The occurrence of *Acanthodactylus hardyi* Haas, 1957 in the Hashemite Kingdom of Jordan and notes on its ecology

by Lina Rifai, David Modrý, Petr Necas and Zuhair S. Amr

Abstract. *Acanthodactylus hardyi* Haas, 1957 has traditionally been treated as a subspecies of the widely distributed *A. scutellatus*, but was recently elevated to specific rank. The occurrence of *A. hardyi* in Jordan was discovered very recently. Four specimens collected from Batn al Ghul and Al Hazim have the diagnostic features of *A. hardyi* and are therefore assigned to this taxon. This finding is considered as further proof of the validity of the taxon and of its recognition at the specific level. Ecological requirements and niche partitioning are discussed in the light of the co-occurrence of *A. hardyi* with *A. schmidti* and/or *A. opheodurus*.

Kurzfassung. *Acanthodactylus hardyi* Haas, 1957 war traditionell als Subspezies der weit verbreiteten Art *A. scutellatus* aufgefasst worden, wurde aber vor Kurzem auf Artrang erhoben. Erst kürzlich wurde das Vorkommen von *A. hardyi* in Jordanien entdeckt. Vier Exemplare, die in Batn al Ghul und in Al Hazim gesammelt wurden, weisen die diagnostischen Merkmale von *A. hardyi* auf und werden daher diesem Taxon zugeordnet. Diese Feststellung wird als weiterer Beleg für die Validität dieses Taxons und ihre Gültigkeit auf Artniveau gewertet. Die ökologischen Ansprüche und die Nischenaufteilung werden im Hinblick auf die Koexistenz von *A. hardyi* mit *A. schmidti* und/oder *A. opheodurus* diskutiert.

Key words. Taxonomy, distribution, zoogeography, Sauria, Lacertidae, Jordan, Near East.

Introduction

Lizards of the genus *Acanthodactylus* Wiegmann are common inhabitants of arid ecosystems in northern Africa and the Near and Middle East. Thanks to several morphological and ecological adaptations and the resulting fine niche partitioning, these lacertids often form rather diverse communities consisting of up to four syntopically living congeners. According to present knowledge, the genus *Acanthodactylus,* is represented in Jordan by 9 species, but the occurrence of *A.* cf. *pardalis* is questionable (DISI et al. 2001).

Acanthodactylus scutellatus (Audouin, 1809) is typically a psammophilous species inhabiting northern Africa and the Near East, east to Kuwait. Together with *A. aureus* Günther, 1903, *A. dumerili* (Milne Edwards, 1829), *A. longipes* Boulenger, 1918 and *A. taghitensis* Geniez & Foucart, 1995 it forms the relatively uniform *scutellatus* group within the genus *Acanthodactylus*. Traditionally, two subspecies are considered as valid within *A. scutellatus*: the nominotypic one, inhabiting Saharan Africa east to Sinai and southern Israel, and *A. s. hardyi* Haas, 1957, described from Saudi Arabia and subsequently reported also from Kuwait and Iraq (SALVADOR 1982). However, in the most recent study dealing with the biogeography and evolution of the genus *Acanthodactylus,* HARRIS & ARNOLD (2001) pointed out morphological differences between the nominotypic form and *A. s. hardyi*, and elevated the latter to specific rank. We follow this classification and treat *A. hardyi* as a separate species.

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The occurrence of *A. hardyi* in Jordan has been discovered very recently (DISI et al. 2001). In this account we report on its known distribution, taxonomic status and discuss its ecological requirements.

Material and methods

Field observations and collections were made during numerous field trips undertaken by the authors in the years 1996 to 2001. Four specimens of *A. hardyi* were collected, photographed and preserved in alcohol; basic meristic and metric characters were collected from all specimens to determine their specific and subspecific status. Sex was determined by dissection and checking the right gonad. All animals are deposited in the herpetological collection of the National Museum Prague, Czech Republic: NMP6V 71352: Batn al Ghul, 29°41'43''N, 35°53'04''E, 950 m a.s.l, 12 June 1999, coll. D. MODRÝ. – NMP6V 71353/1–3: ca 23 km east of police station in Abar al Hazim, 31°35'50''N, 37°16'51''E, 540 m a.s.l., 5 September 2001, coll. L. RIFAI, D. MODRÝ and M. KAMLER.

