

[Research]

## Review of the genus *Alburnoides* Jeitteles, 1861 (Actinopterygii, Cyprinidae) from Iran with description of three new species from the Caspian Sea and Kavir basins

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### ABSTRACT

The genus *Alburnoides* Jeitteles, 1861 in Iran is reviewed, and diagnoses are presented for all eight recognized species. *Alburnoides eichwaldii*, *A. holciki*, *A. idignensis*, *A. namaki*, *A. nicolausi*, *A. petrubanarescui*, *A. qanati* and *A. tabarestanensis* are considered valid and three new species are described: *Alburnoides coadi* sp. n., from Namrud River in Kavir basin, *A. parhami* sp. n., from Atrak River in the south-eastern Caspian Sea basin, and *A. samiii* sp. n., from Sefidroud River in the southern Caspian Sea basin. All species, except unstudied *A. petrubanarescui* are illustrated and characterized morphologically.

**Key words:** : New species, Taxonomy, Freshwater fishes, Alburnini, Spirilin

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### INTRODUCTION

The genus *Alburnoides* Jeitteles, 1861, is characterized by presenting small black spots near the pores located on each side of the lateral line outlining the canal at least along its anterior portion (Bogutskaya & Coad, 2009). Until recently, *Alburnoides bipunctatus* (Bloch, 1782) was the name applied to most populations of riffle minnows across Europe and the Middle East from France north of the Alps eastwards to the Black, Caspian and Aral seas basins (e.g. Berg, 1949; Coad & Bogutskaya, 2009), but ongoing research is revealing a greater diversity (Bogutskaya & Coad, 2009; Coad & Bogutskaya, 2009; Coad & Bogutskaya, 2012; Bogutskaya et

al., 2010; Mousavi-Sabet et al., 2015; Stierandová et al., 2016). Recent studies have shown that at least eight species of the genus *Alburnoides* are found in Iran (Coad & Bogutskaya, 2009; Coad & Bogutskaya, 2012; Jouladeh-Roudbar et al., 2015), namely *Alburnoides eichwaldii* De Filippii (1863), found in river drainages of the south-western Caspian Sea basin, *Alburnoides holciki* Coad & Bogutskaya, 2012 known from north-western Afghanistan and north-eastern Iran, *Alburnoides idignensis* Bogutskaya & Coad, 2009 recorded from upper reaches of tributaries of Karkheh [Qareh Su] River in the Zagros Mountains, *Alburnoides namaki* Bogutskaya &

Coad, 2009 recorded from Hamedan Province, in Qareh-Chay River drainage north of Razan, *Alburnoides nicolausi* Bogutskaya & Coad, 2009 found in Simareh River drainage at Nurabad which flows into the Karkheh River, *Alburnoides petrubanarescui* Bogutskaya & Coad, 2009 from Qasemlou-Chay, Orumiyeh [Urmia] Lake basin, *Alburnoides qanati* Coad & Bogutskaya, 2009 from Pulvar River drainage, Kor River basin, and *A. tabarestanensis* Mousavi-Sabet, Anvarifar & Azizi, 2015 from Tajan River in the south-eastern Caspian Sea basin. *Alburnoides* populations are widely distributed along the southern Caspian Sea basin from the Aras-Kura to the Atrak rivers (Jouladeh-Roudbar *et al.*, 2015; Mousavi-Sabet *et al.*, 2015). Recently, some researchers tried to clarify the taxonomic status of the genus *Alburnoides* in the region (Bogutskaya & Coad, 2009; Seifali *et al.*, 2012; Mousavi-Sabet *et al.*, 2015). As mentioned, *Alburnoides bipunctatus* was the name applied to populations of riffle minnows along the southern Caspian Sea basin. However, Seifali *et al.* (2012) sequenced the mitochondrial cytochrome *b* of *Alburnoides* populations from this region and concluded that *A. bipunctatus* does not exist in the area. Bogutskaya & Coad (2009) confirmed the presence of *A. eichwaldii* in the region and stated that the species is restricted to the south-western Caspian Sea basin at the Aras-Kura drainage. They also suggested that the riffle minnow from Atrak and Safid Rud (or correctly Sefidroud) rivers may represent distinct taxa from *A. eichwaldii*. Seifali *et al.* (2012) stated the *Alburnoides* populations occurring in the southern Caspian Sea basin, are distinct from the remaining species of spiralin in Iran, and that the western and eastern *Alburnoides* populations in the basin are distinct taxa. Seifali *et al.* (2012) data also suggested that the *Alburnoides* populations from Sefidroud and Gorganroud rivers belong to unnamed species, which was suggested previously by Coad & Bogutskaya (2012), based on meristic and vertebral counts. Similar data are showed in a

recent phylogenetic study of the genus *Alburnoides* (Stierandová, *et al.*, 2016). Our morphological and vertebral comparisons of *Alburnoides* specimens from the Atrak and Sefidroud rivers in the southern Caspian Sea basin and Namroud River in Kavir basin, with their nominal congeners in Iranian river basins, demonstrates that they clearly represents three unnamed species, which are described here.

