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A contribution to the knowledge of the herpetofauna of Jordan. VI. The Jordanian herpetofauna as a zoogeographic indicator

Beitrag zur Kenntnis der Herpetofauna von Jordanien. VI. Die jordanische Herpetofauna als zoogeographischer Indikator

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KURZFASSUNG

Zoogeographisch gesehen erweist sich die jordanische Herpetofauna als heterogen, indem sie vier biogeographischen Regionen entstammt (Orientalische, Paläarktische, Saharo-Sindische, Äthiopische Region) und vier unterschiedliche Ökozonen umfaßt. Dreiundneunzig Arten und Unterarten von Amphibien und Reptilien sind für Jordanien bekannt, die unterschiedliche Verbreitungsmuster zeigen. Die Mediterrane Ökozone beherbergt die höchste Anzahl von Arten (35), gefolgt von der tropisch-sudanensischen Penetrationszone (16) und der Badyiah Ökozone (12). Jordanien ist nicht durch landschaftsmorphologische Grenzen von den umgebenden Ländern abgetrennt, sodaß keine diesbezüglichen Isolationsmechanismen wirksam sind, was zum Fehlen von Endemismen geführt haben dürfte. Immerhin gibt es im Ostmediterran als Gesamtheit drei Endemiegebiete: die Badyiah, die sich Jordanien mit Syrien, dem Irak und Saudi Arabien teilt, den Nordteil der Mediterranen Ökozone, der den Libanon, Israel, Syria und Jordanien einnimmt, sowie ein Gebiet, das den Südwesten Jordaniens, Israel and die Halbinsel Sinai umfaßt. Einige paläarktische Arten wie *Coluber schmidti* und *C. ravergieri* sind Relikte postglazialer Perioden und überlebten an ökologisch empfindlichen Refugialstandorten. Das Verbreitungsbild einiger Arten (*Bufo viridis, Mauremys caspica rivulata, Natrix tessellata, Coluber ventromaculatus, C. jugularis asianus, Walterinnesia aegyptia,* and *Vipera palaestinae*) ist maßgeblich durch das Klima und anthropogene Einflüsse geprägt.

ABSTRACT

Zoogeographically, the Jordanian herpetofauna is heterogeneous, originating from four biogeographical regions (Oriental, Palearctic, Saharo-Sindian, and Afrotropical) and occupying four different ecozones. Ninety-three species and subspecies of amphibians and reptiles are recorded from Jordan, showing different distribution patterns. The Mediterranean ecozone harbours the highest number (35) of recorded species, followed by the Sudanian Tropical penetration zone (16), and the Badyiah ecozone (12), respectively. Jordan is not separated by natural boundaries from the surrounding countries, which prevents the operation of isolation mechanisms, and seems to result in the absence of endemism. There are, however, three areas of endemism within the Eastern Mediterranean region taken as one whole unit: the Badyiah shared by Syria, Iraq, Saudi Arabia and Jordan, the northern part of the Mediterranean ecozone shared by Lebanon, Israel, Syria and Jordan, and southwest Jordan, Israel and Sinai. Some Palearctic species such as *Coluber schmidti* and *C. ravergieri* are relicts of the postglacial period and continue to survive in refugal enclaves with delicate ecological patterns. The distribution of some species, such as *Bufo viridis, Mauremys caspica rivulata, Natrix tessellata, Coluber ventromaculatus, C. jugularis asianus, Walterinnesia aegyptia,* and *Vipera palaestinae*, has been greatly influenced by climatic as well as anthropogenic changes.

KEY WORDS

Jordan: zoogeography, herpetofauna, relict and endemic species

INTRODUCTION

The herpetofauna of Jordan consists of 93 species and subspecies belonging to 23 (5 amphibian and 18 reptilian) families. Most previous studies on the herpetofauna of Jordan dealt mainly with systematics and distribution, providing limited information pertaining to the animals' ecology (HART 1891; BARBOUR 1914; SCHMIDT, 1930; PARKER, 1935; HAAS, 1951, 1952; WERNER 1971, 1988; DISI 1983, 1985, 1987, 1991, 1993; DISI & al.1988; AL-ORAN & AMR, 1995).

