

Mapping the terrestrial reptile distributions in Oman and the United Arab Emirates

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Abstract

The terrestrial reptile fauna of Oman and the United Arab Emirates is rich, with at least 79 species of lizards and snakes and a single species of worm lizard. However, to date there have been no accurate maps published of their distribution ranges, and distribution data relies on scattered museum specimen localities and published accounts. Considerable numbers of locality data points do exist, collected by visiting and resident herpetologists, and more recently, from ecologists working on surveys for environmental impact assessments and biodiversity action plans. These data are invaluable, as amongst other uses, they can assist conservation planning and management, and will eventually document changes in distributions over time. This is especially true where there has been extensive habitat loss and degradation due to urbanisation and development activities.

Data have been collected from museum records, published accounts and unpublished data from a variety of sources, including many records made by the author over the last 20 years, with the aim of producing an atlas of species distributions. The number of records is now approaching 5,000, giving sufficient coverage to produce maps that are useful for a variety of applications. Examples are discussed, including endangered and endemic species, snakes of medical importance and species of potential interest in ecological and evolutionary studies.

Keywords

Atlas, mapping, distribution, herpetofauna, Oman, UAE, United Arab Emirates, Reptilia, Squamata, Sauria, Serpentes, Gekkonidae.

Introduction

Oman and the United Arab Emirates support a diverse terrestrial reptile fauna, including a number of species which are endemic at the regional and national levels (Gardner 1999, 2005b, 2008; Hornby 1996). This reflects the countries' position at the crossroads of the Ethiopian, Palaearctic and Oriental biogeographic regions, a wide range of habitats, and the abilities of reptiles to thrive in hot and arid regions. At present, eighty species of terrestrial reptiles have been recorded from Oman and the UAE: these being 58 lizards, 1 amphisbaenian and 21 snakes (Table 1, Appendix 1). The numbers of species on the country lists in both Oman and the UAE has increased dramatically over the last 20 years, as entirely new species have been described, existing species have been split, and further species have been recorded within the national boundaries. For example, since the year 2000, the following five species and subspecies have been added to the known reptile list in the UAE: Leptien's spiny-tailed lizard *Uromastyx aegyptia leptieni* (Wilms and Böhme 2000, 2007; Wilms et al. 2009), Blanford's fringe-toed lizard *Acanthodactylus blanfordii* (Gardner 2005a), Persian leaf-toed gecko *Hemidactylus persicus*, Carter's semaphore gecko, *Pristurus carteri* (Gardner in press) and the Arabian cat snake *Telescopus dhara* (Gardner et al. in press). Due to the relatively poor knowledge of the herpetofaunas in south eastern Arabia, this process will undoubtedly continue, and indeed is likely to accelerate when molecular methodologies are brought to bear on some of the widespread and highly variable "species".

While an up to date and accurate listing of the species is a first requirement for species conservation and management, knowledge of the distributions of the species is critical to guide conservation planning, mitigation for environmental degradation and to follow changes in species status that may occur as habitats become fragmented and lost, climate change alters species ranges or other variables affect individual species. To this end, I have been collating reptile distribution data from published and museum sources, from the field, and from other herpetologists and natural historians who have been generous with their observations. While an atlas project is never ending, sufficient data are now available as a useful tool for a variety of scientific and conservation management applications. A few examples, to illustrate the value of preparing a distribution atlas, are presented.

The data

Data have been collected by numerous herpetologists, ecologists and natural historians, mainly over the last 40 years. A total of 4,683 data points are used here, and this number is continuously increasing. Each data point is a species record at a single locality and time. The number of data points per species ranges from 2 to 361, with a mean of 58. As the data improves, it will be possible to map changes in distributions including range reductions. Older data are mapped to within one kilometre, though most recent data are collected using GPS and are accurate to within about 20 m. Figure 1 illustrates the coverage for all species as of October 2008. It can be seen that the coverage remains patchy, especially in Oman, even at a coarse scale. For example

Table 1. The families and numbers of species of terrestrial reptiles recorded from Oman and the United Arab Emirates.