## MATERIALS AND METHODS

**Sample collection and measurements:** A total of 466 spiralin specimens were collected by electrofishing throughout Iran during 2010-2014 (Table 1). Caught specimens fixed in 10% formaldehyde and stored in 70 % ethanol or directly fixed in 99 % ethanol. Counts and measurements follow Hubbs & Lagler (1958) and Mousavi-Sabet *et al.*, (2015). Measurements were made point to point to the nearest 0.1 mm. The standard length (SL) is measured from the tip of the snout to the end of the hypural complex. Head length and interorbital width were measured to their bony margins. The length of the caudal peduncle is measured from behind the base of the last anal-fin ray to the end of the hypural complex, at the mid-height of the caudal-fin base. The last two branched rays articulated on a single pterygiophore in dorsal and anal-fins are noted as "1½". Mean and standard deviation were calculated without the "½". Lateral-line scales count includes pored scales, from the first one just behind the supracleithrum to the posteriormost one at the base of the caudal-fin rays (i.e. posterior margin of hypurals) excluding 1 or 2 scales located on the bases of the caudal-fin rays. Osteological characters were examined from radiographs. Diagnosis for all the eight existent Iranian spiralin species are based on original descriptions, however detailed comparisons with congeners found in Iranian waters are given in the comparative remarks of each new described species. No material of *A. petrubanarescui* was available for this study and

**Table 1.** Examined *Alburnoides* specimens from Iranian water basins (*n* = number of specimens).

Species	<i>n</i>	Locality	Basin
<i>A. eichwaldii</i>	55	Balekhlu-Chay Stream	Caspian Sea (southwestern)
<i>A. holciki</i>	36	Hariroud River	Hariroud River
<i>A. idignensis</i>	52	Bid-e-Sorkh Stream, Gamasiab River	Tigris River
<i>A. namaki</i>	51	Qareh-Chay River	Namak Lake
<i>A. nicolausi</i>	38	Nurabad Stream, Gamasiab River	Tigris River
<i>A. qanati</i>	34	Kor River	Kor River
<i>A. tabarestanensis</i>	50	Tajan River	Caspian Sea (southeastern)
<i>A. coadi</i> sp. n.	50	Namroud River	Kavir
<i>A. parhami</i> sp. n.	50	Baba-Aman Stream, Atrak River	Caspian Sea (southeastern)
<i>A. samiii</i> sp. n.	50	Sefidroud River	Caspian Sea (southern)

we based our comparisons with this species on the original description by Bogutskaya & Coad (2009). Statistical analyses were performed by Microsoft Excel 2010 package.

**Abbreviations used:** GUIC, the collection of the ichthyology museum of the university of Guilan, Iran; VMFC, Vatandoust and Mousavi-Sabet fish collection, Tehran, Iran. The type series is deposited in VMFC and GUIC.

## RESULTS AND DISCUSSION

Obtained results showed that the genus *Alburnoides* in Iran contains at least eleven species, including eight described; *Alburnoides eichwaldii* De Filippi (1863), *A. holciki* Coad & Bogutskaya, 2012, *A. idignensis* Bogutskaya & Coad, 2009, *A. namaki* Bogutskaya & Coad, 2009, *A. nicolausi* Bogutskaya & Coad, 2009, *A. petrubanarescui* Bogutskaya & Coad, 2009, *A. qanati* Coad & Bogutskaya, 2009 and *A. tabarestanensis* Mousavi-Sabet, Anvarifar & Azizi, 2015, and three unnamed species. A map with all records of *Alburnoides* species considered in this study is shown in Fig. 1.

### *Alburnoides eichwaldii* (De Filippi, 1863)

(Fig. 2)

*Alburnus eichwaldii* De Filippi, 1863: 392 [18 of separatum] (Kura R. at Tiflis [Tbilisi]).

*Alburnoides bipunctatus armeniensis* Dadikyan, 1972: 566 (Marmarik R., Aras R. system).

