Filling the gap of whip spider distribution in Asia: *Phrynichus persicus* sp.n. (Arachnida, Amblypygi), a new Phrynichidae from Iran

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Abstract

The whip spider genus *Phrynichus* (Phrynichidae, Amblypygi) is widely distributed in Africa, the Arabian Peninsula and Asia with a total of 17 species. No records, however, are known from several countries in the Middle East. Here we provide the first record of a whip spider from Iran (Ilam Province), with the description and illustration of a new species, *Phrynichus persicus* sp. n. This discovery fills a gap in the distribution of the group that is known from both sides of this biogeographically interesting region and is also the northernmost record of the family Phrynichidae. Moreover, all distribution records of the *Phrynichus* species are mapped (including the first verified record of the order from the United Arab Emirates), an updated key to the species of the *deflersi* and *ceylonicus* groups is provided, and *Phrynichus andhraensis* Bastawade, Rao, Maqsood Javed and Krishna, 2005 (India) is assigned to the *ceylonicus* group.

Key words: Ilam, Middle East, new species, tailless whip scorpions, taxonomy, Zagros Mountains

Introduction

Whip spiders (Amblypygi) are tropical and sub-tropical arachnids characterized by a flat body, strong raptorial pedipalps and extremely elongate first pair of legs (antenniform legs) (Weygoldt 2000). The order has around 220 species in five families which are commonly found in leaf litter or on tree trunks of forests, inside caves and even in humid micro-habitats of urban areas (Giupponi & Miranda 2016; Miranda et al. 2018a; Miranda & Giupponi 2011; Miranda et al. 2016).

Amblypygids have a considerable large body length, ranging from less than 1.0 cm (family Charinidae Quintero, 1986) to more than 4.0 cm (family Phrynichidae Simon, 1900 and Phrynidae Blanchard, 1852) (Giupponi & Miranda 2016; Weygoldt 1998, 2000). The pedipalps are the structures that give amblypygids their unique mien, and, as whip spiders continue to molt and grow after reaching sexual maturity (Weygoldt 1995; Weygoldt & Hoffmann 1995), the pedipalps can reach the length of 20.0 cm when unfolded (Miranda et al. 2018b; Weygoldt 1998, 1999). The sometimes disproportional pedipalp size between females and males is very likely a result of sexual selection (McArthur et al. 2018).

Phrynichidae is the third most diverse family of Amblypygi (after Charinidae and Phrynidae), with 35 recognized species in seven genera, distributed in Africa, the Arabian Peninsula, Middle East and Asia, with one species also known from the Neotropics (Mello-Leitão 1935; Miranda et al. 2018b; Weygoldt 1998). With 17 species, the genus *Phrynichus* Karsch, 1879 is the most diverse within the family, which also has the widest distribution (Miranda et al. 2018b; Weygoldt 1998).

The species of *Phrynichus* can be recognized by the unique combination of palpal patella with three primary dorsal spines shifted to the distal end together with the tarsus forming a prehensile pincer (or “hand”), the presence of two small tubercles above the cleaning organ on palpal tarsus, basitibia of leg IV undivided, and the presence of ventral sacs with well-developed covers (Weygoldt 1998, 2000). Within the 17 *Phrynichus* species, two groups are recognized (Weygoldt 1998): the *P. deflersi* species group and *P. ceylonicus* species group. The first is
characterized by the presence of spine-like projections on the anterior region of the carapace, ventral to the lateral eyes and above the external margin of the chelicerae; the second group lacks the spine-like projections on the carapace, but can be diagnosed by the dorsal row of clavate setae on the median surface of the chelicerae (Weygoldt 1998, 2000). Species of these groups are distributed from south to northeast Africa, Arabia, over the islands Madagascar, Mauritius, Seychelles to Sri Lanka and India, and finally reaching Thailand, Cambodia, and Malaysia (Weygoldt 1998).

