



REVISION OF THE GENUS *HEMIDACTYLUS* (SQUAMATA: GEKKONIDAE) IN IRAQ WITH DESCRIPTION OF A NEW SPECIES FROM CENTRAL IRAQ

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Abstract

Most of the *Hemidactylus* species are morphologically similar. There are few characters that can rely upon in the separation, except a few species like *H. flaviviridis*, so the scientists relied on molecular studies for separation. In this study, the authors found clear characters and variation in the Baghdad collection of *Hemidactylus*, easily distinguish, depending on morphological characters. This study includes the updated list of *Hemidactylus* species recorded in Iraq, with re description of a new form of Gekkonidae, *Hemidactylus bornmuelleri*, the authors believed it is a valid name from Baghdad city, central Iraq, we gave it *bornmuelleri*, because Werner (1895) discovered it from Baghdad, but later the authors considered it as a synonym of *Hemidactylus persicus* Anderson. We improve that it is a separate and clear species, although it is one of *H. persicus* species group. *Hemidactylus dawudazraqi* also added to Iraqi list of *Hemidactylus*. A key to the species, with notes on variation, ecology and distribution in Iraq were provided.

Key words: Baghdad, *bornmuelleri*, *dawudazraqi*, gecko, *Hemidactylus*.

Introduction

The genus *Hemidactylus* Oken, 1817 is one of the important genera of Gekkonid Lizards. There are more than 145 known species belong to this genus (Sindaco *et al.*, 2009, Hosseinzadeh *et al.*, 2014, Šmíd *et al.*, 2015). In one study Carranza and Arnold (2012) discovered eight new species from Oman. Anderson (1974) in his list of Iranian lizards gave five species. Hosseinzadeh *et al.* (2018) discovered the species *H. romeshkanicus* from southern Zagros Mountains, west of Iran. Previous studies recorded only three species: *H. flaviviridis* Ruppell 1835, *H. persicus* Anderson, 1872, and *H. turcicus* (Linnaeus 1758) to be found in Iraq (Khalaf, 1959, Nader and Jawdat, 1976, Arnold 1986, Leviton *et al.*, 1992). While Disi *et al.* (2001), Lahony *et al.* (2002) and Modry *et al.* (2004) listed two *Hemidactylus* species for Jordanian fauna. But because of complex biogeography within its arid clad of Asia, Africa and Arabia many different neo

taxa described depending on phylogenetic and genetic study. Moravec *et al.* (2011) discovered another species of *Hemidactylus* from Azraq in eastern Jordan. Most of these new species have no clear morphological difference, they are about to be sibling species. Recently Safaei-Mahroo *et al.* (2017) described a new species *H. kurdicus* from Qara Dagh Mountains, southeastern Sulaymaniyah province, northeastern Iraq depends on Morphology and genetic study, also Moravec *et al.* (2011) refers to *Hemidactylus robustus* Heyden, 1827 as one of the Iraqi *Hemidactylus* but as far as the authors know this gecko was not recorded before in Iraq. Reed and Marx (1959) worked in the north east of Iraq without mention any *Hemidactylus* species. In this study, the authors discover a new species in central Iraq depending on clear morphological characters. In the same type locality of *H. bornmulleri* WERNER 1895.

Material and Method

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A total of eight specimens has been collected from Baghdad, deposited in INHRCM with numbers (371INH, 378-380 INHM from Baghdad, Apr. 2018), (378-380. INHM, from Baghdad, Oct. 20. 2019). Four more specimens from stock collection of INHRCM with numbers (4-7, Baghdad, 1959). We used a free hand and sticky glue of mice hunting for capturing geckos (We put little sticky glue on a piece of carton close to light source leave it overnight). Dissecting microscope used for identification and digital camera used for taking photos. Photographs taken before and after preservation. The specimens were compared with those of INHRCM and with literature, especially for *H. robustus* and *H. persicus*. Because we did not have collections. The most important characters we depend for classification Sn.v. length, tail length, shape and number of dorsal scale and tubercle, upper and lower labial, anal pores, sub digital lamella. Cloacal tubercle, front head scale, and dorsal color pattern. All measurements in millimeter were taken by caliper and a plastic ruler.

The genus *Hemidactylus* in Iraq still required more systematic study to solve all taxonomic problems in identification of the species. The specimens of our new form collected from Baghdad city, central Iraq. *Hemidactylus bornmuelleri* sp. n. was discovered by Werner 1895 but then the researchers considered it as a synonym of *H. persicus* Anderson 1872. In the present study the authors have improved that *H. bornmuelleri* is not a synonym, it is clear a separate species depending on collections from Baghdad, central Iraq the same type locality of *H. bornmuelleri* WERNER 1895.