**Material examined.** GUIC AL201EI; 55 specimens, 48.3-67.9 mm SL, Iran: Ardebil Province, Balekhlu-Chay Stream, Aras-Kura drainage, the Caspian Sea basin, 38°02' N, 48°03' E; coll. H. Mousavi-Sabet, S. Vatandoust & A. Jouladeh-Roudbar.

**Diagnosis.** Original diagnosis of *Alburnoides eichwaldii* (De Filippi, 1863): the body is deep, its length exceeds the depth in four times; eye large; dorsal-fin rays branched rays 8 [=8½]; branched anal-fin rays 12 [=12½]; scales in the lateral series 50, 11 scales above and 7 scales below lateral line.

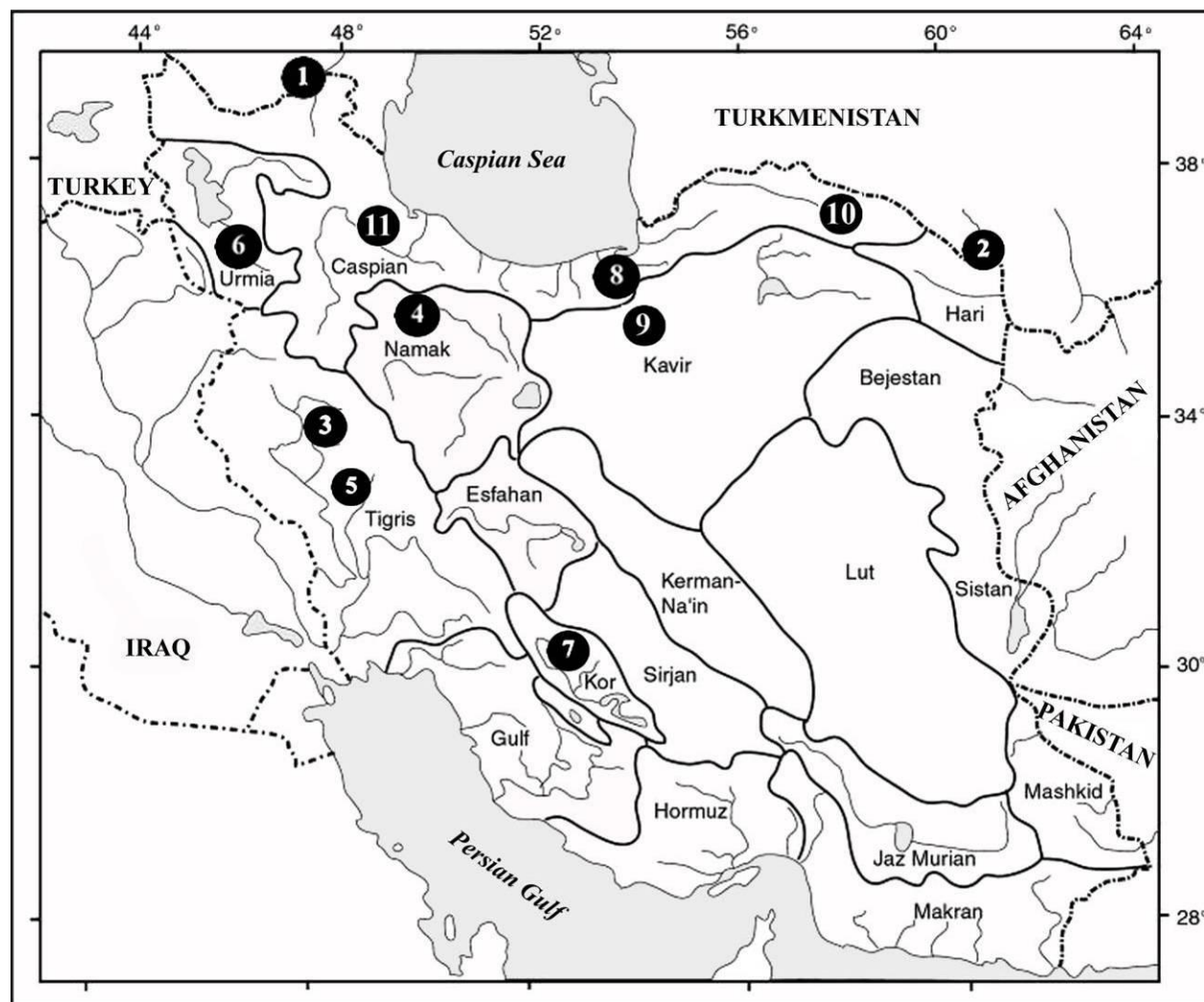
According to Bogutskaya & Coad (2009) and our examined materials, *A. eichwaldii* is distinguished from the other species of *Alburnoides* in Iran by a combination of characters, none of them unique. *Alburnoides eichwaldii* is distinguished from the congeners in Iran by moderately rounded caudal fin lobes, not deeply forked caudal fin; commonly scaleless ventral keel; commonly deep head and slightly to markedly rounded snout; the tip of the mouth cleft is slightly below the level of the middle of the eye or at about the lower margin of pupil; 8½ dorsal-fin rays (rarely 7½ or 9½); (10)11-14½ branched anal-fin rays (commonly