In this paper we describe and illustrate the first whip spider species from Iran, *Phrynichus persicus* sp.n., which fills a gap in the distribution of the order. The closest record of a phrynichid from the locality of *P. persicus* sp.n. is *Phrynichus jayakari* Pocock, 1894 from the United Arab Emirates (Fujairah Wadi Wurrayah National Park, new record), with a distance of around 1200 km. This shows that the absence of records in the surrounding countries is a combination of lack of collecting efforts and biogeographic history (explored further in the discussion).

**Material and methods**

The studied specimen was examined using a Leica M10 stereo microscope and photographed with GIGAmpic Macro Magnify2 (http://www.gigamacro.com/gigapixel-macro-imaging-system/) and Leica MZ16A stereo microscope attached to a Canon 5D and a camera lucida (for drawing), at the National Museum of Natural History, Smithsonian Institution (USA). The holotype is deposited at the Senckenberg Museum, Frankfurt am Main, Germany (SMF). Other studied *Phrynichus* specimens are deposited at the Stuttgart State Museum of Natural History (SMNS).

Measurements and nomenclature follow Quintero (1981) and Weygoldt (1998) in general. The terminology of pedipalp and leg segments follows Harvey & West (1998) and that of the male genitalia follows Giupponi & Kury (2013). The spines of the palpal patella and teeth of the chelicerae were counted from the apex to the base. The measurements of pedipalp articles were taken between the external condyles of each segment in order to establish fixed points and proper length measurements (Baptista & Giupponi 2002). Comparisons with some of the *Phrynichus* species was based in the literature, such as Bastawade (1995); Weygoldt (1996, 1998, 2003); Weygoldt et al. (2002); Whittick (1940). The map was created using ArcGis 10 (ESRI 2014). Localities and coordinates were taken from Bastawade et al. (2005); Maquart et al. (2016); Weygoldt (1998, 2003, 2009); Weygoldt et al. (2002) and Siegfried Huber (Oberuhldingen, Germany, pers. com.). When coordinates were not provided, the localities were georeferenced with Google Earth.

Abbreviations used in the text: bt basitibial, Fi fistula, LaM lamina medialis, LoD lobus dorsalis, LoL1 lobus lateralis primus, LoL2 lobus lateralis secundus, PI processus internus, sbc sub-basocaudal, sc sub-caudal, sf sub-frontal.

**Comparative material analyzed**

*Phrynichus ceylonicus* (C.L. Koch, 1843): Sri Lanka, ca 250 km sud-ostl. Colombo, ca 75 km ost Tatnapura Belliluhoya, 6 43.087'N 80 46.032'E, 07.v.2004, ca. 640, S. Huber leg., P. Weygoldt det. (1 male, SMNS GSM136; 1 female, SMNS GSM143); Sri Lanka, Sigiriya, G.S. Miranda det. (1 male, SMNS GSM9); Sri Lanka, Kirindi Ella Falls, iv. 2001, G.S. Miranda det. (1 female SMNS GSM3);

*Phrynichus cf. ceylonicus* (C.L. Koch, 1843): Sri Lanka, Hiniduma, Galle District, an einer Steinmauer, x.1993, P. Hoffman leg., P. Weygoldt det. (3 females, SMNS GSM89);

*Phrynichus deflersi arabicus* Weygoldt, 2003: Saudi Arabia, Zi Ayn (Marbled Village), about 10km SW Al Baha, N19 55.780' E41 26.47', in wall along stream, 12.iv.2002, 760m, P. Weygoldt & S. Huber leg., P. Weygoldt det. (1 male, 1 female, SMNS GSM3, paratypes);

*Phrynichus dhoifarensis* Weygoldt, Pohl & Polak, 2002: Oman, Dhofar, Eyn Razat, N17 07' 776", E54 14' 238", 06.x.2000, P. Weygoldt & S. Huber leg., P. Weygoldt det. (1 male, 1 female, SMNS GSM140);

*Phrynichus orientalis* Weygoldt 1998: Thailand, Kanchanaburi Prov., Tham Wang Badan Cave, ca. 70km westlich v. Kanachanaburi (ca. 130km westl. Von Bangkok), 24.xii.2003, S. Huber leg., P. Weygoldt det. (1 male,
NEW PHRYNICHUS FROM IRAN

results

taxonomy

Amblypygi theorell, 1883
Phrynichidae simon, 1900
Phrynichus karsch, 1879

Phrynichus persicus sp. n.

