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الجمعية الملكية لحماية الطبيعة
RSCN
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Scope

The Jordan Journal of Natural History is an open access scientific publication published by the Conservation Monitoring Center at the Royal Society for the Conservation of Nature. The aim of the journal is to enrich knowledge on the regional fauna and flora of the Arabian countries of the Middle East (Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, United Arab Emirates, and Yemen). This includes fauna, flora (Systematics, taxonomy, Phylogenetics, Genetics, Morphology, Conservation, Ecology, Biogeography, and Palaeontology) and Geology. Monographs will be published as a supplementary issue.

Type of papers

The journal publishes high-quality original scientific papers, short communications, correspondence, books reviews, and case studies. Review articles are only by invitation. However, review articles of interest and high standard will be considered.

Submission of Manuscripts

Manuscripts should be solely submitted to the Jordan Journal of Natural History and have not been published or submitted elsewhere. All manuscripts will be reviewed by at least two referees. Based on reviewers' recommendations, the Chief Editor will decide whether the manuscript will be accepted or rejected for publication. Electronic submission of manuscripts is strongly recommended. Submit manuscript as e-mail attachment to the Editorial Office at: jjnh@rscn.org.jo. After submission, a manuscript number will be communicated to the corresponding author.

Manuscript format

Title page: the title page should include concise title; a short running title, author(s) full name(s), affiliation, complete postal address, e-mail addresses, phone, and fax numbers of the author to whom all correspondence should be addressed.

Abstract: an abstract not exceeding 300 words, summarized account of the subject, results and conclusions should be given.

Keywords: Three to seven keywords should be included for each paper. Use of abbreviations should be avoided, only standard abbreviations, well known in the established area may be used, if appropriate. These keywords will be used for indexing.

Introduction: Should include a short introduction to the background, a brief literature survey and the scope and aim of the work done.

Materials and Methods: Give adequate information to allow the experiment to be reproduced. Already published methods should be mentioned with ref

erences. Significant modifications of published methods and new methods should be described in detail. Subheading can be used.

Results: Results should be concise and should not include discussions. Text, tables and figures should not duplicate the same information. Newly described taxa must be distinguished from related taxa. For newly described species, the holotype should be deposited and numbered in a recognized museum.

Discussion: Concise discussion without repeating the results with the significance of the present work should be provided. Citations should be given in support of the findings.

Acknowledgment: A brief acknowledgment section may be given after the conclusion section just before the references. The acknowledgment of people who provided assistance in manuscript preparation, funding for research, etc. should be listed in this section.

References: should be listed in alphabetical order and cited according to the Harvard citation style.

Figures and Tables: It is in the author's interest to provide the highest quality figure format possible. Figures must be saved separate to text. Please do not embed figures in the file. Files should be saved as one of the following formats: TIFF (tagged image file format), PostScript or EPS (encapsulated PostScript), and should contain all the necessary font information and the source file of the application.

All figures and tables must be numbered in the order in which they appear in the paper (e.g. Figure 1, Figure 2) and their position should be indicated in the text. In multi-part figures, each part should be labelled (e.g. Figure 1(a), Figure 1(b)). Tables should be numbered using Arabic numerals.

Both black and white and colored photographs are accepted. However, these photographs need to be of high quality, and minimum of 300 dpi resolution. They should not to be submitted within the text, but as a separate attachment with a file name refers to the figure location within the text (e.g figure 1).

Manuscript style

Times New Roman font size 12 should be used. Lines should be doubled spaced. Titles and subtitles should be bold with first word and proper nouns cap only, and paragraphs should be indented.

After final acceptance of the manuscript, the author(s) should sign a copyright form for the journal. No page charges are due for publishing in the journal. The table below summarizes the manuscript style:

Section	Format
Title	**Bold, first word and proper nouns cap only, Times New Roman, size 14, Centred**
Author/s	An Author and Another Author (initials closed up for example if: J.B Hamad), centred, Regular, Times New Roman, size 14
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Abstract	**Abstract:** Text smaller, indented both sides, Centred, Regular, Time New Roman, size 11
Key words	**Keywords:** word; another word; lower case except names. Position aligned with abstract, same size as a abstract
Headings	**A. Bold initial cap only (size 12 bold)** *B.* ***Bold italic initial cap only (size 12 bold, italic)*** *C. Italic initial cap only (size 12 italic)* *D. Italic initial cap only (size 12 italic*) Text runs on after a punctuation mark All ranged left, numbers to be included if supplied, no indent below.
Paragraph	Indented Paragraph: use this for the first paragraph in a section, or to continue after an extract. New paragraph: use this style when you need to begin a new paragraph.

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In memory of Dr. Iyad Nader 1934 - 2015

Prof Dr. Iyad Nader passed away on the 17th of February 2015. He was born in Baghdad, Iraq, on 1.2.1934.

He obtained his Bachelor of Science (Biological Sciences) from Baghdad University in 1954, and later a master degree in 1958 and his doctorate in Zoology from the University of Illinois, USA in 1964. After returning to Iraq, he served as Assistant Professor, University of Bagdad, Iraq (1964-1971), Director, Biological Research Center, Baghdad (1967–1971), UNESCO expert in Biology, King Saud University, Riyadh, Saudi Arabia (1971), Assistant Professor, King Saud University, (1971–1975), Chairman, Department of Biology, College of Education, King Saud University (1975–1976), Chairman of the Department of Science and Mathematics, College of Education, King Saud University Branch, Abha, Saudi Arabia (1976–1981), Advisor, National Commission for Wildlife Conservation and Development, Riyadh, (1987–1998) and Director, King Khaled Wildlife Research Center, Riyadh (1998–2007).

He served as a member in six of the Species Specialist Groups of the IUCN, and he was a co-founder, Saudi Biological Society. In addition, he served as a chairman of the editorial board of the Bulletin of the Biological Research Center, Baghdad, Iraq. 1968 – 1971 and member of the editorial board of the Gulf Journal of Scientific Research during 1982 – 1990, a member of the national board of the Fauna of Saudi Arabia and editor of vertebrates of Fauna of Arabia series during 2002 – 2015.

During his academic career, he published more than 85 scientific papers in local and international journals and attended and participated in more than 45 local and international scientific meetings in the area of environment.

Prof. Dr. Zuhair Amr

In memory of Dr. Adwan Shehab 1967 - 2015

Syria and the Middle East lost one of the most active and renowned zoologists on 16.2.2015 as a result of the bloody conflict in Syria.

Adwan was shot in the streets of Dara'a by a sniper in cold blood leaving behind his wife and four children. It is not just his family, the many people whom loved him all over world.

Adwan was born on 20.10.1967 in Dara'a, Syria. He grew up in a struggling family, and then joined the University of Damascus in 1992 and earned his doctoral degree in 1999. Soon after graduation he joined the General Commission for Scientific Agricultural Research as a senior researcher, where he stayed until his death.

Adwan was a very ambitious and active biologist. By far he was the most outstanding zoologists in Syria. He published over 30 articles on the mammals of Syria covering various aspects of rodents and bats ecology. His work stands as a legacy for his devotion for the gap of knowledge in the Syrian fauna. He teamed up with several zoologists from Algeria, Austria, England, Jordan, Lebanon, Poland and Turkey, and to conduct field work in Syria, Lebanon and Jordan. He attended many meetings all over the Middle East, Netherlands, Bulgaria, Czech Republic and Bulgaria. He represented Syria in the Eurobats Convention.

Adwan published 10 articles in *Zoology in the Middle East* on various topics of the mammals of Syria. His illustrations give an idea about his skills to produce high quality work, besides he was an excellent photographer, where some of his photos became a cover for *Zoology in the Middle East*. I worked very closely with Adwan since 1996; we conducted many excursions in Syria and Jordan, to explore the biodiversity of Syria. He was venturous and very knowledgeable about the terrain of Syria. I visited his family, his mother, father, his four brothers, his wife and children. For me, they represent what a family should be and the strong ties are exceptional.

Adwan will be remembered by all his friends by his sense of humor and warm friendship.

Prof. Dr. Zuhair Amr

Contents

Flora of Shaumari Wildlife Reserve, Jordan

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ABSTRACT

Shaumari Wildlife Reserve is the first reserve established by the Royal Society for the Conservation of Nature in Jordan, yet the total flora accounts has never been published or known to the nearest species number. In this study the flora of Shaumari Wildlife Reserve has been prepared and accumulated based on the latest survey and all previous studies since 1975.

This study has revealed that the flora is composed of a total number of 237 species belonging to 152 genera and 36 families. All taxa and abbreviations were checked in accordance to the latest Plant List of Plants (Royal Botanic Garden, Kew, UK) and according to the Tropicos database (Missouri Botanical Garden, USA).

Key Words: Flora, Shaumari Wildlife Reserve, Eastern Desert, Jordan.

INTRODUCTION

Shaumari Wildlife Reserve (SWR) is the oldest reserve established in 1975 as the first Jordanian wildlife reserve that acts as a breeding center for endangered or locally extinct faunal species and to provide an open station for scientific research programs in the arid and semi-arid habitats. The last ecological survey was conducted in 2002 by Royal Society for the Conservation of Nature (RSCN) staff, and thus the need for updating ecological database of the site is becoming urgently needed.

Unpublished work on the flora of SWR was undertaken by John Clarke in the 1975-1979. He started his investigation by collecting plant specimens as a herbarium collection, then made notes on the reserve and suggested some tracks for walking through, as well as the remarkable center point known as Clarks Point. Ecological and vegetation studies were conducted in SWR almost 30 years ago. Ecological analysis of the vegetation of SWR was studied based on line transect survey. Soils types vegetation covers were described, 46 plant species were recorded, in addition to parameters of vegetation analysis as dominance, density coverage, height and carrying capacity (Al-Eisawi & Hatough, 1987).

Another study was conducted for assessment of the vegetation present at that time in SWR in relation to the number of the introduce heard of Oryx and the total number of animals that can live after their release within the larger area of the reserve based on calculation of the carrying capacity (Hatough & Al-Eisawi, 1988). A further study was also published related to the rodents types namely gerbils occurring within Shaumari boundaries and what type of plants they feed upon, especially *Anabasis syriaca* (Hatough *et al.,* 1986). A study on the Arabian Oryx was made to evaluate the presence of Oryx in SWR and the need for natural feed.

The study recorded a list of palatable species within the reserve such as *Atriplex halimus* and *Artemisia herba-alba* in addition to about 20-30 palatable herbaceous plants occurred in the reserve, where the vegetation within the reserve proved to be very rich and dense (Hatough & Al-Eisawi, 1988).

RSCN (2002) undertook the ecological baseline survey for the reserve which was the latest floral study till now; they produced a list of unpublished work. Nowadays, many challenges are facing SWR as low annual rainfall and human encroachments that cause deterioration and habitat damage, and thus the need for updating ecological database of the site is appeared.

A study was made between February and April, 2014 and resulted in recording 81 species belonging to 63 genera and 22 families. Six species recorded as rare plants and two species were endemic recorded within the reserve. Twenty two species were palatable and eight of medicinal uses and four woody plants, in addition to three edible and two poisonous species (Al-Eisawi *et al.,* 2014). The results showed variation in number of recorded plant species in the reserve during the last 40 years. The difference of plant species number in the reserve in comparison with other studies is a result of sharp fluctuation of rainy season, including amount of annual rainfall and time of falling, and this is confirmed by Al-Eisawi (1996).

In recent years in Jordan a quite good work has been produced related to the flora and biodiversity of Jordan especially, those related to conservation of biodiversity and medicinal plants. Among these studies is the vascular plants of Shoubak (Oran, 1994); Biodiversity of Karak province (Oran *et al.,* 1994); a list of the flowering plants of Tafila Province (Oran, 2014a) and the status of medicinal plants of Jordan (Oran, 2014b).

The present study represents additional records for the flora of SWR.

MATERIALS AND METHODS

Continuous visits to the reserve since the initiations were made. The visits have various objectives either assessing general status of the reserve in terms of conservation validation, studying the flora, students training and observation and sometimes taking groups of interested peoples to observe the biological

diversity. In most visits herbarium species as well as vegetation studies plant samples have been collected. Most of the specimens are deposited at the herbarium, Department of Biological Sciences, University of Jordan, Amman. Some of the specimens are still deposited at the Shaumari Reserve and some are deposited at the RSCN.

The specimens have been treated as routine treatment of collection, pressing, drying, poisoning and mounting on an international sheet size (12x18"). After that the specimens have been identified and then filed and deposited in the herbarium. Most of the important tools used are, note book for recording taxa and other notes, camera, GPS, plastic bags, shears, diggers and private tools. Field guides and identification references were used to verify the identification of collected specimens (*Zohary et al.,* 1966-1986; Al-Eisawi, 1998 & 2013).

Study area

SWR is located in the eastern desert of Jordan between coordinates 28° 7` 100`` to 29° 25` 00`` N and 35° 17` 500`` to 35° 11` 200`` E with a total area of 22 km² which is completely surrounded by a double fence and situated at a distance of about 120 km from the capital city Amman. Eastern Jordan in general including SWR is made more or less of flattened area, composed of loamy to clay-sandy soil, covered mostly by gravels and in some cases with black pebbles as result of lava and old volcanic eruptions in various parts. Thus such terrain is often known as Hammada land formation and Hammada soil (Zohary, 1962 & 1973). However, SWR is part of this natural land formation, others describe it as a Hammada land (Al-Eisawi & Hatough, 1987; Al-Eisawi, 1996).

Nevertheless, SWR consists of three main wadis Al-Shaumari, Al-Dabi and Al-Ghadaf. The clayey-sandy soil land that forms the site has two main component; limestone hammada plains (gravel hammada) in the southern and southwestern parts, intersected with wadis system (Fig. 1). Shaumari is characterized by hot summer and cold winter with lowest annual rainfall in the country ranges between 50-100 ml and specifically, about 70 ml in the Shaumari and Azraq Wetland Reserves. The reserve lies within the Saharo-Arabian region (Fig. 2) and dominated by Hammada vegetation type which covers the whole reserve and characterized by the presence of two subdivisions that are: Runoff Hammada and Gravel Hammada with different plant species.

Rain water as well as drainage water coming through the valley (*wadi*) systems in the reserve are moving towards north-east due to the inclination in soil level and altitude in the direction of the great *Qa'* (Azraq Oasis *Qa`*) since it is the lowest spot in the eastern desert in that region (Al-Eisawi, 1996). This water movement in the reserve often filling the *wadis* system and thus water stays for a little while in the *wadis* and accumulates for sometimes, often up to few months. Therefore, this formation of the soil barrier and thus forming a water pool named as *As-Sad* (Water Dam or *Hafira*).

At the end of the day excess water is absorbed deep in the soil and moves in the same direction (North-East) leaching the salts during the course of movement and thus forming salt accumulation at the end of the water passage. This ends by forming a clear saline water and thus saline plant community with unexpected and totally different plant community from the rest of the reserve.

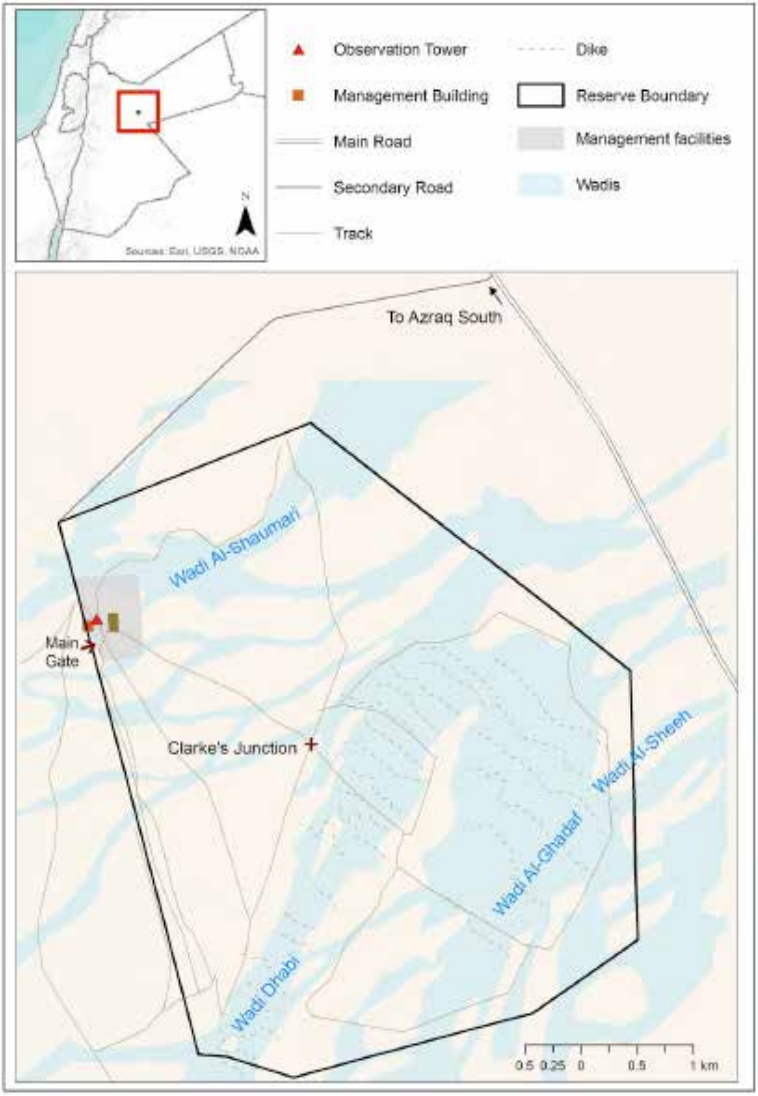
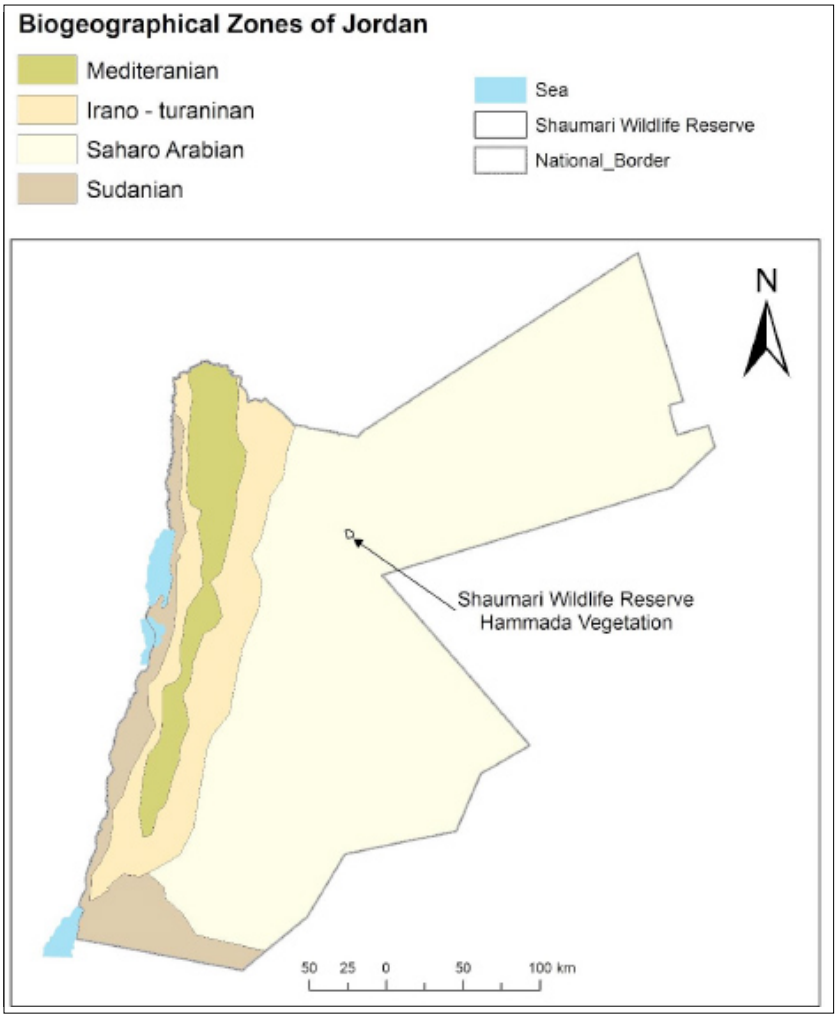


Figure 1: Location and boundaries of Shaumari Wildlife Reserve in Jordan.