Distribution, composition and abundance of the biota in the Mediterranean region are the product of long episodes of changes resulting from evolution, adaptation and migration (ROBINSON 1972). These processes were greatly shaped and affected by several factors:

Jordan is a crossroad of four zoogeographical realms (Afrotropical, Saharo-Sindian, Oriental, Palearctic). The south of Jordan is a part of the Levantine Landbridge. Moreover, Jordan comprises a great variety of plant communities, and geomorphological as well as climatic conditions which allowed the formation of four ecozones in this restricted area (AL-EISAWI 1985). Hence, Jordan appears to be one of the richest and most heterogenous natural areas in the temperate region of the world. In addition, the Eastern Mediterranean region has witnessed intensive geological events that are reflected in paleobiological effects (TCHERNOV 1988). The biotic configuration of the region was modified by extensive plate tectonics which split Jordan and Arabia from Palestine and Sinai, and the latter from Africa. Furthermore, climatic changes occurred resulting from the Pleistocene glaciation (ROBINSON 1972). The anthropogenic factors are man's introduction of exotic species on the one hand and destruction on the other. All above factors have contributed to the heterogeneity of the herpetofauna of Jordan (DISI 1987).

In the present study, the zoogeography of Jordan is discussed, based on the distributional patterns of the herpetofauna. Endemic and relict species and the major environmental changes affecting the abundance and distribution of reptiles and amphibians are enumerated and highlighted.

MATERIALS

The present work is based on reptile and amphibian specimens collected between May 1977 and July 1995. The bulk of this collection is deposited at the Jordan University Museum, Department of Biological Sciences, Amman. Additional specimens have been examined from the following museums: Jordan Natural History Museum, Yarmouk University, Irbid, Jordan; British Musuem of Natural History, London, England, Natur-Museum und Forschungsinstitut Senckenberg, Frankfurt a. M., Germany; Staatliches Museum für Tierkunde, Dresden, Germany; Zoologische Staatssammlung, München, Germany; Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany, Zoologisches Museum der Alexander-Humboldt-Universität, Berlin, Germany; Museum d' Histoire Naturelle, Geneve, Switzerland; Natural History Museum, Basel, Switzerland; Naturhistorisches Museum Wien, Austria.

ZOOGEOGRAPHY OF AMPHIBIANS AND REPTILES OF JORDAN. A REVIEW

(figure 1, table 1)

Mediterranean Ecozone

The Mediterranean ecozone extends from Um Qias in the north through the Ajlun mountains, the hill regions of Amon and Moab to the Edom mountains region in the south, including the upper Jordan Valley. Many creeks and wadies drain this hilly region from east to west and lead to the Jordan River, the Dead Sea and Wadi Araba. The southern mountains are higher than the northern ones, while the reverse is true concerning rainfall, and vegetation types and density. The highest rainfall is found in the Ajlun mountains (600 mm annually), an ecozone characterized by terra rosa and/or rendzina soil. These soil types are the richest in the area, suited for cultivation and dense well-grown forests. The vegetation here is essentiallty formed by the forests: pine, evergreen oak, deciduous oak and *Juniperus*.

A total of 35 species of amphibians and reptiles were found to inhabit this ecozone (2 amphibians, 2 tortoises, 13 lizards and 18 snakes); 32 of these species originate from the Palearctic fauna, and 3 are of Arabian and Saharo-Sindian origin (table 1). Although the Mediterranean ecozone represents less than 20% of the total area of the country, it harbours 37.6 % of the known amphibian and reptile species. The abundance of vegetation, forested mountains, wadi systems along with various types of microhabitats permitted several species to seek refuge in this ecozone. Plentiful insects, rodents, and vegetation are available all over the year as a source of food.

Badyiah

The Eastern Desert 'Badyiah', is part of the Syrian Desert and forms the centre of the Saharo-Syrian-Sindian Desert. The Arabic term 'Badyiah' is more descriptive than 'desert', because the area is capable of supporting vegetation and animal life. Nevertheless, the limiting factor here is the availability of water. This ecozone extends through Syria, Iraq, Jordan, and northern Saudi Arabia. The Badyiah soil is primarily formed of limestone with flints scattered over the surface, or basalt pebbles and boulders that resulted from volcanic outcrops centered around Jabal Druz (Al-Arab) (ATALLAH 1977). This ecozone forms the largest surface area of Jordan. Annual rainfall is around 100 mm and most of the vegetation cover is concentrated in wadies (AL-EISAWI 1985).

Twelve species of reptiles (9 lizards and 3 snakes) are restricted to this ecozone (table 1). Ten are of Arabian and two are of Saharo-Sindian faunal origin. Notwithstanding the vastness of the Badyiah compared with the other ecozones, the number of species present here comprises only 13% of the total herpetofaunal species of Jordan. This ecozone is known for its scarce and scattered vegetation as well as its flat open surface with a reduced number of microhabitats. Reptiles are usually confined to narrow strips where vegetation prevails along wadi beds or depressions that receive more water in the form of floods than do other surrounding areas. For no obvious reason, the False Horned Viper, *Pseudocerastes persicus fieldi* is restricted to the Badyiah ecozone.