Family		Number of species
Agamidae	Agamids or Chisel-toothed lizards	9
Chamaeleonidae	Chameleons	1
Gekkonidae	Geckos	27
Lacertidae	Wall and sand lizards	13
Scincidae	Skinks	7
Varanidae	Monitor lizards	1
Trogonophidae	Worm lizards	1
Typhlopidae	Typical blind snakes	1
Leptotyphlopidae	Thread snakes	2
Boidae	Boas	1
Colubridae	Colubrids	8
Atractaspididae	Burrowing asps	1
Elapidae	Front-fanged snakes	1
Viperidae	Vipers	7

the Muscat area and the Jebel Akhdar mountains in northern Oman are relatively well covered, whilst in the central desert there are many “blanks on the map”. Indeed the main Muscat to Salalah road can be traced by the dot records, with under-recorded areas to either side. On a finer scale the patchiness is much more apparent. Over the last 4 years, much data has been recorded in the UAE during baseline ecology surveys undertaken as part of environmental impact assessments. However these tend to be concentrated in the main areas of urban and industrial development, such as around Dubai, Abu Dhabi, Al Ain and Ruwais.

The data are only as good as the identifications they are based on. Hence only data from recognised authorities, or that are backed up by specimens or clearly identifiable photographs have been included. Even so, there remains some inevitable confusion. For example, before the description of *Uromastix aegyptia leptieni* in 2000, all spiny-tailed lizards in the UAE and northern Oman were assumed to be *Uromastix aegyptia microlepis* and were recorded as such. Following the separation of *U. a. leptieni*, it must be assumed that some of these records are misidentified. As the two forms are so similar and cannot be reliably identified without scale counts, field observations still remain problematic. Records are therefore assigned to subspecies depending on the location of the assumed contact zone, with an assumption that the subspecies have non-overlapping distributions. However, until the exact location and nature of the contact zone is mapped, the identity of some records remains impossible to determine.

Another potential source of confusion arises where records were made on the basis of tracks and traces. While some tracks are unambiguous, such as those of adult Persian wonder geckos *Teratoscincus keyserlingii* (being far larger than any other sand gecko tracks), or the distinctive track of the *Diplometopon zarudnyi*, the only amphisbaenian in the area, other track identifications are problematic. For example a sinuous snake track in the sands of western Abu Dhabi could be a sand boa (*Eryx jayakari*) or a

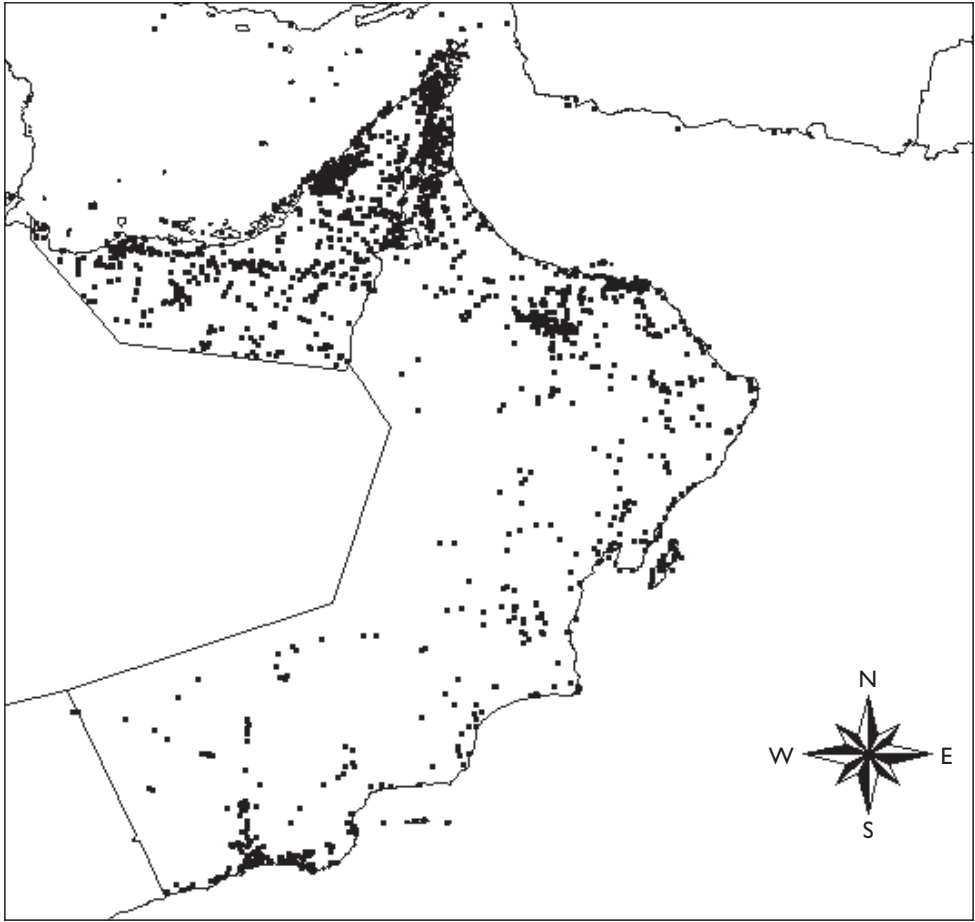


Figure 1. All 4,683 records of terrestrial reptiles in Oman and the UAE. Although the coverage of records remains patchy, there are sufficient records to provide useful distribution information.

leaf-nosed snake (*Lytorhynchus diadema*). Different herpetologists appear to have made different assumptions in identifying species from their tracks.

