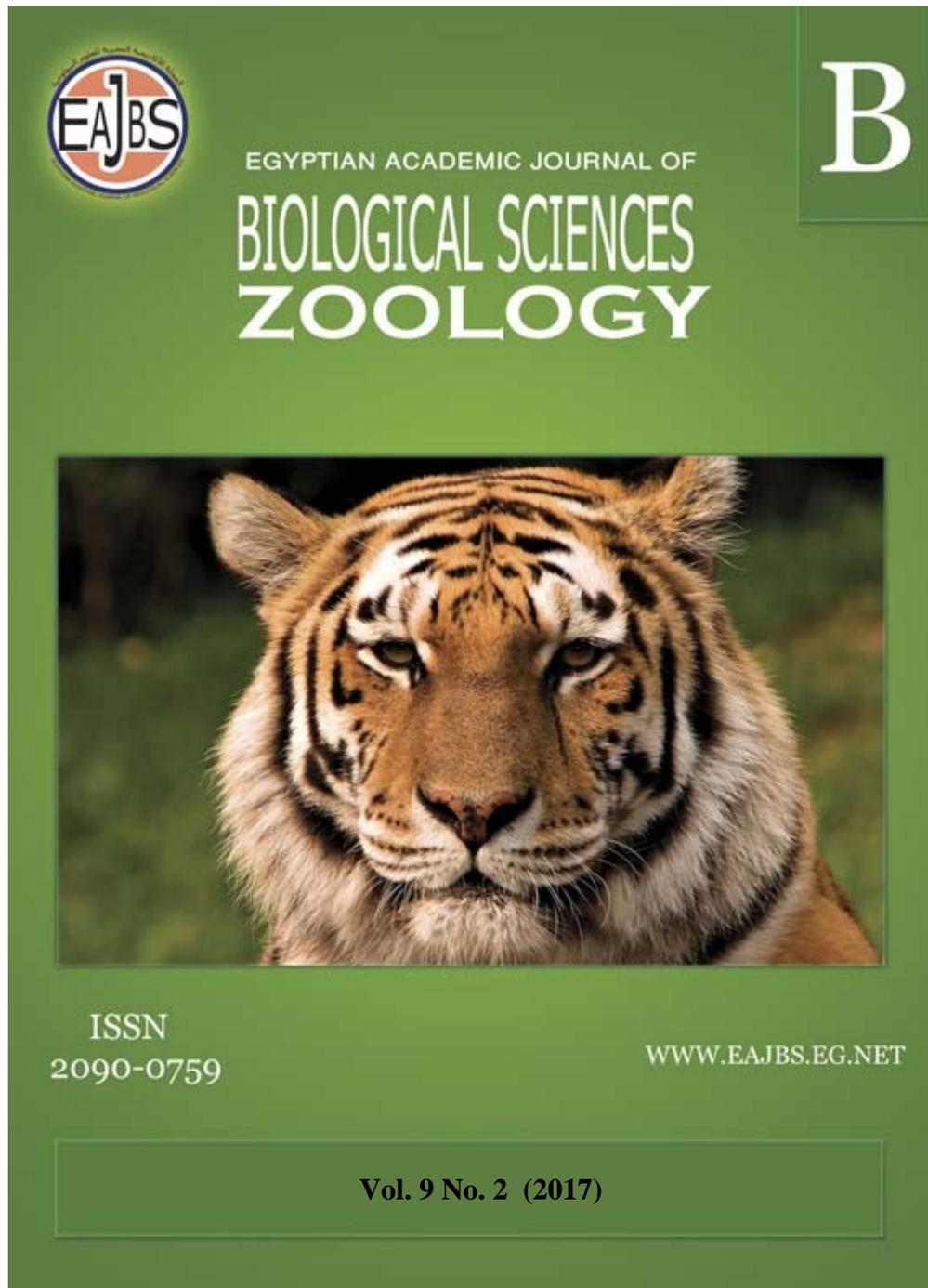


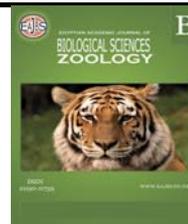
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Ecological Notes on Snake Diversity in Tathleeth District, Aseer Region, Southwest of Saudi Arabia