***Hemidactylus bornmuelleri* sp.n.**

Homotype: (Fig.1, 2a & 2b) Mus. No. (368, INHRCM). Adult male, collected on 21 April, 2019. Type locality: INHRCM, Bab Al-Muadham, Baghdad city, central Iraq collected by the first author at day time. Two specimens, one juvenile and one sub-adult female from the same type locality, Mus. No. (378-380, IMNH). Three additional specimens from Taji, west of Baghdad city. Museum collection (4-7INH) which labeled as *H. persicus* used for confirmation.

Etymology: The authors gave the name *H. bornmulleri* honor the previous author Professor F. Werner 1895, who named this gecko, and to avoid controverters and critic about the synonym. The authors believed it is a valid name.

Measurements and coloration of Homotype:

Adult male. Snout vent (Sn.v.) length 65mm. Tail short regenerated, Head length 15mm. Head width 11mm.

Dorsal color in life is brown with 9 pairs of dark zigzag band, the dark band continues to dorsal of the tail. There is a dark brown stripe the side of the head, started from the snout and pass through the eye to ear and nape. V shaped light mark on the front of the head.

Diagnosis: *Hemidactylus bornmuelleri* sp.n. is uniquely among *H. persicus* species group, in having cloacal tubercles in male, rostral divided, mixed small and enlarged sub caudal scales and dorsal color pattern. Dorsal tubercle large made of a mixture of flat smooth and conical white and dark, on the side larger than mid dorsal tubercle and small granules. Keeled and smooth large and small imbricate scales and series of small pointed tubercle arranged in a ring on the dorsal surface of the tail more or less segmented four scales between each segment. Sub caudal one head length behind vent enlarged plate-like.

Description:

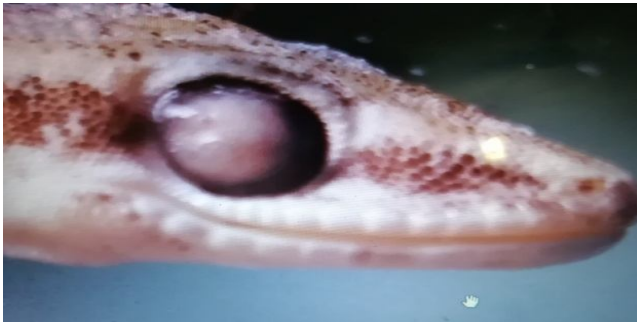
Head triangular, its length from snout to ear opening 15 mm. head width 11mm., rostral divided (Fig. 2a). Nostril bordered by three small nasals, first labial and rostral. The eyelid fringed cover above with small pointed spine scale. A few small tubercle on the nape. Top of the head with small smooth and keeled granules a series of 11 smooth scales on canthus rostralis, the ear-opening large directed toward the eye, a fold from the angle of the ear to shoulder. 12 supra labial, first one contact with nostril. 11 infralabials labials, (Fig. 2a) triangular mental scale. Two pairs of enlarged post mental, first pair contact behind mental shield. Dorsals covered by smooth, keeled tubercle in different size and shape, in 16 rows mixed with small granules, the upper surface of the tail covered by keeled imbricate scales, a series of small tubercles on the dorsal side of the tail forming a terminal ring. Sub caudal on the head behind vent enlarged plate-like. The lateral tubercle white in colour. Mid dorsal tubercle smaller, dark brown. Ventral white with smooth imbricate scale 8 anal pores present, 4 cloacal tubercle is present at the base of the tail (Fig. 2b). Sub caudal scales are a mixture of large



Fig. 1: *Hemidactylus bornmuelleri* sp. n. homotype. Mus. No. (368.INHM) Locality central Baghdad Iraq. Preserved in 75% ethanol.

and small smooth scale. Digits expanded clawed toes with lateral feebly fringed and regular lamellae divided or undivided 7 pairs of lamellae under the first toe and 12 on the fourth toes. Variations were given in (Table 2).

A



B



Fig. 2: *Hemidactylus bornmuelleri* sp. n. Homotype, Mus. No. (368.INHM)
A- Side of the head.
B- Ventral view showing preanal pore and cloacal tubercle.

Table 1: Morphological differences (morphometric and meristic) and measurements of known species of the genus *Hemidactylus* in Iraq.

Character	<i>H. persicus</i> J. Anderson ,1872	<i>H. turcicus</i> (Linnaeus, 1758) = <i>H.</i> <i>dawudazraqi</i> Moravec <i>et</i> <i>al.</i> 20011	<i>H.</i> <i>flaviviridis</i> Ruppel, 1840	<i>H.</i> <i>Kurdicus</i> Safaei- Mahroo, Ghaffari, Ghafoor Amimi, 2017	<i>H.</i> <i>robustus</i> , Heyden, 1827	<i>H.</i> <i>bornmuelleri</i> sp. n. Homotype adult male
Sn.v.	46-58	42	78	40.	44-54.6	65mm.
Sub mental	2	2	2	Single pair	2	2
Supra labia	10-12	10	11	11	8-9	12
Infra labials	8-10	8	9	9	7-8	11
Preanal pores	9 11	6	Femoral pores only	8 10	5 8	8
1 st toe lamellae	8-11	7	10	9-10	6	7
4 th toe la.	12-14	10	12	13	10-9	12
Dorsal tubercle	14-16	14	No dorsal tubercle	14-16	16	16
Sub-caudal	Enlarged	Enlarged	Enlarged	Enlarged	-	Mixed large and small
Rostral	Undivided	Undivided	Undivided	Undivided	Undivided	Divided
Cloacal tubercle	x	x	x	x	x	3

Habitat: Old houses and garden trees. Active at night, feed on insects and spiders.

