

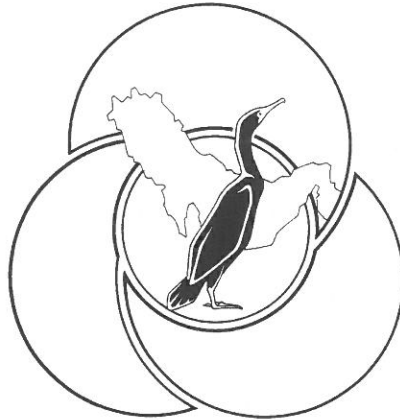
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A Marine Wildlife Sanctuary for the Arabian Gulf

Environmental Research and Conservation Following the 1991 Gulf War Oil Spill

With a Preface by H.R.H. Prince Sultan bin Abdul Aziz Al Saud



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A preliminary survey of the terrestrial reptiles and sea snakes in the Jubail Marine Wildlife Sanctuary

Harald Martens

Abstract: In January and May 1992 a survey of the terrestrial reptiles and sea snakes of the Jubail Marine Wildlife Sanctuary was carried out. Within the area, 14 lizard, one amphisbaenian, four terrestrial snake and three sea snake species were recorded, comprising about 50 % of the herpetofauna known thus far from eastern Saudi Arabia. Abundances of species and individuals observed were generally low. Three terrestrial herpetofaunal assemblages associated with specific substrate conditions and plant formations were identified. In sea snakes, distributional and ecological patterns reported earlier were confirmed. Winter mortality of Hydrophiidae in the northern Arabian Gulf, due to low water temperatures, appears to be a common but still insufficiently understood phenomenon.

دراسة أولية للزواحف البرية والأفاعي البحرية في محمية الجبيل للأحياء البحرية

هارالد مارتنز

خلاصة : تم في كانون أول (يناير) وأيار (مايو) عام ١٩٩٢م إجراء مسح للزواحف البرية والأفاعي البحرية في محمية الجبيل للأحياء البحرية. وتم تسجيل ١٤ نوعاً من العظايا، ونوع واحد من الزواحف عديمة الأطراف (Trogoponidae)، و٤ أفاعي برية، و٣ أفاعي بحرية مما يشكل حوالي ٥٠٪ من الحيوانات الزاحفة والمعروفة إلى الآن في شرق المملكة العربية السعودية. وكانت وفرة الأنواع والاعداد التي تمت مشاهدتها منخفضة بشكل عام. وقد تم تحديد ثلاث تجمعات برية للزواحف مرتبط وجودها بظروف وبيئات معينة وتجمعات نباتية محددة. وقد تم تأكيد ما ذكر في دراسات سابقة عن الانتشار والانماط البيئية للأفاعي البحرية. أن اسباب موت الحيات من العائلة Hydrophiidae في فصل الشتاء شمال الخليج العربي يعود إلى انخفاض درجات حرارة الماء ويبدو أنها ظاهرة عامة ولكنها غير مفهومة بدرجة كافية حتى الآن.

INTRODUCTION

Due to their species diversity and varied ecological roles terrestrial reptiles and sea snakes are considered as two of the predominant vertebrate groups in the deserts and marine areas of the Arabian Gulf region (see e.g. MCKINNON 1990). Consequently, information on these herpetofaunal elements was required to assess the status of the Jubail Marine Wildlife Sanctuary, Saudi Arabia (for further information see introduction to this volume).

To date, no systematic herpetological surveys have been carried out in this area or in adjacent regions, apart from studies on marine turtles (MILLER 1989) which were the subject of detailed investigation (PILCHER & AL-MERGHANI 1994, AL-MERGHANI et al. this volume). Hence, the aim of this faunal survey was the collection of basic information regarding species diversity, distributional patterns and ecological characteristics of the lizards, amphisbaenians and snakes native to the Sanctuary.

Abbreviations:

AT	Air temperature
JMWS	Jubail Marine Wildlife Sanctuary
PTL	Permanent Transect Line (see JONES et al. this volume, for details)
RCS	Reptile Collecting Site
SMF	Senckenberg Museum, Frankfurt a.M.
SNMNH	Saudi Arabian National Museum of Natural History, Riyadh
ST	Substrate temperature
SVL	Snout-vent length
SWT	Surface water temperature

MATERIALS AND METHODS

The Jubail Marine Wildlife Sanctuary is described elsewhere in this volume and in BARTH & NIESTLÉ (1992). See also Figure 1.

The author spent seven weeks in the Sanctuary area during periods of least (January 1992) and most (May 1992) suitable weather conditions, regarding reptile activity. Regular observations and collecting trips focused on terrestrial species while sea snakes were recorded during occasional shoreline walks and boat trips off Abu Ali Island. More than 3500 km were travelled by car or foot during the hot season, mainly between sunrise and 11.00 a.m. and from 04.00 p.m. until midnight.

Permanent transect lines (see JONES et al. this volume and Fig. 1) and five additional locations characterised by different ecological conditions (RCS 1-5; Fig. 1) were checked at least three times. Many specimens were observed along the highway sections surrounding the Sanctuary and during off-road trips by car. Wherever possible, live terrestrial reptiles were collected, identified and released after taking photographs. Only a few specimens, including carcasses, were preserved to establish reference collections for the Saudi Arabian National Museum of Natural History, Riyadh and the Senckenberg Research Institute and Natural History Museum, Frankfurt a.M. Sea snakes were taken to the laboratory for more detailed examination, especially regarding their stomach contents.