Figuer 2: Showing Bio-geographical Zones of Jordan (By Al-Eisawi, 1996) and the location of Shaumari Wildlife Reserve within the Saharo-Arabian region.

RESULTS

Based on recent survey and previous surveys and visits since 1975 tell now, a total number of 237 species belonging to 152 genera and 36 families have been identified (Table 1). Some of the recorded names in the past have been altered according to new names treatment and according to new international databases such as The List of Plant Names produced by the Royal Botanic

Gardens, Kew, UK, as well as the database named Tropicos, produced by the Missouri Botanical Garden, Missouri, USA.

In fact, major groups, taxa and families have been displaced, families have merged or other families have been split into different families. One of the major steps of this kind is the emerging of the family Chenopodiaceae into the family Amaranthaceae and merging the family Asclepiadaceae and Apocynaceae together. In contracts the family Liliaceae has been split into different families and the genus *Allium* was placed in the family Alliaceae then it has been placed in Amaryllidaceae.

Nevertheless, all valid names as well as abbreviations of authors are all recorded exactly in accordance to The List of Plant Names and Tropicos as major internationally accepted databases.

Very few of the recorded species are still suspicious since they have been recorded without the presence of herbarium specimens or the herbarium specimens are missing and the species are

Girgensohnia oppositiflora (Pall.) Fenzl and *Halotis pilifera* Botsch. = *Syn.: Halimocnemis pilifera* Moq.; *Halotis pilosa* Iljin. Both species are belonging to the family Amaranthaceae which were originally under the family Chenopodiaceae.

Table 1. Showing the total list of plant species recorded in Shaumari Wildlife Reserve.

Family	Species
Acantahceae	*Blepharis ciliaris* (L.) B.L.Burtt *Blepharis attenuata* Napper
Aizoaceae	*Aizoanthemum hispanicum* (L.) H.E.K.Hartmann = *Syn.: Aizoon hispanicum* L. *Aizoon canariense* L.
Amaranrhaceae	*Atriplex halimus* L. *Agathophora alopecuroides* (Delile) Fenzl ex Bunge = *Syn.: Agathophora alopecroides* = *Syn.: Halogeton alopecuroides* *Anabasis articulata* (Forssk.) Moq. *Anabasis setifera* Moq. *Anabasis syriaca* Iljin *Arthrocnemum macrostachyum* (Moric.) K.Koch *Atriplex leucoclada* Boiss.
	Atriplex semibaccata R.Br. *Atriplex stylosa* Viv. *Bassia eriophora* (Schrad.) Asch. = *Syn.: Bassia latifolia* (Fresen.) Asch. & Schweinf *Bassia indica* (Wight) A.J.Scott = *Syn.: Kochia indica* Wight *Bassia muricata* (L.) Asch.

	Chenopodium murale L. *Girgensohnia oppositiflora* (Pall.) Fenzl *Halocnemum strobilaceum* (Pall.) M.Bieb. *Halothamnus acutifolius* (Moq.) Botsch.= *Syn.: Aellenia autranii* (Post) Zohary *Halothamnus hierochunticus* (Bornm.) Botsch. *Halotis pilifera Botsch.* = *Syn.: Halimocnemis pilifera* Moq.; *Halotis pilosa* Iljin *Haloxylon salicornicum* (Moq.) Bunge ex Boiss. = *Syn.: Hammada salicornica* (Moq.) Iljin *Hammada eigii* Iljin *Hammada scoparia* (Pomel) Iljin = *Syn.: Hammada scoparia* (Pomel) Iljin *Mesembryanthemum nodiflorum* L. *Salsola imbricata* Forssk. = *Syn.: Salsola baryosma* (Schult.) Dandy *Salsola jordanicola* Eig *Salsola longifolia* Forssk. *Salsola schweinfurthii* Solms *Salsola tetrandra* Forssk. *Salsola vermiculata* L. *Salsola volkensii* Schweinf. & Asch. *Seidlitzia rosmarinus* Bunge ex Boiss. *Suaeda aegyptiaca* (Hasselq.) Zohary *Suaeda vermiculata* Forssk. ex J.F.Gmel. *Suaeda vermiculata* Forssk. ex J.F.Gmel.= *Syn.: Suaeda fruticosa* Forssk. ex J.F.Gmel. *Traganum nudatum* Delile
Apiaceae	*Deverra triradiata* Hochst. ex Boiss. = *Pituranthos triradiatus* (Hochst. ex Boiss.) Asch. & Schweinf. *Eryngium glomeratum* Lam. *Ferula communis* L. *Peucedanum spreitzenhoferi* Dingler *Pimpinella eriocarpa* Banks & Sol.
Asteraceae	*Anthemis pseudocotula* Boiss. *Aaronsohnia factorovskyi* Warb. & Eig *Achillea falcata* L. *Achillea fragrantissima* (Forssk.) Sch.Bip.
	Artemisia herba-alba Asso, Not, *Artemisia sieberi* Besser = *Artemisia inculta var. laxiflora* (Boiss.) Täckh. *Asteriscus graveolens* (Forssk.) Less. *Asteriscus pygmaeus* (DC.) Coss. & Durieu *Atractylis cancellata* L. *Atractylis mutica* C.C.Towns. *Calendula arvensis* (Vaill.) L. = *Syn.: Calendula micrantha Boiss. & Noë* *Calendula arvensis* M.Bieb. *Calendula tripterocarpa* Rupr.

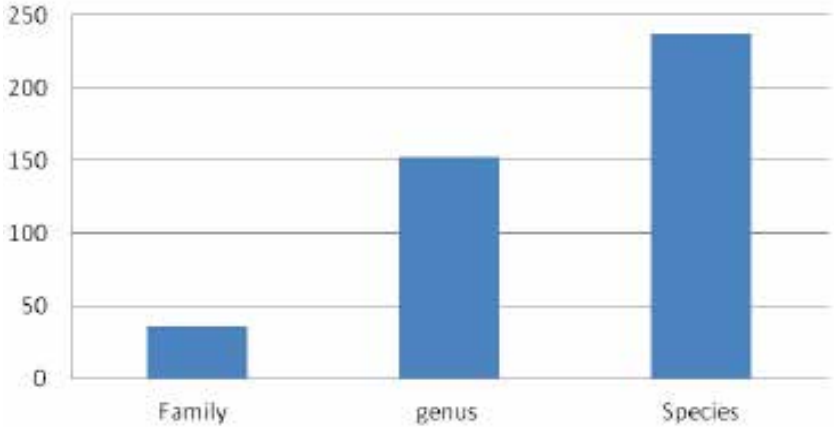
	Carduus australis Jord. *Carduus getulus* Pomel *Carduus pycnocephalus* L. *Carthamus tenuis* (Boiss. & Blanche) Bornm. *Centaurea ammocyanus* Boiss. *Centaurea pallescens* Delile *Crepis aspera* L. *Echinops glaberrimus* DC. *Echinops polyceras* Boiss. *Erigeron bonariensis* L. = *Conyza bonariensis* (L.) Cronquist *Fagonia olivieri* DC. *Filago desertorum* Pomel *Ifloga spicata* (Forssk.) Sch.Bip. *Lactuca undulata* Ledeb. *Lasiopogon muscoides* (Desf.) DC. *Launaea fragilis* (Asso) Pau *Launaea nudicaulis* (L.) Hook.f. *Leontodon laciniatus* (Bertol.) Widder *Notobasis syriaca* (L.) Cass. *Onopordum heteracanthum* C.A.Mey. *Picris longirostris* Sch.Bip. *Picris longirostris* Sch.Bip. *Scorzonera mollis* M.Bieb. *Scorzoneroides hispidula* (Delile) Greuter & Talavera = *Syn.: Leontodon hispidulus* (Delile) Boiss. *Senecio coronopifolius* Burm.f. *Senecio glaucus* L. *Sonchus oleraceus* (L.) L. *Takhtajaniantha pusilla* (Pall.) Nazarova = *Syn.: Scorzonera pusilla* Pall. *Tripleurospermum auriculatum* (Boiss.) Rech.f. *Zoegea purpurea* Fresen.
Boraginacaeae	*Anchusa aegyptiaca* (L.) A.DC. *Arnebia decumbens* (Vent.) Coss. & Kralik *Gastrocotyle hispida* (Forssk.) Bunge *Heliotropium europaeum* L.
Brassicaceae	*Brassica nigra* (L.) K.Koch *Brassica tournefortii* Gouan *Carrichtera annua* (L.) DC. *Diplotaxis acris* (Forssk.) Boiss. *Diplotaxis erucoides* (L.) DC. *Diplotaxis harra* (Forssk.) Boiss. *Eruca vesicaria* (L.) Cav. = *Syn.: Eruca sativa* Mill.; Brassica eruca *L.* *Erucaria hispanica* (L.) Druce

	Erucaria pinnata (Viv.) Täckh. & Boulos *Erucaria rostrata* (Boiss.) A.W.Hill ex Greuter & Burdet *Erucaria rostrata* (Boiss.) A.W.Hill ex Greuter & Burdet = *Syn.: Erucaria boveana Coss.* *Farsetia aegyptia* Turra
Brassicaceae	*Glastaria glastifolia* (DC.) Kuntze = *Syn.: Texiera glastifolia* (DC.) Jaub. & Spach *Isatis lusitanica* L. *Lappula spinocarpos* (Forssk.) Asch. ex Kuntze *Lepidium aucheri* Boiss. *Lepidium draba* L. = *Syn.: Cardaria draba (L.) Desv.* *Malcolmia africana* (L.) R.Br. *Matthiola longipetala* (Vent.) DC. *Neotorularia torulosa* (Desf.) Hedge & J.Léonard = *Syn.: Sisymbrium torulosum* Desf. = *Syn.: Torularia torulosa* (Desf.) O.E.Schulz *Notoceras bicorne* (Aiton) Amo *Pseuderucaria clavata* (Boiss. & Reut.) O.E.Schulz *Sinapis arvensis* L. *Sisymbrium erysimoides* Desf. *Sisymbrium irio* L. *Sisymbrium septulatum* DC. = *Syn.: Sisymbrium bilobum* Grossh. *Thlaspi perfoliatum* L. *Zilla spinosa* (L.) Prantl
Cappracea	*Capparis leucophylla* DC.
Caryophyllaceae	*Paronychia argentea* Lam. *Dianthus strictus* Banks ex Sol. *Gypsophila arabica* Barkoudak *Herniaria hemistemon* J.Gay *Pteranthus dichotomus* Forssk. *Silene* sp. *Spergularia diandra* (Guss.) Heldr.
Cistaceae	*Helianthemum ledifolium* (L.) Mill. *Helianthemum lippii* (L.) Dum.Cours. *Helianthemum salicifolium* (L.) Mill.
Convolvulaceae	*Convolvulus pilosellifolius* Desr. *Cressa cretica* L. *Cuscuta* sp.
Cucurbitaceae	*Citrullus colocynthis* (L.) Schrad.
Dipsacaceae	*Lomelosia palaestina* (L.) Raf. = *Syn.: Scabiosa palaestina* L. *Pterocephalus brevis* Coult. *Pterocephalus pulverulentus* Boiss. & Balansa *Scabiosa polymorpha* Weigel
Ephedraceae	*Ephedra alata* Decne. *Ephedra transitoria* Riedl

Euphorbiaceae	*Euphorbia exigua* L. = *Syn.: Euphorbia retusa* (L.) Cav.
Fabaceae	*Alhagi maurorum* Medik. *Andrachne telephioides* L. *Astragalus boeticus* L. *Astragalus dactylocarpus subsp. acinaciferus* (Boiss.) Eug.Ott = *Syn.: Astragalus acinaciferus* Boiss. *Astragalus hamosus* L. = *Syn.: Astragalus brachyceras* Ledeb. *Astragalus sieberi* DC. *Astragalus spinosus* (Forssk.) Muschl. *Astragalus tribuloides* Delile *Lotus lanuginosus* Vent. *Medicago polymorpha* L. = *Syn.: Medicago hispida* Gaertn. *Medicago sativa* L. *Onobrychis ptolemaica* (Delile) DC. *Prosopis farcta* (Banks & Sol.) J.F.Macbr. *Retama raetam* (Forssk.) Webb *Trigonella caelesyriaca* Boiss. *Trigonella stellata* Forssk. *Vicia palaestina* Boiss. *Vicia peregrina* L.
Geranicaeae	*Erodium oxyrhinchum subsp. bryoniifolium* (Boiss.) Schönb.-Tem. = *Syn.: Erodium bryoniifolium* Boiss. *Erodium cicutarium* (L.) L'Hér. *Erodium crassifolium* L'Hér. ex Aiton = *Syn.: Erodium hirtum* Willd. *Erodium glaucophyllum* (L.) L'Hér. *Erodium laciniatum* (Cav.) Willd. *Erodium touchyanum* Delile ex Godr. = *Syn.: Erodium deserti* (Eig) Eig *Monsonia nivea* (Decne.) Webb
Iridaceae	*Moraea sisyrinchium* (L.) Ker Gawl. = *Gynandriris sisyrinchium* (L.) Parl. = *Syn.: Iris sisyrinchium* L.
Lamiaceae	*Phlomis brachyodon* (Boiss.) Zohary ex Rech.f. *Salvia lanigera* Poir. *Salvia spinosa* L. *Teucrium polium* L. *Thymus bovei* Benth.
Liliaceae	*Bellevalia desertorum Eig & Feinbrun* *Bellevalia eigii* Feinbrun *Bellevalia mosheovii* Feinbrun *Gagea reticulata* (Pall.) Schult. & Schult.f.
Malvaceae	*Althaea ludwigii* L. *Malva parviflora* L. *Malva aegyptiaca* Steud.
Orobanchaceae	*Cistanche salsa* (C.A.Mey.) Beck

Orobanchaceae	*Cistanche tubulosa* (Schenk) Wight *Orobanche cernua* Loefl.
Papaveraceae	*Hypecoum pendulum* L. *Roemeria hybrida* (L.) DC.
Plantaginacae	*Plantago afra* L. *Plantago amplexicaulis* Cav. *Plantago ciliata* Desf. *Plantago coronopus* L. *Plantago lanceolata* L. *Plantago ovata* Forssk.
Plumbaginaceae	*Limonium pruinosum* Kuntze
Poaceae	*Aeluropus lagopoides* (L.) Thwaites *Aeluropus littoralis* (Gouan) Parl. *Avena barbata* Pott ex Link *Avena fatua* L. *Avena sterilis* L. *Bromus danthoniae* Trin. *Bromus rubens* L. *Bromus tectorum* L. *Cynodon dactylon* (L.) Pers. *Echinochloa colona* (L.) Link = *Syn.:* Milium colonum (L.) Moench = *Syn.: Panicum colonum* L. *Eremopyrum distans* (K.Koch) Nevski *Hordeum bulbosum* L.
	Hordeum marinum Huds. *Hordeum murinum subsp. glaucum* (Steud.) Tzvelev = *Syn.: Hordeum glaucum* Steud *Hordeum spontaneum* K.Koch *Leptochloa fusca* (L.) Kunth = *Syn.: Diplachne fusca* (L.) Stapf *Lolium rigidum* Gaudin *Phalaris minor* Retz. *Poa bulbosa* L. *Rostraria berythea* (Boiss. & Blanche) Holub = *Syn.: Lophochloa berythea* (Boiss. & Blancke) Bor *Schismus arabicus* Nees *Stipa capensis* Thunb. *Stipa hohenackeriana* Trin. & Rupr.
Polygonacaea	*Emex spinosa* (L.) Campd. *Polygonum equisetiforme* Sm. *Polypogon monspeliensis* (L.) Desf. *Rheum palaestinum* Feinbrun *Rumex cyprius* Murb.
Ranunculaceae	*Anemone coronaria* L.