Results

Morphology

All collected specimens show a high level of morphological uniformity, and the main morphological characters agree with the diagnosis of *A. hardyi*: relatively slender, dorsally flattened body and pointed snout, 3 supraoculars and a 4th broken up into granules and one row of granules between the supraoculars and the supraciliaries. Suboculars, with a distinct keel, are not in contact with the upper lip but are joined with the 5th and 6th supralabial. Temporals are small and granular. First three pairs of submaxillaries are in contact, ear opening is bordered anteriorly by 3–5 denticulated scales. The dorsal scales are very small, smooth and granular, arranged in 63–74 rows across the mid-body (66–67 in the animals examined, see Tab. 1). Ventrals (counted without marginals) are arranged in 12 more or less straight longitudinal rows. 4 rows of scales are present on fingers; the toes are strongly pectinate. Basic measurements and scale counts are summarised in Tab. 1.

The ground colour of living specimens was very pale, sandy-yellowish with greyish buff, with a fine dark brown reticulated pattern on dorsum. The hind legs were distinctly spotted, the dorsal side of the tail was lighter than its lateral parts, the tail of all three animals from Al Hazim appeared slightly bluish. The ventral side was whitish with a pearl tinge. Alcohol preserved specimens were a typical bluish buff.

Tab. 1. Basic morphological data for the reported specimens of *A. hardyi*. [1] = regenerated tail; [2] = ventrals in longest transversal row, counted without marginals; [3] = dorsals at mid-body.

coll. No.	locality	sex	SVL (mm)	TL (mm)	ventrals[2]	dorsals[3]	no. of supraoculars
NMP6V 71352	Batn al Ghul	♀	52	69[1]	12	67, smooth	3
NMP6V 71353/1	Al Hazim	♀	43	80	12	66, smooth	3
NMP6V 71353/2	Al Hazim	♂	45	82	12	66, smooth	3
NMP6V 71353/3	Al Hazim	♂	41	71	12	67, smooth	3

Fig. 1. Habitat of *Acanthodactylus hardyi* east of Abar Al Hazim (photograph: D. MODRÝ).

Habitat and field observations

Batn al Ghul. A single female was collected in a shallow, sandy wadi, with relatively dense bushes of *Haloxylon persicum*. The wadi intersects the flat hammada formed by fine gravel and interspersed basalt boulders of various size. The slopes of the nearby hills are covered by loose sand. The specimen was collected around 8:00 a.m. when basking close to a dense bush of *Haloxylon*. An intense search during 3 visits in following three years did not reveal further specimens of *A. hardyi*, in contrast to several *A. opheodurus* observed and collected. Syntopically, *Acanthodactylus opheodurus*, *Trapelus pallidus agnetae*, *Scincus scincus meccensis* and *Stenodactylus slevini* were collected. The larger dunes of loose sand, lying in the immediate vicinity, were inhabited by *Phrynocephalus arabicus*; tracks of *Cerastes g. gasperettii* and *Varanus griseus* were observed at the same place.

Al Hazim. All specimens were collected around steep sandstone hills arising abruptly from the flat sandy hammada east of the Abar al Hazim oasis. The microhabitat was formed by undulating low dunes consisting of very fine, partly loose and partly hardened sand with scattered bushes of *Salsola vermiculata*, *Halogeton alopecuroides* and *Anabasis* sp. Three specimens were collected between 9:30 and 10:30 a.m., and two further specimens were observed and photographed. The animals were usually resting in the half-shadow of low bushes and when pursued they ran to the next bush, where they retreated into the shadow between branches. If flushed again, they usually retreated into simple burrows with a rather small opening. Syntopically, a single subadult *A. schmidti* and a single juvenile *A. opheodurus* were collected. Additionally, tracks of *Scincus scincus meccensis* were observed at the same site; the nearby situated sandstone cliffs were inhabited by *Ptyodactylus puiseuxi*.

Fig. 2. A subadult specimen of *Acanthodactylus hardyi* photographed east of Abar Al Hazim (photograph: D. MODRÝ).

Fig. 3. A portrait of *Acanthodactylus hardyi* from Batn al Ghul (photograph: D. MODRÝ).