At each record site, the geographical position was determined using a Ferropilot Magellan GPS Nav 1000 Plus or from maps and by mileage. Major ecological and edaphic conditions (AT, ST, soil etc.) were noted and photographs of habitats were taken.

During January and May 1992, additional observations on the herpetofauna of eastern Saudi Arabia were carried out at four sites outside the JMWS (Fig. 1) which are considered in the following where appropriate.

RESULTS

During both survey periods, 14 lizard species (Agamidae, Gekkonidae, Lacertidae, Scincidae, Varanidae), one amphisbaenian (Trogonophidae), four terrestrial snakes (Boidae, Colubridae, Viperidae) and three sea snakes (Hydrophiidae) were recorded within the Sanctuary. Additionally, three further lizard species (Gekkonidae, Scincidae) were found at extralimital sites close to the Sanctuary area.

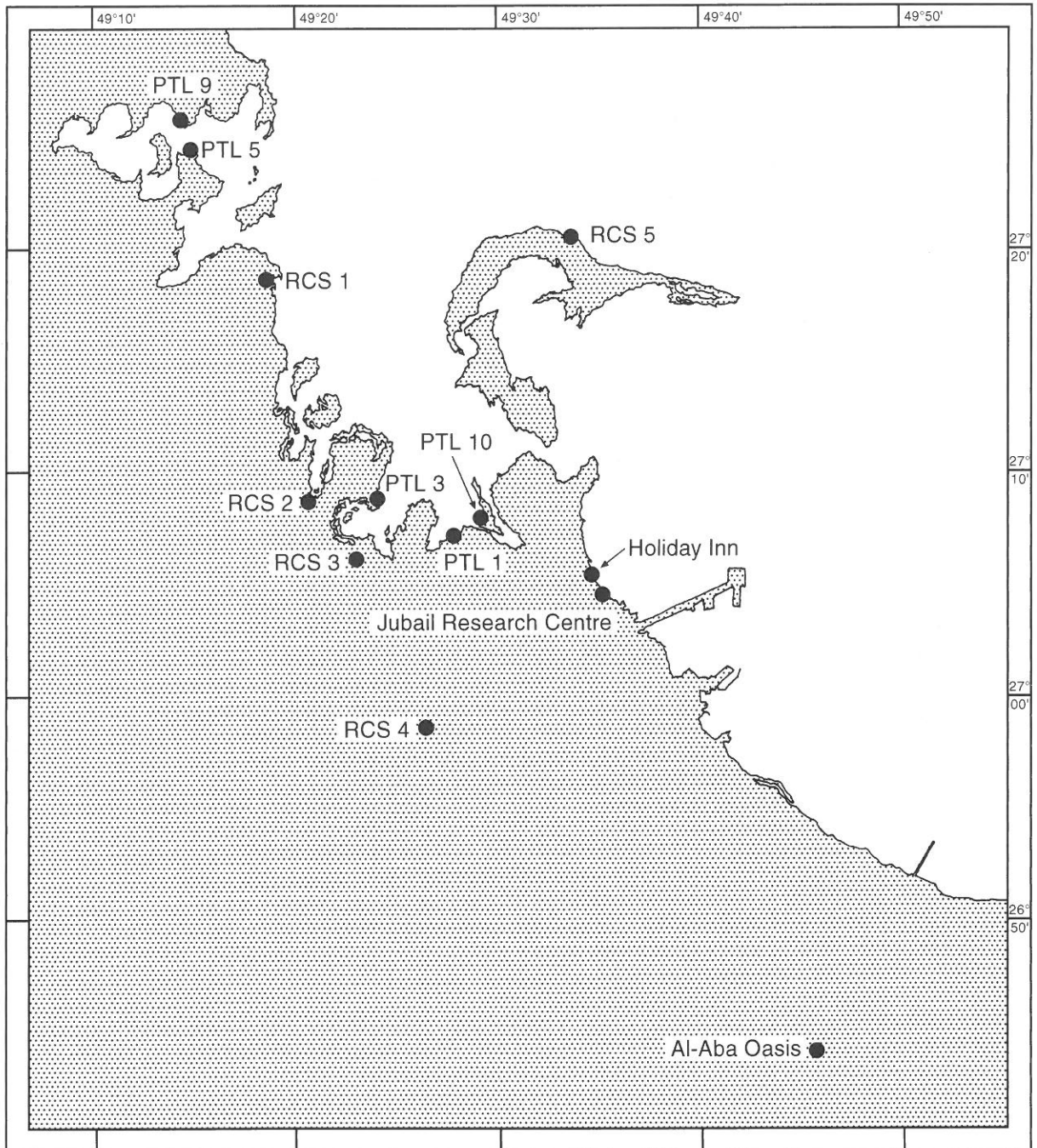


Fig. 1: Geographical position of collecting sites.

Species diversity of these major groups was higher in May than in January (numbers of species in May/January: lizards: 13/7, amphisbaenians: 1/1, terrestrial snakes: 4/1, sea snakes: 2/3), except in sea snakes when two species were found during the warm season only. Sixty specimens of terrestrial reptiles and nine sea snakes were collected within the Sanctuary, with an additional 22 and 11 respectively found at extralimital sites. Also, 33 sight records of terrestrial reptiles and 21 sea snake sightings were registered in the Sanctuary, and nine specimens were observed outside the JMWS.

Table 1: Geographical position of permanent collecting sites (for further information on Permanent Transect Lines (PTLs) see JONES et al. this volume).