Examples of the use of reptile distribution data

Endangered species: The Persian Wonder Gecko *Teratoscincus keyserlingii*

This beautiful gecko species (Fig. 2) is restricted in Arabia to the lowlands of northern Abu Dhabi, Dubai, Sharjah and Umm al Quwayn (Fig. 3), especially those areas with sand sheet or low dune habitats with a relative abundance of grass clumps (*Pennisetum divisum* and *Panicum turgidum*). Although now classified as the Iranian species *T. keyserlingii*, the degree of differentiation between the Arabian form and the Iranian



Figure 2. The Persian Wonder Gecko *Teratoscincus keyserlingii* photographed near Jebel Ali, Dubai.

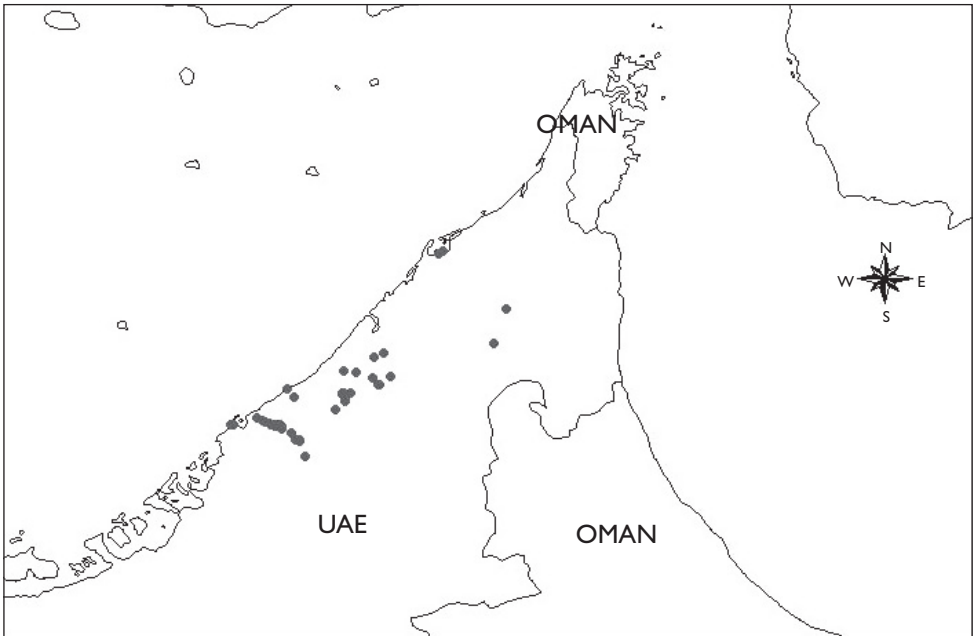


Figure 3. Distribution of the Persian Wonder Gecko *Teratoscincus keyserlingii*. This species is restricted within Arabia to the northern UAE.

ones has not yet been assessed. It is possible that the Arabian form is endemic to the UAE at the sub-specific level. Unfortunately the area of its range is undergoing extremely rapid development, and it remains to be seen whether the species will survive the extensive habitat loss and fragmentation. Already many of the sites at which it was recorded in the 1990s and early 2000s have been cleared, levelled and converted into industrial estates, green golf courses and residential suburbs. A more detailed and current survey of its range is now urgently required to estimate its present status and identify any areas which could be protected as conservation areas.

Endemism

Endemic species are a special responsibility for a country as they are aspects of biodiversity found nowhere else. A knowledge of their distributions is therefore important to ensure that their range can be protected within a system of protected areas. Examples of two regionally endemic species are the two sympatric lacertids in the endemic genus *Omanosaura*, which are restricted to the Hajar mountains (Fig. 4). Their distributions are almost totally overlapping, suggesting they are able to avoid competition. *Omanosaura jayakari* is considerably larger than *O. cyanura* and presumably takes different prey.