Resedaceae	*Caylusea hexagyna* (Forssk.) M.L.Green *Oligomeris linifolia* (Vahl ex Hornem.) J.F.Macbr. *Reseda decursiva* Forssk. = *Syn.: Reseda alba subsp. decursiva* (Forssk.) Maire *Galium aparine L.*
Rubiaceae	*Galium incanum* Sm. *Haplophyllum* blanchei Boiss.
Rutaceae	*Ruta buxbaumii* Poir. = *Syn.: Haplophyllum buxbaumii* (Poir.) G.Don. *Hyoscyamus desertorum* (Asch. & Boiss.) Täckh.
Solanaceae	*Hyoscyamus muticus* L. *Frankenia adpressa* Summerh.
Tamaricaceae	*Frankenia pulverulenta* L. *Reaumuria alternifolia* (Labill.) Britten *Reaumuria hirtella Jaub. & Spach* *Tamarix passerinoides Delile*
Tamaricaceae	*Tamarix tetragyna Ehrenb.= Syn.: Tamarix tetragyna var meyeri* *Nitraria retusa (Forssk.) Asch.*
Zygophyllaceae	*Peganum harmala L.* *Tribulus pentandrous Forssk. = Syn.: T. longipetalus Viv.*



Figuer 3: Showing number of families, genera and species of flora taxa in Shaumari Wildlife Reserve.

CONCLUSION AND DISCUSSION

The total number of 237 species recorded in the reserve is a very impressive number of plant species occurring in Jordan. If we consider the number of species in relation to the total area then Shaumari Wildlife Reserve total area is 22Km² and the total area of Jordan is 90.000 km².

In simple calculation we say Jordan area 90, 000 km² contains 2550 species = 100% present of the total Flora of Jordan.

Thus Shaumari Wildlife Reserve has 22/90000*100 = 0.024 % of the total area of Jordan.

Jordan area is 90,000km² contains 2550 species while Shaumari Wildlife Reserve is 22Km² contain 237 species.

Thus 237/2550 *100 = 9.3 % of the total flora of Jordan.

If 0.24 area of Shaumari Wildlife Reserve contains 237 plant species in relation 100% of the total area and the total number of plant species, then this little area has about ten folds of the area production in terms of land area/ number of plant species.

Therefore, this desert reserve with its small total area situated in a very dry ecosystem according to the world classification holds and supports such a huge number of plant species 237/2550 of the total area. This number is really an impressive number in all means and calculations of biodiversity importance. This in reality projects and highlights the importance and diversity of the dry ecosystem in Jordan, Arab World and at all levels.

This fact becomes much more impotent if we know that lots of the recorded species are really medicinal, edible for humans and highly palatable of animals grazing and natural feed. Accordingly, this result projects the conservation impact and importance for any ecosystem whatever size it is and thus supports the very much appreciated and the noble roll of the Royal Society for the Conservation of Nature in managing and protecting such very important and limited areas in Jordan. This for sure emphasizes the roll of In-Situ conservation as one of the most important tools for the conservation of biodiversity and for the protecting future generation.

These findings agree very much with recent studies on particular parts of Jordan that show richness of the flora, biodiversity and medicinal plants and other resources especially in protected areas (Al-Eisawi, 2104a, 2014b, Oran & Al-Eisawi, 2014).

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Some records of freshwater snail from the Occupied Palestinian territories

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ABSTRACT

This study contributes to the taxonomy and distribution of the freshwater snail fauna in the Occupied Palestinian Territories. A total of 10 species of freshwater snails belonging to five families (Neritidae, Melanopsidae, Lymnaeidae, Physidae and Thiaridae) in seven genera (*Galba, Haitia, Lymnaea, Melanoides, Melanopsis, Pseudoplotia* and *Theodoxus*) were collected. *Melanopsis buccinoidae* was the most common species. *Theodoxus jordani* and *Theodoxus macrii* were noted mostly around the Jordan River basin.

Key Words: Freshwater Snail, Occupied Territories, Palestine, West Bank, Gastropoda.

INTRODUCTION

The Occupied Palestinian Territories, known also as the West Bank, has a rather moderate climate with mostly Mediterranean mountain habitats sloping into the Jordan valley, part of the Great Rift Valley stretching from East Africa to Syria. Despite limitation of water resources in the area, there are some permanent water sources suitable for freshwater snails. Since the occupation of the West Bank, no studies on the freshwater snails of the occupied territories have been undertaken. Previous studies on the freshwater snails of historical Palestine include Tristram (1865) and Germain (1921-1922). Abdel-Azim & Gismann (1956) included data on freshwater snails collected from the West Bank during a study on the snail intermediate host for schistosomiasis in south-western Asia. Recent studies on the snails of the genus *Melanopsis* including records from the West Bank was published by Heller *et al.* (2015). Recently, Bdir & Adwan (2011; 2012) investigated the presence of larval stages of trematodes among freshwater snails collected from the Palestinian Territories.

Regionally, interests in freshwater snails in the Middle East as intermediate hosts for trematodes affecting human and animals resulted in several publications (Burch & Amr, 1990; Neubert, 1998; Amr & Abu-Baker, 2004; Bössneck, 2011; Milstein *et al.,* 2012; Amr *et al.,* 2014).

After the establishment of the Palestine Museum of Natural History (PMNH) in 2014, one of its obligations is to identify the neglected biodiversity elements of the West Bank. In this communication we report on ten species of freshwater snails at the collection of Palestine Museum of Natural History.

Materials and Methods

All specimens were collected from West Bank Territories through several field trips by PMNH team. We collected samples in eighteen localities (Table 1). We classified specimens according to references cited by aid of visual inspection including with a stereo dissecting microscope.

Table 1: Coordinates for locations from which snails were collected.

Location	N	E
Aboud- Wadi Al-Hakeem	32° 1’	35° 4’
Ain Al Beda	32° 22’	35° 30’
Ain Al Ogga	31° 57’	35° 23’
Ain Al Sulttan	31° 52’	35° 26’
Ain Dyouk	31° 52’	35° 26’
Ain Fashkha	31° 44’	35° 28’
Ain Kenya	31° 55	35° 9’
Ain Shible	32° 13’	35° 25’
Al Ogga	31° 57’	35° 29’
Bethlehem	31° 42’	35° 12’
Jiftlik	32° 8’	35° 29’
Kishda	32° 18’	35° 19’
Ras Nakura	32° 22’	35° 33’
Salfit	32° 5	35° 10
Tal Al Smayrat	31° 52’	35° 26’
Wadi Fukeen	31° 71’	35° 10’
Wadi Qana	32° 10’	35° 8’
Wadi Qilt	31° 50’	35° 24’

RESULTS

A total of 10 freshwater snails belonging to five families (Neritidae, Melanopsidae, Lymnaeidae, Physidae and Thiaridae) in seven genera (*Galba, Haitia, Lymnaea, Melanoides, Melanopsis, Pseudoplotia,* and *Theodoxus*) are reported.

Family Neritidae (Rafinesque, 1815)

***Theodoxus jordani* (Sowerby, 1844)** **Figure 1A**

Materials examined: Ras Nakura (PMNH4473a, 5.11.2013; PMNH4480b, 5.11.2013); Jiftlik (PMNH7550, 21.3.2016).

Remarks: This is a wide spread species in western Asia extending along the Orontes basin reaching the Jordan River basin (Bössneck, 2011; Amr *et al*.,

2014). In Palestine, its distribution is confined along the Jordan River (Milstein *et al*., 2012). It is found in large numbers attached to rocks in running water and prefers clear and fast running water. Barash & Zenziper (1980) studied the reproduction of *Th. jordani*.

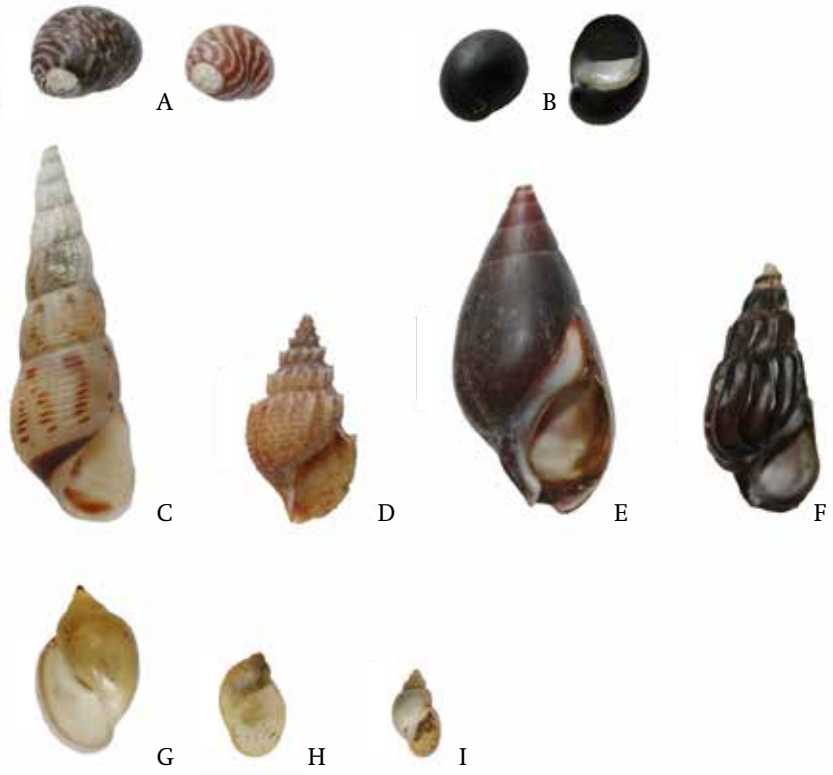

Figure 1: A. *Theodoxus jordani*. B. *Theodoxus macrii*. C. *Melanoides tuberculata*. D. *Pseudoplotia scabra*. E. *Melanopsis buccinoidea*. F. *Melanopsis saulcyi*. G. *Haitia acuta*. H. *Lymnaea natalensis*. I. *Galba truncatula*.

***Theodoxus macrii* (Sowerby, 1844)** **Figure 1B**

Materials examined: Aboud-Wadi Al-Hakeem (PMNH7020, 27.7.2015); Ras Nakura, (PMNH5565, 1.2.2014, PMNH4473b, 5.11.2013, PMNH4474, 5.11.2013, PMNH4480a, 5.11.2013); Ain Al Sulttan (PMNH7428, 21.12.2015); Ain Al Ogga (PMNH7432, 21.12.2015); Ain Dyouk (PMNH7436, 21.12.2015); Tal Al Smayrat (PMNH7443, 21.12.2015).

Remarks: Milstein *et al.* (2012) referred to *Th. macrii* in Palestine as *Theodoxus michonii* with no verification. We will accept the name *Th. macrii* for the meantime, until a clear justification for its taxonomic status. This freshwater snail has a wide range of distribution extending from Syria to Jordan and Palestine southward to Iraq eastwards (Burch *et al*., 1989). It is mostly an inland species known from streams and spring.

Family Melanopsidae (Adams & Adams, 1854)

Melanopsis buccinoidea (Olivier, 1801) **Figure 1E**

Materials examined: Aboud- Wadi Al-Hakeem (PMNH7021, 27.7.2015); Ain Al Beda (PMNH7264, 16.9.2015); Ain Kenya (PMNH7082, 3.8.2015); Ain Fashkha (PMNH4472, 5.11.2013, PMNH4471a, 5.11.2013); Ain Al Ogga (PMNH7411, 4.12.2014, PMNH7433, 21.12.2015); Ras Nakura (PMNH4464, 1.2.2014; PMNH4479, 5.11.2013); Salfit (PMNH7317, 2010); Wadi Fukeen (PMNH7049, 29.7.2015), Wadi Qana (PMNH5188, 1.2.2014 ; PMNH4469, 1.2.2014); Wadi Qilt (4468, 5.11.2013); Ain Al Sulttan (PMNH7427, 21.12.2015); Al Ogga (Palm Farm) (PMNH7431, 21.12.2015); Ain Dyouk (PMNH7437, 21.12.2015), Tal Al Smayrat (PMNH7441, 21.12.2015); Jiftlik (PMNH7548, 21.3.2016).

Remarks: This is a common species inhabiting inland water bodies away from the Jordan River Basin. *Melanopsis biccinoidea* is the most common species in Palestine. It is associated with clear and fast running water. Bdir & Adwan (2011 & 2012) referred to the Palestinian population of this species as *Melanopsis praemorsa*. Schütt & Sesen (1989) considered all *Melanopsis* of the Levant as *M. praemorsa*. This was supported by Heller *et al*. (2005), whom recognized five smooth-shelled *Melanopsis* species; *M. buccinoidea, M. ammonis, M. dircaena, M. khabourensis* and *M. meiostoma.*

Melanopsis costata costata (Olivier, 1804) **Figure 1F**

Materials examined: Ras Nakura (PMNH4475, 5.9.2013; PMNH4477, 5.9.2013); Jiftlik (PMNH7549, 21.3.2016).

Remarks: In the Levant, *M. costata* is represented by four subspecies; *M. c. costata, M. c. lampra, M. c. jordanica* and *M. c. oblique* (Heller *et al*., 2005). This subspecies is widely distributed in the Levant (Heller *et al*., 2005). It is found on rocks near water and in the river, spring and swamp in the Jordan Valley near the River Jordan (Burch & Amr, 1990).

Melanopsis saulcyi (Bourguignat, 1853)

Materials examined: Ras Nakura (PMNH6937, 6.9.2015), Ain Al Sulttan (PMNH7426, 21.12.2015); Jiftlik (PMNH7547, 21.3.2016).

Remarks: This species was reported from Palestine, Jordan and Syria (Heller *et al*., 2005; Amr *et al*., 2014). It is found on rocks along the mud of springs, and in slow running water stream and close to aquatic vegetation (Amr *et al*., 2014; Lev *et al*., 2007).

Family Thiaridae (Gill, 1871)

Melanoides tuberculata (Müller, 1774) **Figure 1C**

Materials examined: Ain Fashkha (PMNH4470, 5.9.2015); Ras Nakura (PMNH4479, 5.9.2013); Al Ogga (Palm Farm) (PMNH7429, 21.12.2015); Ain Dyouk (PMNH7435, 21.12.2015); Tal Al Smayrat (PMNH, 21.12.2015); Ain Al Ogga (PMNH7434, 21.12.2015).

Remarks: This species has a wide distribution across Africa, Asia and Australia (Brown, 1980). This nocturnal species found under rocks and beneath decaying plants in relatively saline water course around the Dead Sea area.

Pseudoplotia scabra (Müller, 1774) **Figure 1D**

Materials examined: Ras Nakura (PMNH4482, 5.9.2013).

Remarks: This species is considered as one of the most successful invasive species in many parts of the world (Thompson *et al*., 2009). Its natural habitat extends over South and Southeast Asia, and the Indo-Australian Archipelago extending eastwards to the western Pacific Islands (Thompson *et al*., 2009). Recently, it became a dominant species in Lake Tiberius, reaching as much as 95% of the total freshwater snail fauna, and bringing four native species to the brink of extinction (Heller *et al*., 2014). It became established in many countries in the Arabian Peninsula (Brown & Wright 1980, Brown & Gallagher 1985, Neubert, 1998; Feulner & Green, 1999) and Jordan (Amr *et al*., 2014).

Family Lymnaeidae (Ranfinesque, 1815)

Galba truncatula (O.F. Müller, 1774) **Figure 1I**

Materials examined: Bethlehem (PMNH7418, 4.12.2015); Tal Al Smayrat (PMNH7444, 21.12.2015).

Remarks: Species of this genus have undergone various radical revisions. Previously, species of *Galba* in the Middle East were placed under the genus *Lymnae*. This species is associated with slow running water and most often found in mud in irrigation canals.

Lymnaea natalensis (Krauss, 1848) **Figure 1H**

Materials examined: Kishda (PMNH7425, 16.12.2015).

Remarks: The taxonomic status of this species is far from being resolved. Some taxonomists considered the species *natalensis* under the genus *Radix* (Bargues *et al*., 2001; Milstein *et al*., 2012). In other areas in Palestine, it is associated with the Mediterranean ecozone.

Family: Physidae (Fitzinger, 1833)

Haitia acuta (Draparnaud, 1805) **Figure 1G**

Materials examined: Bethlehem (PMNH7316, 22.10.2015); Ain Shible (PMNH7421, 16.12.2015); Tal Al Smayrat (PMNH7442, 21.12.2015); Al Ogga (Palm Farm) (PMNH7430, 21.12.2015).

Remarks: This is one of the most common species inhabiting water bodies in the Jordan Valley (Amr *et al*., 2014). It is usually associated with polluted water courses and slow running or still water bodies.

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New records of Jordanian scorpions

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ABSTRACT

Fourteen scorpion species were collected during a recent field expedition to Jordan. Family Buthidae was represented by twelve species in seven genera (*Androctonus, Birulatus, Buthacus, Compsobuthus, Hottentotta, Leiurus,* and *Orthochirus*) and families Diplocentridae and Scorpionidae by one genus and species each (*Nebo* and *Scorpio*) respectively. *Buthacus nigroaculeatus* and *B. yotvatensis* were recorded for the first time in Jordan.