Figs 1D–5

Holotype. IRAN: Ilam province: Dehloran county, near the border with Mehran county, surroundings of Changuleh [33°0'49.37"N 46°36'38.63"E, approximate coordinates], unnamed cave, 12.vii.2013, A.H. Aghaei leg. (male, SMF)

Etymology. The specific epithet is a masculine Latin adjective of Persian or of Persia, referring to the historical region of the Middle East, located in the east of Mesopotamia (nowadays Iran), and to the remarkable first record of a whip spider to this country.

Common Name: We propose Persian Whip Spider (in Persian: Ankabūt-e Šallāqī-ye Pārsī) as a common name

Diagnosis. Phrynichus persicus sp. n. can be recognized by the presence of two weakly clavate setae ventrally on the basal segment of chelicerae (Fig. 3C), the flat upper tooth on external side of the basal segment of the chelicerae (Fig. 3B), the presence of one trichobothrium on sbc (distitibia IV; Fig. 5) and the pair of short and narrow projections close to the inner side of LoL2 on the male genitalia (Fig. 4A, B). Phrynichus persicus sp. n. can be distinguished from all species of the ceylonicus group by the presence of spine-like projections on the carapace (ventral to the lateral eyes) and can be separated from all species of the deflersi group by the above mentioned characteristics.

Description (Male). Carapace (Fig. 2A): flattened, wider than long (1.7 times), with an acute small projection ventral to the lateral triad of eyes; thin median furrow reaches the fovea starting from the median eye tubercle. Anterior margin straight, with a row of small setae and a short setiferous tubercle; a pair of shallow depressions close to the lateral projections of the carapace. Frontal process large, sub-triangular, with a carena V-shaped close to its tip, visible from above. Three pairs of shallow furrows on the lateral side of the carapace, and a deep triangular fovea. 1st pair of furrows placed just behind the lateral boss, converging to the fovea. Median eyes and tubercle present, well developed; a pair of small setae on its top. Lateral eyes well developed, pale colored, one small seta behind each triad of eyes; lenses directed upwards and anteriorly.

Sternum: tetr-segmented, all pieces well sclerotized. Tritosternum with an oval basis and projected anteriorly in a big blunt tubercle, greatly surpassing the base of the pedipalp coxae, with several thin and thick setae from the base to apex; apex with two thick and long setae. Middle piece (tetristernum) wider than long, with several small setae. Third piece (pentasternum) slightly narrower than tetrasternum, with several small setae. Stermites separated from each other by half the length of the third piece. Metasternum with a pair of short and thin setae proximally, close to the border with the membrane region, and two pairs of setae distally on the apex of a bulging area.

Abdomen (Fig. 2A): oblong, with almost indistinguishable punctuations. Tergites covered with several small rhombus tubercles, with a pair of thin and short setae on the posterior-lateral border of the sternites. Ventral sac cover well developed. Fi with wrinkled surface (Fig. 4A, B); external lateral border of Fi curved converging (like in Trichodamon Mello-Leitão, 1935; Fig. 4A, B); LoD curved converging (Fig. 4A, B); the structures projecting from the apex of Fi not telescoped (Fig. 4A, B); LoL1 unarmed, but wrinkled (Fig. 4A, B); LoL2 with a pair of short and narrow projections close to the inner side of the structure; PI straight; LaM separated (Fig. 4A, B).