Wadi Araba and Southern Desert

Wadi Araba and the Southern Desert of Jordan are also known as Sudanian-Tropical penetration zone. This ecozone extends from Al-Karama in the north through the Dead Sea depression, Wadi Araba (Jordan Rift Valley) as far as southern Jordan. It is bordered by Wadi Rum and the Al-Disi region. This ecozone is characterized by the lowest annual rainfall (50 mm), and highest mean annual maximum air temperature (Wadi Araba, 30.8 °C) in the country (National Atlas of Jordan, Part I, 1986). The soil of the Southern Desert is primarily of granite stone, aeolian sand, and sand dunes, while that of Wadi Araba is mainly alluvial sand and gravel carried by flashing floods from the surrounding uplands. The wadies ending in Wadi Araba build up wide alluvial fans (ATALLAH 1977). Qas (Playa) are found in both southern Jordan and Wadi Araba, and formed where a single basin receives surplus rain water and silt drained from the surrounding regions (wadies) as a result of erosion. These Qas are deprived of vegetation and fauna. The vegetation of this ecozone is related to tropical elements such as *Accacia* sp., *Calotropis procera persica* and *Haloxylon persicum* (AL-EISAWI 1985).

The Jordan Rift Valley is part of the Syrian-African Rift. It is regarded as a passageway between Eurasian and African faunal elements, and a gateway for northward and southward dispersal (TCHERNOV & YOM-TOV 1988). The southern end of this ecozone is part of the Levantine Landbridge between the Mediterranean area and the Arabian desert and represents a 'Biogeographic Filter' (POR 1987). The width of this filter has been varying in accordance with the fluctuating geological and ecological changes. POR (1987) also indicated that the Levantine Landbridge can be regarded as the most prominent focal point in the distributional history of the modern terrestrial biota of the globe, because it connects the major old world continental landmasses. The Levantine Landbridge is the amalgamation place of biota of the Palearctic, Afrotropical, Saharo-Arabian, and Oriental zoogeographical realms, resulting in high species diversity, compared to other temperate regions of the same size in the world. TCHERNOV (1988) stated that confrontation of the Palearctic and Afrotropical communities did not cause any large extinction or any massive biotic turnover in the southern Levantine meeting area. ARNOLD (1987) mentioned that changing of the topography and expansion of the desert area southward resulted in separation of North Africa and Arabia. Some species crossed this barrier (*Ptyodactylus hasselquistii, Acanthodactylus boskianus, Spalerosophis diadema, Mesalina olivieri, Varanus griseus, Psammophis schokari, Malpolon moilensis, Lytorhynchus diadema*). Moreover, ARNOLD (1987) stated that Wadi Araba might have acted as a barrier to desert forms in the moist pluvial periods. This barrier resulted from topographic and other abiotic factors. Some North African species failed to pass beyond Wadi Araba (*Stenodactylus sthenodactylus, Sphenops sepoides, Psammophis aegyptia, Uromastyx ornata*), while some Arabian forms did not cross Wadi Araba in the opposite direction (*Stenodactylus grandiceps, Acanthodactylus grandis, A. robustus, A. schmidti, Mesalina brevirostris*). Some other species (*Bunopus tuberculatus, Acanthodactylus opheodurus, Atractaspis microlepidota engaddensis, Coluber elegantissimus, Eirenis coronella, Pseudocerastes persicus fieldi*) extended beyond Wadi Araba into southern Israel and Sinai but did not cross the Suez Canal (ARNOLD 1987).

DE JONG (1976) indicated that the Sahara is 'a life zone', a biome and not a transitional zone between the warm-temperate part of the Afrotropical and the Palearctic realms. He also indicated that the Saharan belt acts as a barrier preventing faunal exchange between the two above-mentioned biogeographic zones. In his discussion of the zoogeography of the Middle East, KOSSWIG (1955) raised the problematic issue of defining natural boundaries of the region, and considered it a subjective judgement. TCHERNOV (1988) stated that the isolation of the Sahara as a unique biogeographic province started during the Pliocene, and that there is no general agreement about the boundary between the Palearctic and the Saharo-Arabian-Sindian realm.

