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Reptiles and Amphibians in Dibbeen Nature Reserve, Jordan

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> Abstract

Twenty-one species of reptiles and amphibians belonging to nine families were recorded in this survey. These species included one amphibian, one tortoise, 12 lizards, and seven snakes. The present study is the first attempt to compare between opportunistic and systematic survey methods in Jordan for reptiles and amphibians. The opportunistic survey is the method of choice when conducting a survey to assess the presence or absence of reptilian species regardless of their abundance. On the other hand, the systematic survey proved to be an excellent method to evaluate the abundance of species, expressed in the total number of observations. *Ophisops elegans* was by far the most frequently observed species and accounted for 28.94 % and 61.03 % of all observations when employing opportunistic and systematic surveys respectively. Additionally, this lizard was found in all types of habitats studied within the reserve.

> Key words

Reptiles, Jordan, conservation, survey methods, diversity.

Introduction

In the past, several taxonomic studies identified the herpetofauna of Jordan (Werner, 1971; Disi, 1991; Disi, 1996; Disi *et al*., 1999, 2001, 2004; Modry *et al*., 1999; Disi & Amr, 1998; Rifai *et al*., 2003, Shwayat *et al*., 2009), however, these studies focused on the reptiles taxonomy, distribution and zoogeographic affinities.

Within the Mediterranean region, Warburg (1978) studied the diversity of reptiles and amphibians in eight Mediterranean regions. He reported a total of 24 species of reptiles and amphibians. In Jordan, other studies focused on reptilian diversity in arid regions. Disi *et al*. (1999) conducted a study on the reptilian diversity in the eastern desert of Jordan, and recorded 42 species. Also, Abu Baker *et al*. (2004) reported on the herpetofauna of Wadi Ramm, southern Jordan, with a total of 34 species. Most species recorded from these areas are Saharo-Arabian or relicts of the Irano-Turanean ecozones. In Petra area, Disi & Hatough-Bouran (1999) listed 42 species of reptiles and one amphibian. These species showed various affinities to the known biogeographical regions of Jordan.

Elsewhere, several studies compared between different sampling techniques for amphibian and reptiles. Crosswhite *et al*. (1999) compared several drift fence arrays, double-ended funnel traps and time-constrained searching for capturing reptiles and amphibians in upland forests of the Ouachita Mountains, Arkansas. Anurans, salamanders, and squamates were appraised for heterogeneity of susceptibility to capture among different methods (Crosswhite *et al*., 1999). Parris (1999) presented a comprehensive review on amphibian surveys methods used in forests and woodlands. He pointed out the bias in some results due to sampling technique employed. Ryan *et al*. (2002) found that sampling methods (cover boards, drift fence technique etc) used in the terrestrial habitats were not equally effective, and resulted in collecting different subsets of the total herpetofauna in a managed forest landscape. Jenkins *et al*. (2003) evaluated the effectiveness of terrestrial funnel traps and pitfall traps for capturing amphibians and reptiles in the northeastern United States. Donnelly *et al*. (2005) found that the use of standard sampling methods (sweeping and walking at random)

Fig. 1. Habitat of Dibbeen Nature Reserve showing mixed pine and oak trees.

employed differed significantly in detecting amphibian and reptile species at Iwokrama Forest, central Guyana.

This study, however, is the first attempt to investigate the spatial distribution and diversity of the reptiles and amphibian within the boundaries of Dibbeen Nature Reserve (DNR) and to compare between systematic and opportunistic surveys.

The Study Area

Location

Dibbeen forest extends over 60 km^2 of mountainous terrain (North-West coordinates 32°15'49'' N, 35°46'31'' E, South-East coordinates 32°12'35'' N, 35°51'06'' E), with elevation varies between 570 to 1050 m asl), and dominated by pine and oak trees (Fig. 1). The Dibbeen Nature Reserve (DNR) represents the core area of this forest and covers an area of 8 km^2. The study area lies within a region of rugged mountains and deep wadis which expose a broad range of geologic strata. Additionally, a predominately east-west fault system exists with minor northwest and northeast oriented systems as well. Most of the deep-cut, steep-walled wadis present are fault controlled and along with steep mountainsides, offer exposed rock ranging from the early to late cretaceous periods. The local climate of Dibbeen forest is characterized by humid, cold winters with an average temperature of 9.6 °C reaching a minimum of 5 °C. Summers are with an average temperature of 27 °C and a maximum temperature of 35–40 °C. The average rainfall in the area is around 400 millimetres per year. Snow fall occurs in some years (AMR *et al*., 2006).