Site	Location
PTL 1	27°07'09"N 49°27'30"E
PTL 3	27°08'23"N 49°23'41"E
PTL 5	27°24'09"N 49°13'53"E
PTL 9	27°25'41"N 49°07'55"E
PTL 10	27°07'59"N 49°29'10"E
RCS 1	27°18'56"N 49°17'59"E
RCS 2	27°08'56"N 49°20'06"E
RCS 3	27°06'24"N 49°22'55"E
RCS 4	26°59'00"N 49°25'40"E
RCS 5	27°21'00"N 49°32'55"E
Jinna Island	27°21'21"N 49°16'59"E
Holiday Inn Jubail	27°05'12"N 49°35'02"E, extralimital
Jubail Research Centre	27°05'08"N 49°35'04"E, extralimital
Al-Aba Oasis	26°44'44"N 49°45'59"E, extralimital

SYSTEMATIC ACCOUNT

Family Agamidae

Phrynocephalus arabicus Anderson, 1894

Material: 1 ♂, SNMNH/R 1, RCS 2, 10.V.1992, 15.00 h, H. Martens; 1 ♀, SNMNH/R 2, RCS 3, 11.V.1992, 09.50 h, H. Martens; 1 ♀, SMF 75251, RCS 4, 20.V.1992, 16.15 h, H. Martens. — Extralimital: 2 ♂♂, SMF 75252-3, Al-Aba Oasis, 16.V.1992, 08.40 h, H. Martens.

The distribution of this small agamid was strictly confined to sites covered with aeolian sand, into which specimens buried themselves when chased. The plant formation of their habitat was characterised by *Calligonum*, *Haloxylon* and, locally, *Phoenix*. AT ranged from 30.7 to 33.8 °C and ST from 35.3 to 40.0 °C when the lizards were active.

Phrynocephalus maculatus longicaudatus Haas, 1957

Material: 1 ♂, SNMNH/R 3, RCS 2, 15.V.1992, 09.45 h, H. Martens.

This single specimen was collected on coastal sabkha bordered by sand sheets with *Haloxylon* vegetation.

Trapelus persicus fieldi (Haas & Y. Werner, 1969)

Material: 1 spm., SNMNH/R 4, RCS 1, 22.V.1992, 08.30 h, H. Martens. — Extralimital: 1 ♀, SNMNH/R 5, Jubail, landfill area beside Holiday Inn, 28.V.1992, 08.15 h, H. Martens; 1 ♂, SMF 75254, Al-Aba Oasis, 31.V.1992, 08.00 h, W. Schneider & A. Alsuhaibany.

Habitats of Field's agama were characterised by consolidated substrate with isolated boulders, debris or shrubs (e.g. *Rhanterium*, *Haloxylon*), where basking specimens remained motionless even when they were approached. At two sites AT and ST were recorded (32.7 °C, 34.0 °C and 32.8 °C, 39.1 °C).

Uromastix aegyptius microlepis (Blanford, 1874)

Material: 1 spm., SNMNH/R 6 (see Plate 1), 2.5 km S of the Ras az-Zaur highway, 27°26'00"N 49°07'59"E, 17.V.1992, 15.45 h, H. Martens, D. Kock & W. Schneider. — Sight records: 1 spm., 15 km E of highway junction to Ras

az-Zaur, 17.V.1992, 15.00 h, D. Kock & H. Martens; 1 spm., 16 km W of PTL 5, 18.V.1992, 07.45 h, D. Kock & H. Martens; 1 spm., golf course at the SE edge of the Sanctuary (10 km W of Jubail), 21.V.1992, 10.00 h, H. Martens; 1 spm., 5.8 km N of highway junction to cement factory, 27.V.1992, 10.00 h, D. Kock & I.A. Nader; 1 spm., 1.2 km E of highway junction to Ras az-Zaur, 27.V.1992, 09.20 h, D. Kock & I.A. Nader.

The dhub was found in nearly all types of geo-ecological units of the JMWS including sabkha, aeolian sand sheets and sites with consolidated loamy substrate covered with *Rhanterium*.

Even near places frequented by man (e.g. Jubail golf course), large specimens were observed sun-basking beside their burrows. During its morning and afternoon activity phases, AT was measured at 34.1-36.1 °C and ST at 38.1-38.5 °C.

Family Gekkonidae

Bunopus tuberculatus Blanford, 1874

Material: 1 ♂, SMF 75255, 27°07'25"N 49°19'34"E, 09.I.1992, 14.30 h, H. Martens; 2 ♂♂, 1 ♀, SMF 75256-8, RCS 1, 10.I.1992, 10.25 h, H. Martens; 1 ♂, SMF 75259, 27°17'47"N 49°16'02"E, 12.I.1992, 14.40 h, R. Kinzelbach; 1 ♂, 3 spms, SNMNH/R 7-10, 27°17'57"N 49°08'44"E, 12.I.1992, 11.30 h, H. Martens & R. Kinzelbach; 1 ♂, 2 ♀♀, 1 spm., SNMNH/R 11-14, 27°18'17"N 49°09'24"E, 12.I.1992, 13.00 h, H. Martens & R. Kinzelbach; 1 ♀, SNMNH/R 15, Jinna Island, 01.I.1992, W. Schneider; 1 ♂, 2 ♀♀, SMF 75260-2, RCS 2, 15.V.1992, 09.00 h, H. Martens. — Sight records: 2 spms, RCS 3, 14.I.1992, 15.00 h, H. Martens; 1 spm., RCS 5, 07.V.1992, 14.00 h, H. Martens; 1 spm., RCS 1, 10.V.1992, 12.00 h, H. Martens; 2 spms, RCS 2, 10.V.1992, 14.00 h, H. Martens; 1 spm., PTL 5, 17.V.1992, 21.00 h, H. Martens; 3 spms, RCS 1, 22.V.1992, 08.30 h, H. Martens.