ARNOLD (1987), JOGER (1987), and GASPERETTI (1988) accepted the Saharo-Syrian-Sindian region as a biogeographical realm of its own, which has a very distinctive fauna separated from the Palearctic and Afrotropical realms. JOGER (1987) suggested that the Irano-Turnian province (Iran) should be classified as a subregion of the Saharo-Syrian-Sindian realm, and this is followed in the present study. TCHERNOV (1988) indicated that the only opportunity for a large-scale successful colonization by the Saharan psammophile taxa might have taken place in the last (Würm) glacial.

Sixteen reptile species inhabit Wadi Araba and southern Jordan (eleven species of lizards and five of snakes). One species is of Palearctic origin, while seven, six, and two are of Saharo-Sindian, Arabian, and Afrotropical origin, respectively. This type of multiple reptilian origin accords with the explanation of the geomorphological changes and mass movements of the biota (KOSSWIG 1955; ARNOLD 1987; JOGER 1987; POR 1987; TCHERNOV 1988). Three species of snakes (*Telescopus dhara, Atractaspis microlepidota engaddensis, Echis coloratus*), inhabiting this biotope succeeded in reaching the Mediterranean ecozone.

Irano-Turanian ecozone

Phytogeographically, the Irano-Turanian ecozone is a strip of variable width surrounding all the Mediterranean ecozone except its north. Mean annual rainfall is less than 150 mm. The Irano-Turanian region is not distinguised zoogeographically from adjacent bioclimatic ecozones, just forming a transitional zone between the Mediterranean and the surrounding ecozones. SAINT GIRONS (1982) pointed out that - from a zoogeographical point of view - the Irano-Turanian ecozone in Israel is of disputed validity.

This ecozone does not have its own entity since it does not possess a specific fauna as do other ecozones in Jordan. The dominant type of soil here is loess and calcareous.