DNR consists of three main stand types, distributed according to altitude. In the lower elevations, Aleppo pine (*Pinus halepensis*) is dominant and there are some pure stands with large native trees, represented by the area of the public park. In the middle elevations, a pine-oak (*Pinus halepensis* and *Quercus calliprinos*) association is dominant and extends over the majority of the area. In the upper elevations, the oak is the dominant species with small stands of deciduous oak (*Quercus infectoria*) on the uppermost slopes. Other trees present in the forest include arbutus (*Arbutus andrachne*), pistachio (*Pistachia palaestina*) and wild olive (*Olea europa*). The ground flora is exceptionally rich and includes several orchid species. This is an especially noteworthy feature of the wadis around the reserve's perimeter. The soil is predominantly *Terra rosa*.

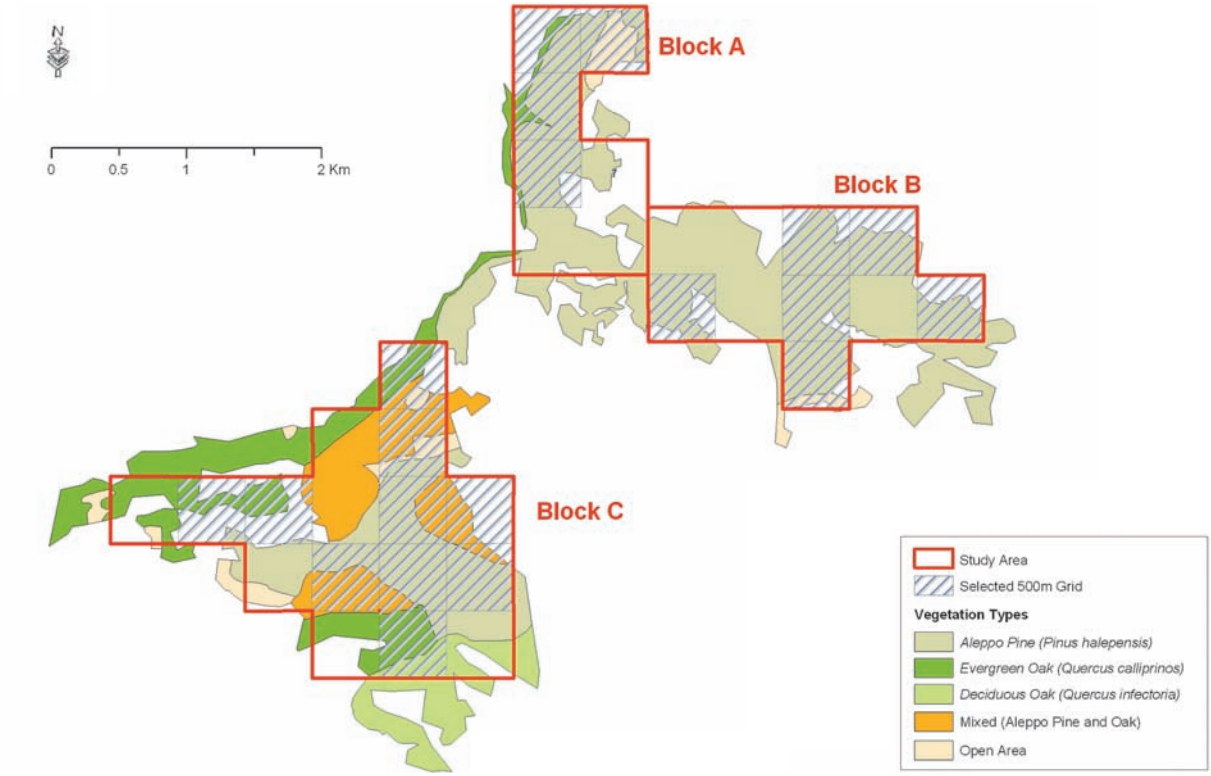

Fig. 2. Map of Dibbeen Nature Reserve showing the vegetation classification and selected grids.

Material and methods

Study area design

The reserve map was divided into 500 × 500 meter major grid with a 100 × 100 minor ones, using the Geography Information System (Arc GIS Software). A total of 77 major grids were on the map of the reserve area. The map then was divided into three major blocks: A, B, and C, where block C represents the largest area in the reserve. Grids with less than 50 % plant coverage were excluded from the blocks. Twenty grids were selected randomly that covers the three blocks (Fig. 2).