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ABSTRACT

The study was carried out in Tathleeth governorate at Aseer region of southwestern Saudi Arabia which is considered the largest district in the region. It lies between 18° 42' - 20° 00' N and 34° 20' - 44° 30' E. The major habitats of the study area were ecologically described and their snake fauna were surveyed in spring 2015 to summer 2017. The present survey contained a checklist of 92 specimens belonging to 12 species and 6 families. These species were *Psammophis schokari*, *Rhagerhis moilensis*, *Spalerosophis diadema cliffordi*, *Platyceps rhodorachis rhodorachis* (Colubridae), *Cerastes gasperettii*, *Echis coloratus*, *Bitis arietanus arietanus* (Viperidae), *Naja haje arabica*, *Walterinnesia aegyptia* (Elapidae), *Eryx jayakari* (Boidae), *Atractaspis engaddensis* (Atractaspididae), and *Leptotyphlops macrorhynchus* (Leptotyphlopidae). Regarding species richness, Colubridae were represented by 42.8% followed by Viperidae 27.2%, Elapidae (7.7%). Boidae (12%), Atractaspididae (8%) and Leptotyphlopidae (2.2%) and were represented by 3 species with 12 samples in total. This study was suggested to highlight on the diversity of snake's fauna of Tathleeth District, Aseer region, south west of Saudi Arabia, as an important part of the ecosystem that has to be maintained.

INTRODUCTION

The ability of reptilian fauna to adapt to habitat changes is low and their dispersal is, therefore, affected by the environmental conditions. Some reptilian species inhabiting Sahara Desert have been adopted to peculiarities of habitats (Abuzinada et al., 2004). Snakes control both insect and rodent populations and thus, they are important pillar in construction the natural ecosystem (Masood, 2012).

Due to medical importance of most snakes, ophidian fauna deserves a particular interest. The kingdom of Saudi Arabia is a vast and an arid country with different habitats like mountains, clefts, flat lands, valleys, and deserts. Its geographical location between tropical and warm temperature zone makes the country a unique in supporting rich and diversified fauna.

Despite its historical, biological and economic significance, Saudi biodiversity in general and snake fauna in particular are poorly documented in terms of

distribution and taxonomy. The biodiversity of the hepetafauna in Arabian Peninsula is considered as a hot spot since approximately, 170 species (100 lizard species, 51 snake species, 10 turtle species and 9 amphibian species) represent this fauna in the country (Al-Sadoon, 2010). Snake species include 9 marine species and 42 terrestrial species with 9 venomous terrestrial ones (Gasperetti, 1988; Al-Sadoon and Al-Otaibi, 2014).

Some ecological studies have been done on snakes of different regions of Saudi Arabia from which were Southern Hijaz (Parker, 1938), Eastern and Northeastern Arabia (Mandeville, 1967) and Central Arabia (Al-Wailly and Al-Uthman, 1971). In the western region of Saudi Arabia, 15 snake species have been recorded by Farag and Banaja (1980) whereas, Masood, (2012) has observed 25 terrestrial snake species belonging to seven families in Jazan. Meanwhile, 14 snake species (belong to 5 snake families) have been recorded by Masood and Asiry (2012) in Aseer region. The authors have mapped the distribution of these 14 species in their distributional range.

In the present study, the collection was conducted in five seasons between spring 2015 and summer 2017 when the environmental conditions were most suitable for the presence of animals. The animals were mostly observed and collected between dawn and midmorning, or shortly before sunset. Tathleeth district is one of the richest biodiversity regions in Saudi Arabia encompassing a large group of wild animals of different families. This survey was undertaken to investigate the barely known snake fauna of Tathleeth district which is considered as the biggest area of Aseer region in southwestern Saudi Arabia.

MATERIALS AND METHODS

Study Area:

Tathleeth governorate lies between 18° 42' - 20° 00' N radians and meridians of 34° 20' - 44° 30' E. Tathleeth is nearly about 1150 m height in the eastern part and 1400 m height in the southwestern part above the sea level (Fig. 1).