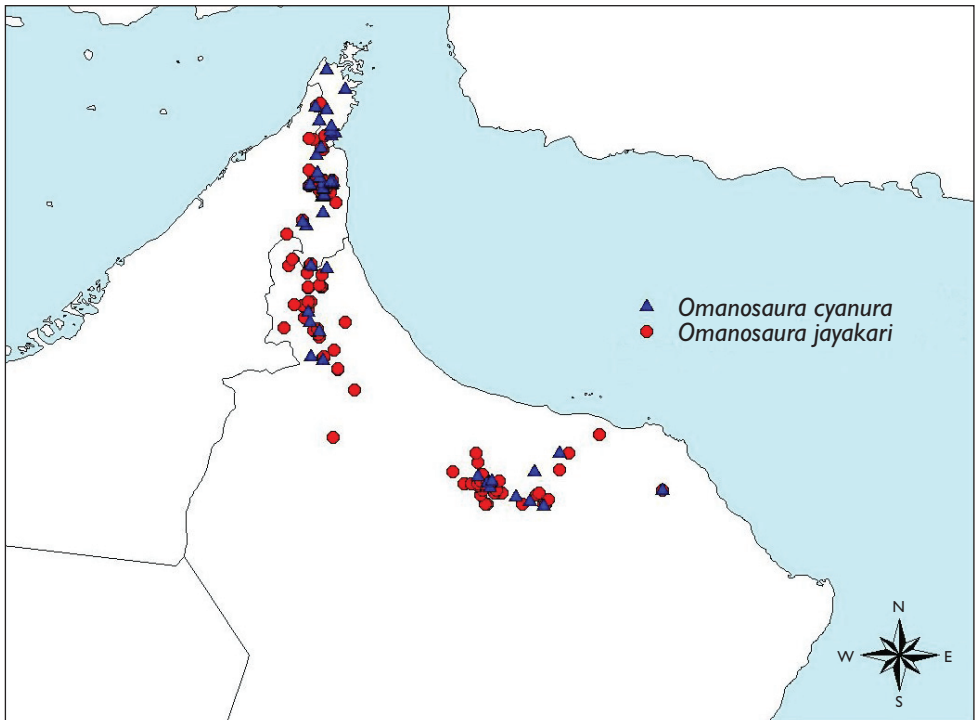


Figure 4. The distributions of two endemic lacertids in the genus *Omanosaura*. Both species are restricted to the Hajar mountains and their distributions overlap broadly.

Species of medical importance

There are nine species of land snakes of significant medical importance in SE Arabia. These are seven species of vipers, of which four are saw-scaled vipers in the genus *Echis*, and one species of cobra and one burrowing asp (Egan 2007; Gardner 2005b). These species are responsible for significant, but often underestimated, morbidity and mortality (Scrimgeour et al. 2001). Indeed, many people living in the cities are unaware that there may be potentially lethal snakes in their vicinity. Of these dangerous species, the saw-scaled vipers are of the greatest health concern. In northern Oman and the UAE, two species occur: the Oman saw-scaled viper *Echis omanensis* is restricted to the Hajar mountains, while the Sind saw-scaled viper *Echis carinatus sochureki* is generally found in sandy habitats in the lowlands. Figure 5 clearly shows the non-overlapping nature of their distributions, based largely on their habitat choice. The other two species, *Echis coloratus* and *E. khosatzkii* are both restricted within this region to south and central Oman.

It is widely recognised that there is interspecific and intraspecific variation in the venom components of snakes, and that this may have major consequences on the neutralisation capacity of antivenoms (Fry et al. 2003). A knowledge of the snake species found in particular areas allows a more informed selection of antivenom and an under-