12-13½); commonly 2.5-4.2 pharyngeal teeth; 44-56 total lateral line scales; 6-10 gill rakers; (38, 39)40-43 total vertebrae; and the most common vertebral formulae are 21 + 21, 21 + 20 and 20 + 21 (Tables 2-4).

See Fig. 2 for general appearance, table 5 for morphometric data, and tables 2-4 for meristic and vertebral counts. See below for more details to distinguish *A. eichwaldii* from the other Iranian *Alburnoides* species examined for this

study.

**Distribution.** *Alburnoides eichwaldii* is distributed in river drainages of the southwestern Caspian coast from Samur (according to Berg, 1932, 1949) down to rivers of the Lenkoran. In Iran this species is restricted to the Aras River drainage, in the southwestern Caspian Sea basin. See Fig. 1 for the distribution of the species in Iran.



**Fig. 1.** Records of *Alburnoides* species in Iran; (1) *A. eichwaldii*, (2) *A. holciki*, (3) *A. idignensis*, (4) *A. namaki*, (5) *A. nicolausi*, (6) *A. petrubanarescui*, (7) *A. qanati*, (8) *A. tabarestanensis*, (9) *A. coadi* sp. n., (10) *A. parhami* sp. n., (11) *A. samiii* sp. n.



**Fig. 2.** *Alburnoides eichwaldii*; Iran, Aras River, GUIC AL201EI, (a) 66 mm SL, (b) 68 mm SL.

***Alburnoides holciki* Coad & Bogutskaya, 2012**

(Fig. 3)

**Material examined.** VMFC AL201HO, 36 specimens, 44.6-66.2 mm SL, Iran: Khorasan-e-Razavi Province, Hariroud River, Hariroud River basin, 35°57' N, 61°07' E; coll. H. Mousavi-Sabet, S. Vatandoust, B. Ganjbakhsh & A. Jouladeh-Roudbar.

**Diagnosis.** According to original diagnosis, *Alburnoides holciki* is distinguished from the other species of *Alburnoides* in Iran by a well-defined, sharp, scaleless or only slightly scaled ventral keel; a short, slightly pointed snout; a terminal mouth with the tip of the mouth cleft,

on a level with the upper half of the pupil; a large eye (orbit width about equal to interorbital width); (46)47-51(55) lateral-line scales to posterior margin of hypurals; 2.5-4.2 pharyngeal teeth; usually 8½ branched dorsal-fin rays; usually 13-16½ branched anal-fin rays; 40-42, usually 41, total vertebrae; caudal vertebral region longer than abdominal region (most frequent vertebral formulae 20 + 21, 20 + 22 and 19 + 21); and usually 13 or 14 predorsal vertebrae. See Fig. 3 for general appearance, table 5 for morphometric data, and tables 2-4 for meristic and vertebral counts. See below for more details to distinguish *A. holciki* from the other Iranian *Alburnoides* species examined for this study.



**Table 4.** Frequency of occurrence of variants of the number of abdominal and caudal vertebrae in the *Alburnoides* species in Iran ( $n$  = number of specimens;  $n^*$ : present study,  $n^{**}$ : Bogutskaya & Coad (2009),  $n^{***}$ : Coad & Bogutskaya (2012)).