Climate and Samples Collection:

The climate of the study area is characterized by hot summers and mild winters. The area is almost dry during the year (Mohandes and Rehman, 2010), except for the rainy months of March, April and sometimes in May. The area of study was annually surveyed during the spring and summer from April to October in 2015, 2016 and 2017. These seasons are characterized with active kinematics of the species. The survey was conducted during the bright days from 8 AM to 6 PM for some species, while others required a night survey from 7 PM to 2 AM. Hand capturing, noosing and traps were used for snake collection during the survey. Snakes were collected by putting a special hard stick on the head and pressing it in such a manner that the snake could not move its head. Date, locality and co-ordinates (latitude, longitude and altitude) have been recorded by a GPS (Table 1). Time of day and other ecological information were recorded. The collected specimens were weighed, anaesthetized and preserved in formalin or 70% ethyl alcohol and finally transferred to the lab for morphological investigations and classification according to serpent's key (Gasperetti, 1988). Species richness was measured by the number of samples collected per species/ total number of samples collected in the study X 100 (Wolf et al., 2016).

Table (1) Co-ordinates: Latitude, longitude and altitude, of the studied areas by a GPS

Species	No	Co-ordinates		Location
<i>Psammophis schokari</i>	2	N 19 ⁰ 22'	E 43 ⁰ 33'	Alhafayer 2
<i>Rhagerhis moilensis</i>	11	N 19 ⁰ 20'	E 43 ⁰ 36'	Aum elherjan 2
		'N 19 ⁰ 40	E 42 ⁰ 56'	Alhantherya
		N 19 ⁰ 20'	E 43 ⁰ 34'	Errael vally
		N 19 ⁰ 13'	E 43 ⁰ 32'	Alhadood
		N 19 ⁰ 21'	E 43 ⁰ 35'	Alhafayer
		N 19 ⁰ 35'	E 043 ⁰ 12'	Almassamah 2
		N 19 ⁰ 24'	E 43 ⁰ 37'	Asherah
		N 19 ⁰ 21'	E 43 ⁰ 32'	Almastawyah
		N 19 ⁰ 00'	E 43 ⁰ 37'	Alhamdha
<i>Spalerosophis diadema cliffordi</i>	17	N 19 ⁰ 22'	E 43 ⁰ 34'	Alhafayer 3
		N 19 ⁰ 29'	E 43 ⁰ 30'	Bjad mountain
		N 18 ⁰ 50'	E 43 ⁰ 44'	Alhamra 2
		N 19 ⁰ 20'	E 43 ⁰ 34'	Errael vally 3
		N 19 ⁰ 16'	E 43 ⁰ 30'	Arriseen vally
		N 19 ⁰ 13'	E 43 ⁰ 32'	Alhadood
		N 19 ⁰ 05'	E 43 ⁰ 19'	Alsubaikhah
		N 18 ⁰ 58'	E 43 ⁰ 26'	Erqah
		N 19 ⁰ 41'	E 43 ⁰ 26'	Almassamah
		N 19 ⁰ 24'	'E 43 ⁰ 37'	Asherah 2
N 19 ⁰ 26'	E 43 ⁰ 32'	Laes		
<i>Coluber rhodorachis</i>	9	N 19 ⁰ 22'	E 43 ⁰ 34'	Alhafayer 3
		N 19 ⁰ 29'	E 43 ⁰ 30'	Bjad mountain
		'N 18 ⁰ 50'	E 43 ⁰ 44'	Alhamra 2
		N 19 ⁰ 20'	E 43 ⁰ 34'	Errael vally 3
		N 19 ⁰ 12'	E 43 ⁰ 29'	Arriseen vally
		N 19 ⁰ 13'	E 43 ⁰ 32'	Alhadood
		N 19 ⁰ 05'	E 43 ⁰ 19'	Alsubaikhah
		N 18 ⁰ 58'	E 43 ⁰ 26'	Erqah
		N 19 ⁰ 41'	E 43 ⁰ 12'	Almassamah
		N 19 ⁰ 24'	E 43 ⁰ 37'	Asherah 2
N 19 ⁰ 26'	E 43 ⁰ 32'	Laes		
<i>Cerastes gasperettii</i>	14	N 19 ⁰ 22'	E 43 ⁰ 34'	Alhafayer
		N 19 ⁰ 29'	E 43 ⁰ 30'	Alhamra
		N 18 ⁰ 50'	E 43 ⁰ 44'	Errael vally 3
		N 19 ⁰ 20'	E 43 ⁰ 34'	Arriseen vally
		N 19 ⁰ 12'	E 43 ⁰ 29'	Alhadood
		N 19 ⁰ 13'	'E 43 ⁰ 32'	Alsubaikhah
		N 19 ⁰ 05'	E 43 ⁰ 19'	Erqah
		N 18 ⁰ 58'	E 43 ⁰ 26'	Almassamah
		N 19 ⁰ 41'	E043 ⁰ 12'	Asherah 3
		N 19 ⁰ 24'	E 43 ⁰ 37	Laes
<i>Echis coloratus</i>	9	N 19 ⁰ 22'	E 43 34'	Alhafayer 3
		N 19 ⁰ 29'	E 43 ⁰ 30'	Bjad mountain
		N 18 ⁰ 50'	E 43 ⁰ 44'	Alhamra 2
		N 19 ⁰ 20'	E 43 ⁰ 34'	Errael vally 3
		N 19 ⁰ 12'	E 43 ⁰ 29'	Arriseen vally
		N 19 ⁰ 13'	E 43 ⁰ 32'	Alhadood
		N 19 ⁰ 05'	E 43 ⁰ 19'	Alsubaikhah
		N 18 ⁰ 58'	E 43 ⁰ 26'	Erqah
		N 19 ⁰ 41'	E 43 ⁰ 12'	Almassamah
		N 19 ⁰ 24'	E 43 ⁰ 37'	Asherah 2
N 19 ⁰ 26'	E 43 ⁰ 32'	Laes		