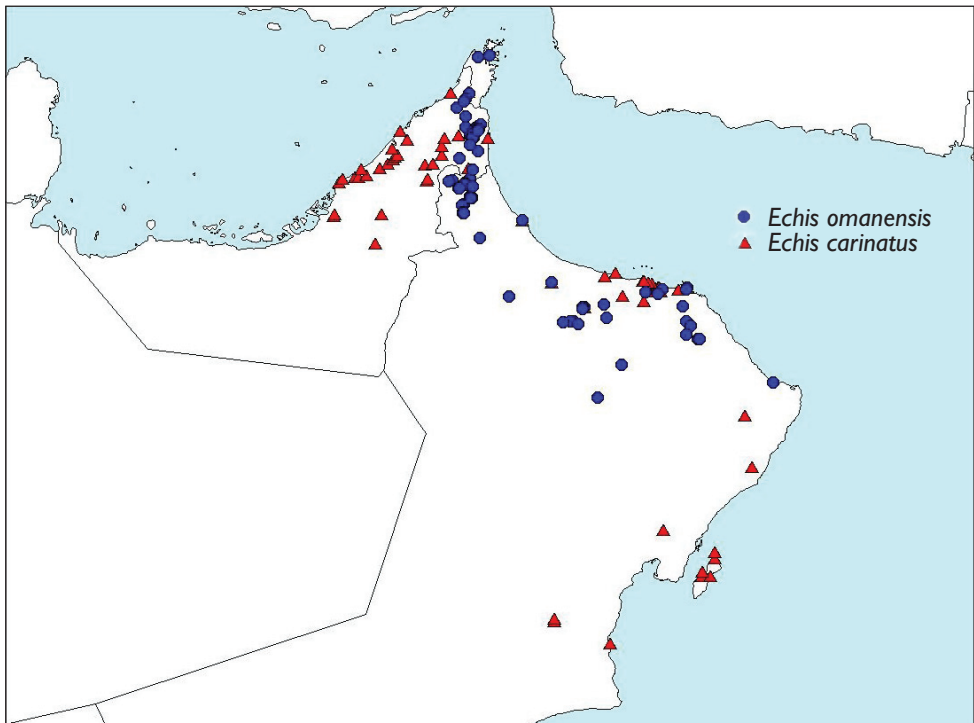


Figure 5. The distributions of two venomous saw-scaled vipers. The distributions have little overlap as *Echis carinatus sochureki* is a lowland species preferring sandy and gravel plains, while *E. omanensis* lives in rocky habitats in the mountains.

standing of its potential efficacy. In the future, it may be possible to develop more specific and effective antivenoms towards particular species, subspecies or venom components. An understanding of the snake distributions will be important in this endeavour.

Studies in ecology and evolution

A study of species distributions may allow questions to be formulated to test scientific theories. For example, two species with contiguous but non-overlapping distributions, that are able to utilise similar habitats, may have distributions resulting from ecological competition, species movements, or evolution and speciation. Figure 6 illustrates the ranges of two species of sand geckos that have contiguous distributions: *Stenodactylus leptocosymbotes* and *S.slevini* which both live on firmer desert surfaces such as sandy gravel inter-dune plains and mountain outwash plains. These distributions suggest that they cannot coexist in sympatry, though the reasons for this have not been investigated.

Future developments

A handbook and atlas of the reptiles and amphibians of Oman and the United Arab Emirates is currently being prepared and will detail the current state of knowledge of this herpetofauna, as well as facilitate identifications for professional

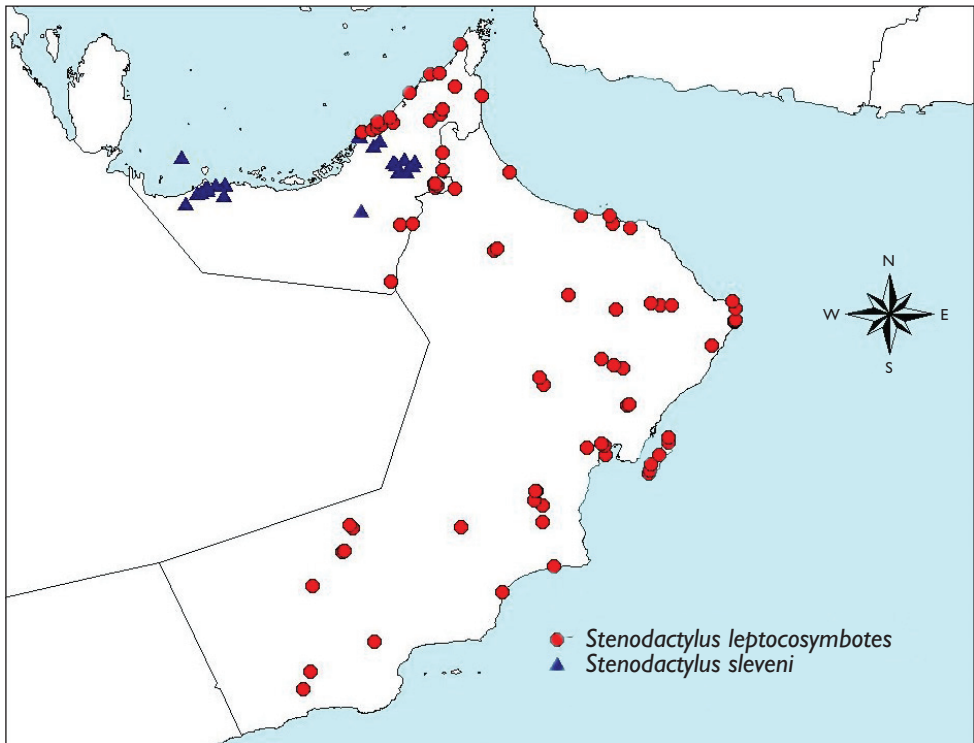


Figure 6. Non-overlapping and contiguous distributions of two species of sand geckos *Stenodactylus slevini* and *S. leptocosymbotes*.