Species	$n^*$	$n^{**}$	$n^{***}$	Abdominal vertebrae					Caudal vertebrae				
				18	19	20	21	22	18	19	20	21	22
<i>A. eichwaldii</i>	55	160	-	1	4	62	134	14		14	86	99	16
<i>A. holciki</i>	36	-	18		9	44	2				5	39	11
<i>A. idignensis</i>	52	46	-	1	45	52			1	47	50		
<i>A. namaki</i>	51	48	-		28	68	3			21	65	13	
<i>A. nicolausi</i>	38	42	-		23	53	4		15	41	24		
<i>A. petrurbanarescui</i>	-	30	-			3	25	2		15	14	1	
<i>A. qanati</i>	34	30	-			61	3				38	26	
<i>A. tabarestanensis</i>	50	-	11		18	43					31	30	
<i>A. coadi</i> sp. n.	50	-	-		12	38				12	27	9	
<i>A. parhami</i> sp. n.	50	-	10		1	57	2			2	42	16	
<i>A. samiii</i> sp. n.	50	31	84		41	108	16			9	79	76	2

**Distribution.** *Alburnoides holciki* is distributed in the Hariroud River basin at the border of three countries including northwestern Afghanistan, northeastern Iran and southern Turkmenistan. See Fig. 1 for the distribution of the species in Iran.

***Alburnoides idignensis* Bogutskaya & Coad,  
2009  
(Fig. 4)**

**Material examined.** VMFC AL201ID; 52 specimens, 49.0-82.4 mm SL, Iran: Kermanshah Province, Bid-e-Sorkh Stream, Gamasiab River, the Tigris River basin, 34°26' N, 47°46' E; coll. H. Mousavi-Sabet, S. Vatandoust, H. Bagherpour & A. Jouladeh-Roudbar.

**Diagnosis.** According to original diagnosis (Bogutskaya & Coad, 2009), *Alburnoides idignensis* is distinguished from the other species of *Alburnoides* in Iran by a combination of characters, none of them unique. An unbranched pectoral fin ray strongly lined with melanophores on its inner margin; an eye of an average size, the orbit diameter larger than the snout length and markedly smaller than the

interorbital width; caudal fin lobes rounded and fin shallowly forked; a variably scaled ventral keel though most commonly scaled along about 1/3-2/3 of its length; a deep head with a markedly rounded, stout snout; a small mouth which is between terminal and subterminal; a tip of the mouth cleft on a level from the lower margin of the pupil; commonly 8½ branched dorsal-fin rays; 10-12(13-14)½ branched anal-fin rays; 41-49(50-51) total lateral line scales (39-49 scales to posterior margin of hypurals); commonly 2.5-4.2 or 2.4-4.2 pharyngeal teeth; (37)38-40, with a mode of 39, total vertebrae; 11-13(14) predorsal vertebrae, (18)19-20 abdominal vertebrae; (18)19-20 caudal vertebrae; a caudal vertebral region most commonly one vertebra shorter or one vertebra longer than the abdominal region; the most common vertebral formulae are 20 + 19 and 19 + 20, and the difference between the abdominal and caudal counts averaging 0.

See Fig. 4 for general appearance, table 6 for morphometric data, and tables 2-4 for meristic and vertebral counts. See below for more details to distinguish *Alburnoides idignensis* from the other Iranian *Alburnoides* species examined for this study.



**Fig. 3.** *Alburnoides holciki*; Iran, Hariroud River, VMFC AL201HO, (a) 64 mm SL, (b) 58 mm SL.

**Distribution.** *Alburnoides idignensis* is known from some upper reaches of tributaries of Karkheh [Qareh Su] River in the Zagros Mountains. The Karkheh is falling into the Tigris just below its confluence with the Euphrates. *Alburnoides idignensis* is normally found in western Iran, in Kermanshah and Ilam provinces. This species is found in springs and qanats in the region. Other species found sympatrically together with *Alburnoides idignensis* are *Barbus lacerta*, *Alburnus mossulensis*, *Cobitis avicennae*, *Capoeta aculeata*, *Cyprinion macrostomum*, *Garra rufa*, *Oxynoemacheilus kiabii*, *Oxynoemacheilus kermanshahensis*. This species is restricted to the Tigris River basin. See Fig. 1 for the distribution of the species in Iran.

***Alburnoides namaki* Bogutskaya & Coad, 2009**  
(Fig. 5)

**Material examined.** VMFC AL201NA; 21 specimens, 44.8-94.4 mm SL, Iran: Markazi Province, Qareh-Chay River, Namak Lake basin, 34°53' N, 050°02' E; coll. H. Mousavi-Sabet, S. Vatandoust, H. Bagherpour & A. Jouladeh-Roudbar. VMFC AL201NA2; 20 specimens, 46.5-77.2 mm SL, Iran: Markazi Province, Qareh-Chay River, Namak Lake basin, 34°53' N, 050°02' E; coll. H. Mousavi-Sabet & S. Vatandoust. VMFC AL201NA3; 10 specimens, 48.0-81.5 mm SL, Iran: Markazi Province, Qareh-Chay River, Namak Lake basin, 34°53' N, 050°02' E; coll. H. Mousavi-Sabet.