Table 1 Continued

<i>Bitis arietanus arietanus</i>	2	N 18 ⁰ 30	E 43 ⁰ 34'	Alwahalan vally
		N 18 ⁰ 29	E 43 ⁰ 30'	Jaboob vally
<i>Eryx jayakari</i>	11	N 19 ⁰ 22'	E 43 ⁰ 34'	Alhafayer 3
		N 19 ⁰ 29'	E 43 ⁰ 30'	Bjad mountain
		N 18 ⁰ 50'	E 43 ⁰ 44'	Alhamra 2
		N 19 ⁰ 20'	E 43 ⁰ 34'	Errael vally 3
		N 19 ⁰ 12'	E 43 ⁰ 29'	Arriseen vally
		N 19 ⁰ 13'	E 43 ⁰ 32'	Alhadood
		N 19 ⁰ 05'	E 43 ⁰ 19'	Alsubaikhah
		N 18 ⁰ 58'	E 43 ⁰ 26'	Erqah
		N 19 ⁰ 41'	E 43 ⁰ 12'	Almassamah
		N 19 ⁰ 24'	E 43 ⁰ 37'	Asherah2
		N 19 ⁰ 26'	E 43 ⁰ 32'	Laaes
<i>Naja haje arabica</i>	3	N 17 ⁰ 39'	E 42 ⁰ 41'	Jaboob vally
		N 17 ⁰ 39'	E 42 ⁰ 41'	Arrashdah vally
		N 17 ⁰ 39'	E 42 ⁰ 41'	Alsubaikhah
<i>Walterinnesia aegyptia</i>	4	N 19 ⁰ 24'	E 43 ⁰ 34'	Alquwaem
		N 19 ⁰ 20'	E 43 ⁰ 36'	Aum Alherjan
		N 19 ⁰ 18'	E 43 ⁰ 31'	Arriseen vally
<i>Atractaspis microlepiota</i>	8	N 18 ⁰ 58'	E 43 ⁰ 26'	Erqah
		N 19 ⁰ 35'	E 43 ⁰ 12'	Almassamah 2
		N 18 ⁰ 46'	E 43 ⁰ 36'	Bayer 2
		N 19 ⁰ 20'	E 43 ⁰ 34'	Errael
		N 19 ⁰ 43'	E 43 ⁰ 47'	Rabah
<i>Leptotyphlops macrorhynchus</i>	2	N 19 ⁰ 00'	E 43 ⁰ 29'	Qurra
		N 19 ⁰ 22'	E 43 ⁰ 33'	Alhafayer 2

RESULTS AND DISCUSSION

Area of Study :