Key words: Scorpions, Jordan, Buthidae, Diplocentridae, Scorpionidae, *Buthacus yotvatensis.*

INTRODUCTION

Although the scorpion fauna of Jordan has never been systematically surveyed, it is better known than that of many other countries in the Middle East. Thus far, 18 species and subspecies representing 10 genera in three families, Buthidae (*Androctonus, Birulatus, Buthacus, Buthus, Compsobuthus, Hottentotta, Leiurus* and *Orthochirus*), Diplocentridae (*Nebo*) and Scorpionidae (*Scorpio*) have been reported from Jordan (Vachon, 1966; Levy *et al*., 1973; Kinzelbach 1984; Amr *et al*., 1988; Amr & El-Oran, 1994; Stathi & Mylonas, 2001; Lourenço *et al*., 2002, 2010; Kovařík, 2003, 2012; Amr & Abu Baker, 2004; Kovařík & Whitman, 2004; Lowe *et al*., 2014).

During September 2013, we conducted a field trip to collect scorpions from Jarash, along the desert highway to Aqaba, Ash Shawbak, Wadi Ramm and Al Mudawwarah. The present report documents the fourteen species of scorpions collected.

Materials and Methods

Scorpions were mostly collected by ultraviolet light detection at night, although some were collected by turning stones or excavating burrows during daytime. Material examined is deposited in the Collection of Arachnida and

Myriapoda at the American Museum of Natural History, New York. Table (1) indicates localities from which materials were collected.

Table 1: Coordinates for collecting sites.

Location	N	E
Al Barah, Wadi Rum	29°32'47.7''	35°19'36.3''
Al Brerah, Wadi Ramm	29°32'08.4''	35°32'14'00"
Al Gaal (Al Ghal), Wadi Rum	29°33'54.0''	35°37'48.4''
Al Hussainiha (Hysayneiah), ca. 2 km N on Amman–Aqaba Highway	30°52'26.9''	35°59'06.7''
Al Hussainiha (Hysayneiah)–Al Qadasiah (Qadeseah/ Qadessyah/Qadisiyeh) road	30°35'14.1''	35°46'29.2''
Al Khoshakhashe (Kheshkhasheh), Wadi Rum	29°29'52.1''	35°25'54.4''
Al Shaubak (Showbak/Shawbak) castle, hillside opposite	30°31'35.6''	35°33'57.2''
Al Shaubak (Showbak/Shawbak) castle, slopes below	30°31'56.9''	35°33'36.1''
Ash Shawbak Castle	30°31'35.6''	35°33'57.2''
Dana Guest House, cliffs above	30°40'27.4''	35°36'29.7''
Dibbin (Dibeen) Forest Reserve	32°14'46.9"	35°49'22.0"
Jabal Al Romman	30°41'40.0''	35°33'46.7''
King Talal Dam road	32°11'52.4"	35°50'13.4"
Makheet, Wadi Rum	29°31'27.8''	35°23'02.3''
NW of Al Mudawwarah (Modawarah)	29°19'10.6''	35°58'58.9''
NW of Al Mudawwarah (Modawarah)	29°19'15.7''	35°59'51.5''
Wadi Al Ahmar	30°41'21.6''	35°34'28.1''
Wadi Al Mohark, Wadi Ramm	29°36'15.6''	35°31'00.4''
Wadi 'Araba, Qaser Al Tlah	30°49'47.5''	35°24'38.2''
Wadi 'Araba, Wadi Al Ghwaibeh (Ghwaqibeh)	30°48'13.3''	35°24'21.6''
Wadi 'Araba, Wadi Khanzeerah (Khanzairh)	30°53'39.9''	35°25'38.2''
Wadi Daba'a, ca. 1 km W of Amman–Aqaba Highway	31°35'49.2''	35°59'27.1''
Zogreet (Zograit), Jarash–Ajloun road	32°17'03.6''	35°51'27.7''

RESULTS

Family Buthidae was represented by twelve species in seven genera (*Androctonus, Birulatus, Buthacus, Compsobuthus, Hottentotta, Leiurus,* and *Orthochirus*) and-families Diplocentridae and Scorpionidae by one genus and species each (*Nebo* and *Scorpio, respectively*). *Buthacus nigroaculeatus* and *B. yotvatensis* are recorded for the first time in Jordan.

Family Buthidae C.L. Koch, 1837

Androctonus bicolor Ehrenberg, 1828 **Fig. 1A**

Material Examined: 1 ♂, 1 ♀, Ash Shawbak Castle, 8.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam.

Remarks: *Androctonus bicolor* was previously reported from only a few localities in Jordan, including Aqaba, Karak, Ma'an, Petra, Wadi Ramm (El-Hennawy,

1988; Amr & El-Oran, 1994; Kovařík & Whitman, 2004). At Ash Shawbak, it was collected from the wadi and slopes below the castle ruins.

Androctonus crassicauda (Olivier, 1807) **Fig. 1B**

Material Examined: 1 ♀, Al Brerah, Wadi Ramm, 11.ix.2013, Z. Amr, N. Hamidan & T. Al Share.

Remarks: *Androctonus crassicauda* is one of the most venomous scorpion species in the Middle East. In Jordan, it is widely distributed in the eastern desert and Wadi Araba to Aqaba and Wadi Ramm (Levy & Amitai, 1980; Amr *et al.,* 1988; Amr & El-Oran, 1994; Stathi & Mylonas, 2001, Kovařík & Whitman, 2004). It was also collected from the Mediterranean region but in low numbers. It lives in horizontal burrows or rodent burrows.

Birulatus haasi Vachon, 1974

Material Examined: 1 ♀, Al Hysayneiah, ca. 2 km N on Amman–Aqaba Highway, 7.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. --1 ♂, Ash Shawbak Castle, 8.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam.

Remarks: *Birulatus haasi* was originally described from the Tafilah area (Vachon, 1974). It was redescribed by Lourenço (1999), who mistakenly suggested that it is a cave-dwelling scorpion. This is the second collection of this species from Jordan, with an additional locality from Al Hussainiha, expanding the known distribution into more arid regions of Jordan.

Buthacus nigroaculeatus Levy et al., 1973 **Fig. 1C**

Material Examined: 2 juv. ♂, Wadi Al Mohark, Wadi Ramm, 11.ix.2013, L. Prendini, O. Abed & L. Al Azam. -- 3 ♂, 3 ♀, Al Barah, Wadi Ramm, 10.ix.2013, Z. Amr, N. Hamidan & L. Al Azam. -- 1 ♀, Al Barah, Wadi Ramm, 10.ix.2013, Z. Amr, N. Hamidan & L. Al Azam.

Remarks: Specimens from Wadi Ramm (Kinzelbach, 1984; Stathi & Mylonas, 2001; Kovařík & Whitman, 2004), previously referred to as *Buthacus leptochelys* (Ehrenberg, 1829), are here referred to *Buthacus nigroaculeatus*, making this the first record of the species from Jordan.

Buthacus yotvatensis Levy, Amitai & Shulov, 1973 **Fig. 1D**

Material Examined: 1 ♀, Wadi 'Araba, Wadi Khanzeerah, 9.ix.2013, L. Prendini, Z. Amr & L. Al Azam. -- 2 ♂, 1 ♀, Wadi 'Araba, Wadi Al Ghwaibeh, 9.ix.2013, L. Prendini, Z. Amr & L. Al Azam. -- 2 ♂, 1 ♀, Wadi 'Araba, Wadi Al Ghwaibeh, 9.ix.2013, L. Prendini, Z. Amr & L. Al Azam.

Remarks: *Buthacus yotvatensis* was collected in the sand dunes of Wadi Al Ghwaibeh and Wadi Khanzeerah, the first records of this species in Jordan. It was previously found on sand dunes of Wadi Araba on the Israeli side (Levy & Amitai, 1980).

Compsobuthus jordanensis Levy, Amitai & Shulov, 1973

Material Examined: 6 ♂, 6 ♀, 1 subad. ♀, Wadi Daba'a, ca. 1 km W of Amman–Aqaba Highway, 7.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. -- 9 ♂, 4 ♀, Al Hysayneiah–Al Qadessyah road, 7.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam.

Remarks: *Compsobuthus jordanensis* was previously reported from around Wadi Daba'a, southeast of Amman, and Al-Hasa toward Ma'an (Levy *et al.*, 1973). It appears to be widely distributed in Jordan, extending further south and to the west of the Irano-Turanian zone.

Compsobuthus levyi Kovařík, 2012

Material Examined: 1 ♂, Dana Guest House, 8.ix.2013, L. Prendini. -- 5 ♂, Ash Shawbak Castle, 8.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. -- 4 ♂, Ash Shawbak Castle, 8.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam.

Remarks: *Compsobuthus levyi* was previously reported from Qasr Burqu, in the eastern desert of Jordan (Kovařík, 2012). The new locality records extend its distribution further into southwestern Jordan.

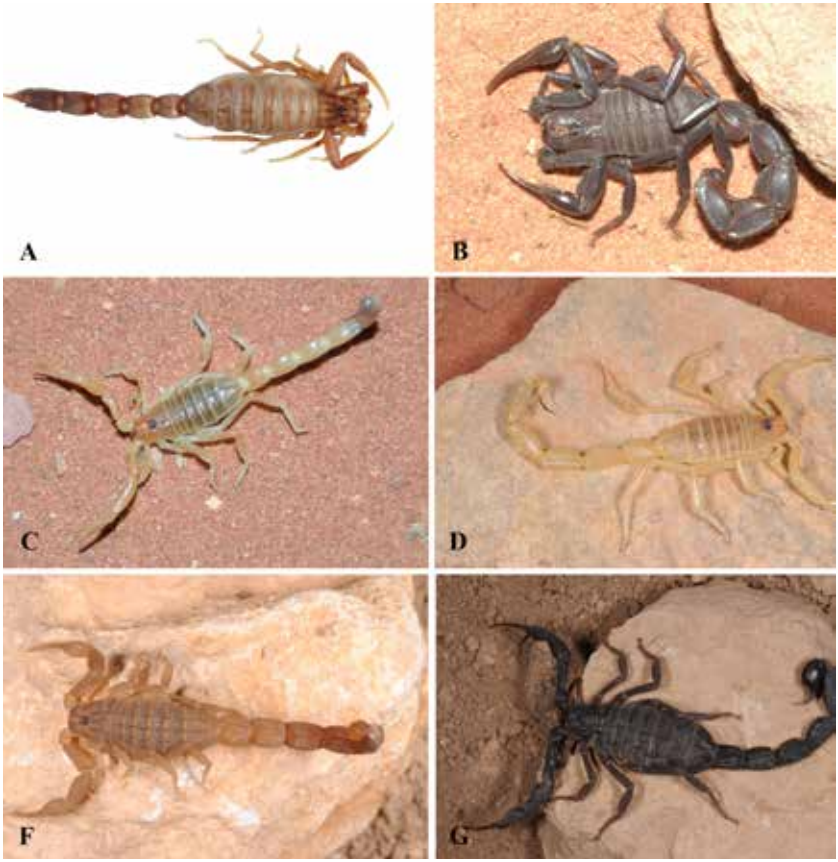

Figure 1: A. *Androctonus bicolor.* B. *Androctonus crassicauda.* C. *Buthacus nigroaculeatus.* D. *Buthacus yotvatensis.* E. *Compsobuthus schmiedeknechti.* F. *Hottentotta judaicus.*

Compsobuthus schmiedeknechti Vachon, 1949 **Fig. 1E**

Material Examined: 8 ♂, 2 ♀, Dibeen Nature Reserve, 6.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam.

Remarks: *Compsobuthus schmiedeknechti* occurs in rocky habitats in the Mediterranean region of Jordan (Levy & Amitai, 1980). Published records include Bonifica and Petra (Vachon, 1949; Kovařík & Whitman, 2004).

Hottentotta judaicus (Simon, 1872) **Fig. 1F**

Material Examined: 3♀, Zogreet, Jarash–Ajloun road, 6.ix.2013, L. Prendini, Z. Amr. -- 1juv., Dibeen Forest Reserve, 6.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam.

Remarks: *Hottentotta judaicus* was previously reported from several localities within the Mediterranean region of Jordan (Wahbeh, 1976; Kinzelbach, 1984; El-Hennawy, 1988; Amr & El-Oran, 1994). It is often associated with the *terra rossa* soil.

Leiurus jordanensis Lourenço, Modry & Amr, 2002 **Fig. 2A**

Material Examined: 1♂, NW of Al Mudawwarah, 10.ix.2013, L. Prendini, O. Abed & T. Al Share.

Remarks: *Leiurus jordanensis* was originally described from a desert habitat in southern Jordan composed of sandstone cliffs surrounded by flat sand dunes (Lourenço *et al*., 2002). It was subsequently recorded from northern Saudi Arabia (Hendrixson, 2006; Lowe *et al*., 2014).

Leiurus hebraeus (Birula, 1908) **Fig. 2B**

Material Examined: 6 ♂, 10 ♀, 1subad. ♂, 1subad.♀, 9 juv. ♂, 6 juv. ♀, King Talal Dam road, 6.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. -- 2 ♀, 1 juv. ♂, 4 juv. ♀, Jabal Al Rumman, 9.ix.2013, O. Abed & T. Al Share. -- 1♂, Wadi Al Ahmar, 9.ix.2013, O. Abed & T. Al Share. -- 2♂, Dana Guest House, 9.ix.2013, L. Prendini. -- 55♂, 42 ♀, 8 subad. ♂, 8 subad. ♀, 11 juv. ♂, 12 juv. ♀, Ash Shawbak Castle, 8.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. -- 50♂, 63♀, 6subad. ♂, 7subad. ♀, 1 juv. ♂, 3 juv. ♀, Ash Shawbak Castle, 8.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. -- 3♂, 8♀, 2subad. ♀, 1 juv. ♂, Ash Shawbak Castle, 8.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam.

Remarks: This species, previously regarded as a subspecies of *Leiurus quinquestriatus* (Ehrenberg, 1828), is the most venomous scorpion species in Jordan (Amr *et al*., 1994). It is also the most common species with a wide distribution covering much of the western part of the country (Levy *et al*., 1970; Wahbeh, 1976; Levy & Amitai, 1980; El-Hennawy, 1988; Amr & El-Oran, 1994; Stathi & Mylonas, 2001; Lowe *et al*., 2014). More than a hundred specimens were collected near Ash Shawbak Castle, on the walls of caves, under bushes and in rocky areas.

Orthochirus scrobiculosus negebensis Shulov & Amitai, 1960 **Fig. 2C**

Material Examined: 2♂, 2 ♀,Wadi Daba'a, ca. 1 km W of Amman–Aqaba Highway, 7.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. -- 1♂, 1 ♀, Al Hysayneiah, ca. 2 km N on Amman–Aqaba Highway, 7.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. -- 1 ♀, Wadi 'Araba, Qaser, Al Tlah, 9.ix.2013, L. Prendini, Z. Amr & L. Al Azam.

Remarks: The status of this taxon is unclear. *Orthochirus* populations from Jordan, Palestine, and Sinai were initially described as *O. innesi negebensis* Shulov & Amitai, 1960 and later regarded as *O. scrobiculosus negebensis* (Levy & Amitai, 1980; Fet & Lowe, 2000). Kovařík (2004: 27) suggested these populations may be a 'separate species' while Kovařík & Whitman (2004) identified specimens from Wadi Ramm as *Orthochirus innesi* Simon, 1910. Hendrixson (2006) referred specimens from neighboring Saudi Arabia to *O. innesi. Orthochirus scrobiculosus negebensis* is usually found under stones and was previously reported from arid and semi-regions of Jordan, e.g., Azraq, Jerash, Madaba, Thgrat al Jubb (Wahbeh, 1976; Amr & El-Oran, 1994; Stathi & Mylonas, 2001). High population densities were previously reported in the Azraq area (Amr & El-Oran, 1994). The newly reported material was collected along the desert highway within the Irano-Turanian region and from Wadi Araba.

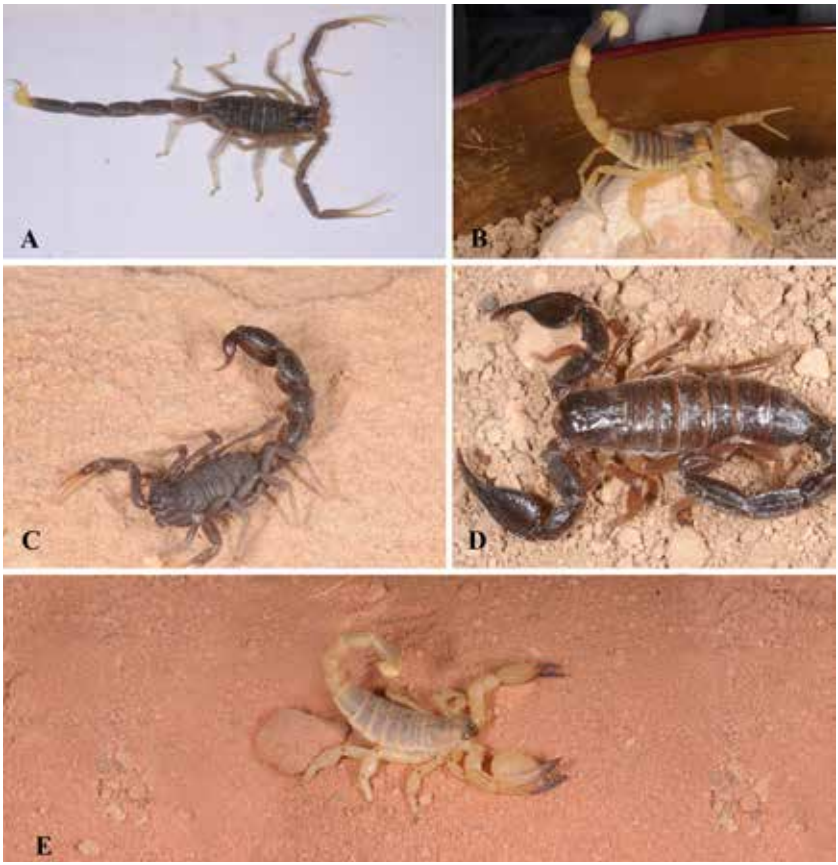

Figure 2: A. *Leiurus jordanensis.* B. *Leiurus hebraeus.* C. *Orthochirus scrobiculosus negebensis.* D. *Nebo hierichonticus.* E. *Scorpio kruglovi.*

Family Diplocentridae Karsch, 1880

Nebo hierichonticus (Simon, 1872) **Fig. 2D**

Material Examined: 1 subad. ♀, King Talal Dam road, 6.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. -- 1♂, Wadi Al Ahmar, 9.ix.2013, O. Abed & T. Al Share.