**Chelicera** (Fig. 3A, B, C): Cheliceral furrow with three internal (prolateral) teeth (Fig. 3A); first tooth (upper) bifid, proximal cusp slightly larger than the distal cusp. Second and third teeth long and curved; second tooth half the third. One bicuspidate tooth on the external row of the basal segment, the upper flat. Mesal face with an oblique row of two long and thick setae, with some smaller and thinner dorsal to them in both chelicera (Fig. 3A, C). Several setae on dorsal border of basal segment with prominent (projected) sockets (Fig. 3A). Cheliceral claw with a row of setae on the ectal side from the base until close to the apex (dorsal side) and on the mesal side (Fig. 3B). Eight setae scattered between the two rows of setae on the cheliceral claw. Claw with 5 denticles (Fig. 3B).

**Pedipalp** (Fig. 2B): **Coxa**: in dorsal view with a triangular carena with around five small setae on its frontal border. **Trochanter**: dorsal-frontal border with a carena bearing a series of tubercles and a small spine on the external border; a series of spines following the external border from dorsal to ventral; frontal face of the segment glabrous and unarmed until its middle, where several series of setiferous tubercle and spines are present; large ventral spine, located in the posterior border of the trochanter; spine with a few short setae and a long/thin setae close to the tip of the spine; two subequal spines, one at about the center of the anterior row of setiferous tubercles, and the other at the posterior border, above the ventral spine. **Femur** (Fig. 2B, E): five dorsal spines in the main series, decreasing in size; one prominent spine between spine 1 and trochanter, two thirds spine 1; several short spines between the spines of the main series, with two prominent between spines 1 and 2, three prominent between spines 2 and 3, four prominent between spines 3 and 4, and two to three prominent between spines 4 and 5; four ventral spines in the main series, decreasing in size; several short spines between spines of the main series, with one prominent between spines 1 and 2, two prominent between spines 2 and 3, and two prominent between spines 3 and 4. **Patella** (Fig. 2B, D): four dorsal spines; first and second spines subequal, third slightly shorter; the first three spines close to each other in the apex of the patella forming, with the other spines on the phrynichid hand (Weygoldt 1995, 1998); fourth spine longer than a setiferous tubercle; three ventral spines in the main series decreasing in size, second half the size of the first, third a bit longer than a setiferous tubercle; one spine between spine 1 and tibia, thicker and shorter than spine 1, curved forward. **Tibia** (Fig. 2B): two dorsal spines, one long (more than half the size of the article), close to the middle of the article, pointing forwards, and one short, between the long spine and the patella; this spine is curved backwards; one lone ventral spine, half the size of the article, pointing forwards; a row of five wide setiferous tubercle is placed from the base to the middle of the spine. **Tarsus**
FIGURE 2. Habitus and details of the pedipalp of *Phrynichus persicus* sp.n. A. Dorsal habitus. B. Dorsal view of left pedipalp tarsus; s = spines. C. Ventral view of left palpal trochanter and proximal femur spines. D. Ventral view of spines of left palpal patella. E. Dorsal view of left pedipalp. Scale bars: A, B, 5.0mm; C, D, E, 1.0mm.
**FIGURE 3.** Chelicera of *Phrynichus persicus* sp.n. **A.** Mesal view of left chelicera. **B.** Ectal view of cheliceral claw and teeth of the basal segment. **C.** Detail of the setae on the basal segment of chelicera. Scale bars: **A, B**, 1mm; **C, 0.5mm.**

+ **claw** (Fig. 2C): with two short spines dorsal the cleaning organ; with several long and thin setae with apex flat and rugged. Cleaning organ about half of the article length; ventral row of the cleaning brush with 19 setae (in both palps); invagination of the attachment rod of the tarsal adductor muscle present anterior to the cleaning organ.