The area of study is characterized by unique topography, geomorphology and biodiversity. It contains several landscape types such as isolated rugged mountains, clumps, pen plains, escarpments, flat-topped plateaus, valleys, rock, and sandy desert. The mountain heights are found in the western part, while some valleys are in the southern part. Wide plains like Al'amq, Almassamah and Almethab extend along with Tathleeth valley from the south to the north of the governorate. Across the valleys, agricultural activities are encountered along their sides. At the northern and east northern parts, the mountain diminishes with the presence of some sandy dunes which finally connects with Rub Alkhali desert (Fig. 1). The area is one of the richest regions of the Kingdom characterized by the presence of a large group of wild animals belonging to different families. This study was undertaken to survey and identify the barely known snake fauna of Tathleeth region. The collection was included five seasons between spring 2015 and summer 2017 at environmental conditions suitable for animal activity. The animals were mostly observed and collected between dawn and midmorning, or shortly before sunset.

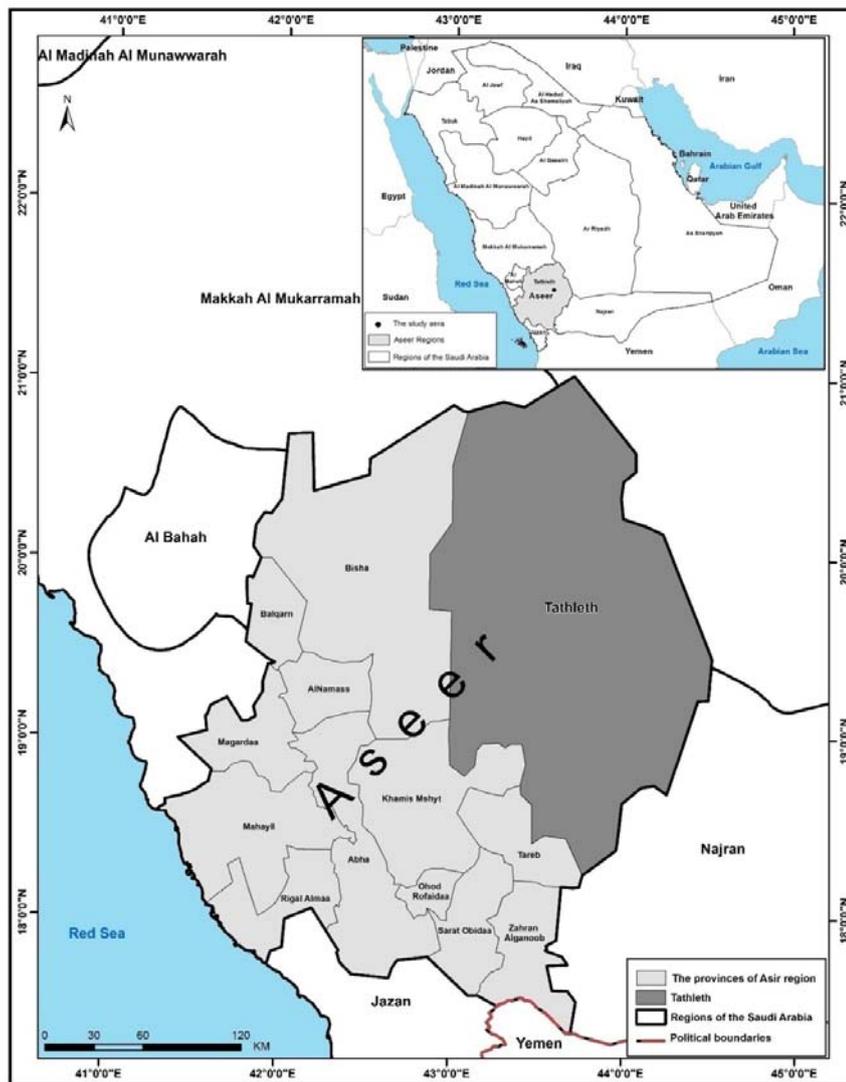


Fig. 1. Map of Saudi Arabia showing the location of the study area.