and amateur herpetologists. It is clearly important that the database on which the mapping is based is accessible to researchers, conservationists and planners, and is continually updated as further records are collected and taxonomic revisions undertaken. However it is not yet clear where such a record should be housed and maintained in the region.

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References

- Egan D (2007) Snakes of Arabia: A Field Guide to the Snakes of the Arabian Peninsula and its Shores. Motivate Publishing, Dubai, 208 pp.
- Fry BG, Winkel KD, Wickramaratna JC, Hodgson WC, Wüster W (2003) Effectiveness of snake antivenom: Species and regional venom variation and its clinical impact. *Journal of Toxicology – Toxin Reviews* 22: 23–34.
- Gardner AS (1999) The Reptiles and Amphibians of Oman: Herpetological history and current status. In: Fisher M, Ghazanfar S, Spalton JA (Eds) *The Natural History of Oman: A Festschrift for Michael Gallagher*. Backhuys Publishers, Leiden, 65–88.
- Gardner AS (2005a) Blanford's Fringe-toed lizard (Lacertidae: *Acanthodactylus blanfordii* Boulenger, 1918): a new species record for the UAE. *Tribulus* 15: 25–26.
- Gardner AS (2005b) Terrestrial reptiles. In: Hellyer P, Aspinnall S (Eds) *The Emirates: A Natural History*. Trident Press, London, 229–241.
- Gardner AS (2008) The Terrestrial Reptiles of the United Arab Emirates: Herpetological History, Zoogeography and Conservation. In: Perry R (Ed) *Terrestrial Environment of Abu Dhabi Emirate*. Environment Agency Abu Dhabi, Abu Dhabi, 281–307.
- Gardner AS (in press) Two new gecko species records for the United Arab Emirates: *Pristurus carteri* (Gray, 1863) and *Hemidactylus persicus* Anderson, 1872. *Tribulus* 18.
- Gardner AS, Egan J, Tovey N (in press) The Arabian cat snake (*Telescopus dhara* (Forskål, 1775)): a new species record for the UAE, with notes on the species in Oman. *Tribulus*.
- Hornby R (1996) A checklist of amphibians and reptiles of the UAE. *Tribulus* 6: 9–13.
- Scrimgeour EM, Gallagher MD, Gardner AS, Al Kaabi JMM (2001) Venomous snake-bite and use of polyvalent snake antivenom in Oman. *Oman Medical Journal* 18: 20–26.

- Wilms T, Böhme W (2000) A new *Uromastyx* species from south-eastern Arabia, with comments on the taxonomy of *Uromastyx aegyptia* (FORSKÅL, 1775) (Squamata: Sauria: Agamidae). *Herpetozoa* 13: 133–148.
- Wilms T, Böhme W (2007) Review of the taxonomy of the spiny-tailed lizards of Arabia (Reptilia: Agamidae: Leiolepidinae: *Uromastyx*). *Fauna of Arabia* 23: 435–468.
- Wilms T, Böhme W, Wagner P, Lutzmann N, Schmitz A (2009) On the phylogeny of the genus *Uromastyx* Merrem, 1820 (Reptilia: Squamata: Agamidae: Uromastycinae) – Resurrection of the genus *Saara* Gray, 1845. *Bonner zoologische Beiträge, Bonn* 56: 55–99.