A total of 4 grids were studied in block A. This block is covered mainly with pine trees and few oak cover on its western borders, with one block of open area. Block A is not under heavy use and remains isolated from weekend activities and the least affected from wood cutting and grazing. Block B represents the heart of the reserve with pine cover. Most of tourist activities are restricted to this area especially during weekends. Also, wood cutting and grazing are considered at their minimum. Six grids were systematically studied within this block. Block C is the largest, and has pine and oak covers. 10 grids were extensively surveyed in this block. The wood cutting and grazing activities are evident within this area, however, picnicking is low.

Systematic day route

The study was planned to be complete in 20 days, one selected grid for each day, it began on the 14th of April 2005 until the 12 of May 2005. Team consists of 3 persons was moving in a sweeping route side to side by leaving a constant distance of 10 m between them. The sweeping pace was set in order to cover the largest area possible in the selected grid. The systematic survey was conducted at 6:00–8:00, 12:00–13:00 and 18:00–20:00hrs. A total of six hours were spent in each grid.

All specimens identified were transferred to the data sheets with their time of recording. Other notes were recorded in the selected grid such as the human activities and the GPS coordinates.

Opportunistic survey

Method used was foot sweeping, by walking throughout randomly selected areas in the forest and recording all specimens found with their time of recording on the data sheets. The opportunistic survey was conducted at 6:00–8:00, 12:00–13:00 and18:00–20:00hrs. A total of six hours were spent in each grid with three persons conducting the survey.

Opportunistic night route

This method was done using two routes:

Foot route: Movement began after 8:00pm; Torches (hand and head) were used during the movement to locate the nocturnal species in the forest. A total of 48 hours of effort among 4 persons was spent (12 hours each person).

Car route: This method involves simply moving by vehicles slowly (10–20km/hr) along a road while watching carefully for reptiles. If any reptile species was spotted, light was focused on it for identification**.** 36 hours was used to undertake car rout.

Statistical treatment

Chai square and regression tests were used to analyze results obtained by systematic and opportunistic surveys to compare between the number of recorded species and the number of observations resulted from both methods.

Results

A total of 21 species of reptiles and amphibians were recorded during this survey (Table 1). A single amphibian (*Bufo viridis*), one tortoise (*Testudo graeca*), 12 lizards representing four families (Gekkonidae, Chamaeleonidae, Lacertidae and Scincidae), and seven snakes including two families (Colubridae and Viperidae) were observed. Figure 3 and 4 shows some of species found in the reserve.

Species encountered during this study in DNR are mostly Mediterranean species (e.g. *Lacerta media, L. laevis, Ablepharus rueppellii, Cyrtopodion kotschyi, Testudo graeca*, *Coluber nummifer* and *Vipera palaestinae*). Few exhibits wide range of distribution (*Ptyodactylus puiseuxi*, *Hemidactylus turcicus* and *Ophisops elegans*) extending to the Irano-Turanean ecozone. Reptiles that are strictly associated with oak forests include *L. media, L. laevis and A. rueppellii*.

We recorded the highest number of total observations of reptiles in block C (44.8 %), with a total of 15 species. This block is covered by pine trees with few open grassy areas. The lowest was observed in block B with 5 species (Table 2). Only 8 species were recorded in block A. Five species were shared among the three blocks (*Laudakia stellio, Lacerta laevis, Ablepharus rueppellii, Ophisops elegans* and *Coluber jugularis*). *Laudakia stellio* was more common in block C, since rocky outcrops are more abundant than in the other two blocks, however, both *Lacerta laevis* and *Ablepharus rueppellii* were more or less equally observed in the three blocks especially in humid leaf litter under oak trees.

The Green Toad, *Bufo viridis*, was found in Block C, close to the only permanent water spring in the reserve. Also, the Mediterranean Spur-thighed Tortoise was observed in both Block A and C, since both areas are not utilized extensively by visitors.

