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TAXONOMIC REVISION OF *Phrynocephalus arabicus* ANDERSON, 1984 COMPLEX WITH DESCRIPTION OF A NEW SPECIES FROM AHVAZ, SOUTH-WESTERN IRAN

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A revision of taxonomic structure of *Phrynocephalus arabicus* Anderson, 1984 complex is presented. *Phrynocephalus nejdensis* Haas, 1957 and *Phrynocephalus macropeltis* Haas, 1957 are considered as valid species, based on the morphological and genetic difference. A new species from south-western Iran, the Ahvaz plains is described. It differs morphologically from all other representatives of the species *Ph. arabicus* complex by body and tail proportions, dorsal coloration, undertail coloration and genetic characters.

Keywords: Squamata; Acrodonta; Agamidae; *Phrynocephalus* sp. nov.; south-western Iran; Ahvaz plains.

INTRODUCTION

Phrynocephalus arabicus Anderson, 1984 was described by John Anderson based on two specimens collected by James Theodore Bent expedition on the Hadramut plateau, Yemen (he went from Al Mukalla inland in the Hadramaut to Al Qatan where he stayed for a month) in 1893 – 1894 (Fig. 1). Georg Haas studied herpetological collections of John Gasperetti from Arabia (gifted to California Academy of Sciences in 1947) and described *Phrynocephalus nejdensis* Haas, 1957, from the northern Nejd desert, north-western Saudi Arabia and its subspecies *Phrynocephalus nejdensis macropeltis* Haas, 1957, from the Dhahran vicinity in the central part of the coastal eastern Saudi Arabia (Fig. 1). In 1967 Alan E. Leviton and Steven C. Anderson studied same Gasperetti's collections together with new materials of this collector from the Trucial States, Abu Dhabi (1964), and synonymized *Ph. nejdensis* Haas, 1957 and *Ph. nejdensis macropeltis* Haas, 1957 with *Ph. arabicus* Anderson, 1984. An isolated population of *Ph. arabicus sensu lato* from Iran was discovered in 1973 by Douglas Lay (S. C. Anderson, 1993), who collected a single specimen, and that was probably the only known specimen from Iran till now.

During 2008 – 2013 field work in Iran and Arabia we collected a series of all *Ph. arabicus sensu lato* representatives from different parts of its range (Fig. 1). And after visiting the California Academy of Sciences in 2013 and studying the type materials of J. Anderson and G. Haas, together with other extensive materials of *Ph. arabicus sensu lato* from Arabia, we were ready to make a taxonomic revision of this group that is presented herein.

Institutional abbreviations. ZISP, Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia; ZMMGU, Zoological Museum of the Moscow State University, Moscow, Russia; CAS, California Academy of Sciences, San Francisco, California, USA; BMNH, British Museum of Natural History, London, UK; HUJ, Hebrew University of Jerusalem, Jerusalem, Israel; MVZ, Museum of Vertebrate Zoology, Berkeley, California, USA.

MATERIAL AND METHODS

Type material studied. Syntypes of *Ph. arabicus* Anderson, 1984: BMNH 1946.8.28.33 (formerly BMNH

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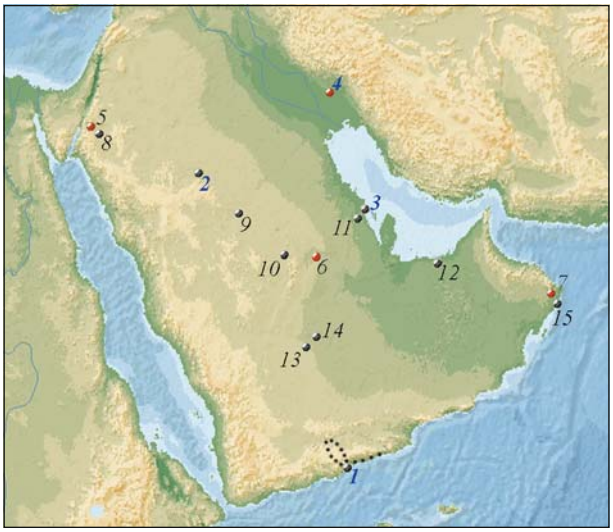

Fig. 1. Map showing type localities (blue numbers), localities for tissue sampling and specimens studied (red marks), and localities for specimens studied without tissue (gray marks) of *Ph. arabicus sensu lato*. Type localities: *1*, *Ph. arabicus*, Al Mukalla, Hadramaut plateau, Yemen (route of James Theodore Bent expedition shown by black dots); *2*, *Ph. nejdensis*, Qana, northern Nejd, northern Saudi Arabia; *3*, *Ph. nejdensis macropeltis*, Dhahran, eastern Saudi Arabia; *4*, *Phrynocephalus* sp. nov., Ahvaz, south-western Iran. Tissue samples: *5*, Wadi Ram, southern Jordan; *6*, Sahnah, 100 km south east of Riyadh, central Saudi Arabia; *7*, 50 km from Sur, northern Oman. Specimens without tissues studied: *8*, Al Mudawwara, southern Jordan; *9*, Riyad al Khabra, central Saudi Arabia (CAS 97585); *10*, 35 km N 75 km E Khashm Dalgan, central Saudi Arabia (CAS 113719); *11*, Abqaiq, eastern Saudi Arabia (CAS 183068 – 183077; 183076 and Paratypes of *Ph. n. macropeltis*); *12*, UAE, Abu Dhabi, 15 km radius circle (CAS 97814 – 97820); *13*, 95 km S, 69 km W Rayda water well, southern Saudi Arabia (CAS 119252); *14*, Rayda, southern Saudi Arabia (CAS 119190); *15*, Ash Sharqiyah Region, northern Oman (CAS 251008, 251022, 251023).