Common species

Twenty-seven species inhabit more than one ecozone (twenty species occupy

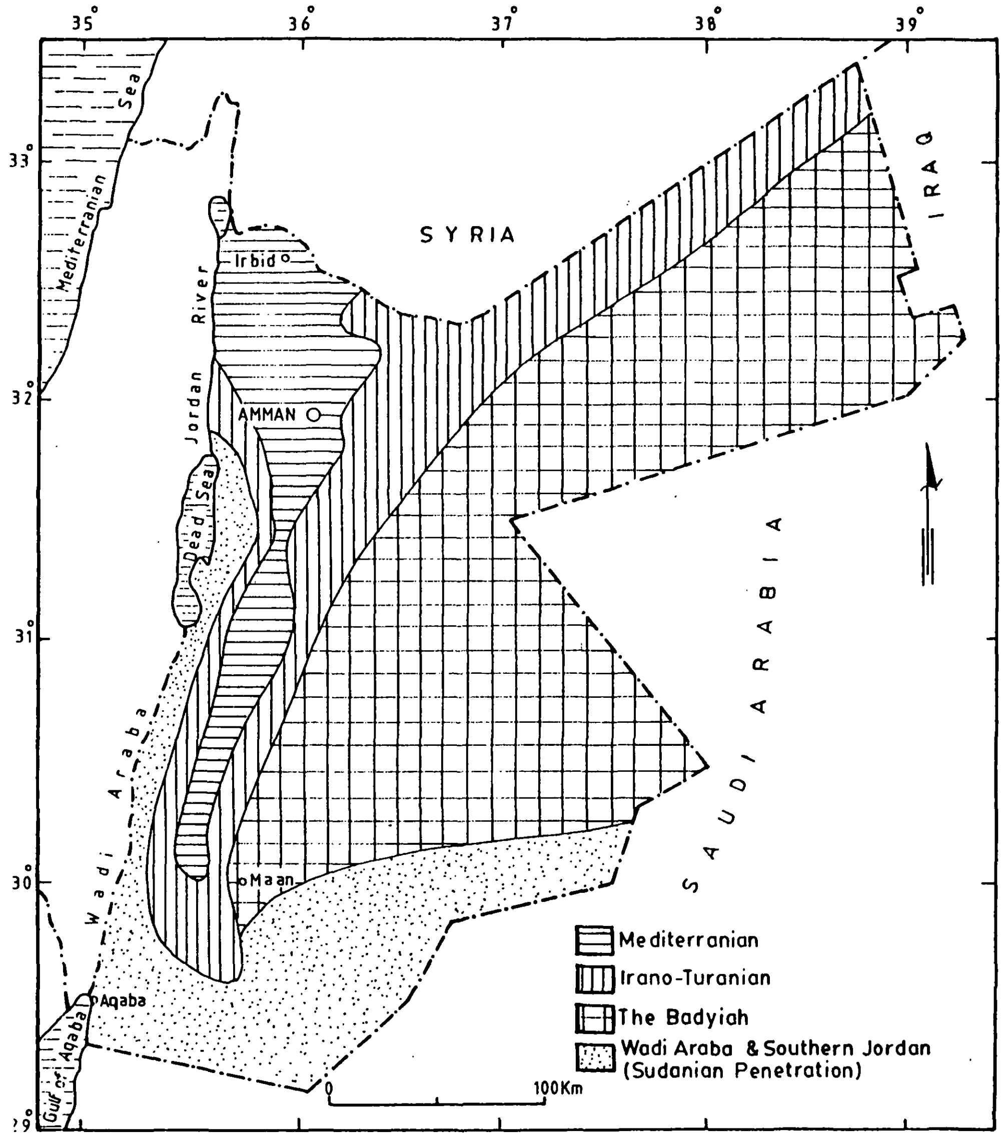

Fig. 1: Main ecozones of Jordan.
Abb. 1: Die Hauptökozonen Jordaniens.

two ecozones). This may be due to (1) adaptability of the species to colonize different habitats with different biotic and abiotic factors (DISI 1987); (2) the borders between the four ecozones in Jordan are not well defined, thereby allowing intermingling of faunal elements among adjacent ecozones. KOSSWIG (1955) indicated that there are difficulties in distinguishing natural biogeographic barriers within the Levantine region. Some species, extend their range through the Irano-Turanian ecozone (*Malpolon monspessulanus insignitus*), or through wadi systems penetrating into the Mediterranean ecozone (*Echis coloratus*, *Atractaspis microlepidota engaddensis*). (3) Climatic conditions are not stable (AL-EISAWI 1985), and (4) anthropogenic factors may also play a role in this respect. Some species such as *Coluber ventromaculatus*, *Walterinnesia aegyptia* and *Bufo viridis* are described as agricultural followers (DISI 1987, 1993).

Seven species are found in all biotopes of Jordan. Three are anuran amphibians and their presence is affected by the availability of water bodies (table 1). The other four, (*Hemidactylus turcicus*, *Chalcides ocellatus*, *Mabuya vittata*, *Psammophis schokari*), attain a wide but discontinuous distribution in Jordan, their presence being favoured by moist terrain; they are often found in and around farms, or near human settlements. Similar observations were made by ARNOLD (1987) in Arabia, and he suggested that this scattered type of distribution resulted from man's introduction. According to JOGER (1987) *Hemidactylus turcicus* and *H. flaviviridis* are widely distributed and are easily introduced by man. SCHÄTTI & GASPERETTI (1994) indicated that *Psammophis schokari* is particularly abundant in some areas and is possibly the most frequently encountered snake in Arabia where it occupies different habitats. WERNER (1987) stated that *C. ocellatus* and *P. schokari* have been found throughout Israel.

RELICT SPECIES

The distribution of amphibians and reptiles in the Middle East compared to that in Jordan suggests that one amphibian (*Pelobates syriacus*) and three reptile species (*Lacerta kulzeri*, *Coluber ravergieri*, *C. schmidti*) are relict species. *P. syriacus* was collected from two localities in northern Jordan, which are isolated from the nearest populations in Syria. This species continued to survive in a very delicate ecological habitat which necessitates immediate protection. There are debates on the classification of *L. kulzeri*, but the population of this lacertid lizard from Petra is clearly different from those in Jabal Al-Arab (Al-Druz) in Syria, and in Lebanon as well (BISCHOFF, pers. comm.). Further taxonomic work is needed to clarify the status of *L. laevis* and *L. kulzeri*. The populations of *Coluber ravergieri* and *C. schmidti* are relicts from postglacial periods and occupy a habitat which is ecologically similar to that of previous (postglacial) conditions. Both species are in complete isolation in the remote mountainous areas of the southern Jabal Al-Arab, separated by a considerable distance from the known area of distribution (SCHÄTTI & AGASIAN 1985; DISI 1993).