This ground-dwelling gecko was commonly found under debris or boulders during the day but was seen only once at night, active and away from such hiding places. Habitats ranged from plain aeolian sands and *Calligonum* hummocks to sabkhas with sparse halophytic vegetation (e.g. *Zygophyllum*), with a slight preference for sandy soil. Even during the cold season specimens seemed to be active, as they spontaneously tried to hide when their shelter was removed. Winter temperatures (ST) of the hiding places ranged from 11.8 to 17.8 °C; the highest value in May was 27.1 °C.

Cyrtopodion scaber (Heyden, 1827)

Material: 1 ♀, SMF 75263, PTL 5, 17.V.1992, 21.00 h, H. Martens. — Extralimital: 1 ♂, 1 ♀, SMF 75264-5, Jubail Research Centre, 30.XII.1991, W. Schneider; 1 ♂, 1 ♀, SNMNH/R 16-17, landfill area beside Holiday Inn, Jubail, 13.I.1992, 09.15 h, H. Martens; 1 ♀, 1 spm., SNMNH/R 18-19, Jubail Research Centre, 06.V.1992, 17.00 h, H. Martens. — Sight records: 2 spms, PTL 5, 17.V.1992, 21.30 h, H. Martens; 1 spm., PTL 9, 25.V.1992, 07.00 h, H. Martens.

Cyrtopodion scaber was observed under boulders on consolidated substrate, exclusively at sites very close to the coast e.g. at the cliffs of Ras al-Abkhara (AT: 27.4 °C, ST: 27.1 °C). At extralimital localities the species was found in residential areas under debris.

Hemidactylus flaviviridis Rüppell, 1835

Material: Extralimital: 1 ♀, SNMNH/R 20, Jubail Research Centre, 05.I.1992, W. Schneider; 1 ♀, SMF 75266, same locality, 08.V.1992, 20.00 h, H. Martens; 1 ♂, SMF 75267, same locality, 09.V.1992, T. Müller; 1 ♀, SMF 75268, same locality, 14.V.1992, T. Müller; 1 ♂, SMF 75268, same locality, 26.V.1992, H. Martens.

The yellow-bellied house gecko was recorded only outside the Sanctuary in residential areas on walls of buildings.

Hemidactylus persicus Anderson, 1872

Material: Extralimital: 1 ♂, SMF 75269, 1 ♂, SNMNH/R 22, Jubail Research Centre, 06.V.1992, 21.00 h, H. Martens.

This species occurred syntopically with *H. flaviviridis* and was collected while hunting for night-flying insects near wall lights.

Stenodactylus khobarensis (Haas, 1957)

Material: 1 ♂, SMF 75270, 1 spm., SNMNH/R 23, PTL 3, 14.I.1992, 12.30 h, H. Martens.

The sabkha habitat of this gecko was interspersed with small hummocks covered with *Halopeplis* vegetation and debris under which both specimens were found in their burrows (ST: 19.2 °C). *Stenodactylus khobarensis* is one of two reptile species which were only found during the cold season.

Stenodactylus doriae (Blanford, 1874)

Material: 1 spm. carcass, SNMNH/R 24, RCS 4, 19.V.1992, 23.20 h, H. Martens; 1 ♀, SNMNH/R 25, PTL 5, 17.V.1992, 21.30 h, H. Martens; 1 ♂, SMF 75271 (see Plate 2), RCS 4, 28.V.1992, 21.45 h, H. Martens.

Active specimens of this nocturnal lizard were observed both in sand dunes with *Haloxylon* vegetation and in non-vegetated escarpments with large boulders (AT: 25.0-27.4 °C, ST: 25.2-27.1 °C).

Family Lacertidae

Acanthodactylus opheodurus Arnold, 1980

Material: 1 spm., SNMNH/R 26, PTL 5, 28.V.1992, A. Alsuhaibany.

A single specimen was collected on a coastal escarpment interspersed with large boulders.

Acanthodactylus gongrorhynchatus Leviton & Anderson, 1967

Material: 1 ♂, SMF 75272, 1 ♀, SNMNH/R 27, RCS 4, 25.V.1992, 16.30 h, H. Martens & D. Kock.

This lacertid was observed on *Calligonum* hummocks in aeolian sands, where typical tail-waving tracks indicated the occurrence of this species before any specimen was spotted.

Acanthodactylus schmidti Haas, 1957

Material: Extralimital: 1 spm., SNMNH/R 28, Jubail Research Centre, 24.I.1992, W. Schneider; 2 ♀♀, SMF 75273, SNMNH/R 29, same locality, 12.V.1992, 11.00 h, H. Martens; 1 ♂, SMF 75274, landfill area beside Holiday Inn, Jubail, 19.V.1992, 10.00 h, W. Schneider. — Sight records: 1 spm., PTL 3, 14.V.1992, 17.00 h, H. Martens; 2 ♂♂, RCS 2, 24.V.1992, 10.00 h, H. Martens.