97.3.11.51) and BMNH 1946.8.28.34 (formerly BMNH 97.3.11.52). Holotype of *Phrynocephalus nejdensis* Haas, 1957: HUJ 2711 (by photographs from Leviton and Anderson, 1967). Holotype of *Ph. nejdensis macropeltis* Haas, 1957 CAS 84619 and forty three Paratypes: CAS 84262, 84263, 84278 – 84281, 84283 – 84285, 84287 – 84290, 84292, 84294, 84295, 84297, 84379 – 84387, 84421, 84432, 84437, 84479, 84484, 84485, 84502, 84510, 84513, 84536, 84542, 84543, 84545, 84547, 84617 – 84620 from Dhahran, Abqaiq, El Alat and Shimal, eastern coastal Saudi Arabia (Figs. 1 and 2).

Other material. Original material: *Ph. arabicus sensu lato* from: Ahvaz, Iran, 14 specimens (ZISP 25019 – 25023, 26645, 26646, 27088 and ZMMU R-12713/1 – 12713/6); Wadi Ram and Al-Mudawwara, Jordan, 8 specimens (ZISP 26641 – 26644, 27090 – 27093); 50 km from Sur, Oman, 1 specimen, obtained from the pet trade (ZISP 27089); Sahnah about 100 km south east of Riyadh, Saudi Arabia (ZISP TS 2540 – 2542, tissue samples) (Fig. 1).

Collections of *Ph. arabicus sensu lato* from the California Academy of Sciences: CAS 84279, 84291, 84322, 84375 – 84378, Dhahran and Abqaiq that wasn't included in the type series of *Ph. nejdensis macropeltis* Haas, 1957; CAS 97585, Unayzah-Buraydah-Ar Rass area, Saudi Arabia; CAS 97814, 97816 – 97818, 97820, 97821, 97823 – 97825, Abu Dhabi (15 km radius circle), Trucial States; CAS 97815, Murban — near Santa Fe Drilling Co. Camp, Abu Dhabi, Trucial States; CAS 97819, Habshan, Abu Dhabi, Trucial States; CAS 97822, Abu Dhabi (5 km radius circle), Trucial States; CAS 113719, 35 km N75E Khashm Dalgan on W. edge Nafud Qunayfidhah, Saudi Arabia; CAS 119190, Rayda, Saudi Arabia; CAS 119252, 95 km S, 69 km W Rayda water well, Saudi Arabia; CAS 134137, near Rayda, Rub-Al-Khali, Saudi Arabia; CAS 153846, near Al Jish, on dunes at W. edge of Qatif Oasis, Saudi Arabia; CAS 183068 – 183077, soft sand just north of Abqaiq, Saudi Arabia; CAS 251008, 251022, 251023, Ash Sharqiyah Region, 21.5 km SW (by road), Oman. In total we have studied 108 specimens of *Ph. arabicus sensu lato* from its whole distributional range (Fig. 1).

Measurements. The sex of the specimens was determined by the presence of follicles or testes and measurements were taken with calipers to the nearest 0.1 mm. The following values were used: snout-vent length (SVL), measured from the tip of the snout to the cloaca; head width (HW), measured at the point of greatest width; head height (HH), measured at the point of greatest height; head length (HL), measured from behind the tip of the retroarticular process to the tip of the snout; tail length (TL), measured from the posterior lip of the cloaca to the tip of the tail; supralabials (SL), the number of all supralabial scales (not including interlabial); infralabials (IL), the number of all sublabial scales, (not including interlabial); ventral scales (VS), the number of longitudinal ventral scales along midbody from shoulders to cloaca; gular scales (GS), the number of longitudinal gular scales along midbody from the mental scales to gular fold.

Molecular analysis. We obtained the fragment of the cytochrome oxidase subunit I (COI) gene (standard DNA barcode region) for the 8 specimens of *Ph. arabicus sensu lato*. Based on morphological and locality data, tissue from northern Oman (50 km from Sur) were considered as corresponding to *Ph. arabicus sensu stricto*. Tissues from the southern Jordan (Wadi Ram) were considered as corresponding to *Ph. nejdensis*. Tissues from central Saudi Arabia (Sahnah, 100 km south east of Riyadh) were considered as corresponding to *Ph. n. macropeltis*.

Fig. 2. Comparative photographs of type specimens: *a*, Syntypes of *Ph. arabicus* BMNH 1946.8.28.33, 1946.8.28.34 from Al Mukalla, Hadramaut plateau, Yemen; *b*, holotype of *Ph. nejdensis* HUJ 2711 from Qana, northern Nejd, northern Saudi Arabia (from Anderson and Leviton, 1967); *c*, holotype of *Ph. nejdensis macropeltis* CAS 84619 from Dhahran, eastern Saudi Arabia.

Tissues from south-western Iran corresponds to the undescribed species.

Total DNA was extracted from the finger fixed in 96% ethanol following a salt extraction method (Miller et al., 1988). The fragment of COI gene was amplified with the primers (VUTF and VUTR) and protocol as was described earlier (Melnikov et al., 2012c). The sequencing was carried out on ABI 3130 automated DNA analyzer (Applied Biosystems) using the manufacturer's protocols in both directions. Sequences were aligned using the Clustal W algorithm (Thompson et al., 1994) in BIOEDIT 7.0.5.3 (Hall 1999).