**Legs** (Fig. 2A): All setose and with acute tubercles. Ventral corner of the prolateral face of femora II–IV projecting in a distinct spiniform process. Femora length: I>III>II>IV. Tibia I with 32 articles (both legs). Tarsus (basitarsus+distitarsus) I with 72 articles (both legs).

**Leg IV** (both legs): **Basitibia:** undivided; trichobothrium bt on the distal third (Fig. 5). **Distitibia:** five proximal and 36 distal trichobothria (total of 41); **sbc** with one trichobothrium and frontal series with four trichobothria; **sf** with 15 and **sc** with 16 trichobothria (Fig. 5). **Tarsus:** without white ring in distal part of first article of distittarsus IV.

**Measurements** (in cm): Carapace: length 0.6, width 1.0. Pedipalp: Femur 3.0, Patella 3.0, Tibia 0.4, Tarsus+claw 0.3. Leg I: Femur 2.4. Leg IV: Femur 2.6, Basitibia 1.5, Distitibia 0.9, Basitarsus 0.1, other tarsal articles 0.1.

**Color Pattern (alcohol preserved material)** (Fig. 1D, 2A): Carapace, chelicerae and pedipalps dark brown. Abdomen and legs yellowish–brown.

**Female:** Unknown.

**Distribution.** *Phrynichus persicus* is currently known only from the type locality, which is the northernmost global record of the family Phrynichidae (Fig. 6). It is worth mentioning that the presence of another amblypygid genus, *Charinus* Simon, 1892 in the Arabian Peninsula (e.g. *Charinus omanensis* Delle Cave, Gardner and Weygoldt, 2009) and in Pakistan (*Charinus pakistanus* Weygoldt, 2005) suggest that there might be species of this genus occurring somewhere in southern Iran, but no records have been made so far (Harvey 2013).
Life history and habitat preferences. The single specimen was collected in a natural, limestone karst cave with two small entrances and two large passages, with its highest walls reaching a height of about 16 meters, and occupying a total area of about 2000 m$^2$, with the substrate covered with a layer of bat guano. The mean temperature of this hot and humid cave is quite constant during the year, ranging between 20–25°C, with mean humidity of 60–70%. Other inhabiting animals of this cave include a colony of Trident leaf-nosed bat (Asellia tridens), two species of geckos (Asaccus elisae, Hemidactylus robustus), unidentified species of huntsman spiders (Sparioelenus sp.) and roaches (Blattodea). It is noteworthy that this cave was visited by the collector for three times: the first lead to the finding of the holotype, while during the second visit (June 6, 2014) a juvenile was observed but not collected, and in the third visit (January 15, 2015) no specimens were observed at all. It is possible that this species has a very restricted range and extent of occurrence, and might already be threatened by habitat loss and destruction of subterranean ecosystems.

**FIGURE 4.** Male gonopod of Phrynichus persicus sp.n. A. Ventral view. B. Detail view of the left side. Fi fistula, LaM lamina medialis, LoD lobus dorsalis, LoL1 lobus lateralis primus, LoL2 lobus lateralis secundus, Pl processus internus. Scale bars: A, B, 0.5mm.

Updated key to the species of the Phrynichus deflersi species group (modified from Weygoldt et al. (2002))

1. Pedipalp tibia dorsal with one long spine plus a smaller spine or tubercle. ................................................................. 2
1'. Pedipalp tibia dorsal with one long spine only (Weygoldt et al., 2002, fig 19). ................................................................. Phrynichus heurtaultae Weygoldt, Pohl and Polak, 2002

2. Pedipalp tibia dorsal with one long spine and a tubercle only ................................................................................. 3
2'. Pedipalp tibia dorsal with one long spine, plus a smaller spine and a tube (Weygoldt, 1998, fig. 32). ................................................................. Phrynichus spinitarsus Weygoldt, 1998

3. Adult specimens without distinct pattern and leg annulations ...................................................................................... 4
3'. Adult specimens with a distinct color pattern and annulated leg femora ................................................................. 6