Remarks: *Nebo hierichonticus* is endemic to the Levant. In Jordan, it was previously reported from several localities including Al-Mazar al-Janubi, Al Karak Amman,Jarash,Madaba, Petra, Wadi Araba, Wadi Karak, and Wadi Ramm (Wahbeh, 1976; Levy & Amitai, 1980; Amr & El-Oran, 1994; Stathi & Mylonas, 2001; Kovařík & Whitman, 2004). This species constructs burrows and can be found under rocks and in crevices. In the Jarash area, it was found in deep crevices among large boulders and in earthen walls.

Family Scorpionidae Latreille, 1802

Scorpio kruglovi Birula, 1910 **Fig. 2E**

Material Examined: 1 ♂, Jabal Al Rumman, 9.ix.2013, O. Abed & T. Al Share. -- 3♂, Ash Shawbak Castle, 8.ix.2013, L. Prendini, Z. Amr, O. Abed, T. Al Share & L. Al Azam. -- 1 ♂, Al Barah, Wadi Ramm, 10.ix.2013, Z. Amr, N. Hamidan & L. Al Azam. -- 1 ♂, Al Khoshakhashe, Wadi Ramm, 11.ix.2013, Z. Amr, N. Hamidan & T. Al Share.

Remarks: *Scorpio kruglovi* was previously reported, as *Scorpio maurus palmatus* (Ehrenberg, 1828), from Ajloun, Amman, Theban, Wadi Musa, and Wadi Ramm (Wahbeh, 1976; El-Hennawy, 1988; Amr & El-Oran, 1994; Kovařík & Whitman, 2004). The new material was collected from rocky areas around Ash Shawbak and compacted sand areas at several localities in Wadi Ramm.

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A revised account of the geographical distribution of the endangered freshwater fish *Garra ghorensis* in Jordan and implications for conservation

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ABSTRACT

The spatial distribution of the endangered cyprinid fish *Garra ghorensis* was initially assessed through sampling of 6 riverine sites across Jordan in 2002, with a repeat survey completed in 2010 to detect changes in their distribution. In this latter survey, an additional 8 sites were also sampled in an attempt to fully describe their distribution range, although only one more population was recorded. Comparison of the presence/ absence data in the sites sampled in both 2002 and 2010 revealed no changes in this aspect of their distribution. In 2002 survey, their populations co-existed with either native or invasive species, whilst the population detected in 2010 was in allopatry. Between the two survey periods, however, the physical characteristics of the majority sites had altered with, for example, a series of significant water impoundments constructed. These will potentially result in a loss of longitudinal connectivity in these rivers, leasing to habitat and population fragmentation. Although no detrimental effects of these changes were detected in 2010, given the endangered status of *G. ghorensis,* efforts to minimise potential effects of population fragmentation are recommended.

INTRODUCTION

The causal factors involved in extirpations and extinctions of threatened freshwater fishes include the negative consequences that arise from anthropogenic disturbances including engineering works, industrial and domestic pollution, acidification, fishing and fishery management, and land use practices (Maitland, 1995). Consequently, the successful conservation of freshwater fish is highly reliant on data on their ecology and distribution, and understanding their relationships with their physical habitat (Dudgeon, 2000). Indeed, understanding how species respond to disturbances is

important for understanding how human activities affect key habitats, such as spawning and nursery areas (Maitland, 1995). Maintaining habitat connectivity is especially important for species that undertake spawning migrations, with impoundments usually resulting in losses of both longitudinal and lateral connectivity (Falke & Gido, 2006; Fullerton *et al*., 2010). Data on the consequences of habitat alterations on threatened fishes are, however, often either unavailable or expensive to collect, especially in remote areas and where countries have limited conservation resources (Helfmann, 2007). This can result in conservation efforts often being undermined by insufficient understandings on the ecology and distribution of the species.

The importance of understanding the distribution and ecology of threatened freshwater fishes is highlighted by the genus *Garra* of the Cyprinidae family that has attracted attention and dispute in their taxonomic and biogeographic origins (Hamidan *et al*., 2014). This genus is encountered across subtropical and tropical Asia, the Middle East and Africa (Menon, 1964), with ten species recognised by Geiger *et al*. (2014) in the Mediterranean basin. Of these ten species, four have a mental adhesive disc, being *Garra variabilis*, distributed in the Orontes and Nahr al Kabir drainages in Syria, *Garra ghorensis*, distributed in the southern tributaries of the Dead Sea basin, but currently only found in in Jordan (Hamidan & Mir, 2003), *Garra jordanica*, distributed in the northern Dead Sea basin of Jordan and Syria, and *Garra rufa*, distributed in the Qweik, Euphrates, Tigris and in rivers in the Persian Gulf south to the Mond River (Hamidan *et al*., 2014). *Garra ghorensis* was originally described by Krupp (1982) as a subspecies of *Garra tibanica*, an Arabian species closely related to, or even identical with the African *Garra quadrimaculata* (Stiassny & Getahun, 2007). However, recent genetic studies indicate that *G. ghorensis* is of Mediterranean and Mesopotamian origin (Hamidan *et al*., 2014).

The distribution of *Garra* fishes in Jordan was discussed further by Krupp & Schneider (1989) and Mir (1990). These studies provided a comprehensive account of the fish fauna of Jordan and adjacent areas. These data were used as the basis of a review of the conservation status of freshwater fishes in the Arabian Peninsula, including southern and eastern Jordan, at a conservation assessment and management plan meeting (CAMP) in 2002. The outcome was a conservation plan outlining that three Jordanian fish species, *Aphanius ricardsoni, A. sirhani,* and *G. ghorensis,* were priority species for conservation as they faced an imminent risk of extinction (EPPA, 2002). At that time, *G. ghorensis* and *A. sirhani* were evaluated on the IUCN Red List as a critically endangered species while *A. ricardsoni* as endangered. A recent evaluation has reduced *G. ghorensis* to endangered status due to their area of occupancy not allowing for the classification of critically endangered (Freyhof *et al*., 2014).

Despite this conservation prioritisation in 2002, there was a paucity of data on the status of these fishes, including *G. ghorensis.* This presented a major challenge to any efforts to conserve these species in light of potential impacts of anthropogenic disturbances (e.g. impoundments) and climatic events (e.g.

drought). Correspondingly, Hamidan & Mir (2003) assessed the status of *G. ghorensis* in Jordan in 2002, building on knowledge provided by earlier studies of Krupp & Schneider (1989) and Mir (1990). Since this survey, however, there have been substantial alterations to many natural watercourses in Jordan, such as the construction of impoundments that have transformed lotic habitats to lentic in order to meet societal demands for potable water and irrigation. This shift in lotic characteristics, allied with reduced volumes due to water abstraction and the introduction of alien species (e.g. *Oreochromis aureus*), suggest there has been some anthropogenic disturbances that could potentially have impacted the status of populations of *G. ghorensis* since the 2002 surveys (Hamidan & Mir, 2003). Consequently, the aims of this study were to (1) assess the spatial distribution of *G. ghorensis* in Jordan in 2010 and compare it to the distribution recorded by Hamidan & Mir (2003); (2) assess the extent of the increased anthropogenic disturbances at the survey sites in 2010 compared with 2002, and (3) identify the issues that could result in conservation threats to the current status of *G. ghorensis*.

MATERIALS AND METHODS

Study area

Sampling for *Garra ghorensis* in 2010 was conducted in October at 14 riverine sites at the southern end of the Dead Sea in Jordan. Of these sites, 6 had been sampled in 2002, with a further eight sampled here to identify other sites where the species might be present (Fig. 1; Table 1). Of the six sites sampled in both years, four were impounded in their lower reaches where the water used to drain to the Dead Sea. In entirety, the spatial area covered in the 2010 surveys encompassed the distribution range of *G. ghorensis* as reported by Krupp (1982), Krupp & Schneider (1989), Mir (1990), Hamidan & Mir (2003) and Hamidan (2004). It is thus comprised the area from Ein Al-Haditha (31°17'47.74" N, 35°32'35.38"E) at the northern border and extended south to Wadi Khneizerah (30°52'53.79"N , 35°26'1.00"E) app. 50 km to the south of Ibn Hammad. It also extended east to Wadi al-Burbaitah (30°59'1.11"N, 35°40'13.71"E) at the upper tributaries of Wadi Al-Hassa (31° 0'44.95" N, 35°31'19.08"E), and from western site to rivers outlets down to the Dead Sea (Fig. 1). A brief description of each site is provided in Table 1.

Fish sampling

Fish sampling at the 14 sites was completed in October 2010. At all sites, sampling used electric fishing. Where sites were impounded, then the downstream limit of the site would be the impoundment. Sampling was completed at all sites in an upstream direction and continued for 15 minutes before moving 500 m upstream to repeat. This was repeated once more so that a total of 45 minutes fishing was completed per site and over a distance

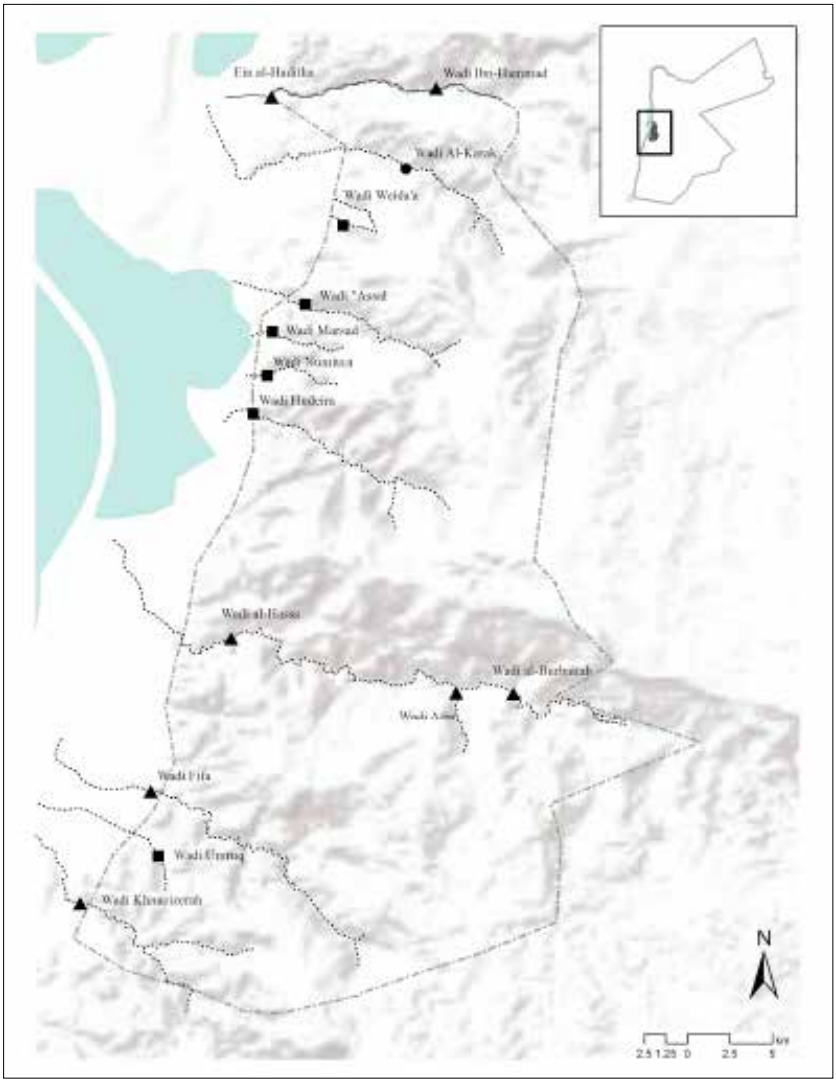

Figure 1. Locations of the sampling sites in Jordan (inset) and in Southern Jordan (main image). Filled triangles represent sites where *Garra ghorensis* was pre sent, filled squares represent sites where they were absent. The filled circle is the site where only *Oxyneomacheilus insignis* was captured. The dashed line marks the limit of the known up to date distribution range of *G. ghorensis* described by Krupp & Schneider (1989), Mir (1990), Hamidan & Mir (2003), and Hamidan (2014).

Table 1. Sample size, sub-sample size and length characteristics of *Garra ghorensis* at the three sites where they were most abundant. Site codes are those referred to in Table 1. Site Codes: Ain al-Haditha (HD), Ibn-Hammad (IB), and Wadi al Burbaitah (BR).

Year	Site code	Number fish sampled	Sub-sample size (n)	Mean length (mm)	Length range (mm)
2002	HD	123	-	57.4 ± 1.3	29.0 - 99.0
2010	HD	15	15	35.1 ± 2.6	20.7 – 48.8
2010	BR	78	15	45.2 ± 2.8	24.9 – 62.0
2010	IB	9	9	32.7 ± 3.4	21.2 – 57.3

of approximately 1500 m river length. The electric fishing equipment was a hand-held Samus 725 MP electro-fishing unit. At each section of each site, sampling concluded before 15 minutes if 15 *G. ghorensis* individuals were captured. This was to prevent excessive numbers of this endangered fish being captured.

With the exception the sites Ain al-Hadihta, Wadi Ibn-Hammad, and Wadi Burbaitah, field identification of *G. ghorensis* was completed at the conclusion of the fishing and then all fish were immediately returned to the water to prevent excessive handling and stress associated with capture. As sample sizes at Ain al-Hadihta, Wadi Ibn-Hammad and Wadi Burbaitah were relatively high, then up to 15 individual fish were removed, euthanized (overdose of anaesthetic, clove oil) and taken back to the laboratory for identification and measuring (standard length, nearest 0.1 mm). Permission for removing individuals was granted by licence from the Royal Society for the Conservation of Nature, Jordan.

Across the 14 sites, reporting of *G. ghorensis* was on a presence/ absence basis, with supplementary data only provided for Ain al-Hadihta, Wadi Ibn-Hammad, and Wadi Burbaitah. Qualitative assessment of the extent of anthropogenic disturbance was through noting the additional alterations to the sites since 2002. As length data were available in both 2002 and 2010 for the site at Ein Al-Haditha, differences in the length distribution of *G. ghorensis* between the years were tested using a Mann Whitney U-test, as they were not normally distributed (Shapiro-Wilk test, $P < 0.05$ in both years). In reporting, where error is expressed around the mean, it represents standard error.

RESULTS

In 2002, *G. ghorensis* was detected in all of the six sites that were sampled (Hamidan and Mir 2003). In 2010, all of these sites were still found to have populations, with an additional population detected in one of the eight extra sites fished (Table 1). This was an allopatric population in the lower reaches of Wadi Ibn Hammad (Table 1). The samples collected in 2010 revealed that the seven recorded *G. ghorensis* populations comprised: (i) an isolated population at the lower part of wadi Ibn Hammad; (ii) a population that was sympatric with invasive *O. aureus* in Ein Al-Haditha; and (iii) populations that coexisted naturally with the native *Capoeta damascina* (Wadi Al-Hassa (including Burbaitah and wadi Fifa), and wadi Khneizerah) (Table 1). In the upper part of Wadi Al-Karak, no *G. ghorensis* were sampled, but the nemacheilid loach *Oxyneomacheilus insignis* was found (Fig. 1, Table 1). There were no fish recorded from Wadi Weida'a, Wadi Assal, Wadi Marsad, Wadi Numeira, Wadi Hudeira, and Wadi Umruq (Fig. 1, Table 1).

Across the three sites where samples were recorded in more detail, the number of sampled *G. ghorensis* was the lowest at wadi Ibn Hammad (n = 9) and highest at Wadi al-Burbaitah (n = 78) (Table 2). Data of collected samples at Ein Al-Haditha in 2002, and the three sites in 2010, revealed *G. ghorensis* present in samples from 21 to 99 mm, suggesting a recruiting population comprising of juvenile and mature fish, with mean lengths highest in Ein Al-Haditha and lowest in Ibn Hammad (Table 2). Between the samples collected in 2002 and 2010 at Ein Al-Haditha, their mean standard lengths differed (2002: 55.0 ± 1.2 mm; 2010: 35.1 ± 2.6 mm), with these differences being significant (Mann Whitney U test: $Z = -4.95$, $P < 0.01$).

Additional anthropogenic disturbances were apparent at all sites sampled (Table 1). The primary disturbances were increased impoundment, leading to decreased flows, channel deepening and the potential for increased silt deposition (Table 1). At a large level, a 17 million cubic metres dam, Al-Tannour, was established at the upstream of Wadi Al-Hassa and was operational from 2005, after which seasonal flooding was controlled and non-native fishes introduced into the impoundment (*O. aureus, Cyprinus carpio*, and *Clarias gariepinus*). However, no introduced fish were present in the samples collected downstream.