The maximum-likelihood criteria (ML) tree reconstruction and bootstrapping were performed using Treefinder (Jobb, 2008). To choose the best model of molecular evolution we used AIC (Akaike, 1974) criterion in Treefinder. Bootstrap analysis employed 1000 replicates. For the COI the best-fit model chosen was J2 (I) (Jobb, 2008). Genetic distances were creating in MEGA 5.10 (Tamura et al., 2011).

To root the tree following sequences were used: *Xenagama taylori* (Parker, 1935) (GenBank DQ008215) and *Phrynocephalus helioscopus* (Pallas, 1771) (GenBank HQ543966).

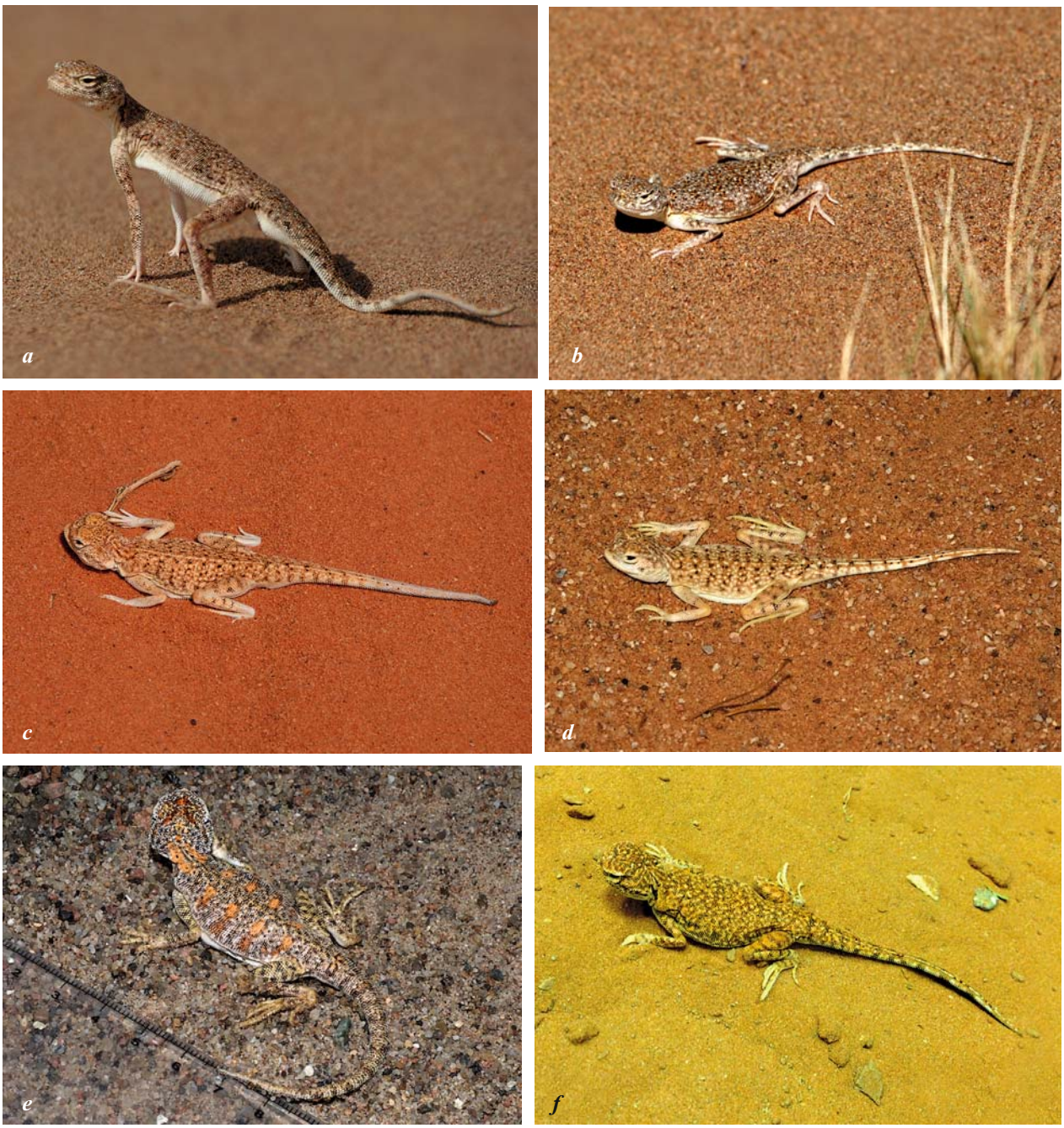

Fig. 3. Comparative photographs of *Ph. arabicus sensu lato* from different localities: *Phrynocephalus* sp. nov.: *a*, Iran, Ahvaz, male *in situ*; *b*, Iran, Ahvaz, female *in situ*; *Ph. nejdensis*: *c*, Jordan, Wadi Ram, male *in situ*; *d*, Jordan, Wadi Ram, female *in situ*; *Ph. arabicus*: *f*, Oman, Sur, female in captivity; *Ph. macropeltis*: *g*, Saudi Arabia, Sahnah about 100 km south east of Riyadh, female in captivity. Scales vary from part to part.