Based on our observations, three different habitats were found to be preferable by different species; those are:

- Pure oak vegetation cover which was found to be preferred by species such as *Cyrtopodion kotschyi, Chamaeleo chamaeleon, Ablepharus rueppellii,* and *Vipera palaestinae*.
- Mixed forest vegetation cover which was found to be preferred by species such as *Hemidactylus turcicus, Ptyodactylus puiseuxi, Testudo graeca*, *Lacerta media*, *Coluber jugularis*, and *Coluber nummifer*.
- Pine forest vegetation with grassy area and rocky outcrops included *Eumeces schneiderii* and *Ptyodactylus guttatus*.
- Water springs habitat inhabited by *Bufo viridis,* and *Mabuya vittata*.

The opportunistic survey resulted in 70 observations for 18 species (Table 1). On the other hand, we recorded 16 species with 308 observations during the systematic day route survey. Both night rout (car and by foot) recorded 4 observation for 2 nocturnal species (Table 1). The opportunistic survey includes two arboreal species (*Chamaeleo chamaeleon* and *Cyrtopodion kotschyi*), that were not observed during the systematic survey. Also, 3 terrestrial reptiles, *Mabuya vittata*, *Coluber rubriceps* and *Eirenis rothi* were observed. *Mabuya vittata* was observed three times, while *C. rubriceps* and *E. rothi* were observed only once.

There were overall significant differences between the systematic and opportunistic surveys, regarding the number of observations and the number of observed species and regardless the activity time of the species observed ($p = 0.000$ and $p < 0.003$) respectively.

Ophisops elegans was by far the most observed species in day-time surveying methods. It accounted for 61.03 % and 28.94 % employing systematic and opportunistic surveys respectively. Additionally, this lizard was found in all types of habitats studied within the reserve (table 1 and 2). Similarly, systematic survey yielded higher number of observations for *Laudakia stellio* (4.2 %), *Lacerta laevis* (12.01 %) and

Tab. 1. Species recorded and number of observations using different methods of sampling.

Species	Systematic day survey		Opportunistic day survey		Opportunistic night survey	
	No. of observations	%	No. of observations	%	No. of observations	%
Bufo viridis	1	0.33	0	0	3	75
Testudo graeca	4	1.29	1	1.4	0	0
Hemidactylus turcicus	1	0.33	1	1.4	1	25
Ptyodactylus guttatus	2	0.46	3	4.3	0	0
Ptyodactylus puiseuxi	1	0.33	0	0	0	0
Cyrtopodion kotschyi	0	0	2	2.8	0	0
Laudakia stellio	13	4.22	4	5.6	0	0
Chamaeleo chamaeleon	0	0	2	2.8	0	0
Lacerta laevis	37	12.01	6	8.6	0	0
Lacerta media	7	2.27	1	1.4	0	0
Ophisops elegans	188	61.03	25	35.7	0	0
Ablepharus rueppellii	39	12.66	13	18.6	0	0
Eumeces schneiderii	7	2.27	1	1.4	0	0
Mabuya vittata	0	0	3	4.3	0	0
Coluber jugularis	3	0.99	2	2.8	0	0
Coluber nummifer	2	0.46	2	2.8	0	0
Coluber rubriceps	0	0	1	1.4	0	0
Eirenis rothi	0	0	1	1.4	0	0
Malpolon monspessulanus	1	0.33	1	1.4	0	0
Rhynchocalamus melanocephalus	1	0.33	1	1.4	0	0
Vipera palaestinae	1	0.33	0	0	0	0
Total number	**308**	**100**	**70**	**100**	**4**	**100**

Ablepharus rueppellii (12.66 %), however, at lower frequency compared to the other surveying methods (Table 1). Both opportunistic car night and foot night routes recorded only nocturnal species including *Bufo viridis* and *Hemidactylus turcicus*.

Discussion

Most species recorded in the present study show Mediterranean affinities (e.g. *L. media, L. laevis, A. rueppellii, C. kotschyi, T. graeca*, *C. nummifer* and *V. palaestinae*). Reptiles that are strictly associated with oak forests include *L. media, L. laevis, A. rueppellii*. Our records are in agreement with Warburg (1978), where he recorded the same typical lizards and skinks of the Mediterranean.

Reptiles inhabiting desert regions of Jordan are more diversified than those in the Mediterranean region. Disi *et al*. (1998) and Abu Baker *et al*. (2004) recorded 42 and 34 species of reptiles from the eastern desert of Jordan and Wadi Ramm respectively. Species composition of these reptiles are very much different from those in the Mediterranean ecozone, including desert adapted species known in arid regions of the Middle East (*Acanthodactylus* sp., *Uromastyx aegyptius microlepis* etc.).

