gerbillus dasyurus* was collected from different localities within the arid Mediterranean such as Al Kawm al Amar, Um el Quttein, and Sama as-sirhan.

Microtus guentheri was found in the Mediterranean biotope, with colonies located between Irbid and Al Mafraq (Amr, 2012). In this study, this species was only trapped near Jordan's northern border with Syria, in the Ash-Shajarah region, where intensive agriculture is widespread (Shehab *et al.*, 2018).

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