RESULTS

Morphological analysis. Morphological analysis of *Ph. arabicus* complex type specimens and specimens series from different localities, together with observations of living animals in the wild and in captivity, showed that they represent at least four well distinguished taxa. They are: *Ph. arabicus sensu stricto* from the southern Arabia (Yemen, Oman, southern Saudi Arabia), *Ph. nejdensis* from the north-western Arabia (southern Jordan, northern and central Saudi Arabia), *Ph. macropeltis* from the eastern coastal Arabia (eastern Saudi Arabia, UAE), and the

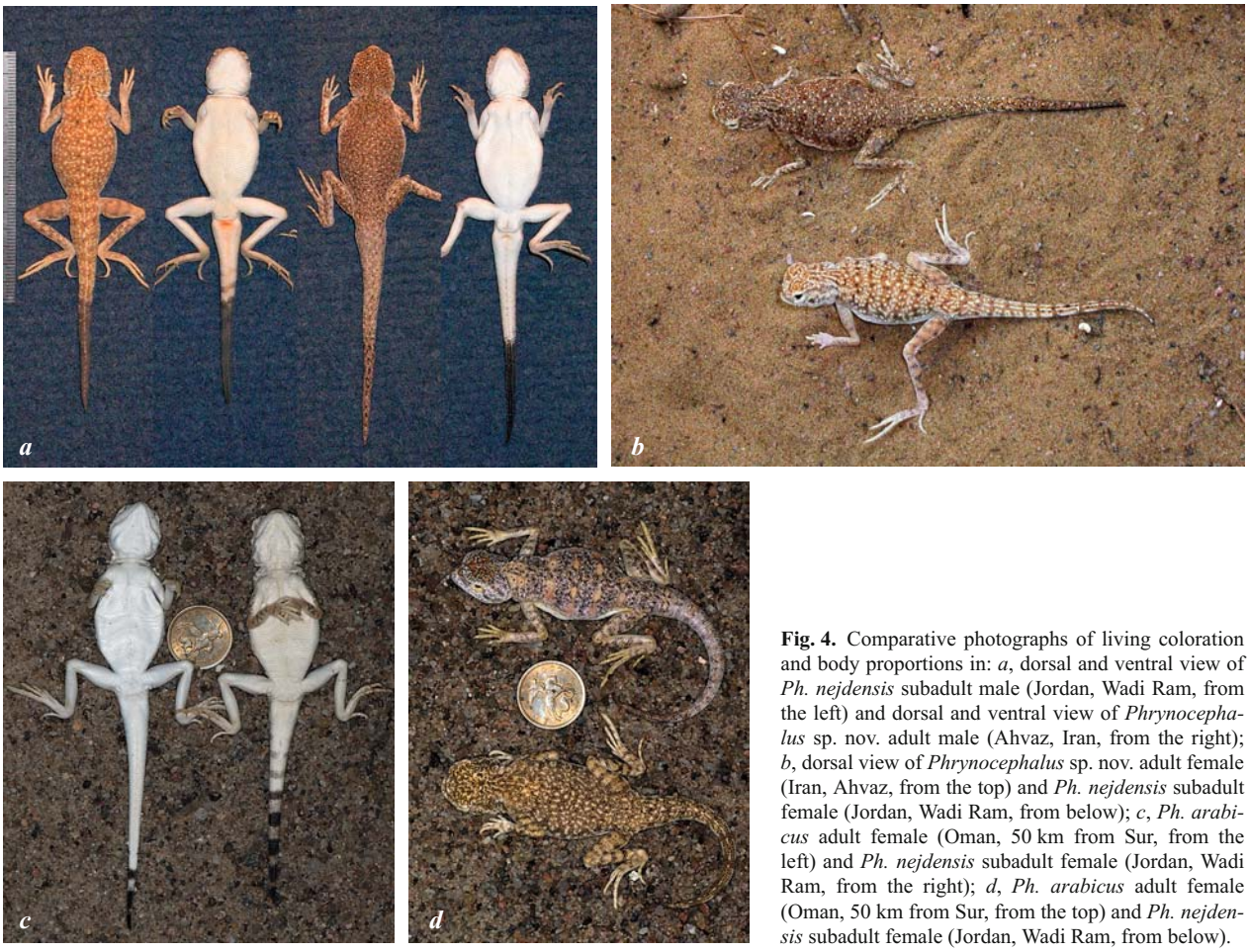

Fig. 4. Comparative photographs of living coloration and body proportions in: *a*, dorsal and ventral view of *Ph. nejdensis* subadult male (Jordan, Wadi Ram, from the left) and dorsal and ventral view of *Phrynocephalus* sp. nov. adult male (Ahvaz, Iran, from the right); *b*, dorsal view of *Phrynocephalus* sp. nov. adult female (Iran, Ahvaz, from the top) and *Ph. nejdensis* subadult female (Jordan, Wadi Ram, from below); *c*, *Ph. arabicus* adult female (Oman, 50 km from Sur, from the left) and *Ph. nejdensis* subadult female (Jordan, Wadi Ram, from the right); *d*, *Ph. arabicus* adult female (Oman, 50 km from Sur, from the top) and *Ph. nejdensis* subadult female (Jordan, Wadi Ram, from below).

new species *Phrynocephalus* sp. nov., represented by a isolated population in the north-western Iran.

Ph. arabicus sensu stricto is characterized well by the very contrasting coloration of the upper side of the body (Figs. 3*e* and 4*d*). Background is bluish gray with bright dark orange-red pattern on the head, two bright orange stripes on the neck, two longitudinal rows of six bright orange (salmon) patches on the back, and dark orange-red on the sides of the body, joined to form a transverse bright pattern with clear middorsal line, similar smaller patches are on the tail, forming transverse pattern (Fig. 3*e*). This pattern was mentioned in the J. Arnold original description, but due to preservation is not present in the type specimens now (Fig. 2*a*). But the main character of *Ph. arabicus sensu stricto* is the unique tail coloration, as this species has white coloration of the undertail and only the tail tip (last quarter) has very small black bands. In the type specimens two and three small bands on the tail tip are present (Fig. 2*a*) and in the specimens from Oman only two small black bands (Figs. 4*c* and 5*c*). Probably in alerted animals the whole last quarter of the tail becomes totally black. This species is characterized also by pointed snout and relatively long tail (Table 1).