Species Composition :

The present survey contains 92 specimens belonging to 12 intergeneric species. These 12 species belong to 6 families (Colubridae, Viperidae, Elapidae, Boidae, Atractaspididae, and Leptotyphlopidae) with quite variable generic representation. Colubridae, Viperidae and Elapidae were represented by 4, 3 and 2 genera, respectively while each of Boidae, Atractaspididae, and Typhlopidae were represented by 1 genus only (Table 2). These species were *Psammophis schokari*, *Rhagerhis moilensis*, *Spalerosophis diadema cliffordi*, *Platyceps rhodorachis rhodorachis* (Colubridae), *Cerastes gasperettii*, *Echis coloratus*, *Bitis arietanus arietanus* (Viperidae), *Naja haje arabica*, *Walterinnesia aegyptia* (Elapidae), *Eryx jayakari* (Boidae), *Atractaspis engaddensis* (Atractaspididae), and *Leptotyphlops macrorhynchus* (Leptotyphlopidae). According to species richness, Colubridae was represented by 42.8% followed by Viperidae which was represented by 27.2% (Table 2). Boidae, Atractaspididae, Elapidae and Leptotyphlopidae were represented by 12%, 8%, 7.7%, and 2.2%, respectively.

Figure 2 showed the species richness in the study area based on the number of captured samples per species. Colubridae constituted approximately half density of the species collected where the largest species richness (*Spalerosophis diadema cliffordi*) was belonged to this family together with the other three species (*Rhagerhis moilensis*, *Psammophis schokari*, *Coluber rhodorachis*). The habitat of the 4 species varied between plains, valleys, mountains, farms and wells (Rota et al., 2017). A total of 25 specimens of three species (*Cerastes gasperettii*, *Echis coloratus* and *Bitis arietanus arietanus*) belong to Viperidae were collected. This family represented over quarter (27.2%) of the total snakes collected.

Although, one species of family Boidae (*Eryx jayakari*) was recorded, it was represented with reasonable highly density (12%) among the collected snakes. The other three families were poorly represented in the area of study with Leptotyphlopidae being the lowest one (2.2%).

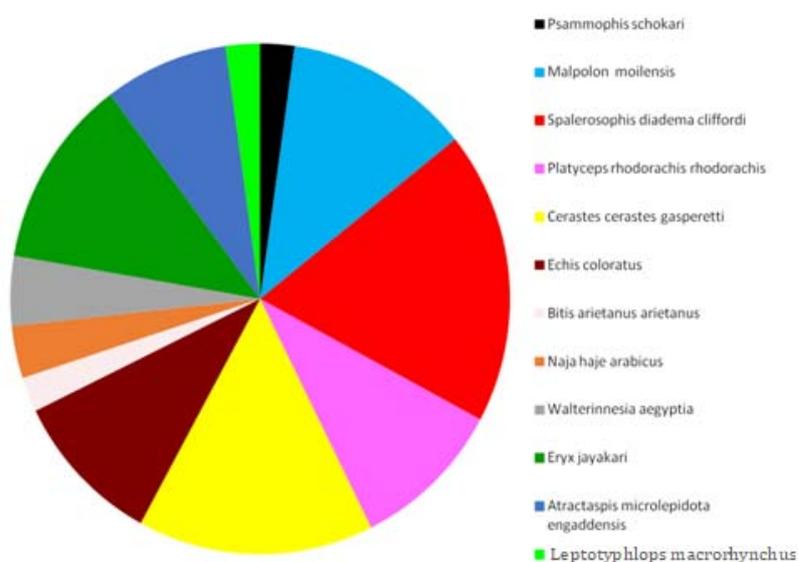


Fig. 2. Species richness in the study area.

Species Notes:

Colubridae:

It constitutes 70% of all snake genera and distributes throughout temperate and tropical regions. It is either terrestrial or aquatic containing 23 species in Arabia. Some species are diurnal and some are nocturnal. They are usually non-poisonous with teeth in both jaws. It is found everywhere in Saudi Arabia.

Psammophis schokari (Forskal, 1775):

It appears light gray with longitudinal lines on the dorsal side and rarely recorded in farms during day time (Table 2). It is fast-moving and semi poisonous with back-canines feeding on rodents (Abdel-Baki et al., 2014). It has been reported in Hail, Dhahran, Al-Qatif, Al-Hasa, Riyadh, Afif, Jeddah, and Jizan (Al-Sadoon, 2010).

Rhagerhis moilensis (Reuss, 1834):

It is widespread snake in open environments and is recorded in valleys, sandy plains and rugged areas (Table 2). It shows grayish yellow color with dark brown dots behind eyes and diurnally and nocturnally active. It is characterized by lifting behavior similar to Cobra snake so it is called Pseudo Cobra (Böhme and de Pury, 2011). It was recorded throughout Al-Zulfi, Abqaiq, Dhahran, Al-Hasa, Jabrin, Riyadh, Al-Kharj, Jeddah, Thuwal (Al-Sadoon, 2010; Masood, 2012; Masood and Asiry, 2012).