**Table 5.** Morphometric data of *Alburnoides eichwaldii* (GUIC AL201EI,  $n = 55$ ), and *A. holciki* (VMFC AL201HO,  $n = 36$ ).

	<i>A. eichwaldii</i>			<i>A. holciki</i>		
	range	mean	SD	range	mean	SD
Standard length (mm)	48.3-67.9			44.6-66.2		
<b>In percent of standard length</b>						
Head length	19.6-25.0	21.2	1.7	19.9-24.1	22.1	1.9
Body depth	26.9-32.4	29.1	1.5	25.2-30.8	27.8	1.3
Maximum body width	11.3-16.5	14.4	1.1	11.8-17.0	14.1	1.8
Dorsal-fin base	13.0-16.2	14.8	1.0	13.1-16.1	14.6	1.1
Dorsal-fin depth	19.4-24.6	23.2	1.4	17.5-23.7	20.5	1.6
Anal-fin base	13.1-19.2	16.7	2.3	17.4-21.8	19.4	2.1
Anal-fin depth	12.7-16.0	14.7	1.3	11.9-15.8	13.5	1.3
Pectoral-fin length	17.2-21.1	19.8	1.3	17.0-20.9	19.1	1.1
Pelvic-fin length	12.8-16.5	14.8	1.6	12.5-16.3	14.9	1.5
Predorsal distance	47.5-53.7	50.6	2.1	48.6-55.9	52.8	2.0
Preanal distance	60.2-65.8	62.8	1.7	61.3-66.1	62.2	1.5
Prepectoral length	17.2-23.5	20.8	2.5	18.0-24.6	21.8	2.6
Preventral distance	41.6-47.3	44.2	2.2	43.8-50.5	47.4	2.3
Dorsal-ventral distance	5.3-8.8	6.8	1.3	4.9-9.0	6.3	1.1
Pectoral-ventral distance	20.3-26.1	23.2	1.9	22.1-28.5	25.5	1.7
Ventral-anal distance	16.1-21.4	19.6	1.7	14.8-20.0	17.1	1.8
Caudal peduncle length	17.6-25.2	19.2	2.7	18.1-24.9	20.1	2.6
Caudal peduncle depth	11.0-13.1	11.2	0.7	10.2-12.8	9.6	0.9
Caudal peduncle width	6.5-8.8	7.1	0.9	6.2-9.1	7.0	1.0
Caudal upper lobe length	15.5-23.3	18.6	3.2	14.2-22.1	16.7	4.8
Caudal lower lobe length	15.1-23.0	17.0	2.9	15.3-22.8	17.1	2.8
<b>In percent of head length</b>						
Head depth	79.1-92.7	87.6	4.4	68.3-81.5	78.4	4.7
Head width	48.2-56.9	51.4	3.1	45.8-54.2	48.4	4.0
Interorbital distance	33.0-38.2	35.6	1.6	30.6-38.1	33.7	1.9
Internasal distance	18.8-22.7	21.3	1.3	15.7-22.0	19.8	1.6
Eye diameter	23.5-31.8	28.4	2.9	23.2-31.4	29.8	3.2
Pupil diameter	11.3-15.1	12.6	1.5	11.4-15.2	12.0	1.4
Preorbital distance	21.1-28.2	24.5	2.7	20.5-28.6	23.4	2.9
Postorbital distance	45.5-53.0	48.9	3.1	44.7-54.2	49.4	3.6

**Diagnosis.** According to original diagnosis (Bogutskaya & Coad, 2009), *Alburnoides namaki* is distinguished from the other species of *Alburnoides* in Iran by a combination of characters, none of them unique. *Alburnoides namaki* is distinguished from the congeners in Iran by the lack of strong spots or dark outline to the lateral line canal (however, some