Ph. nejdensis is also characterized by special coloration of the dorsal side of the body and undertail. This species does not have bright color marks on the dorsal side. General coloration is in one color tone, with contrasting yellow-brown or yellow-reddish-orange with dark-brownish transverse bands (Fig. 3*c*, *d* and 4*a* – *c*). Upper side of the head has the same pattern and color as body. White dots on the middorsal line can be distinguished, with some individuals appearing as a longitudinal row along the vertebrae. This species is also well characterized by many black transverse tail bands (up to seven), that cover about half of the undertail in the calm condition of the animal (Fig. 4*c*). These bands sometimes are not well distinguished in alerted individuals, especially in males, as whole distal half of the tail became black and bands became just slightly visible, but the additional bands in the proximal half of the tail appear

(Fig. 5*b*). The black tail coloration of the alerted animal is recognizable even on the upper side of the tail, while in calm condition it is whitish. In the Holotype there are two additional bands on the proximal half of the tail and a totally black distal half (Fig. 2*b*). This is the biggest and most short-tailed species — the tail almost the same length as body even in males (Table 1).

Ph. macropeltis is characterized by intermediate morphological characters between *Ph. arabicus sensu stricto* and *Ph. nejdensis*, which needs further investigation, due to probable hybridization between these species. The diagnostic characters proposed by G. Haas (1957) for this subspecies were similar to those of *Ph. arabicus sensu stricto*. For *Ph. nejdensis* he stated that it differs from *Ph. arabicus* in: small size of gular scales, smaller ventrals and proximal subcaudals, higher number of upper and lower labials, and flatness of the dorsal head scales. But *Ph. nejdensis macropeltis* differs from *Ph. nejdensis nejdensis* in some opposite characters: larger ventral scales, head scales more bulging, and some of the pectoral scales keeled (Haas, 1957). In other words, G. Haas mixed the difference between his species *Ph. nejdensis* and *Ph. arabicus* by describing the subspecies *Ph. n. macropeltis* which differs from *Ph. nejdensis* in opposite characters which distinguish *Ph. nejdensis* from *Ph. arabicus*. Probably because of that, Leviton and Anderson (1967) showed that differences of *Ph. nejdensis* and *Ph. n. macropeltis* from *Ph. arabicus* was "illusory," and that all meristic characters are overlapping in the populations they studied. As for diagnostic characters proposed by us, Haas (1957) mentioned for *Ph. nejdensis* — "posterior half of the tail blackish, with faint darker cross-bands" (Holotype also have additional bands in the proximal half of the tail (Fig. 2*b*)), but for *Ph. n. macropeltis* — "last third of the tail is black below" (Fig. 2*c*). All studied specimens from the coastal eastern Arabia (eastern Saudi Arabia and UAE) are characterized by black last third of the tail and no additional cross bands on the rest of the undertail and this is useful taxonomic character for them. To access the living dorsal coloration of *Ph. n. macropeltis* more material is needed, but it seems similar to those of *Ph. nejdensis* (Fig. 3*g*). Body and tail proportions also similar to *Ph. nejdensis* (Table 1).

TABLE 1. Comparative Data on Body Length and Body Length to Tail Length Ratio in Studied Taxa (Adults, Except *Ph. arabicus* Syntypes)

	L	L/L_{cd}
	min(med)max	
Ph. arabicus		
Syntypes		
juveniles (n = 2)	36	0.88(0.89)0.90
Oman		
male (n = 1)	45	0.88
females (n = 2)	50(49.5)53	0.84(0.86)0.88
Ph. nejdensis		
Holotype*		
male	54	0.87
Jordan		
males (n = 3)	53(56)58	0.88(0.91)0.95
females (n = 3)	48(50)52	0.95(0.96)0.97
Ph. macropeltis		
Type series		
males (n = 5)	54(56)59	0.89(0.94)0.98
females (n = 5)	45(48.6)52	0.88(0.95)0.98
***Phrynocephalus* sp. nov.**		
Type series		
males (n = 6)	50(51.3)54	0.79(0.82)0.84
females (n = 8)	42(46.4)50	0.81(0.88)0.94

* from Haas (1957).

Phrynocephalus sp. nov. from Iran is characterized by unique coloration of the dorsal side of the body, almost without pattern. General color is grayish or light-brownish with black, white, orange and red scales, that makes coloration uniform with small irregular black, white and orange dots (Figs. 3*a*, *b* and 4*a*, *b*). There are some bright dark red patches similar to *Ph. arabicus sensu stricto*, that on the sides of the body are with black edging, both in males and in females (Figs. 3*a*, *b* and 4*a*, *b*). Upper side of the head is the same pattern and color as body. Undertail coloration is white without any pattern in calm condition (Fig. 3*a*), but distal half of the tail is black and proximal half uniformly white in alerted condition (Figs. 4*a*, 5*a*). The black tail coloration of alerted animal is recognized even on the upper side of the tail, while in calm condition its same color as body. This is the smallest and most long-tailed species — the tail always longer than body even in females (Table 1).