***Spalerosophis diadema cliffordi* (Schlegel, 1837):**

It is abundant in open environments, valleys and farms (Table 2). It appears with dark gray color and has several points along the dorsal side and was seen throughout day and night. It is a non-venomous snake with no fangs however it has an aggressive behavior and attacks and bites vigorously. It has small strong teeth, recorded in the environment throughout the year feeding on rodents, lizards and birds (Böhme and de Pury, 2011). It is widely distributed throughout the Arabian Peninsula (Al-Sadoon, 2010).

***Platyceps rhodorachis rhodorachis* (Jan, 1865):**

It is a non-venomous nocturnal snake with shy behavior. The appearance varies according to the surrounding environment from black, dark to gray reddish. It is recorded in different seasons. The body is dotted with non dotted tail (Ramesh et al., 2015). It has been reported from Riyadh, Jeddah and Abha (Al-Sadoon, 1989).

Viperidae:

Members of this family are poisonous and characterized by triangle shaped heads. Their thick and short bodies have a clear neck and short tail with small overlapping dorsal scales. They have front needle shaped tusks on the sides of the upper jaw and are hemotoxic.

***Cerastes gasperettii* Leviton and Anderson, 1967;**

This Gasperetti's sand viper is wide-spread in the north and east of the region with sandy color being active in open plains with trigonal head. The snake is short, nocturnal and with poisonous front canines. It feeds on lizards and small mammals. It has been recorded from Hail (Al-Shammari and Ibrahim, 2015), Al-Hasa, Dharan, Central region, Ummlaj, Mahd Al-Dhahab and Bishah (Al-Sadoon, 2010), Asir region (Masood and Asiry, 2012) and Jizan (Masood, 2012).

***Echis coloratus* Günther, 1878:**

Carpet Viper is widely spread in all areas except for the sand dunes. It has a gray color and patches along the body. The head is bell-like having poisonous frontal canines. It is nocturnal feeding on mammals, lizards and small animals. Nine specimens of this carpet viper were collected from the study area inhabiting rocky and sandy regions (Table 2). The adult ranged from 60 to 75cm in length. The body is stocky, short with large and wide head. This viper is usually gray or brownish in color. A series of dark-edged pale dorsal cross-bands run along the back. It is aggressive and considered as one of the most dangerous venomous vipers. It has been reported from Al-Hasa, central region, Tabouk, Ummluj, Yanbu Jeddah, Asir and Jazan (Gasperetti, 1988; Al-Sadoon, 2010; Masood, 2012; Masood and Asiry, 2012; Al Oufi and Amr, 2015).

***Bitis arietans arietans* (Merrem, 1820):**

It is found in all habitats except true deserts. Chiefly nocturnal, but it is also found basking in the early morning (in spring and autumn). It feeds on small frogs, toads, small reptiles and small rodents. Two specimens were recorded in the study area and only found in the south of Tathleeth.

Boidae:

It contains 80 species distributing throughout tropical and semitropical regions. It is most primitive, with 2 functional lungs with vestigial hind limbs being as spurs in the two species inhabiting Arabia. It is borrowing in sands and non-poisonous.

***Eryx jayakari* Boulenger, 1888:**

The Arabian Sand Boa, *E. jayakari* is a small harmless snake and only found in the Arabian Peninsula. It is nocturnal, lives mostly

under the desert sand and buries itself under the sand when feels danger. Eyes are positioned on the top of head. It is carnivorous feeding on small rodents, reptiles and arthropods (Al-Sadoon and Al-Otaibi, 2014).

Atractaspididae:

Members of this family are characterized by strong hollow needle shaped tusk having the ability to move in all directions. They are highly poisonous snakes and are globally widespread.

***Atractaspis engaddensis* Haas, 1950:**

It has a bright black color with slow movement and unaggressive behavior. It is very poisonous with a moving front tooth that is extremely dangerous. It is characterized by folding around itself and could activate during the night hour. Eight samples were recorded in plain and mountain environment.