Discussion

All the animals examined have the morphological characters typical for *A. scutellatus sensu lato*. Furthermore, the 12 rows of ventral scales across the belly, smooth dorsals, rather large gular scales and smooth temporals fit well HAAS' description of *A.* (*scutellatus*) *hardyi*. In contrast to the widely distributed, often collected and relatively well-studied nominotypic form, the field data on *A. hardyi* are limited. The original description is based on a single specimen from the Hirmas Station near Tebuk in Saudi Arabia (HAAS 1957), whilst a further three specimens were collected and described by HAAS & WERNER (1969) from Lake Habbniyah, Iraq. SALVADOR (1982) reported on more than a dozen further specimens from Saudi Arabia, Kuwait and Iraq, concluding that the uniformity in the distinctive diagnostic features and the absence of intermediate forms supported the subspecific status of *A. s. hardyi* despite its great similarity with the nominotypic form. Recently, HARRIS & ARNOLD (2001) pointed out morphological differences between the nominotypic form and *A. s. hardyi* and divided both forms.

Despite the fact that Jordanian localities are much closer to the range of the nominate form in Israel, no evidence of clinal variation was observed. It is probable that both taxa are separated by a narrow gap formed by the Wadi al Arabah region. Being a northern part of the Great African Rift, this region and the surrounding mountain ranges represent a significant biogeographic barrier separating several reptile taxa. Based on its current distribution, *A. hardyi* can be considered an Arabian taxon, as its occurrence in Batn al Ghul and Al Hazim corresponds with the occurrence of several other psammophilous Arabian reptiles (e.g. *Scincus scincus meccensis*, *Phrynocephalus arabicus*, *Stenodactylus doriae*, *Cerastes g. gasperettii*). To solve the taxonomic status of *A. hardyi* based on the limited material examined is beyond the scope of our note. However, we believe that the data we have presented support the proposal by HARRIS & ARNOLD (2001) to treat this taxon as a separate species.

Lizards of the genus *Acanthodactylus* display strong niche partitioning, allowing several species to occur syntopically (e.g. ARNOLD 1984, ROSS 1989, MODRÝ et al. 1999). Based on our observations from Jordan, *A. hardyi* seems to inhabit the marginal, more or less hardened part of sandy areas with some quantities of stones and scattered chamaephyte vegetation. In Batn al Ghul it shares the locality with the much more common *A. opheodurus,* which attains approximately the same size. The only specimen of *A. hardyi* collected at that particular place may suggest that the real microhabitat there of this species may be different and that it has been overlooked during our relatively short visits.

At the locality east of Al Hazim, a single specimen of *A. opheodurus* and single subadult specimen of *A. schmidti* were collected syntopically with *A. hardyi*. By contrast, ca. 2 km westwards, in the well-studied sandy dunes in the close vicinity of Abar al Hazim, *A. schmidti* co-occurs with *A. opheodurus* but without *A. hardyi*. In the western part of its range *A. schmidti* is the largest psammophilous *Acanthodactylus* confined purely to dunes consisting of more or less loose sand. In such microhabitats, it usually occurs syntopically with one of the smaller *Acanthodactylus* species. It has been found together with *A. opheodurus* at several Jordanian localities (see maps and references in DISI et al. 2001) and with *A. tilburyi* in Al Mudawwarah (MODRÝ et al. 1999). It is probable that these smaller species exploit a different food spectrum from their larger congener *A. schmidti*. A similar type of co-existence has been reported for *A. s. scutellatus* and *A. longipes* in N Africa and Sinai, but in that particular case *A. scutellatus* is the larger of the two species (BAHA EL DIN 1996). Since *A. opheodurus* has only slight pectination on toes and fingers and is less dependent on the

sandy substrate, we can tentatively conclude that in the studied locality east of Al Hazim it is a species inhabiting the hardened substrate between areas covered with sand. Dunes are then occupied by two psammophilous species: the larger *A. schmidti* and the smaller *A. hardyi*. However, the exact ecological requirements of the individual species of *Acanthodactylus* in Jordan and the forces controlling the co-existence of three species at one particular site are awaiting future investigation.

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Authors' addresses: Lina Rifai, Department of Biology, 139, Life Science Bldg., University of Louisville, Louisville, KY 40292, USA. – Prof. Dr. Zuhair S. Amr, Department of Biology, Faculty of Sciences, Jordan University for Science and Technology, P.O. Box 3030, 22110 Irbid, Jordan. – Dr. David Modrý, Department. of Parasitology, University of Veterinary & Pharmaceutical Sciences, Palackého 1-3, 61242 Brno, Czech Republic, and Institute of Parasitology, Academy of Sciences of the Czech Republic, České Budějovice, Czech Republic. – Petr Necas, Sportovní 11, 60200 Brno, Czech Republic. – Corresponding author: D. Modry. E-mail: modryd@vfu.cz.