Molecular analysis. The aligned sequences were 645 base pair (bp) from 9 specimens of *Ph. arabicus sensu lato* and represent six haplotypes. Sequences of *Ph. arabicus sensu lato* formed four groups with high bootstrap support: *Ph. arabicus sensu stricto* from Oman, *Ph. nejdensis* from Jordan, *Phrynocephalus* sp. nov. from Iran and *Ph. macropeltis* from Saudi Arabia (Fig. 6).

Ph. arabicus sensu stricto is basal to all other species in this group and differs from them by 5.5 – 6.0% in the uncorrected pairwise distance (Table 2). *Ph. nejdensis* is sister taxa to the group of *Ph. macropeltis* and *Phrynocephalus* sp. nov. from Iran. The level of genetic distance between *Ph. nejdensis* and *Ph. macropeltis* is 4.8% and between *Ph. nejdensis* and *Phrynocephalus* sp. nov. is 5.3%. *Ph. macropeltis* and *Phrynocephalus* sp. nov. are

Fig. 5. Comparison of undertail coloration in series of: *a*, *Phrynocephalus* sp. nov. type series; *b*, *Ph. nejdensis* from Wadi Ram and Al Mudawwara, southern Jordan; *c*, *Ph. arabicus sensu stricto* from Ash Sharqiyah, northern Oman.

grouped together, genetic difference between them 2.7% in the uncorrected pairwise distance. *Ph. arabicus sensu lato* group differ from outgroup of *Ph. helioscopus* by 16.2 – 17.4% in the uncorrected pairwise distance.

Based on the morphological and molecular differences of the Iranian *Ph. arabicus sensu lato*, and on its geographical isolation from the other parts of the species complex range by the Mesopotamian wetland plains of Euphrates, Tigris, Karun, and Karkheh rivers, we herein describe them as a new species.

Phrynocephalus ahvazicus sp. nov.

Holotype. ZISP 27131 (formerly R-12713/2), adult male (Fig. 7).

Paratypes. ZISP 25019 – 25023, ZISP 27088, ICSTZM6H 1291, 1292 (formerly ZISP 26645, 26646) and ZMMU R-12713/1, R-12713/3 – 12713/6 with the same data as Holotype.

Type locality. Ahvaz, Khuzestan province, Iran.

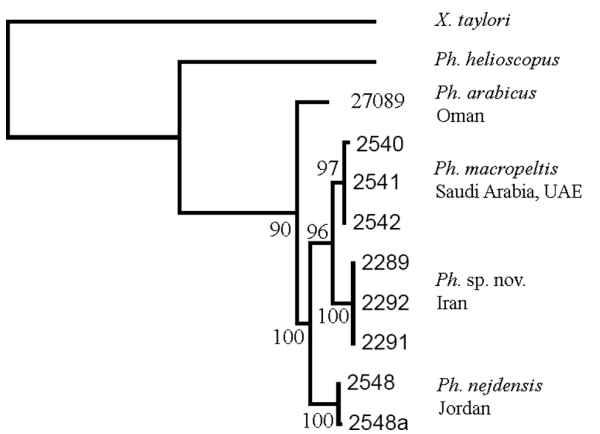

Fig. 6. Phylogenetic relationships of *Ph. arabicus sensu lato* representatives based on mtDNA sequences (COI) by the maximum-likelihood analysis.

Diagnosis. A small and slender *Phrynocephalus* species with tail longer than body in both sexes, ground dorsal coloration uniform, almost without pattern; with dark

TABLE 2. The Level of Genetic Divergence (*p*-distance, percentage) in the COI Among Studied Samples of *Ph. arabicus* sensu lato

	Ph. arabicus sensu stricto Oman; ZISP 27089	*Ph. macropeltis* Saudi Arabia, UAE; ZISP TS 2540 – 2542	*Phrynocephalus* sp. nov. Iran; ZISP TS 2289 – 2292
Ph. macropeltis Saudi Arabia; ZISP TS 2540 – 2542	5.9		
Phrynocephalus sp. nov. Iran; ZISP TS 2289 – 2292	6.0	2.7	
Ph. nejdensis Jordan; ZISP TS 2548, 2548a	5.5	4.8	5.3

red patches on body sides; head coloration same as body, without any patches; with white undertail coloration without bands and without black tail tip (undisturbed animal) and black distal half and no bands in white proximal half (alerted).

Description of the holotype. ZISP 27131 (formerly R-12713/2). Left forth limb without third finger. Small cut at the ventral side of the left thigh. Skin on the left kneel slightly damaged, black colored. Hemipenises are turned inside out.

Measurements (mm)**:** SVL 51, TL 64, HH 8.28, HW 12.6, HL 12.78, length of left forelimb 27, length of left hind limb 45 (including toe length).

Description. Slender body. Head and body depressed. Nostril directed almost forward, pierced in the central upper part of small nasal scales. Nasal scales are visible from above, lower nasal is large, about two times larger than surrounding scales, upper nasal about same size as surrounding scales. Nasals separated from the first canthal scale by two scales. There are no obvious enlarged scales on the head except nasals, supraorbitals, occipital and canthal scales. Interorbital scales about same size as parietal, temporal and occipital scales. Occipital about two-three times larger than surrounding scales. Supraorbitals about same size as interorbitals. There are 16 upper and 13 lower labial scales. There is no external ear. Gular fold bordered by two transverse lines of small granules. Dorsal scales are smooth, heterogeneous, almost same size as lateral scales. Lateral body scales are small and smooth. There are 91 scales rows around midbody, 95 dorsal scales along the vertebrae and 65 ventral scales along the belly between the anterior border of the shoulders and cloaca. No precloacal or femoral pores. Dorsal body scales are smooth, not mucronate. Gular scales are smooth, slightly mucronate, ventral scales smooth, about four times larger than dorsal body scales, some with little keel in the hind half, hardly mucronate. Scales of the upper side of the fore limb are smooth, about the same size as dorsal body scales. Scales of the upper side of the hind limb are smooth, about two-three times larger than dorsal body scales. Hind limb long, toes reaching nasals line when adpressed. The fourth toe is longest, reaching 10 mm. Lamellae 23 under the left fourth finger, 33 lamellae under the left fourth toe. Toes and fingers with fringes. Forelimb is relatively short, digits reaching femoral articulation when adpressed. In the manus fourth finger is the longest, reaching 6 mm. Tail little depressed at its base. Dorsal tail scales are smooth, mucronate, about same size as dorsal body scales. Ventral tail scales are smooth at it base, but than became mucronate and keeled, together with lateral tail scales. Tail scales not arranged in whorls.