DISCUSSION

The 2010 surveys revealed that across the range of *G. ghorensis* described by Krupp (1982), Krupp & Schneider (1989), Mir (1990), Hamidan & Mir (2003) and Hamidan (2004), seven populations were detected, of which six had previously been detected in 2002. These populations covered three scenarios: allopatry, present in sympatry with native *C. damascina* and present in sympatry with invasive *O. aureus*. This reveals that *G. ghorensis* is present in fish communities with inherently low species diversity, perhaps due to the often

extreme conditions that occur at the sites, including very high summer water temperatures (> 30°C) and low flows, and winter flood events (Hamidan & Mir, 2003). In terms of conservation threat, Hamidan *et al*. (2015) suggested that the coexistence of *G. ghorensis* with these native and invasive fishes did not represent a constraint to their population status due to low evidence for competitive interactions.

In comparison with 2002, the six sites re-sampled in 2010 all revealed additional physical modifications from anthropogenic disturbances, particularly at the lower reaches close to their confluence to the Dead Sea, where the water tended to be impounded and/ or heavily abstracted for domestic and agricultural use. With the exception of the Al-Tannour dam, these schemes tended to be relatively small-scale. As these impoundments are mainly at the lower end of the rivers, then their potential impacts of *G. ghorensis* were likely to relate more to shifting conditions from lotic to lentic, rather than being connected to population fragmentation. Across the seven populations, although no apparent issues were yet apparent for *G. ghorensis* from these impoundments, it should be noted that these surveys were restricted in scope, with a primary focus on their presence/ absence and so restricting further inferences on the effects of habitat change on other aspects of their ecology.

The use of impoundments to manage freshwater availability in water-poor countries such as Jordan is only likely to increase in future. It thus represents an increasing conservation threat to the sustainability of Jordanian freshwater resources and the fish communities they support. Although they might provide some benefits in minimising the harmful effects of annual flood cycles, and especially the damaging effects of stochastic summer flood events, flooding can also play important ecological and engineering roles in river systems (Hamidan & Britton 2014; Kingsford, 2000; Jackson, 1989; Olden & Poff, 2005). Moreover, impoundments tend to provide conditions suitable for the establishment of introduced fishes (Johnson *et al*., 2008), with non-native fishes such as *Tilapia zillii, O. aureus* and *C. carpio*, and *Clarias gariepinus* already been introduced into some impoundments in Jordan (Hamidan, 2014), primarily for fishery purposes (Khoury *et al*., 2012). Should these species develop invasive populations then there would be potential for detrimental ecological consequences to develop (Gozlan *et al*., 2010; Simberloff *et al*., 2013).

In conclusion, despite a range of additional anthropogenic disturbances across their range, the distribution range of *G. ghorensis* did not decrease between 2002 and 2010, although the habitat changes are likely to have resulted in some ecological and life-history changes (e.g. Hamidan & Britton, 2014). Whilst these data provide some support to their recent downgrading from critically-endangered to endangered on the IUCN Red List, (Freyhof, 2014), given these on-going and increasing disturbances from human activities, then it is suggested that their Red List status remains at endangered for the foreseeable future.

Table 2. The sites sampled in 2010 across the described range of *G. ghorensis*; presented theses refer to sites used in Table 2. Year represents the year(s) the sites were sampled.

Site name	Location	Alt.*	Year	Brief description
Ibn-Hammad (IB)	31° 18` 4.25`` N, 35° 37` 47.36`` E	81	2002, 2010	Deep cliff, shallow water (30-10 cm), fast running (app. 1.2 m/s). Width of sampling site: 4-2 metres, and depth is less than 10 m.
Ain al-Haditha (HD)	31° 17` 47.74`` N, 35° 32` 35.38`` E	-316	2002, 2010	Local impoundments, natural water pond at the spring head (app. 28 m Length by 8-4 m width), deep (3 m), artificial concrete collection ponds, and a fast running (1.3 m/s) open channelled water between the natural and artificial ponds.
Wadi al-Hassa	31° 0` 44.95`` N, 35° 31` 19.08`` E	-184	2002-2010	Drainage system for several tributaries and springs extending along the Karak Mountains.
Afra hot spring	30° 59` 2.97`` N 35° 38` 24.96`` E	180	2002-2010	Originated from Wadi al-Hassa, sulphuric hot spring with temperature of almost 40º C originated from the main Afra hot spring 2.6 km from the confluence point with Wadi al Burbaitah. Fast running wadi (1.3 m/s), with long gorge, narrow 1 m width to wide edges 20 m width especiall at the lower part.
Wadi al Burbaitah (BR)	30° 59` 1.11`` N, 35° 40` 13.71`` E	250	2002-2010	Originated from Wadi al-Hassa at the confluence point with Afra hot spring. Fast running water
is Wadi Fifa	30° 55` 52.57`` N, 35° 28` 46.55`` E	-260	2002-2010	Fust running (1.4m /s) narrow width 3-1m wadi.
Wadi Khneizereh	30° 52` 53.79`` N, 35° 26` 1.00`` E	-256	2002-2010	A narrow wadi surrounded by hills of sandstone and limestone with large boulders, Fast running water (1.3 m/s) water depth varies from 50- 10 cm depth)
wadi al-Karak	31° 15` 32.11`` N, 35° 36` 50.68`` E	-51	2010	Fast running river (0.9 m/s) water depth is 30-15 cm, wadi width is varied from 1 m water width to 12 m at the eastern side.
Wadi Weida'a	31° 13` 45.29`` N, 35° 34` 51.67`` E	50	2010	perennial shallow and slow running stream (0.3 m/s)
Wadi 'Assal	31° 11` 16.40`` N, 35° 33` 39.98` E	-190	2010	perennial shallow and disconnecting water flow.
Wadi Marsad	31° 10` 24.81`` N, 35° 32` 38.02`` E	-250	2010	little, shallow, and slow running (0.1-0.3 m/s) streams of water that is not extended over the wadis
Wadi Numeira	31° 8` 59.69`` N, 35° 32` 9.91`` E	-266	2010	
wadi Hudeira	31° 7` 49.81`` N, 35°32` 1.73`` E	-245	2010	Slow running (0.3m/s) and low amount water that is extended to a dead end
wadi Umruq	30° 54` 7.14`` N, 35° 28` 51.69`` E	-150		Thick and heavy riparian vegetation that is covering the little amount of water along of the wadi

from north (Ibn-Hammad) to south (Wadi Khneizereh). In site name, codes in paren

	Human impact		Fish species
	2002	2010	
	Minimum number of visitors with no facilities. Water extraction for agriculture at a local scale.	Over visit especially in summer, tourism facilities Agricultural encroachment on the wadi beds, and water extraction.	*G. ghorensis*
	Impoundment Water extraction for agriculture, recreation, and invasion with *O. aureus*.	Large scale water extraction to apply the growing demand of agriculture, invasion with *O. aureus*, grazing around the natural ponds and livestock drinking, and recreation.	*G. ghorensis* *Oreochromis aureus*
	Tourism activities, water extraction.	Large scale dam up stream, Tourism facilities, Over visiting at both Afra and Burbita site. Enlarged agricultural scheme, water extraction, and river diversion especially at the upper reaches.	*G. ghorensis* *Capoeta damascina*
			G. ghorensis (Only juvenile fish were found close to the confluence point with wadi Burbaitah)
			G. ghorensis *C. damascina*
	Domestic use of water.	Water impoundment, large scale water extraction to apply the expanded agricultural demand on water, recreation activities including over visiting, grazing and livestock drinking.	*G. ghorensis* *C. damascina*
	Domestic use of water. Water extraction for agriculture. Impoundment at the down stream. Tourism.	Increased water extraction to apply the expanded agricultural demand. Over visiting / recreation.	*G. ghorensis* *C. damascina*
	Water extraction for agriculture.	Increased water demand, that block the water to reach the downstream leaving behind a dry wadi of 1.5 km river length, the wadi became over visited by tourists at local and national levels.	*Oxyneomacheilus insignis*
	Tourism activities.	Tourism activities.	-
	Tourism activities.	Tourism activities and grazing around the site.	-
	Tourism activities.	Tourism activities and grazing around the site.	-
	Tourism activities.	Tourism activities, grazing around the site, and water collection in artificial ponds for domestic and agricultural use.	-
	Water extraction for agriculture. Local tourism.	Large water extraction for agricultural purposes, High tourism activities at national level.	-

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Ecological study on the Nubian Nightjar, *Caprimulgus nubicus*, at Fifa Nature Reserve, southern Jordan

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ABSTRACT

The Nubian Nightjar is extremely rare and endangered species in the Middle East. Minimum population was estimated to be 45 calling males in Fifa area in Jordan. There was a significant positive relationship between the tree cover and the number of calling males with the number of calling males increasing as tree cover increased. This study suggests that there is breeding population of Nubian Nightjar in Fifa Nature Reserve and surrounding areas and the presence of the Nubian Nightjar in Fifa Nature Reserve is of special conservation value, where this little known species is breeding, thus more attention to protect its natural habitats should be addressed.

Key words: Nubian Nightjar, Jordan, Fifa, nesting habitat.

INTRODUCTION

The Nubian Nightjar *Caprimulgus nubicus* Lichtenstein 1823 is the smallest and slightest Nightjar in Western Palaearctic (Snow & Perrins, 1998). The species is relatively widespread in the arid part of eastern Africa, though recorded as uncommonand scarce (Perlman, 2008). In the Middle East, it was reported along the Rift Valley in southern Palestine and the Red Sea coast of southern Arabian Peninsula (BirdLife International, 2012).

The status of the Nubian Nightjar in Jordan is unknown. Only three records of Nubian Nightjar were documented in Azraq during 1963 (Nelson, 1973), in addition, a record of a breeding population was recorded in Wadi Araba in the 1980s (Shirihai, 1996). In Fifa Nature Reserve, south to the Dead Sea, there are unpublished records of Nubian Nightjar calls (RSCN, 2010, 2011). In Palestine, the natural history of the Nubian Nightjar was studied by Perlman (2008), including data on its diet, population estimate and ecological requirements.

Shirihai (1996) indicated that the population of the Nubian Nightjar in the region is declining greatly in recent decades, and is regarded as critically

endangered. The main reason for the populationdeclineis presumably habitat loss due to agricultural development.

The Nubian Nightjar is confined to hot dry low altitudes (Snow & Perrins, 1998). In Palestine, the Nubian Nightjar requires heterogeneous habitats, with dense salt marsh patches of at least 50 ha for breeding and roosting, and adjacent open areas for foraging especially near water sources (Perlman, 2008). In East Africa it is confined in frequents desert thorn scrub in close proximity to water, inhabiting open *Acacia* bush in close proximity to wells that provide a permanent overflow of water (Cramp, 1985). In Jordan, the breeding habitat of Nubian Nightjar was never studied. Eggs were found in nests in mid April in Palestine (Snow & Perrins, 1998).

The present nesting behavior of the Nubian Nightjar in Jordan is unknown (Al-Shamlih *et al*., 2005). The objectives of this study were to determine the minimum population size of Nubian Nightjar, the relationship between number of calling Nubian Nightjars males and percent tree cover, and the relationship between number of calling Nubian Nightjar and distance to nearest farms in Fifa Nature Reserve, southern Jordan.

Figure 1: Nubian Nightjar, *Caprimulgus nubicus* adult, Fifa Nature Reserve, Jordan, April 2014. © Jérôme DUBOS.

MATERIALS AND METHODS

Study Site

Fifa Nature Reserve (FNR) is located at the southern end of the Dead Sea along the western border of Jordan (30° 56' N, 35° 24' E) (Figure 2). It is centered between Wadi Um Jufna in the north, Wadi Dahel to the south and west of Fifa village. The reserve area is 26.4 km2with elevation -421 mb.s.l). It is listed as an Important Bird Area according to Birdlife International.

Four vegetation communities have been identified at FNR; *Tamarix tetragyna, Acacia tortilis, Haloxylon salicornicum* and mud flat (RSCN, 2011). *Tamarix tetragynais* the most widespread tree and is found in all vegetation communities. *Tamarix* dominated vegetation community is the largest habitat in the study area (24.6 km^2), follow *Acacia tortilis* (3 km^2) and *Haloxylon salicornicum* (2.6 km^2) In addition, farmland surrounds the entire study area. The northern part of the reserve consists of mudflat with no tree and very little shrub covers (Figure 2).

Field Methods

Surveys were carried out between April 14-16 and May 15-16,2014, for a total of six days. Thirty-four spot counts were selected randomly covering farm areas, *T. tetragyna* and *A. tortilis* communities. Counts were performed within a period of one hour after dusk until one hour before dawn for 15 minutes each. The detection radius of Nubian Nightjar calls was estimated at 150 m by playing audio calls and walking in a straight distance until the call could no longer be clearly heard. The Nubian Nightjar was identified either by the distinctive males calls during breeding season, orby direct observations.

Tree cover percent was determined in each survey point by two perpendicular line transects (300 m), post-hoc, using satellite imagery in Google Earth to determine if there is a relationship between percent tree cover and number of calling males. In addition, the distance between each point and nearest farm was measured to determine if there is a relationship between number of Nubian Nightjar calls and the distance to nearest farms. ANOVA was used to analyze the data.

RESULTS

Minimum population size was estimated to be 45 calling males. In addition, eleven males of the 45 calling males wereobserved. Figure 2 shows sites and the number of calling males. Number of callsvaried between sites ranging from 0-5 ($\bar{x}$= 1.29, STD= ±.47). Most birds were recorded from *T. tetragyna* tree cover. Figure 3 shows the relationship between tree cover and the number of calling birds. Calls number significantly increased as tree cover increased ($F_{1,32}$=26.97, t=-5.19, r^2=0.46; P<0.0001). There was no significant relationship between the number of calling nightjars and distance of the sampling point to the nearest farm ($F_{1,32}$=0.14, t=-0.37, r^2=0.004; P=0.71; Figure 4).

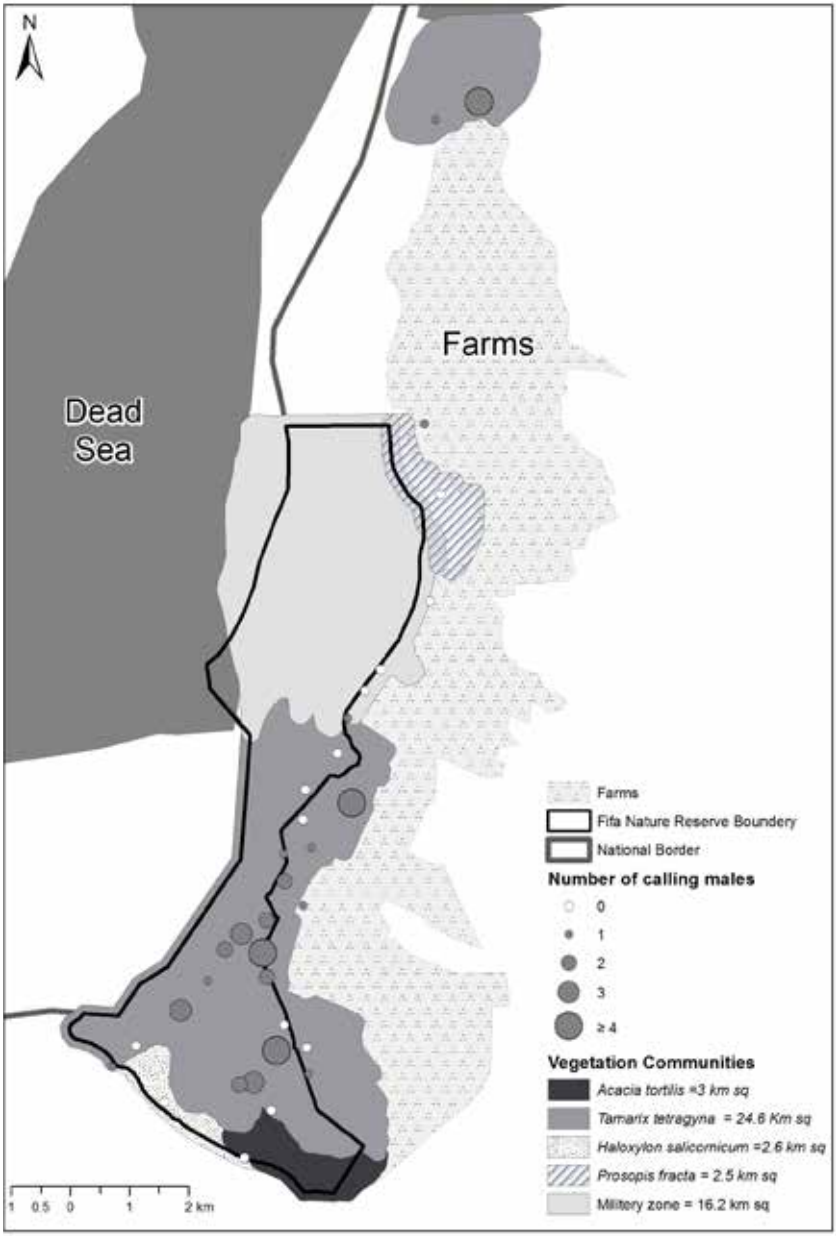

Figure 2: Results of Nubian Nightjar counts in Fifa Nature Reserve.