4. Tarsus I with less than 74 articles ................................................................. Phrynichus jayakari Pocock, 1894 (Fig. 1C)
4'. Tarsus I with more than or equal to 74 article. ................................................................. Phrynichus dhofarensis Weygoldt, Pohl and Polak, 2002 (Fig. 1B)

5. Pedipalp patella spine III (ventral) well developed in adults; basal segment of chelicerae with oblique row with four clavate setae in the female and five in the male; sbe on distitibia IV with 3–4 trichobothria. ................................................................. Phrynichus madagascariensis Weygoldt, 1998
5'. Pedipalp patella spine III (ventral) completely reduced in large animals; basal segment of chelicerae with oblique row with two weakly clavate setae in the male; sbe on distitibia IV with one trichobothrium. ................................................................. Phrynichus persicus sp.n. (Fig. 1D)

6. Ventral row of chelicerae with clavate setae on inner or median surface distinct. ................................................................. Phrynichus deflersi Simon, 1887 (Fig. 1A)
6'. Ventral row of chelicerae with clavate setae indistinct, hidden among smaller setae; the apices of the female genitalia pointing posteriorly; pedipalp trochanter and femur with long, conspicuous setae; large animals. ................................................................. Phrynichus madagascariensis Weygoldt, 1998

7. Female genitalia sclerotized and dark; pedipalp trochanter and femur without long conspicuous setae; tibial spine III reduced to a tubercle in large animals; medium sized animals. ................................................................. Phrynichus deflersi Simon, 1887 (Fig. 1A)
Female genitalia with non-sclerotized and white medial walls; pedipalp tibia spine III well developed; number of femoral spines higher in large specimens; very distinct color pattern and annulated leg femora. 

\[ \textit{Phrynichus gaucheri} \text{ Weygoldt, 1998} \]

\textbf{FIGURE 5.} Basi- and distitibia of leg IV showing number and position of trichobothria. Right rectangle shows frontal series and left rectangle shows caudal series of trichobothria. Scale bars: 1mm.
Updated key to the species of the *Phrynichus ceylonicus* species group  
(modified from Weygoldt (1998))

1. Pedipalp patella spines 3 and III are reduced completely or to tiny tubercles in large specimens  
1'. Pedipalp patella spine 3 is retained even in large specimens  

2. Female gonopod soft, white cushions the anterior or proximal walls of which are surrounded by strong sclerotization; row of cheliceral setae on the inner side of basal segment poorly developed, surrounded by many small setae  
3. Female genitalia forming pointed tooth-like structures  
3'. Female genitalia forming rounded, heavily sclerotized structures  

4. Large or medium sized animals; only the largest with tibial spines 3 and III reduced to small tubercles; trichobothrial row *sbc* with four to five setae  
5. Femur even in large specimens with sharp spines  
6. Tarsus I with more than 70 articles  
7. Tibia I with 31 and tarsus I with 71 articles  
8. Male gonopod fistula in dorsal view slightly gaping (Weygoldt 1998, figs 80, 91)

*Phrynichus scaber* (Gervais, 1844)  
*Phrynichus ceylonicus* (C. L. Koch, 1843)  
*Phrynichus pusillus* Pocock, 1894  
*Phrynichus nigrimanus* (C. L. Koch, 1848)  
*Phrynichus exophthalmus* Whittick, 1940  
*Phrynichus andhraensis* Bastawade, Rao, Javed & Krishna, 2005  
*Phrynichus longespina* (Simon, 1936)  
*Phrynichus longespina* (Simon, 1936)  
*Phrynichus longespina* (Simon, 1936)  
*Phrynichus longespina* (Simon, 1936)
Discussion

Whip spiders are widely present in tropical and subtropical regions, but still large gaps in the distribution of the group are observed. The African continent and Asia, for example, have enormous areas where amblypygids are unknown and their absence is clearly due to a lack of collecting effort (Weygoldt 1998, 1999). African and Asian whip spiders are conspicuous animals that bear long pedipalps and inhabit mainly humid caves, a way of protecting themselves from the arid surrounding environment (Weygoldt 1998). Therefore, the exploration of caves generally reveal new populations of whip spiders and most of the times, new species (Baptista & Giupponi 2002; Baptista & Giupponi 2003; Giupponi & Miranda 2016; Vasconcelos et al. 2016; Vasconcelos & Ferreira 2016; Vasconcelos & Ferreira 2017).