Coloration after ethanol preservation. Coloration of the type specimens are different due to different ethanol percentage used for preservation. ZISP specimens except the holotype are grayish, ZMMU specimens colored similar to original living coloration. Upper parts of the body formed by black, white, orange and red scales, make coloration uniform with small irregular black, white and orange dots, almost without pattern. Only some dark slightly visible patches can be recognized on the dorsal body side. Sides are more grayish with less orange (sandy) color. Head with more yellow-orange (sandy) color. Tail from above is the same color as dorsal body side, with black distal half. Ventral body side coloration is off-white, breast with irregular dark patches. Tail is black in the distal half. Throat is off-white, with dirty gray dots as on breast.

Coloration in life. General color is grayish or light-brownish with black, white, orange and red scales, that makes coloration uniform with small irregular black, white and orange dots. There are some bright dark red patches, that appear on the sides of the body with black edging, both in males and in females. Upper side of the head is the same pattern and color as body. Undertail coloration is white without any pattern in calm condition, but distal half of the tail is black and proximal half uniformly white in alerted condition. The black tail coloration of alerted animal is recognized even on the upper side of the tail, while in calm condition is the same color as body.

Etymology. Species named by the place of origin — the Ahvaz plains in Khuzestan province in southwestern Iran.

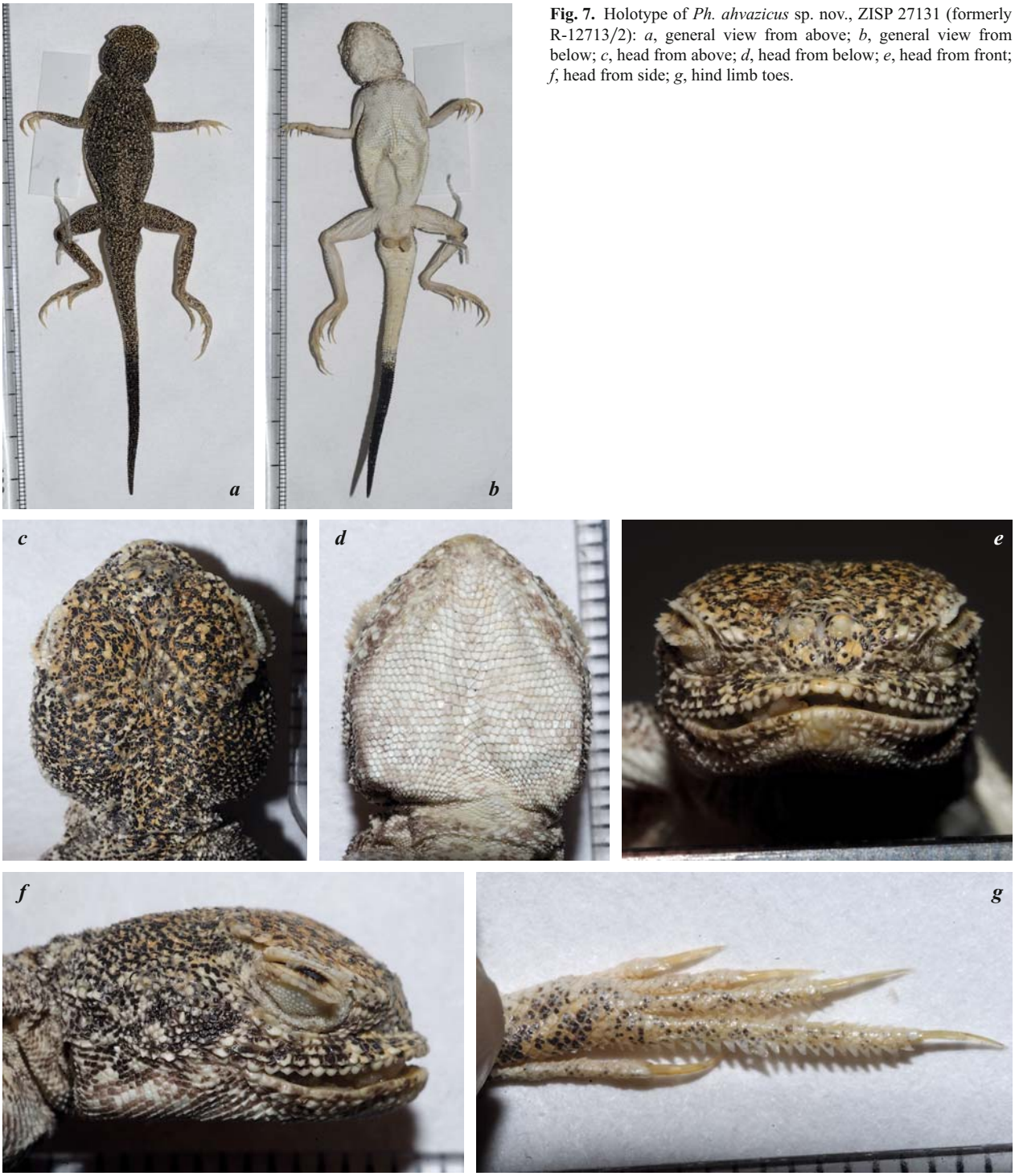

Fig. 7. Holotype of *Ph. ahvazicus* sp. nov., ZISP 27131 (formerly R-12713/2): *a*, general view from above; *b*, general view from below; *c*, head from above; *d*, head from below; *e*, head from front; *f*, head from side; *g*, hind limb toes.