No obvious habitat preferences were noted for this, the largest lacertid of the Sanctuary. The species was found in various desert biotopes except for fine aeolian sands where *A. gongrorhynchatus* occurred. At one site, foraging animals were observed when the temperature had reached 33.4 °C (AT) and 33.9 °C (ST).

Mesalina brevirostris Blanford, 1874

Material: 2 spms, SMF 75276-7, Jinna Island, 01.I.1992, W. Schneider; 1 spm., SMF 75275, PTL 3, 09.I.1992, 13.30 h, E. Neubert; 2 ♂♂, 2 spms., SNMNH/R 31-34, same locality, 14.I.1992, 12.00 h, H. Martens; 1 ♂, SMF 75278, RCS 5, 08.V.1992, 14.00 h, H. Martens. — Extralimital: 1 spm., SNMNH/R 30, Jubail Research Centre, 30.XII.1991, W. Schneider.

All record sites were close to the coast (sabkhas, sandy beaches) and thus characterised by halophytic vegetation, e.g. *Halopeplis*, *Zygophyllum*. Compared with other diurnal lizards this species was more commonly spotted in January than in May, even at rather low AT (14.0 °C).

Family Scincidae

Mabuaya aurata septemtaeniata (Reuss, 1834)

Material: Sight records: Extralimital: 1 spm., Al-Aba Oasis, 15.V.1992, 16.00 h, H. Martens & D. Kock; 1 spm., landfill area beside Holiday Inn, Jubail, 28.V.1992, 09.00 h, D. Kock & W. Schneider.

This skink was observed outside the Sanctuary at irrigated sites with ornamental vegetation or in semi-shaded sites among date palms of the Al-Aba Oasis.

Scincus mitranus mitranus Anderson, 1871

Material: 1 spm. carcass, SNMNH/R 35, 27°17'15"N 49°10'18"E, 21.V.1992, 20.45 h, W. Schneider.

The incomplete carcass was found on a sand sheet with *Calligonum* hummocks.

Family Varanidae

Varanus griseus griseus (Daudin, 1803)

Material: 1 spm. carcass, SNMNH/R 36, RCS 3, 14.I.1992, H. Martens. — Sight records: 1 spm., RCS 1, V.1992, R. Benson.

Although there were only two records of the desert monitor in the Sanctuary, according to local residents it was more common. Amongst others, a "huge lizard with a thin tail" close to the golf course at the south-western edge of the Sanctuary was reported several times.

Family Trogonophidae

Diplometopon zarudnyi Nikolsky, 1907

Material: 2 spms, SMF 75279-80, 1 spm., SNMNH/R 37, RCS 1, 16.I.1992, 15.15 h, H. Martens; 4 spms, SNMNH/R 38-41, RCS 5, 08.V.1992, 14.00 h, H. Martens; 1 spm., SMF 75281, PTL 9, 25.V.1992, 07.00 h, H. Martens. — Sight records: 5 spms, RCS 2, 10.V.1992, 15.00 h, H. Martens; 6 spms, RCS 1, 22.V.1992, 08.30 h, H. Martens; 1 spm., PTL 9, 25.V.1992, 07.00 h, H. Martens.

This amphisbaenid and its conspicuous burrow systems were commonly found under wooden debris. There seemed to be no clear preference for a particular soil but substrate moisture was always comparatively high. The frequency of specimens seemed to decrease with increasing seasonal temperature. ST in the burrows ranged from 18.5 to 29.3 °C (January/May).

Family Boidae

Eryx jayakari Boulenger, 1888

Material: 1 spm., SMF 75282, RCS 4, 26.V.1992, 21.15 h, H. Martens.

Jayakar's sand boa was collected on a tar road bordered by aeolian sand dunes with *Haloxylon* vegetation (ST: 29.1 °C).

Family Colubridae

Malpolon moilensis (Reuss, 1834)

Material: 1 spm. carcass, SNMNH/R 42, Batina Island, 27°15'54"N 49°29'45"E, 23.V.1992, 17.00 h, H. Martens.

This specimen was found as a road casualty in an area characterised by sabkha vegetation (e.g. *Zygophyllum*).

Plate 1. *Uromastyx aegyptius microlepis*, SNMNH/R: 6, see systematic account (photo F. Krupp).



Plate 2. *Stenodactylus doriae*, SMF 75271, see systematic account.



Plate 3. *Cerastes cerastes gasperettii*, SMF 75285, see systematic account.



Psammophis schokari (Forsskål, 1775)

Material: 1 spm., SMF 75283, Jinna Island, 01.I.1992, W. Schneider; 1 spm., SNMNH/R 43, RCS 5, 08.V.1992, 14.00 h, H. Martens; 2 spms carcasses, SNMNH/R 44-45, Abu Ali Island, 31.V.1992, P. Symens & G. Keijl. — Extralimital: 1 spm. carcass, SMF 75284, Al-Aba Oasis, 29.V.1992, D. Kock.

Amongst the five specimens, a juvenile was collected while it was active during the cold season (AT about 18 °C according to collector).

Family Viperidae

Cerastes cerastes gasperettii Leviton & Anderson, 1967

Material: 1 spm. skin, SNMNH/R 46, RCS 3, 20.V.1992, D. Kock; 1 ♂, SMF 75285 (see Plate 3), PTL 9, 24.V.1992, 19.45 h, H. Martens & W. Schneider; 1 ♀, SNMNH/R 47, 15.8 km E of highway junction to Ras az-Zaur, 24.V.1992, 20.40 h, H. Martens & W. Schneider.