ENDEMISM

KOSSWIG (1955) stated that there are difficulties in distinguishing natural biogeographic barriers within the Levant. He also indicated that the Levantine region is a transitional zone between the Palearctic and the Saharo-Arabian desert belt, with complex mosiac patterns of distribution. Jordan is not separated from the surrounding countries by natural barriers, which prevents the operation of isolation mechanisms and seems to result in the absence of endemism. There are, however, three areas of endemism in the Eastern Mediterranean region taken as a unit: (1) An area with *Micrelaps muelleri*, *Typhlops simoni*, and *Chalcides guentheri* which is shared by northern Jordan, Israel, Lebanon, and the western part of Syria. A fourth endemic species, *Cyrtopodion amictopholis*, has been reported only from Mt. Hermon (WERNER 1988; SIVAN & WERNER 1992); (2) Southern Jordan bordering the northwest of Saudi Arabia and southern Israel, illustrated by the presence of *Coluber elegantissimus*; (3) the Syrian Desert exemplified by the presence of *Stenodactylus grandiceps, Acanthodactylus robustus, A. tristrami, Trapelus persicus fieldi*, and *Laudakia stellio picea*.

IMPACT OF ENVIRONMENTAL CHANGES ON LOCAL RANGE EXPANSION AND SPECIES ABUNDANCE

Man-induced environmental changes, through agricultural projects in the eastern Badyiah, southern Jordan and Wadi Araba, resulted in the expansion of the known range of distribution for certain species (*Bufo viridis, Coluber ventromaculatus, Walterinnesia aegyptia*), called agricultural followers (DISI 1987). Meanwhile polluted water bodies in the Jordan Valley increased the population density and distribution area of *Mauremys caspica rivulata*. On the other hand, for other species, ecological changes have resulted in a rapid decline of natural habitats due to overgrazing, urban expansion, unorganized construction plans, mismanagementent of the highlands, and fire. All these factors led to deforestation, soil erosion and desertification, resulting in a patchy fragile ecocomplex, and affecting the abundance of lacertid lizards in the Edom Mountains. JONES (1981) indicated that grazing induced structural changes in vegetation which reduced lizard abundance and diversity. And WERNER (1988) stated that decrease of woodland areas in Israel was followed by decreasing abundance of *Lacerta media israelica*. Another example of habitat destruction in Jordan is land use for housing, and agricultural purposes which led to decreasing biodiversity and extermination of breeding sites of *Pelobates syriacus*. Moreover, extensive use of insecticides, herbicides, and many other chemicals as fertilizers or for sterilization of soil in agricultural projects, permits transfer of these chemicals through food chains; several trophic levels may be affected by this. In addititon, high concentrations may be accumulated in the bodies of organisms occupying higher trophic levels. In the Jordan Valley, I saw dead rodents out of their burrows on several occasions, and most probably chemicals have been the cause of death. PAZ (1987) reported that the number of breeding pairs of Grey Heron (*Ardea cinerea*) was high in 1953 and 1954, but the population was exterminated in 1964, apparently as a result of the birds feeding on poisoned rodents. The amount of herbicides, insecticides and fertilizers imported and used in 1995 was several times higher than that used in the sixties and seventies of the century; Jordan has increased its use of fertilizers eight-fold since 1978; (HATOUGH-BORAN & DISI 1995).

CONCLUSIONS

In spite of extensive work on the herpetofauna of Jordan in the last decade (DISI, 1983, 1985, 1987, 1991, 1993; AMR & al., 1994; AL-ORAN & AMR, 1995), the zoogeographical overview is still limited. This is the first detailed study dealing with the herpetogeography of Jordan, and, although certain aspects may still need further elabortation, the following conclusions may be drawn:

1. Several taxonomic problems are still unsolved as exemplified by certain species of the genus *Coluber*, *Telescopus dhara* complex, *Malpolon moilensis* and *Malpolon monspessulanus insignitus*, as well as members of the genus *Laudakia*, and the *Rana* cf. *ridibunda* complex.

2. Interpretation of fine patterns of the Middle Eastern herpetofaunal distribution has been hampered by inadequate herpetological inventories from some surrounding countries, thus suggesting that more field work is necessary to allow a more accurate and detailed understanding

Table 1: Distribution of the herpetofauna in the main ecozones in Jordan. The indication of the zoogeographical affinity is based on data from ARNOLD (1987), JOGER (1987), WERNER (1987, 1988), LAMARCHE & CLEMENT (1988), GASPERETTI (1988), and SCHÄTTI & GASPERETTI (1994). Ecozones: M - Mediterranean, B - Badyiah, W & S - Wadi Araba and southern Jordan. Zoogeographical affinity: A - Arabian, Af - Afrotropical, P - Palearctic, SS - Saharo-Sindian. (+) - Species penetrates into the periphery of the indicated ecozone.