Appendix I

Checklist of the terrestrial reptiles and amphibians of Oman and the UAE

Order Squamata	
Suborder Sauria (lizards)	
Family Agamidae (Chisel-toothed lizards or agamas)	
<i>Acanthocercus adramitanus</i> (Anderson, 1896)	Hadramaut Agama
<i>Calotes versicolor</i> (Daudin, 1802)	Bloodsucker
<i>Phrynocephalus maculatus</i> Anderson, 1872	Spotted Toad-headed Agama
<i>Phrynocephalus arabicus</i> Anderson, 1894	Arabian Toad-headed Agama
<i>Pseudotrapelus sinaitus</i> (Heyden, 1827)	Sinai Agama
<i>Trapelus flavimaculatus</i> Rüppell, 1835	Yellow-spotted Agama
<i>Uromastyx aegyptia</i> Forsskål, 1775	Egyptian Spiny-tailed lizard
subsp. <i>microlepis</i> Blanford, 1874	Egyptian Spiny-tailed Lizard
subsp. <i>leptieni</i> Wilms and Böhme, 2000	Leptien's Spiny-tailed Lizard
<i>Uromastyx benti</i> (Anderson, 1894)	Bent's Spiny-tailed Lizard
<i>Uromastyx thomasi</i> Parker, 1930	Thomas's Spiny-tailed Lizard
Family Chamaeleonidae (Chameleons)	
<i>Chamaeleo arabicus</i> Matschie, 1893	Arabian Chameleon
Family Gekkonidae (Geckos)	
<i>Asaccus caudivolvulus</i>	
Arnold and Gardner, 1994	Musandam Leaf-toed Gecko
<i>Asaccus gallagheri</i> (Arnold, 1972)	Gallagher's Leaf-toed Gecko
<i>Asaccus montanus</i> Gardner, 1994	Mountain Leaf-toed Gecko
<i>Asaccus platyrhynchus</i> Arnold & Gardner, 1994	Flat-snouted Leaf-toed Gecko
<i>Bunopus spatalurus</i> Anderson, 1901	Banded Ground Gecko
subsp. <i>spataluru</i>	
subsp. <i>hajarensis</i> Arnold, 1980	
<i>Bunopus tuberculatus</i> Blanford, 1874	Baluch Ground Gecko
<i>Cyrtopodion scabrum</i> (Heyden, 1827)	Rough-tailed Bowfoot Gecko
<i>Hemidactylus flaviviridis</i> Rüppell, 1835	Yellow-bellied House Gecko
<i>Hemidactylus homoeolepis</i> Blanford, 1881	South Arabian Leaf-toed Gecko
<i>Hemidactylus lemurinus</i> Arnold, 1980	Oman Ghost Leaf-toed Gecko
<i>Hemidactylus leschenaultii</i> Duméril & Bibron, 1836	Indian Bark Gecko
<i>Hemidactylus persicus</i> Anderson, 1872	Persian Leaf-toed Gecko
<i>Hemidactylus robustus</i> (Linnaeus, 1758)	Red Sea Leaf-toed Gecko
<i>Hemidactylus yerburii</i> Anderson, 1895	Yerburi's Leaf-toed Gecko
<i>Pristurus carteri</i> (Gray, 1863)	Carter's Semaphore Gecko
<i>Pristurus celerrimus</i> Arnold, 1977	Bar-tailed Semaphore Gecko
<i>Pristurus gallagheri</i> (Arnold, 1986)	Gallagher's Semaphore Gecko
<i>Pristurus minimus</i> Arnold, 1977	Least Semaphore Gecko