The only venomous terrestrial snake species was found both on aeolian sand with *Calligonum* and *Rhanterium* vegetation and close to the shoreline in *Haloxylon* sites with consolidated substrate. AT and ST were 26.7-27.1 °C and 26.4-27.1 °C respectively, during the evening when animals were active. Both specimens collected alive represent horned varieties of this subspecies.

Family Hydrophiidae

Pelamis platurus (Linnaeus, 1766)

Material: 1 ♀ carcass, 3 spms embryos, SMF 75286-89, 2 spms carcasses, SNMNH/R 48-49, Ras Abu Ali (most eastern tip of Abu Ali Island), 27°18'28"N 49°41'01"E, 18.I.1992, H. Martens; 1 ♀, SNMNH/R 50, RCS 5, 24.I.1992, H. Martens.

Pelamis platurus was observed during the cold season only (SWT 15.3-16.5 °C); specimens had been washed ashore after stormy weather where they were found between litter and seagrass. One gravid female (500 mm SVL) contained three well-developed embryos (173 mm, 170 mm, 166 mm SVL).

Hydrophis cyanocinctus Daudin, 1803

Material: 1 spm. carcass, SNMNH/R 51, PTL 1, 09.I.1992, E. Neubert; 1 spm. carcass, SNMNH/R 52, PTL 10, 11.I.1992, E. Neubert; 1 ♀, SNMNH/R 54, RCS 5, 21.V.1992, M. Richmond; 1 spm., SMF 75290, 6 km N of RCS 5, 29.V.1992, 12.00 h, H. Martens, W. Richmond & T. Woodhouse. — Extralimital: 1 spm. carcass, SMF 75291, 1 spm. carcass, SNMNH/R 53, Judhaim Island (25°28'N 50°42'E), 13.I.1992, R. Kinzelbach & T. Müller.

A few specimens were collected at or along the southern coast of the Sanctuary. Only one *H. cyanocinctus* was observed in its natural habitat, drifting on the surface of the sea (4 m deep; SWT 29.8 °C). However, it appeared to be in weak condition, probably due to 61 barnacles (*Platylepas ophiophilus*) covering its skin. The ovaries of a female collected in May contained 12 (5/7) eggs of 5-7 mm length.

Hydrophis lapemoides (Gray, 1849)

Material: 1 ♀, SNMNH/R 55, 6 km N of RCS 5, 29.V.1992, 11.00 h, H. Martens, M. Richmond & T. Woodhouse. — Extralimital: 1 ♂ carcass, 3 ♀♀ carcasses, SNMNH/R 56-59, 2 ♂♂ carcasses, SMF 75292-3, 2 ♀♀ carcasses, SMF 75294-95, 1 spm. carcass, SMF 75296, Judhaim Island, 25°28'N 50°42'E, 13.I.1992, R. Kinzelbach & T. Müller.

The Arabian Gulf sea snake was recorded only once within the Sanctuary during the survey periods (SWT 28.9 °C; but see *Hydrophis* sp.). A small collection from an extralimital site comprised 3 ♂♂, 5 ♀♀ and 1 juvenile carcasses which were found within a range of 1 km along the shoreline. The stomachs of 4 ♀♀ contained partly digested fishes identified as *Amblygobius*

albimaculatus (Rüppell, 1830) and *Plotosus lineatus* (Thunberg, 1781). In one female's ovaries, nine (4/5; SMF 75294) eggs of 8 mm length were found.

Hydrophis sp.

Material: Sight records: 21 spms, inshore area N of Abu Ali Island, 29.V.1992, H. Martens, M. Richmond & T. Woodhouse.

Several unidentified *Hydrophis* specimens were observed drifting on the water surface. Others were spotted while they were swimming slowly above the sandy sea bottom (water depth c. 3-6 m).

Faunal and distributional characteristics

Among the terrestrial reptiles 12 diurnal, six nocturnal and one species with an undetermined activity phase (*Diplometopon zarudnyi*) were encountered. Three of these species (*Scincus mitranus mitranus*, *Eryx jayakari* and the amphisbaenid) have adopted a burrowing lifestyle. *Bunopus tuberculatus* (10), *Uromastix aegyptius microlepis* (5) and *D. zarudnyi* (4) were the most frequently encountered species within the Sanctuary, living in all three major biotope types (see below). Among the remaining species four were found at three different sites, three at two and nine at only one site each. In all species the number of specimens at each site was low (< 2) apart from *B. tuberculatus*, *D. zarudnyi* and *Mesalina brevirostris* which were occasionally found in small aggregations (> 4).

Three general herpetofaunal assemblages seem to be associated with specific types of substrate and vegetation within the Sanctuary (euryoecious reptile species are given in parentheses):

Aeolian sand (plant formation: e.g. *Calligonum*, *Haloxylon*):

Phrynocephalus arabicus, (*Uromastix aegyptius microlepis*), (*Bunopus tuberculatus*), (*Stenodactylus doriae*), *Acanthodactylus gongrorhynchatus*, *Scincus mitranus mitranus*, (*Varanus griseus griseus*), (*Diplometopon zarudnyi*), *Eryx jayakari*, (*Cerastes cerastes gasperettii*).

Euryoecious/stenoecious species: 6/4.

This assemblage is characterised by comparatively many stenoecious psammophile species well adapted to burrowing in, or moving on, sandy substrate. Focal points of distribution are the southernmost and northernmost parts of the Sanctuary and the dune slopes bordering the sabkhas of western Dauhat ad-Dafi.