Almost a third of the Iranian land area is covered by mountains, with the Zagros Mountains (a part of Alpine–Himalayan chain) covering the whole of the country, and the Alborz Mountains extending into northern Iran. The Zagros fold was formed during the Miocene (10–12 million years ago) after the collision of two tectonic plates, the Eurasian and the Afro-Arabian Plate (Mouthereau 2011; Sborshchikov et al. 1981). The Zagros Mountains play strong physical barrier against distribution of animals (Heidari et al. 2014) and the presence of species in caves west of this mountain can be the result of recent dispersal from the Arabian Peninsula or a much older distribution of a widespread population (Heidari et al. 2014). Due to the biogeographic history, high biodiversity and intense land use, those areas are considered as a potential biodiversity hot spots (Malek-Hosseini & Zamani 2017).

The speciation of Phrynichus species in Saudi Arabia, Iran, Oman and United Arab Emirates (UAE) might be linked with the uplifting of Zagros and Oman mountains, once prior to the formation of the Persian Gulf, these two mountain ranges were connected (Moradmand & Jäger 2011). These hypotheses still need verification by molecular dating and biogeographic studies with material from across the wide distribution known in the genus.

The closest region to Iran with Phrynichus whip spiders is the Arabian Peninsula, which has four species (P. jayakari, P. deflersi, P. dhofoarensis, P. gaucheri), all belonging to the deflersi group. This species group is characterized by the presence of lateral spine-like projections on the carapace and the presence of a ventral row of clavate setae on the basal segment of the chelicera (Weygoldt 1998). Phrynichus persicus sp.n. have both defining characters and is, therefore, included in the deflersi species group. The new species differs from all other species of the group due to the presence of only one trichobothrium on sbe and the presence of two ventral weakly clavate setae on the inner side of the basal segment of the chelicera.

The male genitalia of Phrynichus species is not well studied, but the male organ of P. persicus sp.n. resembles that of other species in the deflersi group with a known male genitalia (P. heurtaultae, P. deflersi, P. gaucheri, P. dhofoarensis, P. jayakari) and Trichodamon princeps Melo-Leitão, 1936 (Miranda et al. 2018b). Phrynichus persicus sp.n., however, has a unique shape of LoL2, with a pair of short and narrow projections close to the inner side of the structure.

Also belonging to the deflersi group, Phrynichus jayakari is currently known only from two localities in Oman, one in the south and one in the surroundings of Muscat in the north (Fig. 6) (Weygoldt 1998). A picture of a specimen similar to P. jayakari in the neighbor country United Arab Emirates was published by Hellyer & Aspinall (2005), but without a precise locality or mentions in the text. Here we provide the first verified record from U.A.E., on the basis of material photographed and collected by S. Huber: 1 male, 1 female, 2 juveniles; 25.v.2015, U.A.E., Fujairah Wadi Wurrayah National Park, Wadi Al Abadilah, perennial water, narrow Wadi (rocky) with palm plantation, N25°26′19″ E56°12′02″, 270m, S. Huber & L. Monod leg.

Phrynichus andhraensis was described from India by Bastawade et al. (2005), but was not included in any species group. As expected from its geographical position, P. andhraensis belongs to the ceylonicus species group, due to the presence of a dorsal row of strong and clavate setae and the absence of small lateral spine-like projections on the carapace (Weygoldt 1998). As result of the new placement of the species in the group, an updated key to the ceylonicus group is provided above.
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