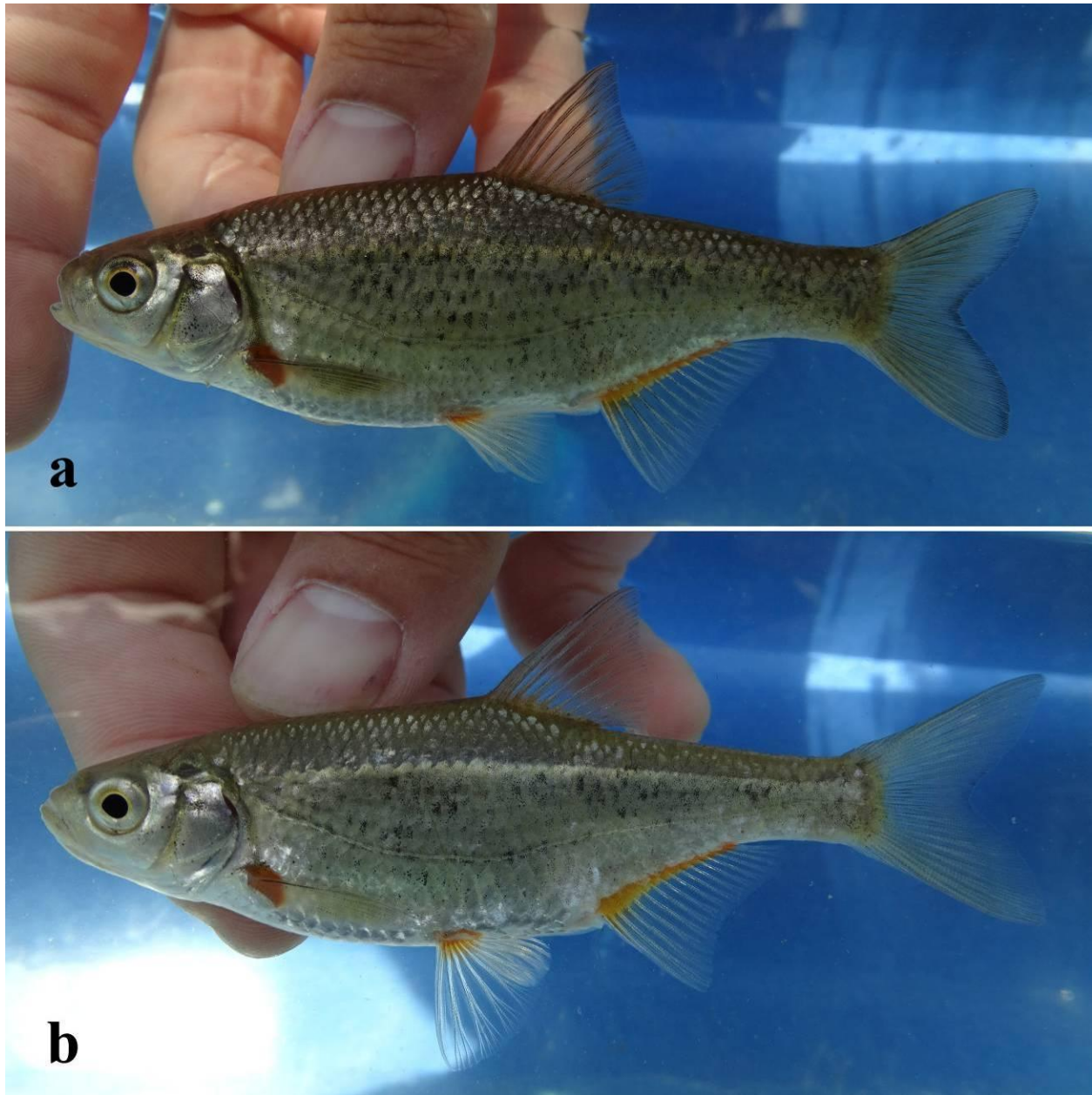
specimens have strong pigmentation above and below the lateral line pores, forming an evident pale line margined with dark. As mentioned by Bogutskaya & Coad (2009), a broad mid-flank stripe can be well developed or weakly expressed and, on the caudal peduncle, obscures the lateral line pigment pattern. The lateral line pattern can be weak and this can be seen over

the anal fin where the flank stripe does not extend down to the decurved lateral line); a small eye, the orbit width about equal to the snout length but markedly smaller than the interorbital width; caudal fin lobes rounded and fin shallowly forked; a sharp scaleless ventral keel behind the pelvic fins along the abdomen to the anus; a deep head with a stout snout which is markedly rounded; a small, almost subterminal mouth with the tip of the mouth cleft on a level from the lower margin of the eye or below; commonly  $8\frac{1}{2}$  branched dorsal-fin rays;  $10-13\frac{1}{2}$ , commonly  $11-12\frac{1}{2}$ , branched anal-fin rays; (43)44-50(52) total lateral line scales (42-51 scales to posterior margin of hypurals); 2.5-

4.2 pharyngeal teeth (or other variants with four teeth on the right ceratobranchial); commonly 39-41 total vertebrae; 11-13(14); a low number of predorsal vertebrae, commonly 12-13; 19-20(21) abdominal vertebrae; 19-21 caudal vertebrae; a caudal vertebral region most commonly equal to the abdominal region; and the most common vertebral formulae are  $20 + 20$ ,  $20 + 19$  and  $19 + 20$ . See Fig. 5 for general appearance, table 6 for morphometric data, and tables 2-4 for meristic and vertebral counts. See below for more details to distinguish *Alburnoides namaki* from the other Iranian *Alburnoides* species from the related water basins in northern and eastern parts, examined for this study.