Sabkha and transitional sand sheets (plant formation: e.g. *Zygophyllum*, *Halocnemum*):

Phrynocephalus maculatus longicaudatus, (*Uromastix aegyptius microlepis*), (*Bunopus tuberculatus*), *Stenodactylus khobarensis*, (*Acanthodactylus schmidtii*), *Mesalina brevirostris*, (*Diplometopon zarudnyi*), *Malpolon moilensis*, *Psammophis schokari*.

Euryoecious/stenoecious species: 4/5.

This faunal assemblage was found along western Dauhat ad-Dafi and on the inshore islands. Most taxa were encountered at Kuthban hummocks or *Zygophyllum* belts, but some species (e.g. *P. maculatus longicaudatus*) occurred on non-vegetated sabkha sites far from hiding places.

Areas with consolidated substrate and boulders (plant formation: e.g. *Rhanterium*):

Trapelus persicus fieldi, (*Uromastix aegyptius microlepis*), (*Bunopus tuberculatus*), *Cyrtopodion scaber*, (*Stenodactylus doriae*), (*Acanthodactylus schmidtii*), *Acanthodactylus opheodurus*, (*Varanus griseus griseus*), (*Diplometopon zarudnyi*), (*Cerastes cerastes gasperettii*).

Euryoecious/stenoecious species: 7/3.

Included here are central parts of the survey area and some elevated locations at the coast of Dauhat al-Musallamiya. Most species were euryoecious and were recorded also from other geo-ecological units of the Sanctuary.

Sea snakes were only observed at coastal sites which are exposed to the prevailing sea currents, i.e. Abu Ali Island and southern Dauhat ad-Dafi. Among the few records *Hydrophis lapemoides* was represented only once, *Hydrophis cyanocinctus* (4) and *Pelamis platurus* (4) were collected at four and two different localities, respectively. The habitat of *Hydrophis* species off Abu Ali Island was characterised by rather bare sandy sea bottom, interspersed with small coral outcrops. Within an area of about 20 × 10 km, 23 specimens were spotted during a three-hour boat trip.

DISCUSSION

Several comprehensive publications compiling the available data on Arabian reptiles have shown that the herpetofauna of eastern Saudi Arabia and the adjacent sea is one of the least documented of the Arabian Peninsula (JAGER 1984, ARNOLD 1986, GASPERETTI 1988, LEVITON et al. 1992, GASPERETTI et al. 1993). Distributional records and notes on the biology have mainly resulted from occasional collections and observations (e.g. VOLSOE 1939, HAAS 1957, 1961, MANDAVILLE 1967, 1974, HAAS & WERNER 1969, BASSON et al. 1977). Only in marine turtles (MILLER 1989) and in some lizard species (ROSS 1988, 1989 a, 1989 b, 1991, 1993) were more recent surveys carried out in the Eastern Province of the Kingdom, providing detailed data on individual species.

This paper represents the first inventory of terrestrial reptiles and sea snakes native to a large area of eastern Saudi Arabia and it reveals some general characteristics of the herpetofauna, though the list of species must be regarded as preliminary.

All species recorded in the Sanctuary have been found previously elsewhere in the east of the Kingdom and they all are typical faunal elements of the coastal area of the Arabian Gulf and its hinterland. To date, 27 lizard, one amphisbaenian, ten terrestrial snake and six sea snake species have been recorded from eastern Saudi Arabia (ARNOLD 1986, GASPERETTI 1988, GALLAGHER 1990, LEVITON et al. 1992); 52 % (n = 14), 100 % (n = 1), 40 % (n = 4) and 50 % (n = 3) of these species are represented in the Sanctuary. Compared to the Eastern Province as a whole, species diversity of lizards and snakes in the Sanctuary appears to be low. This may be explained partly by the generally low abundances of species and individuals and the low probability of finding some secretive species such as *Lytorhynchus diadema* (Duméril, Bibron & Duméril, 1854), considering the large survey area. However, it is apparent that even species common elsewhere were not found during the surveys (e.g. *Coluber ventromaculatus* Gray, 1834, *Spalerosophis diadema cliffordi* Schlegel, 1837), or do not enter the Sanctuary though recorded at adjacent sites (e.g. *Mabuya aurata septemtaeniata*, *Hemidactylus persicus*). This is probably due to the almost complete lack of sites with permanent freshwater (e.g. oases, irrigated sites) or with gravel and rocky substrate which represent suitable habitats for such species in eastern Arabia (GALLAGHER 1971, 1990; ROSS 1993).

All record sites are located within the known range of the species. Only in three species, *Stenodactylus khobarensis* (see ARNOLD 1980), *Acanthodactylus gongrorhynchatus* (see ROSS 1989 b) and *Hydrophis lapemoides* (see GASPERETTI 1988), the distributional limits are slightly extended to the north along the Arabian coast by the new findings. With respect to zoogeographical characteristics (ARNOLD 1987), terrestrial reptiles are mainly represented by Arabian or Saharo-Arabian

species (e.g. *Phrynocephalus arabicus*, *Stenodactylus doriae*, *Malpolon moilensis*), but also by species confined to the more mesic areas of the Arabian Gulf (e.g. *Diplometopon zarudnyi*, *Stenodactylus khobarensis*; extralimital: *Hemidactylus flaviviridis*, *Hemidactylus persicus*). Accordingly, the lizard fauna of the Sanctuary largely resembles that of Kuwait and southern Iraq (see STUART & CLAYTON 1983, AFRASIAB & ALI 1989, LEVITON et al. 1992), but differs from inland deserts of Saudi Arabia by containing more species which are associated with coastal areas (see AL-SADOON 1988, AL-SADOON et al. 1991) and from areas of the southern Gulf by containing fewer proper Arabian species (see ARNOLD 1984).