Distribution: Type locality in central Baghdad city. Paratype, Baghdad and Taji, western Baghdad, maybe its distribution extends to the south of Iraq. *H. kurdicus* population Kurdistan northeastern of Iraq, *H. persica* in the south of Iraq, *H. turcicus* in the western desert, *H. flaviviridis* from north to south of Iraq, and *H. robustus* (unknown).

-*Hemidactylus dawudazraqi* Moravec *et al.* (2011)

Hemidactylus turcicus (Linnaeus, 1758)

Depending on a single specimen collected from Rutba west of Iraq 1991. Close to Azraq, east of Jordan Type locality of *H. dawudazraqi*. The authors listed it within Iraqi *Hemidactylus* as a new record for this species in Iraq. All the characters as shown in (Table 1) fit with Jordanian collection of *H. dawudazraqi*. It is an endemic species in Baghdad (Table1).

The previous authors believed that *H. bornmuelleri* is a synonym of *H. persicus* (Khalaf, 1959, Nader and Jawdat, 1976, Leviton *et al.*, 1992, Castilla *et al.*, 2013, Safaei-Mahroo *et al.*, 2017). In the new collection of INHRCM the authors discovered many characters in collected specimens sharing with *H. persicus* and differ in rostral, cloacal sacs and tubercle and lamellae of first toe Anderson, 1872 with *H. turcicus* L. 1840 in the number of first toe lamellae and differ in longer nails and tail shape divided rostral and presence of cloacal tubercle. Even sharing with *H. inintellectus* of Sindaco *et al.* (2009) from Socotra Island, Yemen in few characters

like subcaudals. Nader and Jawdat (1976) stated that Baghdad collections of *Hemidactylus* are (*H. turcicus*) and *H. flaviviridis*, the present collection quite differ from *H. turcicus* complex in tail structure, in divided rostral and presence of cloacal tubercles supra and infra labial, and also differs from *H. persicus* for the same mentioned reasons and in lamellae number and presence of small lateral fringes of toes lateral fold of rars. Rastegar-pouyani *et al.* (2008) believed that all Iranian *Hemidactylus* refer to *H. robustus* Heyden, 1827 (Torki *et al.*, 2011). While Šmíd *et al.* (2015) in their study on phylogeny of *H. robustus* said that distribution cannot reach Iraq or north Arabia. We agree with Šmíd *et al.* (2015). The

Table 2: Variations within the species in *H. bornmuelleri* sp. n. of Baghdad

Locality	Central Baghdad	10 km. western Baghdad	Central Baghdad
T.L.	55 regenerated	65	54-53
Sn.v.	65	60	50-49
4 th toe lamella	12	14-12	11-12
1 st toe lamella	7	8-9	7-8
Supra/infra -Labials	12/11	12-13/11	12-13/10-11

new form differs from *H. robustus* in presence of cloacal tubercle, divided nasal and in supra and infra labials and caudal scales.

Identification Key for updated Iraqi Known species of the genus *Hemidactylus* Oken, 1817.

- 1a. Adult male 65 mm. rostral divided, cloacal tubercle and pronounced, toes feebly fringed less than 8 lamellae under first toe, 10 supra and 11 infralabials, sub caudal heterogeneous (small and large scale) *Hemidactylus bornmuelleri*
- 1b. Rostral not divided no cloacal tubercle, enlarged sub caudal.....2
- 2a. No enlarged dorsal tubercle. No preanal pore only femoral pores present *H. flaviviridids*.
- 2b. Enlarged dorsal tubercle preanal pores present3
- 3a. One pair of enlarged post mental mostly not contact with each other, 9-10 lamellae under the 1st toe *H. kurdicus*
- 3b. Two pairs of enlarged post mental, the first pair in contact.....4
- 4a. Less than 8 lamellae under 1st toe. nail short. Tail thick tapering at the end snout vent less than 42 mm. *H. turcicus* complex
- 4b. More than 8 lamellae under 1st toe. Snout vent more than 45 mm. *H. persicus*
- 4c. Less than 8 lamellae under 1st toe. Snout vent 54.6. snout convex. 9 supra and 8 infralabial..... *H. robustus* (?)

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Abbreviations: Fig. = Figure, INHRCM = Iraq Natural History Research Center and Museum, University of Baghdad, No. = Number, Sn.v. = Snout vent length, T.L. = Tail length, mm. = Millimeter, Km. = Kilometer.

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