Tab. 1: Verteilung der Herpetofauna auf die Hauptökozonen Jordaniens. Die Angabe der zoogeographischen Affinität basiert auf Daten aus ARNOLD (1987), JOGER (1987), WERNER (1987, 1988), LAMARCHE & CLEMENT (1988), GASPERETTI (1988), und SCHÄTTI & GASPERETTI (1994). Ökozonen: M - Mediterran, B - Badyiah, W & S - Wadi Araba und südliches Jordanien. Zoogeographisches Element: A - Arabisch, Af - Äthiopisch, P - Paläarktisch, SS - Saharo-Sindisch. (+) - Die Form dringt in die Peripherie der Ökozone ein.

Taxon	Ecozone / Ökozone M	B	W & S	Zoogeograph. affinity / Affinität
Amphibia Urodela				
Salamandridae				
Triturus vittatus (JENYNS, 1835)	+			P
Amphibia Anura				
Pelobatidae				
Pelobates syriacus BOETTGER, 1889	+			P
Bufonidae				
Bufo viridis LAURENTI, 1768	+	+	+	P
Hylidae				
Hyla savignyi (AUDOUIN, 1827)	+	+	+	P
Ranidae				
Rana cf. *ridibunda* PALLAS, 1771	+	+	+	P
Reptilia Testudines				
Cheloniidae				
Chelonia mydas (LINNAEUS, 1758)	Gulf of Aqaba			
Eretmochelys imbricata (LINNAEUS, 1766)	Gulf of Aqaba			
Dermochelyidae				
Dermochelys coriacea (LINNAEUS, 1766)	Gulf of Aqaba			
Emydidae				
Mauremys caspica rivulata (VALENCIENNES, 1833)	+			P
Testudinidae				
Testudo graeca terrestris FORSKAL, 1775	+			P
Reptilia Squamata Sauria				
Gekkonidae				
Bunopus tuberculatus BLANFORD, 1874			+	A
Cyrtopodion kotschyi orientalis STEPANEK, 1937	+			P
Cyrtopodion scaber (HEYDEN, 1827)			+	A
Hemidactylus turcicus turcicus (LINNAEUS, 1758)	+	+	+	P
Pristurus rupestris BLANFORD, 1874			+	SS
Ptyodactylus guttatus HEYDEN, 1827		+	+	A
Ptyodactylus hasselquistii (DONNDORFF, 1798)		+	+	SS
Ptyodactylus puiseuxi BOUTAN, 1893	+	+		A
Stenodactylus doriae (BLANFORD, 1872)			+	A
Stenodactylus grandiceps HAAS, 1952		+		A
Stenodactylus sthenodactylus (LICHTENSTEIN, 1823)			+	SS
Tropiocolotes steudneri (PETERS, 1869)(?*T. nattereri* STEIND., 1901)			+	Af
Chamaeleonidae				
Chamaeleo chamaeleon recticrista BOETTGER, 1880	+	+		Af
Agamidae				
Laudakia stellio brachydactyla (HAAS, 1951)			+	P
Laudakia stellio picea (PARKER, 1935)		+		A
Laudakia stellio stellio (LINNAEUS, 1758)	+			P
Phrynocephalus arabicus ANDERSON, 1894			+	A
Pseudotrapelus sinaitus HEYDEN, 1827		+	+	A
Trapelus pallidus haasi (WERNER, 1971)	(+)	+	+	A
Trapelus persicus fieldi (HAAS & WERNER, 1969)		+		A
Uromastyx aegyptia microlepis BLANFORD, 1874		+	+	SS
Lacertidae				
Acanthodactylus boskianus (DAUDIN, 1802)	(+)	+	+	SS
Acanthodactylus grandis BOULENGER, 1909		+		A
Acanthodactylus opheodurus ARNOLD, 1980	(+)	+	+	A
Acanthodactylus pardalis (LICHTENSTEIN, 1823)		+		SS
Acanthodactylus robustus WERNER, 1929		+		A
Acanthodactylus schmidti HAAS, 1957		+		A
Acanthodactylus tristrami (GÜNTHER, 1864)		+		A
Lacerta kulzeri MÜLLER & WETTSTEIN, 1932	+			P
Lacerta laevis GRAY, 1838	+			P

Table 1: Continued.
Tab. 1: Fortsetzung.