The present study is the first attempt in Jordan to compare between opportunistic and systematic survey methods. Our results show clearly that each method has its use when employed in studying reptilian communities. It is suggested here that the opportunistic survey is the method of choice when conducting a survey to assess the presence or absence of reptilian species regardless their abundance. The opportunistic survey resulted in recording a significantly higher number of species when compared to the systematic survey; however, it yielded much lower number of observations. For preparation of inventory lists of reptile species in a particular nature reserve or a habitat, it is suggested to adopt the opportunistic survey method. Despite the wealth of herpetological studies in the Middle East (See Disi *et al*., 2001) not a single study addressed this issue.

All previous studies recommend incorporating several trapping methods to study the biodiversity of reptiles and amphibians in order to generate a complete assemblage of the herpetofauna in a certain area. Corn & Bury (1990) stated that no single technique is sufficient for a community study, and a combination of pit-

Fig. 3. Reptiles from Dibbeen Nature Reserve. **A**. *Lacerta media*. **B**. *Ophisops elegans*. **C**. *Lacerta laevis*. **D**. *Mabuya vittata*. **E**. *Ablepharus rueppellii*. **F**. *Cyrtopodion kotschyi*.

fall trapping and hand collecting is the most effective approach. On the other hand, DONNELLY *et al*. (2005) found out that visual encounter surveys and opportunistic collecting yielded the largest number of species in Iwokrama. Similarly, CROSSWHITE *et al*. (1999) showed that time-constrained searching was overall the most efficient.

RYAN *et al*. (2002) concluded that the survey techniques used in the terrestrial habitats were not equally effective in that they resulted in the collection of different subsets of the total herpetofauna. The drift fence technique revealed the presence of more species and individuals in every habitat and was the only one to detect species dissimilarity among habitats. Nonetheless, coverboards contributed to measures of abundance and revealed species not detected by other techniques. They suggest that a combination of census techniques be used when surveying and monitoring herpetofaunal communities in order to maximize the detection of species.