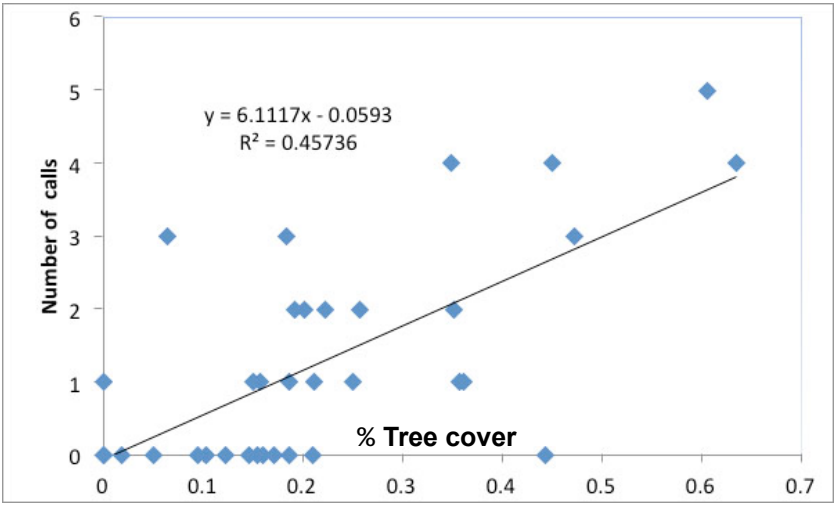

Figure 3: The relationship between percent tree cover and number of calling Nubian nightjar.

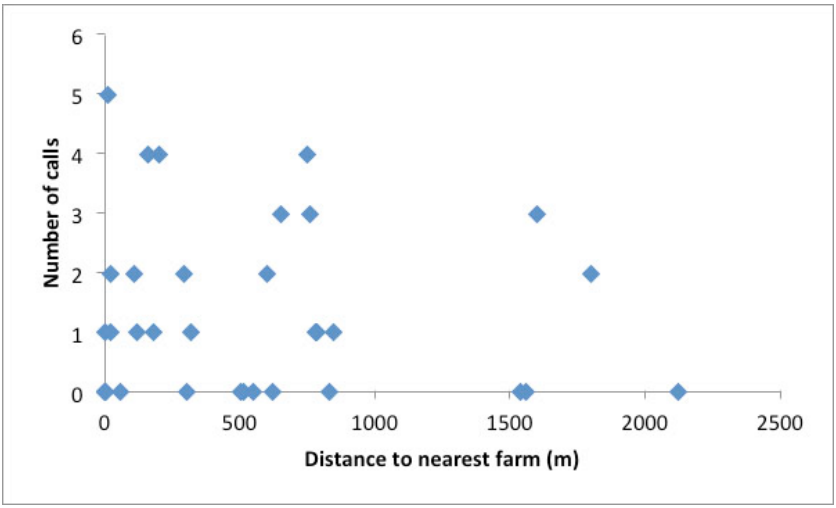

Figure 4: The relationship between distance to nearest farm and number of calling Nubian nightjar.

DISCUSSION

This study confirmed the presence of the Nubian Nightjar based on both the distinctive male's calls and actual observations in FNR. Perlman (2008) suggested that FNR population together with the Palestinian one may represent a larger population in the region. In this study 45 callings were

recorded, higher than those recorded inthe Palestinian side across the borders (Perlman, 2008). This may be attributed to the rich habitat suitable for nesting and breeding of the Nubian Nightjar in FNR, compared tothe smaller and more fragmented habitats in Palestine (Alon & Mayrose, 2003).

Perlman (2008) suggested that the main reasons for the decline of Nubian Nightjar population is the loss of breeding and foraging habitats and the excessive use of the natural water sources for agriculture. This study showed that the highest number of Nubian Nightjar calls were recorded in *Tamarix* dominated habitat with tree cover more than 25% (Figure 3). Higher tree cover has greater potential to host multiple nests and better conceal nests from predators and disturbance.

Holyoak (2001) reported that nightjars preferred foraging in agricultural fields compared to their relative distribution in the total area of their home range. This study found no relationship between the number of calling males and proximity to agricultural areas.

Snow & Perrins (1998) stated that the Nubian Nightjar population in Palestine is an isolated population from the global population in Africa and southern Arabian Peninsula. This study confirms the presence of a breeding population of the Nubian Nightjar in southern Jordan. The presence of the Nubian Nightjar in FNR is of special conservation value, where this little known species is breeding, thus more attention to protect its natural habitats should be addressed.

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Habitat use of *Gerbillus nanus* and *Dipodillus dasyurus* at Azraq Wetland Reserve, north eastern Jordan

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ABSTRACT

The Balochistan Gerbil (*Gerbillus nanus*) and Wagner Gerbil (*Dipodillus dasyurus*) at Azraq Wetland Reserve were captured from different habitat types. *Gerbillus nanus* was more common species than *D. dasyurus*, accounting for 61.9% of the total capture during spring season, its prefer *Tamarix tetragyna* and *Nitraria retusa*, and *Nitraria retusa* vegetation types and avoid clay/soft sand. On the other hand, *D. dasyurus* was the highest captured species among *Tamarix passerionoides* and dry *Phragmites australis* vegetation community, and was absent in *Nitraria retusa*, silt island and *Tamarix passerionoides*, *Tamarix tetragyna, Nitraria retusa,* and *Alhagi maurorum* communities.

INTRODUCTION

In arid regions, rodent communities are considered important components of desert ecology. They play important ecological roles as consumers, producers and mechanical processors (Brown, 1986) and have been used to examine ecosystems quality (Rosenzweig & Winakur, 1969). Rodent's species are significantly considered rapid respondent to any environmental changes. They can be used as representative model in studying effects of environmental deterioration in ecosystems (Tchabovsky et al., 1999).

In Jordan, twenty eight species of rodents representing seven families are distributed in four biogeographic regions (Mediterranean, Irano-Turanian Sudanian Penetration and Saharo Arabian) and inhabiting a wide variety of habitats (Amr, 2012).

In last three decades, the northeastern deserts of Jordan have witnessed several changes to its environment, including effect of climate change and habitat deterioration due to agricultural development and water abstraction. These changes affected the distributions of wildlife within wetlands and arid regions. Azraq Wetland Reserve (AWR) was severely affected by changes in water level due to continuous pumping of water, and resulted in decline of many elements of biodiversity within the reserve (Quatrameez & Nassar, 1997; Abu-Laban, 1999; Abu Yahya *et al.,* 2014).

At AWR, little is known on rodents' communities and habitat preference (Abu-Laban, 1999). Therefore, the present study addressed habitat preference and association with vegetation type for two rodent species known to occur at AWR.

MATERIALS AND METHODS

Description of study area

The AWR is the only natural wetland in the Jordan Badia, it's located in northeastern part of Jordan, which covers around 12,710 km² surrounded by desert environment. The reserve is located in the lowest point of the Azraq basin, with an elevation of 500 m asl (Budieri, 1995). The primary source of water to the basin is the recharge of the basalt aquifers from Jabal al-Arab, and the secondary source of water comes deeply from Tulul al-Ashaqif highlands (Abu-Jaber *et al*., 1998). The reserve is characterized by hot summer average 38.9° C and a moderately cold winter average 7.3° C with a mean rainfall of 69.5 mm per year (Al-Eisawi 1985 and 1995). The landscape is gently undulating eroded plateau at north site to gently undulating plateau to southern direction through salt plains area. The view is open and the soil is shallow and sandy and broken by patches of *Phragmites australis* around water, with occasional patches of *Nitraria retusa, Tamarix passerinoides,* and *Tamarix tetragyna* in northwestern part of the reserve.

Figure (1) shows vegetation communities identified at AWR (Abu Yahya *et al*., 2014). This include either monotypic (e. g. *Nitraria retusa* and *Arthrocnemum macrostachyum*) or mixed communities.

The vegetation communities at AWR are considered anisotropic, based on differences in soil quality, texture, humidity and salinity (Al-Eisawi, 1995). Abu Yahya *et al.* (2014) stated that vegetation structure within AWR in terms of plant species composition differs in association with soil salinity and fresh water percentage, and thus halophytic species are expected to dominate.

Trapping effort

The field work was carried out during April and August, 2015 for five consecutive days. A total of 315 Sherman traps were distributed in nine vegetation communities. In total, 3150 trapping nights during both seasons was performed. Grids were randomly selected using Arc-GIS software program, with a minimum distance of 100 m between every other grid (Figure 1). In each grid, nine traps were placed with 25 m space between each trap. Two sizes of Sherman traps (30X10X8) cm and (23X9X8) cm were used and baited with white oats and peanut butter. Traps were set and baited daily between 15:30 pm and 17:30 pm and checked in the early morning in the following day. Species were identified, marked and released at the same site.

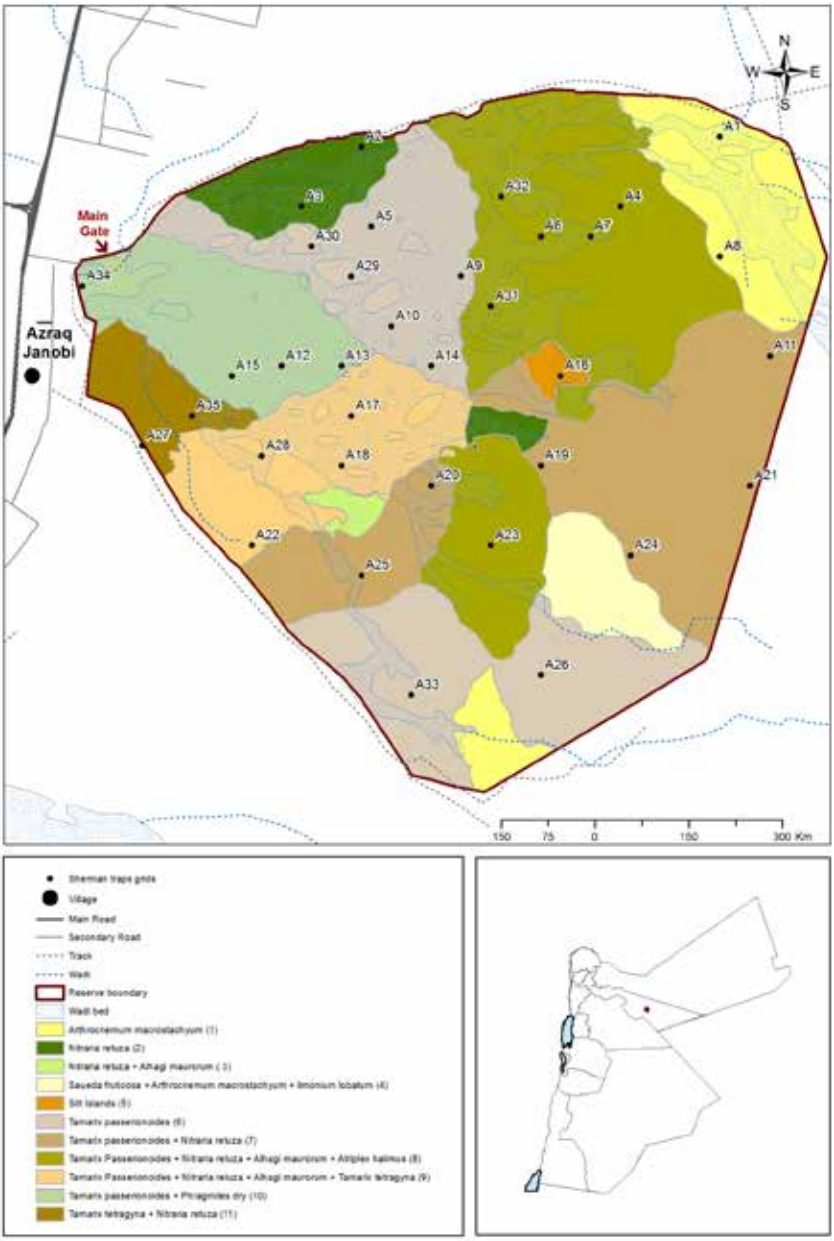


Figure 1: Grids where traps were set at Azraq Wetland Reserve.

RESULTS

Species abundance

The Balochistan Gerbil was more common than Wagner Gerbil, accounting for 61.9% of the total capture. During spring season, number of captured *G. nanus* was about twice as much compared to *D. dasyurus*. However, number of both species was almost similar during summer season (Table 1). In total, 32 *Dipodillus dasyurus* and 52 *Gerbillus nanus* were captured during both seasons. Number of captured *D. dasyurus* during both seasons did not differ significantly (Table 1), while *G. nanus* showed higher number of captures during spring compared to the summer season.

Table 1: Number of captured *Dipodillus dasyurus* and *Gerbillus nanus* during the study period.

	Spring		Summer	
	No. of trap	No. of captured	No. of traps	No. of captured
Dipodillus dasyurus	1575	17	1575	15
Gerbillus nanus	1575	36	1575	16

Association of Rodents with Vegetation communities

Table (2) shows numbers of trapped species in nine vegetation communities at AWR. In spring, the heights number of trapped *D. dasyurus* was among *Tamarix passerionoides* and dry *Phragmites australis* vegetation community. Wagner Gerbil was absent in both summer and spring season in *Nitraria retusa*, silt island void of vegetation and *Tamarix passerionoides*, *Tamarix tetragyna, Nitraria retusa,* and *Alhagi maurorum* communities.

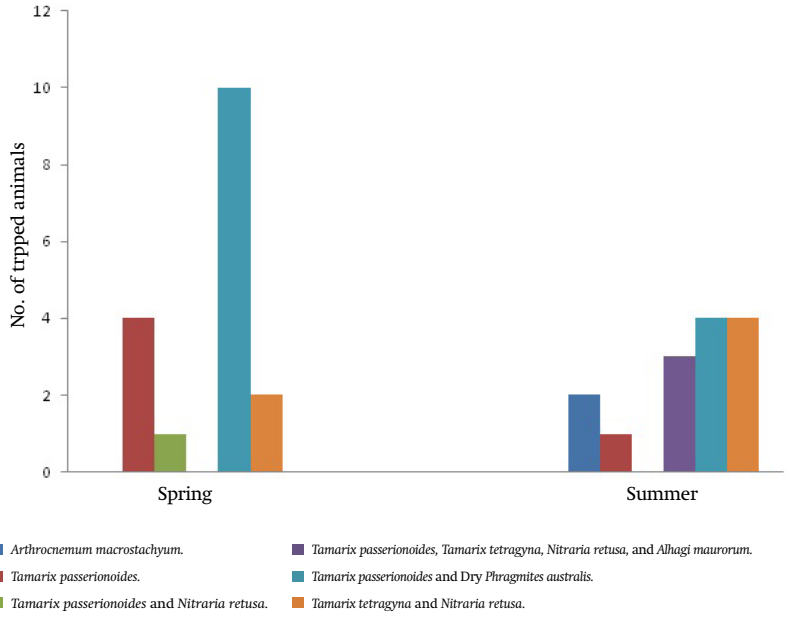
Table 2: shows trappability in the different vegetations types during the study period.

Vegetation type	*Dipodillus dasyurus*		*Gerbillus nanus*	
	Spring	Summer	Spring	Summer
1	0	2	3	3
2	0	0	5	1
3	0	0	1	0
4	4	1	2	1
5	1	0	4	1
6	0	3	3	4
7	0	0	2	4
8	10	4	2	0
9	2	4	12	1

1. *Arthrocnemum macrostachyum.* 2. *Nitraria retusa.* 3. Silt Island. 4. *Tamarix passerionoides.* 5. *Tamarix passerionoides* and *Nitraria retusa.* 6. *Tamarix passerionoides, Nitraria retusa, Alhagi maurorum,* and *Atriplex halimus.* 7. *Tamarix passerionoides, Tamarix tetragyna, Nitraria retusa,* and *Alhagi maurorum.* 8. *Tamarix passerionoides* and Dry *Phragmites australis.* 9. *Tamarix tetragyna* and *Nitraria retusa.*

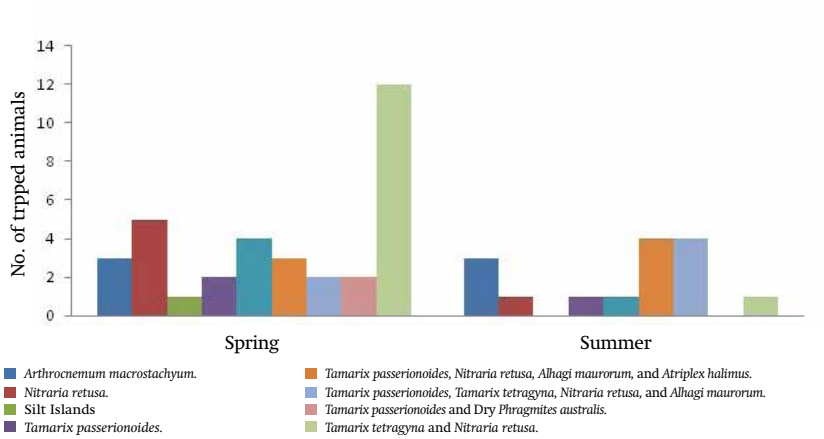
On the other hand, in the summer season, this species was recovered only from *Arthrocnemum macrostachyum* and *Tamarix passerionoides*, *Nitraria retusa, Alhagi maurorum,* and *Atriplex halimus* communities. In the summer season, highest number of *D. dasyurus* was among *Tamarix passerionoides* and dry *Phragmites australis*, and *Tamarix tetragyna* and *Nitraria retusa*.

During this survey, we distinguished nine vegetation communities in the reserve.



Figuer 2. Number of *D. dasyurus* trapped during spring and summer.

As for *G. nanus*, the heights number of trapped animals in the spring season was among *Tamarix tetragyna* and *Nitraria retusa*, and *Nitraria retusa vegetation* types (Figure 3). This species was recovered from all types of vegetation communities during the spring season at various densities. Balochistan Gerbil was absent from silt islands and *Tamarix passerionoides* and dry *Phragmites australis* during the summer season.



Figuer 2. Number of *G. nanus* trapped during spring and summer.

DISCUSSION

Dipodillus dasyurus and *G. nanus* at AWR were found in various habitats types with interaction between vegetation type and soil structure. Krasnov *et al.* (1996) reported that spatial distribution of rodents' communities in Negev Desert, south Palestine, was effected by the gradient of soil hardness from rock to sand, and gradient of vegetation from high vegetated area to hammada. They stated that *G. nanus* is an inhabitants of open gravel plains, while *D. dasyurus* is considered as habitat generalists. Abu-Laban (1999) studied rodent communities at AWR and reported five different species, at the time when pools were dried and sever ecological changes occur at AWR. These changes led to alteration in vegetation communities, thus affecting the overall rodent communities.