<i>Pristurus rupestris</i> Blanford, 1874	Rock Semaphore Gecko
<i>Ptyodactylus hasselquistii</i> (Donndorff, 1798)	Hasselquist's Fan-footed Gecko
<i>Stenodactylus arabicus</i> (Haas, 1957)	Arabian Sand Gecko
<i>Stenodactylus doriae</i> (Blanford, 1874)	Dune Sand Gecko
<i>Stenodactylus khobarensis</i> (Haas, 1957)	Gulf Sand Gecko
<i>Stenodactylus leptocosymbotes</i> Leviton & Anderson, 1967	Eastern Sand Gecko
<i>Stenodactylus slevini</i> Haas, 1957	Slevin's Sand Gecko
<i>Teratoscincus keyserlingii</i> (Schlegel, 1858)	Persian Wonder Gecko
<i>Tropicolotes scorteccii</i> Cherchi and Spano, 1963	Scortecci's Dwarf Gecko
Family Lacertidae (Wall and Sand lizards)	
<i>Acanthodactylus blanfordii</i> Boulenger, 1918	Blanford's Fringe-toed Lizard
<i>Acanthodactylus boskianus</i> (Daudin, 1802)	Bosk's Fringe-toed Lizard
<i>Acanthodactylus felicitis</i> Arnold, 1980	South Arabian Fringe-toed Lizard
<i>Acanthodactylus gongrorhynchatus</i> Leviton & Anderson, 1967	Saudi Fringetoed lizard
<i>Acanthodactylus haasi</i> Leviton & Anderson, 1967	Haas's Fringe-toed Lizard
<i>Acanthodactylus masirae</i> Arnold, 1980	Masirah Fringe-toed Lizard
<i>Acanthodactylus ophiodurus</i> Arnold, 1980	Snake-tailed Fringe-toed Lizard
<i>Acanthodactylus schmidti</i> Haas, 1957	Schmidt's Fringe-toed Lizard
<i>Mesalina adramitana</i> (Boulenger, 1887)	Hadramaut Sand Lizard
<i>Mesalina ayunensis</i> Arnold, 1980	Ayun Sand Lizard
<i>Mesalina brevirostris</i> Blanford, 1874	Short-snouted Sand Lizard
<i>Omanosaura cyanura</i> Arnold, 1972	Blue-tailed Oman Lizard
<i>Omanosaura jayakari</i> Boulenger, 1887	Jayakar's Oman Lizard
Family Scincidae (Skinks)	
<i>Ablepharus pannonicus</i> (Lichtenstein, 1823)	Asian Snake-eyed Skink
<i>Chalcides ocellatus</i> (Forsskål, 1775)	Ocellated Skink
<i>Mabuya tessellata</i> Anderson, 1895	Tessellated Mabuya
<i>Scincus mitranus</i> Anderson, 1871	Arabian Sand Skink or Sand Fish
<i>Scincus scincus conirostris</i> Blanford, 1881	Common sand skink
<i>Trachylepis septemtaeniata</i> (Reuss, 1834)	Southern Grass Skink
<i>Trachylepis brevicollis</i> (Wiegmann, 1837)	Sudan Mabuya
Family Varanidae (Monitor lizards)	
<i>Varanus griseus</i> (Daudin, 1802)	Grey or Desert Monitor
Suborder Amphisbaenia (worm lizards)	
Family Trogonophidae (Worm lizards)	
<i>Diplometopon zarudnyi</i> Nikolsky, 1907	Zarudny's Worm Lizard
Suborder Serpentes (snakes)	
Family Typhlopidae (Typical blind snakes)	
<i>Ramphotyphlops braminus</i> (Daudin, 1803)	Brahminy Blind Snake or Flowerpot
Family Leptotyphlopidae (Thread snakes)	
<i>Leptotyphlops macrorhynchus</i> (Jan, 1860)	Hooked Thread Snake

	<i>Leptotyphlops nursii</i> (Anderson in Boulenger, 1896)	Nurse's Thread Snake
Family Boidae (Boas)		
	<i>Eryx jayakari</i> Boulenger, 1888	Jayakar's Sand Boa
Family Colubridae (Colubrids)		
	<i>Lytorhynchus diadema</i> (Duméril, Bibron & Duméril, 1854)	Leaf-nosed Snake
	<i>Malpolon moilensis</i> (Reuss, 1834)	Hooded Malpolon
	<i>Platyceps rhodorachis</i> (Jan, 1865)	Wadi Racer or Desert racer
	<i>Platyceps thomasi</i> Parker, 1931	Thomas's Racer
	<i>Platyceps ventromaculatus</i> (Gray, 1834)	Gray's racer or rat snake
	<i>Psammophis schokari</i> (Forsskål, 1775)	Schokari Sand Racer
	<i>Spalerosophis diadema cliffordi</i> (Schlegel, 1837)	Diadem Snake
	<i>Telescopus dhara</i> (Forsskål, 1775)	Arabian Cat Snake
Family Atractaspididae (Mole vipers)		
	<i>Atractaspis microlepidota andersonii</i> Boulenger, 1905	Small-scaled Burrowing Asp
Family Elapidae (Front-fanged snakes)		
	<i>Naja haje arabica</i> Scortecci, 1932	Arabian Cobra
Family Viperidae (Vipers)		
	<i>Bitis arietans</i> (Merrem, 1820)	Puff Adder
	<i>Cerastes gasperettii</i> Leviton & Anderson, 1967	Arabian Horned Viper
	<i>Echis carinatus sochureki</i> Stemmler, 1969	Sind Saw-scaled Viper
	<i>Echis coloratus</i> Günther, 1878	Burton's Saw-scaled Viper
	<i>Echis khosatzkii</i> (Cherlin, 1990)	Khosatzki's Saw-scaled Viper
	<i>Echis omanensis</i> Babocsay, 2004	Oman Saw-scaled Viper
	<i>Pseudocerastes persicus</i> (Duméril, Bibron & Duméril, 1854)	Persian Horned Viper