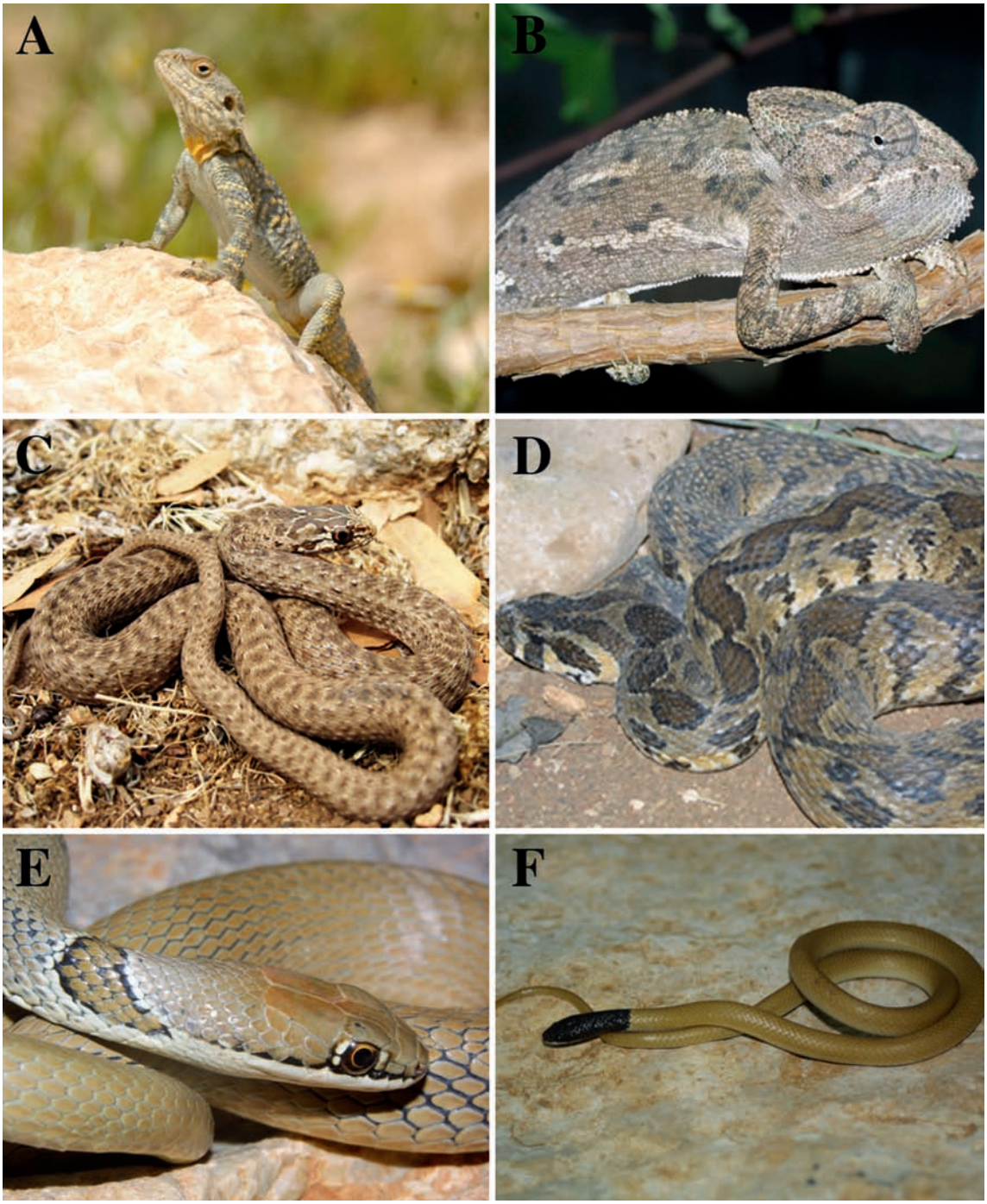

Fig. 4. Reptiles from Dibbeen Nature Reserve. **A**. *Laudakia stellio*. **B**. *Chamaeleo chamaeleon*. **C**. *Malpolon monspessulanus*. **D**. *Vipera palaestinae*. **E**. *Coluber rubriceps*. **F**. *Rhynchocalamus melanocephalus*.

Among studied terrestrial habitats (recent clear-cut, pine plantation, and mixed pine–hardwood forest), Ryan *et al*. (2002) found that the total herpetofaunal communities were dissimilar, although neither faunal constituent group alone (amphibians and squamate reptiles) varied significantly with regard to habitat. Indeed, structural complexity of the habitat significantly increases population density and number of species in assemblages (Kohn & Leviten, 1976).

Despite wood cutting and grazing activities in block C, 15 species and a total of 138 observations were recorded. It seems that human activities (camping and picnicking) have an impact on reptilian communities, since this block is the least frequented area by visitors and have the highest number of species recorded and observed. In contrast, Block B yielded the lowest number of recorded species (5). This is due to the dominance of pine trees, since several species are more associated with oak forests.

Cyrtopodion kotschyi was associated with oak

Tab. 2. Species recorded during the systematic day route.

Species	No. of Observations during the systematic day transect		
	Block A	Block B	Block C
Bufo viridis	0	0	1
Testudo graeca	1	0	3
Hemidactylus turcicus	0	0	1
Ptyodactylus guttatus	0	0	2
Ptyodactylus puiseuxi	0	0	1
Laudakia stellio	2	1	10
Lacerta laevis	11	15	11
Lacerta media	5	0	2
Ophisops elegans	30	75	83
Ablepharus rueppellii	15	12	12
Eumeces schneiderii	0	0	7
Coluber jugularis	1	1	1
Coluber nummifer	0	0	2
Malpolon monspessulanus	1	0	0
Rhynchocalamus melanocephalus	0	0	1
Vipera palaestinae	0	0	1
Total Number	**66**	**104**	**138**

trees more than pine. We observed all records for this species on oak trees. This species was also observed in other oak forests in Jordan (Zobia and Beerain) (Personal observations). *Ophisops elegans* was the most abundant species during the study period. This is a rather common species inhabiting a wide variety of habitats in Jordan (DISI & AMR, 1998). Similar observations were recorded in Syria (AMR *et al*., 2007). *Lacerta laevis* and *Ablepharus rueppellii* were the second most common species in DNR. This is in part due to the location of this reserve, where it is located within the Mediterranean ecozone. Both species are forest dwelling species (DISI & AMR, 1998).

Further studies should address the dial activity, reproductive status and feeding behavior of some selected and key species in DNR. It is recommended to employ other sampling methods such as open and closed drift fences and evaluate their results with currently used methods by wildlife biologist in Jordan.

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