Abu Yahya *et al.* (2014) stated that *T. passerionoides* community became more dominant in the southern part of the reserve, while *N. retusa* became more dominant in salt plains areas compared with Al-Esawi (1995). *Dipodillus dasyurus* and *G. nanus* were considered as the most common species found at the reserve. *Dipodillus dasyurus* was trapped near *T. tetragyna* vegetation type and coarse sandy soil with gravels, and avoids clay and soft sandy soil with low vegetation density.

Shenbort *et al.* (1997) observed that *D. dasyurus* avoided sandy habitats and demonstrated selectivity for habitats with high rock and clay contents in Negev desert. Abu-Laban (1999) stated that vegetation cover and soil type are the most important factors that effected on the distribution of rodents at AWR. *Dipodillus dasyurus* was trapped from habitat with high vegetation cover.

In contrast, *Gerbillus nanus*, was found in sandy salty soil with *N. retusa* shrubs, and avoided clay/soft soil. Zahavi and Wahrman (1957), Qumsiyeh (1996), Abu-Laban (1999), and Amr et al., (2004) observed that *G. nanus* was collected from low sandy wadis with considerable salty nature with rich cover of *N. retusa* or *Tamarix* sp. It is common in arid regions especially along wadis, plateaus and hammada. It seems that *G. nanus* is dependent on seeds of *N. retusa*, where most burrows are located. On the other hand, *D. dasyurus* prefers leaves of *Ph. australis*. Wagner Gerbil is more generalist that *G. nanus*, with a wider range of distribution (Amr, 2012). Decline of water precipitation and limited of pools areas at AWR affected directly on vegetation diversity and density, which led to change on distribution and numbers of the rodents' species at the reserve.

Certainly, feeding behaviour and food selectivity are integral part of species diversity within desert habitats. These associations should be examined very closely to better understand the natural history. Interaction of different rodent species at AWR should be studied over an extended period of time to understand the dynamics of these desert adapted species to coexist in such habitat.

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The Stone Marten, *Martes foina*, in Dibeen Forest Reserve, Jordan

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ABSTRACT

The Stone Marten, *Martes foina*, was studied in Dibeen Forest Reserve during 2006, using live- traps, spoor route, and spotlight methods. A total of 164 trapping nights were performed, where as six individuals were captured. Spotlight and spoor route methods were ineffective. Details on morphometric measurements, sex, habitat preferences and threats were obtained. Threats are represented mainly by habitat destruction, agricultural expansion, road killing, poisoning, woodcutting and urban developments.

Keywords: Stone Marten, *Martes foina*, Dibeen Forest Reserve, Morphometric measurements, Jordan.

INTRODUCTION

The Stone Marten, *Martes foina*, is has a wide range of distribution extending from Europe, Asia Minor, Iran and extends into northern India to China and Mongolia (Harrison & Bates, 1991). In the Middle East, it is confined to Jordan, Lebanon, Palestine, Syria and Turkey (Harrison & Bates, 1991). In Jordan, the subspecies *Martes foina syriaca* was described by Nehring (1902) from Wadi Syr. Details on its distribution and threats were given by Al- Shafee et al. (1997) and Amr (2012).

A detailed study on the carnivores in Dibeen Forest Reserve (DFR) was performed in 2004 by the Royal Society for the Conservation of Nature (RSCN), and confirmed the presence of the Stone Marten. Our present study was conducted to provide further knowledge on the Stone Marten at DFR, and define threats affecting its population.

METHODS

The Study Area

Dibeen Forest Reserve extends over 8.5 km² of mountainous terrain, with an elevation ranges between 570 to 1050 m asl, and a vegetation dominated by

pine/oak trees. The reserve consists of three main stand types, distributed according to altitude. In the lower elevations, Aleppo pine (*Pinus halepensis*) is dominant with some pure stands and large native trees. The middle elevations is characterized by a pine-oak (*Pinus halepensis*/ *Quercus calliprinos*) association and extends over the majority of the area. The oak is the dominant species in the upper elevations, with small stands of deciduous oak (*Quercus infectoria*) on the uppermost slopes. Other trees present in the forest include *Arbutus andrachne*, *Pistacia palaestina* and *Olea europaea*.

Figure 1: the Stone Marten in Dibeen Forest Reserve.

METHODOLOGY

Three standard methods were employed during the study; live trapping, spotlighting and spoor route.

Live- trapping

A total of 164 trapping nights were performed using 10 medium sized box traps manufactured locally (100X40cm). Traps were placed in wadis, open areas, and slopes. All traps were left *in suite* for 10 successive nights and hidden as much as possible to provide shelter for the captured animals as well as to prevent the trap from being taken by locals. Traps were checked every morning and reset in the late afternoon using sardines and/ or boiled eggs as a bait. Captured animals were weighted and then anesthetized using three shots composed of Atropine Sulfate, followed by Xylocaine and then Ketamine. Anesthetic materials were given with care and based on the

animal body weight. After the animal is fully anaesthetized (around 8 – 12 minutes), it was measured, and sexed. Subsequently, all captured animals were released.

Spotlight

Night time spotlight transects was carried out to cover as much area as possible within the reserve. One-million candle-power spotlight was used during the night, while the car was at low speed (5 to 10 km/h). Nine transects were studied by four persons for a total of 72 man/hour.

Spoor Route

Six routes were performed and involved selecting a start point randomly with researchers walking parallel to each other, depending on the topography of the land. Signs for the presence of the Stone Marten were recorded including footprints, droppings, dens, dead specimens, and skull remains. The total effort for spoor route was 48 man/hour.

RESULTS

A total of six specimens were trapped (4 males and 2 females), with a trapability rate of 3.7%. Spotlight and spoor route methods yielded no results throughout the study.

Tabel 1: Efforts used to study the Stine Marten.

Method	Total effort	No. of captured, sings or observed animals	%
Spotlight	72 man/hour	0	0
Spoor routes	48 man/hour	0	0
Traps	164 trap nights	6	3.7

Table 2 shows morphometric measurements for the captured animals. Measurements were compared to other studies available.

Table 2: Morphometric measurements of Stone Marten from Dibeen Forest Reserve.

No	Sex	Weight (g)							
			HB	T	FA	HF	E	HPD	FFD
1	Male	1700	45	26	10.06	7.06	2.03	3.08	4.05
2	Male	1900	46	24	10.04	7.04	2.04	3.08	4.07
3	Male	1760	45.5	24	10.06	7.07	2.08	3.09	4.06
4	Male	1400	44	27	10.05	7.08	2.07	3.03	4.04
5	Female	1300	41	25	10.08	7.08	2.01	2.01	3.03
6	Female	1350	42	25	9.05	7.02	2.02	2.02	3.05
Mean	Male	1690	45.13	25.25	10.05	7.06	2.06	3.07	4.06
	Female	1325	41.50	25.00	9.57	7.05	2.02	2.02	3.04
Std. deviation	Male	211	0.85	1.50	0.01	0.02	0.02	0.03	0.01
	Female	35	0.71	0.00	0.73	0.04	0.01	0.01	0.01

HB: Head and Body length; T: tail length; FA: forearm length; HF: forearm length; E: ear length; HPD: hind pad length; FFD: forearm pad length.

DISCUSSION

Despite that the Stone Marten is listed as a least concern species based on International Union for the Conservation of Nature Red Lists, its population is sharply declining in Jordan, and is restricted to the rocky mountains of the north part of Jordan (Amr, 2012). In addition, the stone marten is considered a forest dwelling species, which threatening its status as forests in Jordan are severely degraded and represents less than 1% of the total country area (Al Eisawi, 1996). Al- Shafee *et al.* 1997 stated that the population declines are caused by human interference represented by habitat destruction, large-scale of urban developments; construction of roads, agricultural expansion and direct killing.

Knowledge on the Stone Marten external body measurements came from Al-Shafee *et al.* 1997, which was in accordance with the current survey results. Harrison & Bates (1991) provided information about external body measurements for specimens obtained from Iraq and Lebanon. Their results showed larger specimens compared to the specimens collected during this survey. No details were provided on the species body weight based on the available literature, where the average was measured as 1.69 Kg for males and 1.33 Kg for females.

Spotlight and spoor routes were ineffective in the forest for studying the Stone Marten, due to the behavior of this species which has a very fast reaction against the disturbance around (car engine sound and/or human sound). In addition, forest provides a very suitable habitat for hiding due to the dense vegetation and understory cover, which doesn't allow seeing the animal and/or its signs. The high agility of the Stone Marten in tree climbing provides more protection to the species, and decrease the opportunities to eye- contact.

Habitats preferences were studied in accordance to Sacchi & Meriggi (1995) who showed that the Stone Marten prefer bushy area, avoid large forest, preference of low altitudes with abandon houses or isolated houses surrounded by shrubs and crops. Thus; Dibeen Forest can be considered as typical habitat for Stone Marten which has good variety in food sources, and also safe sheltering and breeding sites. Table 2 below illustrates habitats preferences of the Stone Marten in Dibeen Forest Reserve.

Despite the establishment of Dibeen as a forest reserve, several challenges are threatening the status of the Stone Marten and represented by wood cutting, mass tourism, road driving, uncontrolled grazing and habitat fragmentation. Locals around the reserve usually depend on woods for charcoal production or trading, which highly affect this woodland associated species; in addition to reduction in the shelters availability in the reserve. Mass tourism impact and other human activities in the current time is larger than reserve capacity, especially in the weekends, in what known as one

day picnicking. This cause waste dispersal in the picnicking area which attracts the carnivores and may has decayed food. In addition to the negative impacts on the habitat and soil resulted from different activities such as off road driving.

Table 2: Habitat Variability at Dibeen Reserve according to Sacchi & Meriggi (1995).

Habitat variables (Sacchi & Meriggi, 1995)	Variables availability in DFR.
Deciduous forest	+
Conifer Forest	+
Wood fragmentation	+
Mediterranean shrubs	+
Streams	-
Density of abandoned houses	+

Uncontrolled grazing is considered as a major factor in disturbance for wild zone within the reserve. The reserve area is overlapped with the private lands which are used for random agriculture, the reserve is suffering from the degradation of the habitat because of large agricultural demands. The Stone Marten depends directly on habitat quality for survival, so it is highly affected by habitat degradation, in addition to increasing the probability of animals exposure to hunting and absence of safe wildlife corridors. The reserve has large number of roads some of them link the locals villages and the other roads outside the reserve which were increased recently due to urbanization development in Jordan, all these roads cause what called road kill incidences which cause declining in the population sizes. Conserving the site should continue in order to minimize the harmful impact of human on the viability of this species.

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Short Communication

Competition on favourable nest location between Griffon Vulture and Bonelli's Eagle in Dana Biosphere Reserve

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Dana Biosphere Reserve holds a high diversity of raptors-whether residents or migrants due to the location at the eastern edge of Jordan Rift Valley, the hard terrain, and the variety in elevation from 150 meter below sea level at the western parts of the reserve in Wadi Araba up to 1500 meter above sea level at the eastern parts in Al Sharrah Mountains. Up to date, a total of 40 species of birds of prey were recorded in the reserve, eleven of which are known to breed annually (Evans & Al Mashaqbah, 1995).

This number of "top predator" indicates the relative richness and intactness of the ecosystem in the area of the reserve. A special monitoring program of breeding raptors was established by the reserve management in 1995 targeting the Egyptian Vulture *Neophron percnopterus*, Griffon Vulture *Gyps fulvus*, Short-toed Eagle *Ciraetus gallicus*, Bonelli's Eagle *Aquila fasciatus*, Verraux's Eagle *Aquila verreauxii*, Lesser Kestrel *Falco naumanni*, and Eagle Owl *Bubo bubo*. The raptor monitoring program is performed using 12 vantage watching points (Fig. 1), all of which were selected based on the steep and broken slopes with ledges and crevices that enables a clear scanning of the facing cliffs with binoculars and telescopes from several different angles to locate nesting raptors (Evan & Al-Mashaqbah, 1995). Once a nest is located, watching for the arrival birds and the subsequent visits are documented from nesting to fledging.

A case of nest competition between two species was reported at one of the nesting sites in the reserve. A pair of Bonelli's Eagle was nesting in 2010 at the given nest (Fig. 2a) that was reused in 2012, and 2014 by a Griffon Vulture (Fig. 2b), with success breed of one chick per each pair of Griffon Vulture, and two checks for Bonelli's Eagle.

The nest competition between raptors is not unusual phenomena, it's recorded many times in many places of the world and between many species, for example: in Spain, Competition between: Bonelli's Eagle and Golden Eagle, Bonelli's and Griffon Vulture, Bonelli's and Peregrine falcon were recorded (Ontiveros *et al.,* 2008). In Europe, Eurasian Griffon compete extensively with Lammergeiers for nest sites (Fernández & Donázar, 1991; Margalida & Garcia, 1999; Bertran & Margalida, 2002).

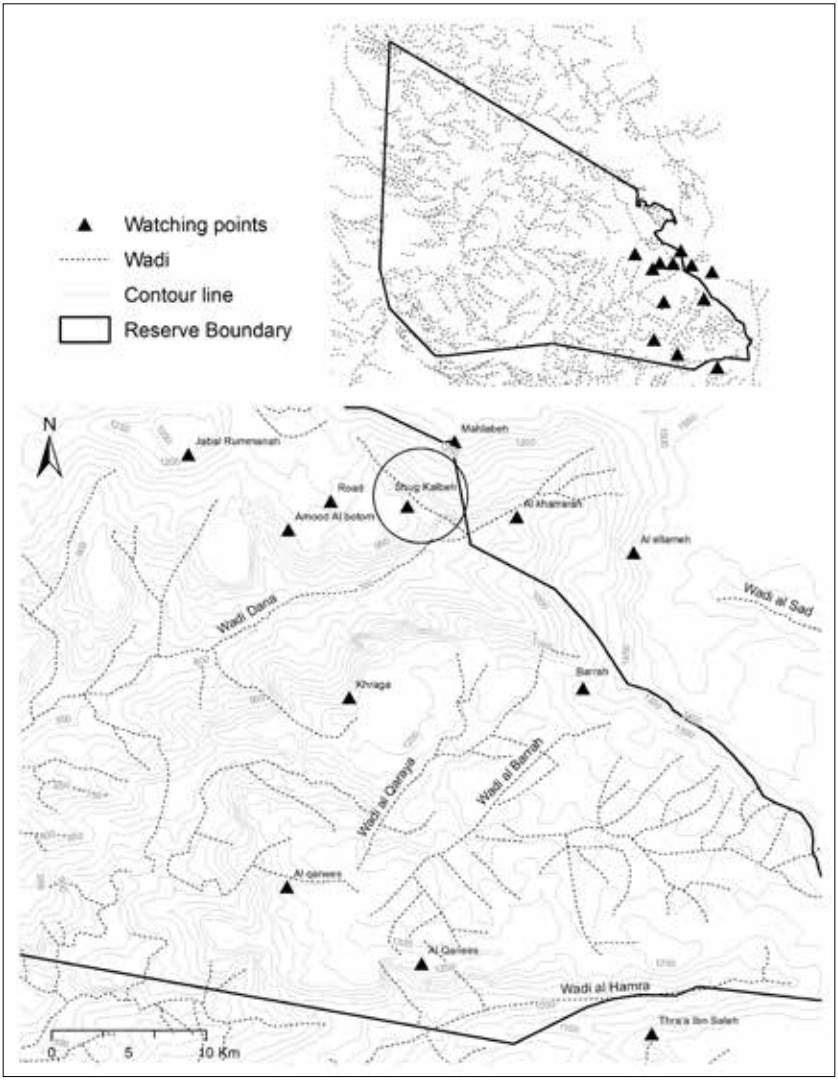

Fig. 1: Raptors survey viewpoints in Dana Biosphere Reserve showing the selected point in the black circle.

Figure 2: Bonelli's Eagle nest (a) in 2010, and at the same nest used by Griffon Vulture in 2014 (b), there is no available photograph for 2012 nest of Griffon Vulture.

Evidence of interspecific aggression at nest sites also has been observed between Eurasian Griffon and Cinereous Vultures (Blanco *et al*., 1997), between Eurasian Griffon and Egyptian Vultures (Pascual & Santiago, 1991), and between Cinereous Vulture and Bearded Vultures (Aykurt & Kiraç, 2001). Four cases of European Magpie nests usurpation occurred within among different raptor species in Zuojia Natural Reserve, northeast China. (Zhou *et al*., 2009). All of these examples give clear idea about the level of competition between raptors on the suitable nesting sites which considered little based on the fact that the platform should contain many factors together to be suitable nest-site, like the heights, aspects, slops, tree cover, wind direction and other factors.

Raptors are among the few groups of birds in which population size and breeding success are clearly limited by the availability of nesting sites (Newton, 1979). Dana Biosphere Reserve contain limited high platforms which suitable for raptors breeding. Griffon Vulture and Bonelli's Eagle are cliff-nesting raptors. As a result, nest competition could be recorded from time to time.

Competition on nesting sites in Dana Biosphere Reserve can be resulted when nesting sites became scares, exposed, and sometimes unsafe. In this case the nest of interest is located at the highest point of Wadi Dana in *Shag Kalbeh*, (Fig. 1) that reduces the needed effort for takeoff. On the other hand, the nest located exactly at the narrowest eastern tip of the wadi that is forming a bottle neck for uplifting winds. Finally, the nest direction took the advance of sun light where the nest is facing west / south so both shade and light options are available within the nest and for long period of time during the day. These three factors were the favourable conditions that cause the competitions on this given nest.

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