Taxon	Ecozone / Ökozone			Zoogeograph. affinity / Affinität
	M	B	W & S	
Lacerta media israelica PETERS, 1964	+			P
Mesalina brevirostris microlepis (ANGEL, 1936)		+		A
Mesalina guttulata guttulata (LICHTENSTEIN, 1823)		+	+	SS
Mesalina olivieri schmidti (HAAS, 1951)		+	+	SS
Ophisops elegans blanfordi SCHMIDT, 1939	+			P
Ophisops elegans ehrenbergi WIEGMANN, 1835	+			P
Ophisops elegans elegans MENETRIES, 1832	+			P
Scincidae				
Ablepharus kitaibelii (BIBRON & BORY, 1833)	+			P
Chalcides guentheri BOULENGER, 1823	+			A
Chalcides ocellatus (FORSKAL, 1775)	+	+	+	SS
Eumeces schneiderii pavimentatus (G.-ST.HILAIRE, 1827)	+			SS
Eumeces schneiderii schneiderii (DAUDIN, 1802)		+	+	SS
Mabuya vittata (OLIVIER, 1804)	+	+	+	?SS(A)
Ophiomorus latastii BOULENGER, 1887	+			P
Scincus scincus meccensis WIEGMANN, 1837			+	A
Sphenops sepsoides (AUDOUIN, 1827)			+	SS
Anguidae				
Ophisaurus apodus PALLAS, 1772	+			P
Varanidae				
Varanus griseus (DAUDIN, 1802)		+	+	SS
Reptilia Squamata Ophidia				
Leptotyphlopidae				
Leptotyphlops macrorhynchus (JAN, 1860)	+			SS
Typhlopidae				
Typhlops simoni (BOETTGER, 1879)	+			P
Typhlops vermicularis MERREM, 1820	+			P
Boidae				
Eryx jaculus (LINNAEUS, 1758)	+	+		SS
Colubridae				
Coluber elegantissimus (GÜNTHER, 1878)			+	A
Coluber jugularis asianus (BOETTGER, 1880)	+			P
Coluber nummifer REUSS, 1834	+			P
Coluber ravergieri MENETRIES, 1832	+			P
Coluber rhodorachis (JAN, 1865)		+	+	?
Coluber rogersi (ANDERSON, 1893)	+			P
Coluber rubriceps (VENZMER, 1919)	+			P
Coluber schmidti NIKOLSKY, 1909	+			P
Coluber ventromaculatus GRAY, 1834		+		A
Eirenis coronella (SCHLEGEL, 1837)	+	+		SS
Eirenis decemlineatus (DUMERIL & BIBRON, 1854)	+			P
Eirenis lineomaculatus SCHMIDT, 1939	+			P
Eirenis rothi JAN, 1863	+			P
Lytorhynchus diadema (DUMERIL & BIBRON, 1854)			+	SS
Lytorhynchus kennedyi SCHMIDT, 1939		+		SS
Malpolon moilensis (REUSS, 1834)		+	+	SS
Malpolon monspessulanus insignitus (GEOFFROY, 1827)	+	(+)		P
Micrelaps muelleri BOETTGER, 1880	+			P
Natrix tessellata (LAURENTI, 1768)	+	(+)		P
Psammophis schokari (FORSKAL, 1775)	+	+	+	SS
Rhynchocalamus melanocephalus (JAN, 1862)	+			P
Spalerosophis diadema cliffordi (SCHLEGEL, 1837)		+	+	SS
Telescopus dhara (FORSKAL, 1775)			+	SS
Telescopus fallax syriacus (BOETTGER, 1880)	+			P
Telescopus nigriceps (AHL, 1924)	+	+		A
Atractaspididae				
Atractaspis microlepidota engaddensis HAAS, 1950	(+)		+	Af
Elapidae				
Walterinnesia aegyptia LATASTE, 1887	(+)	+	+	A
Viperidae				
Cerastes cerastes (LINNAEUS, 1758)			+	SS
Echis coloratus GÜNTHER, 1878	(+)		+	SS
Pseudocerastes persicus fieldi SCHMIDT, 1930		+		A
Vipera palaestinae WERNER, 1938	+			P

of the true distribution of various species.

3. There are debates concerning the zoogeographical stem of some species e. g., *Chamaeleo chamaeleon, Pseudotrapelus sinaitus* and others, which may hinder any comprehensive conclusion being drawn.

4. Complexity of geological and climatic effects in the Eastern Mediterranean areas and absence of fossil records of the present reptile and amphibian groups (ARNOLD 1987; TCHERNOV 1988) are other problems to be faced.

5. Some authors have considered the generic level, while others have utilized the specific level for their zoogeographic conclusions. However, the species is an objective and real unit which exists in nature, and is the basic one in taxonomy and evolution, while other (higher) taxonomic units are arbitrary. So, the species is the only unit that should be utilized in zoogeographical studies.

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