Overall distributional patterns within the Sanctuary are difficult to assess due to the general scarcity of species records. However, it can be assumed that all species occur in their preferred biotopes within the Sanctuary, since major ecological or geomorphological barriers are missing. Habitat preferences, and thus assemblages of terrestrial reptiles, largely correspond to records from other desert areas of the Arabian Peninsula (e.g. ARNOLD 1984; AL-SADOON et al. 1991). In the Sanctuary, three general herpetofaunal communities were identified which are associated with different types of substrate and vegetation. Dunes, sand sheets and sabkhas are inhabited by comparatively more stenoeic species than sites with more consolidated substrate. Among those some are strongly specialised with regard to their spatial niche e.g. *Phrynocephalus arabicus* and *Stenodactylus khobarensis* (GALLAGHER 1971, ARNOLD 1980, 1984), while others were only found at coastal habitats within the Sanctuary, e.g. *Psammophis schokari* and *Mesalina brevirostris*, but are known to occur at inland sites and in various habitats elsewhere in Arabia (AL-SADOON 1988, GASPERETTI 1988, ROSS 1988, AL-SADOON et al. 1991). It is clear from other surveys in Bahrain (GALLAGHER 1971) and the United Arab Emirates (ARNOLD 1984) that these faunal characteristics are widely encountered in eastern Arabia.

Due to the low number of records of sea snakes, an interpretation of distributional and ecological characteristics of this group is much more difficult than in terrestrial reptiles. In general, species distributed in the entire Gulf (*Pelamis platurus*, *Hydrophis cyanocinctus*) were more commonly recorded than *Hydrophis lapemoides* which is apparently absent from the northernmost part of the Gulf (GASPERETTI 1988), though it is listed for Kuwait without exact locality data (FARMER 1983). To the contrary, in the sea snake collection from the more southerly Judhaim Island, *H. lapemoides* is the dominant one of the two *Hydrophis* species, similar to observations from Bahrain (GALLAGHER 1971). In agreement with the latter, most sea snakes washed ashore at the coast of the Sanctuary were found during the cold season. This could represent a general winter phenomenon in the northern Gulf, caused by low water temperature and storms, when chilled specimens respond less actively to waves and currents and are thus washed ashore. Although the pelagic *P. platurus* has been recorded in temperate waters and is commonly washed ashore elsewhere (KROPACH 1975), the northern part of the Arabian Gulf generally appears to be an extreme habitat for sea snakes due to large seasonal changes in water temperature (10-35 °C; BASSON et al. 1977). Cold northerly winds (Shamal) have regularly caused widespread mortality of corals and other marine groups (SHEPPARD et al. 1992). According to GASPERETTI (1988) the low winter temperature "... adds to the considerable speculation concerning sea snake migration, of which very little or nothing is known, even whether or not they do or do not migrate." In tropical waters, seasonal migrations of Hydrophiidae have indeed been observed (HEATWOLE 1987). In this context, it is an interesting result of the ichthyological survey in the Sanctuary that remarkable seasonal changes in species assemblages of marine fish were recorded along inshore reefs (KRUPP & MÜLLER 1994). In December 1991 almost all fish disappeared at these sites and reappeared in spring 1992 whereas this phenomenon was not observed at offshore reefs. The question whether sea snakes respond by

similar migrations to minimise winter mortality requires further studies on the ecology and seasonal behaviour of Hydrophiidae in the Gulf.

Hydrophis species were usually found in shallow water above a sandy sea bottom along the Sanctuary coast. Nevertheless, specimens from the Gulf of Salwa (Judhaim Island) had apparently foraged in other habitats as well, since they had fed on individuals of a venomous coral reef fish species (*Plotosus lineatus*) and sand-dwelling gobiids (*Amblygobius albimaculatus*). This habit had been recorded previously by BASSON et al. (1977), although they did not include *Hydrophis* species in their list of coral reef species. In individuals of *H. lapemoides* and *H. cyanocinctus* from the Iranian Gulf coast the diet consisted of subtidal gobiids and mudskippers respectively (VOLSOE 1939), while FARMER (1983) depicted a *Hydrophis (cyanocinctus?)* specimen swallowing a yemyam (*Helotes sexlineatus*).

Only eggs were found in the ovaries of *Hydrophis* females, whereas one specimen of *Pelamis platurus* was gravid containing three embryos of about 200 mm total length. Since the minimum size at birth has been estimated at about 220 mm in this species (KROPACH 1975) it can be assumed that the individual would have given birth in late winter or spring. This represents the first published record of reproduction of *P. platurus* in the Arabian Gulf.

This preliminary inventory of herpetofauna, other than marine turtles (MILLER 1989), of the Jubail Marine Wildlife Sanctuary does not reveal any peculiarities regarding species diversity or population sizes, although further studies are required for a final assessment, in particular for sea snakes. Both terrestrial reptiles and sea snakes are represented by typical faunal elements of eastern Arabia, with preferences for habitats which do not appear to be particularly threatened in the western Gulf region. However, with regard to conservation measures within the Sanctuary the aeolian sand community is probably the least common one among the terrestrial herpetofaunal assemblages and thus should be assigned a special conservation status.

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