Elapidae:

Members of this family are big sized up to a meter in length, with large head and long tail. They have cylindrical bodies covered with small overlapping dorsal scales and at the ventral side the scales are large and broad. They have small tusks on the upper jaw and are neurotoxic. Two species belong to this family have been reported. Arabian cobra (*Naja haje arabica*) inhabiting the south-western region and the black cobra (*Walterinnesia aegyptia*) reported from central, northern and eastern regions.

Table 2. Distribution of snakes recorded at different study sites

Family	Species	Habitat	Collection time	Number of samples (%)
Colubridae	<i>Psammophis schokari</i>	Farms and Valleys	During days, Spring and Summer	2 (2.20)
	<i>Rhagerhis mouilensis</i>	Open Plains	Days and Nights, Spring and Summer	11 (12.00)
	<i>Spalerosophis diadema cliffordi</i>	Valleys and Plains	Days and Nights, Spring and Summer	17 (18.80)
	<i>Platyceps rhodorachis rhodorachis</i>	Plains and Mountains	During Days, Summer	9 (9.80)
Viperidae	<i>Cerastes gasperettii</i>	Sands and Sandy Plains	Nights, Spring and Summer	14 (15.20)
	<i>Echis coloratus</i>	Mountains, Hills and Gravel Plains	Nights, Spring and Summer	9 (9.80)
	<i>Bitis arietanus arietanus</i>	Mountains, Hills and valleys	Nights, Spring and Summer	2 (2.20)
Elapidae	<i>Naja haje arabica</i>	Open Valleys	Days, Spring and Summer	3 (3.30)
	<i>Walterinnesia aegyptia</i>	Plains, hills	Nights, Spring and Summer	4 (4.40)
Boidae	<i>Eryx jayakari</i>	Sandy Dunes	Nights, Spring and Summer	11 (12.00)
Atractaspididae	<i>Atractaspis engaddensis</i>	Valleys, hills and mountains	Nights, Spring and Summer	8 (8.00)
Leptotyphlopidae	<i>Leptotyphlops macrorhynchus</i>	Holes	Nights, summer	2 (2.20)

***Walterinnesia aegyptia* Lataste, 1887:**

It inhabits compact flat areas and rocky hills. It lives in large burrows of lizards and rodents. It is a very poisonous snake with front canines feeding on small

mammals, lizards and birds. It is considered as neurotoxic snake spreading in many parts of Saudi Arabia from Riyadh, Wadi Qatan, Ain Dar, Al-Mishaab, Rumah, Khurais, Tumair and Al-Hasa (Al-Sadoon, 2010). Gasperetti (1988) stated that this species is rare or rarely seen in Arabia. It is highly secretive spending most of its time in burrows of mammals or large spiny-tailed lizards. Four specimens of this species were collected from the study area. It is rarely seen in the southwestern part of the kingdom.

***Naja haje arabica* (Linnaeus, 1758):**

It inhabits areas with least vegetation and water, never in deserts, semi desert. It was occasionally observed climbing on trees. It is diurnal active feeding on frogs, toads, birds and small mammals. It is widespread and threatened by intensive commercial collection. Three samples were recorded in the study area.

Leptotyphlopidae:

It is a non-venomous small blind snake distributed in tropical and sub-tropical areas. It has rudiment eyes, cylindrical body with smooth scales without difference of dorsal and ventral sides. It inhabits loose soil with forest litter. Only one species is found in Arabia (Gasperetti, 1988).

***Leptotyphlops macrorhynchus* (Jan, 1860):**

It is thread-like non-poisonous snake with smooth tinny body. Eyes are vestigial as black spots. It is slow moving with pale red to pink color. It lives in holes (Table 2) and woody trunks. It is widespread in most regions of Arabia (Gasperetti, 1988).

In conclusion, the snake species is reported in Tathleeth compared with those from other areas (Gasperetti, 1988; Hussein and Darwish, 2001; Masood and Asiry, 2012), it can be noted that the snake fauna in Tathleeth district of Aseer region is not identical to any other areas in Saudi Arabia regarding species richness. Additionally, studying Tathleeth snake fauna is considered next to Masood and Asiry (2012) who focused on herpetofauna of southwestern Saudi Arabia. It may contribute to future work on the medical and economic importance of the venomous snakes in this part of the country.

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