Distribution. Species known from the type locality.

Morphological comparisons. *Ph. ahvazicus* sp. nov. is distinguished from the other representatives of the *Ph. arabicus* complex by the following characters: smallest body size; longest tail both in males and in females; uniform coloration of dorsal parts without patches on

head and dorsum; coloration of the undertail white in calm condition, and distal half black and proximal half is white without pattern in alerted animals.

The new species differs from *Ph. arabicus sensu stricto* in undertail coloration — distal half is totally black in alerted *Ph. ahvazicus* sp. nov. vs. distal quarter totally black or two-three small black cross bars in distal quarter in *Ph. arabicus sensu stricto*.

The new species differs from *Ph. nejdensis* in undertail coloration — distal half is uniformly black and proximal is white without cross bands in alerted *Ph. ahvazicus* sp. nov. vs. more than half of the tail is blackish in alerted *Ph. nejdensis* with black cross bands both in distal (blackish) and proximal (white) parts.

The new species differs from *Ph. macropeltis* in undertail coloration — distal half is black in alerted *Ph. ahvazicus* sp. nov. vs. distal third is black or with two-three cross bands in alerted *Ph. macropeltis*.

DISCUSSION

Taxonomic characters used for species delineation in *Phrynocephalus* Kaup, 1825 can be unequal, especially with attempts to use quantitative characters that traditionally works well in the groups where scale arrangements can be distinguished and equal scales can be counted and compared in different taxa. But in *Phrynocephalus*, with small granules covering whole body, including head, only a few characters can be distinguished, for example the number of labials, often also without success. For example, very different morphological species as the huge orange colored with massive black vertebral stripe of *Phrynocephalus przewalskii* Strauch, 1876 and is small gray with red axillar patches and white tail stripe of *Phrynocephalus frontalis* Strauch, 1876 (comparative photographs in Melnikov and Ananjeva, 2012) can not be delineated using such approach (Gozdzik et Fu, 2009).

The most distinguishable morphological characters of *Phrynocephalus* are the bright signaling marks that are used for social interactions between individuals (Dunayev 1996) and probably for species ecological isolation. For example, the bright patches in the underarm area (axillar patch) in representatives of *Phrynocephalus versicolor* Strauch, 1876 complex, bright patches on the dorsal side of the body like double marks in the neck area in *Ph. helioscopus* complex, or like double marks in the middle of the body in *Ph. raddei* Boettger, 1888 and *Ph. interscapularis* Lichtenstein, 1856 complexes. But the most important and most successfully used character for species identification in *Phrynocephalus* is undertail coloration. This character can be very different in different species or even different representatives of the species complexes (Melnikov et al., 2008; 2009a, 2009b; 2012a). The only problem is the disappearing or even changing of the original bright coloration after specimen preservation. But some tail coloration characters, like white or black tail tip coloration or black cross bands, can be successfully used even for identification of old specimens. For example our study of *Ph. helioscopus* complex showed that nominative subspecies *Ph. h. helioscopus* can be easily distinguished from all others complex representatives by the presence of jet-black tail tip (Melnikov et al., 2008; 2009a). Another example is *Ph. axillaris* and *Ph.* cf. *hispidus* from the *Ph. versicolor sensu lato* complex, that can be distinguished by white last third or white tip of the tail, respectively (Melnikov et al., 2009b). This study provides another example of such difference in bright color marks between closely related species. It shows the differences between species both in the bright dorsal color marks and in the undertail black bands.

Many new species recently were described from Arabia, despite the fact that it was well studied in the past. For example, in result of taxonomic revision of *Hemidactylus* Oken, 1817 eight new species were described only from Oman (Carranza et Arnold, 2012). Three new *Pseudotrapelus* Fitzinger, 1843 species and three new *Ptyodactylus* Fitzinger, 1826 species were described by us from Jordan and Oman (Melnikov et. al. 2012b; Melnikov et. Pierson 2012; Melnikov et. al. 2013a; Melnikov et. al. 2013c; Nazarov et al., 2013). Many more new descriptions and reviews are now in preparation. As for toad-headed agamas, *Ph. ahvazicus* sp. nov. is the second new *Phrynocephalus* species described recently from Iran, *Ph. ananjevae* Melnikov, Melnikova, Nazarov et Rajabizadeh, 2013 was described from the Zagros mountains (Melnikov et al., 2013b). New descriptions and phylogenetic reconstructions lead to better understanding of the origin and biogeography of Arabian herpetofauna. For example, south Arabian origin was shown for *Stenodactylus* Fitzinger, 1826 (Metallinou, 2012) and in this report we stated that for *Ph. arabicus* species complex basal lineage is also represented by south Arabian *Ph. arabicus sensu stricto*. To clarify relationships within the *Ph. arabicus* complex more investigations are needed especially in Saudi Arabia.

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