**Fig. 4.** *Alburnoides idignensis*; Iran, Gamasiab River, VMFC AL201ID, (a) 51 mm SL, (b) 55 mm SL.



**Fig. 5.** *Alburnoides namaki*; Iran, Qareh-Chay River, VMFC AL201NA, (a) 71 mm SL, (b) 67 mm SL.

**Distribution.** *Alburnoides namaki* is known from the qanat in the Qareh-Chay drainage of the Namak Lake basin.

This species is restricted to the Namak Lake basin. About 25 years ago, Tave qanat has been dried and now there is no river or qanat around the type locality. This species is restricted to the Namak Lake basin. See Fig. 1 for the distribution of the species in Iran.

*Alburnoides nicolausi* Bogutskaya & Coad, 2009  
(Fig. 6)

**Material examined.** VMFC AL201NI; 38 specimens, 35.4-67.8 mm SL, Iran: Lorestan Province, Nurabad Stream, Gamasiab River, the Tigris River basin, 34°05' N, 48°00' E; coll. S. Vatandoust, A. Jouladeh-Roudbar & H. R. Bagherpour.

**Diagnosis.** According to original diagnosis, *Alburnoides nicolausi* is distinguished from the other species of *Alburnoides* in Iran by a combination of characters, none of them unique. *Alburnoides nicolausi* is distinguished by an eye of an average size, the orbit diameter larger than the snout length and smaller than the

interorbital width; caudal fin lobes rounded and fin shallowly forked; a variably scaled ventral keel though most commonly scaled only along about 1/3 of its length or scaleless; a deep head with a moderately stout snout which is slightly pointed; a tip of the mouth cleft on the level about the lower margin of the pupil, commonly

**Table 6.** Morphometric data of *Alburnoides idignensis* (VMFC AL201ID,  $n = 52$ ), and *A. namaki* (VMFC AL201NA,  $n = 51$ ).

	<i>A. idignensis</i>			<i>A. namaki</i>		
	Range	Mean	SD	Range	Mean	SD
Standard length (mm)	49.0-82.4			44.8-94.4		
<b>In percent of standard length</b>						
Head length	22.6-28.2	24.6	1.8	22.2-28.3	23.5	1.9
Body depth	28.6-33.9	31.1	1.7	26.4-31.3	28.3	1.7
Maximum body width	14.1-17.0	15.5	1.2	13.2-16.8	14.2	1.0
Dorsal-fin base	13.4-16.7	14.6	1.3	12.1-16.0	13.8	1.1
Dorsal-fin depth	16.7-22.0	19.3	1.6	16.1-22.6	19.4	1.4
Anal-fin base	14.1-19.5	17.4	2.1	14.4-19.9	17.4	2.0
Anal-fin depth	11.0-14.1	12.6	1.6	13.2-17.4	15.4	1.3
Pectoral-fin length	16.1-19.8	17.6	1.4	16.0-20.2	17.1	1.3
Pelvic-fin length	12.5-15.7	13.9	1.5	13.0-16.3	14.5	1.4
Predorsal distance	49.2-55.1	51.1	2.0	51.1-57.5	53.4	1.8
Preanal distance	61.7-67.2	63.3	2.2	63.8-69.1	65.3	1.9
Prepectoral length	20.2-26.0	22.8	1.8	21.4-27.7	24.4	2.0
Preventral distance	42.9-49.1	45.8	2.2	42.2-50.1	45.9	2.1
Dorsal-ventral distance	4.4-8.7	5.3	1.3	4.5-8.9	6.5	1.2
Pectoral-ventral distance	22.5-27.8	25.1	1.7	20.8-26.2	22.9	1.9
Ventral-anal distance	14.7-19.4	17.2	1.4	16.0-20.8	19.7	1.5
Caudal peduncle length	16.7-24.1	20.3	2.1	14.9-22.3	18.1	2.2
Caudal peduncle depth	11.5-12.7	12.4	0.4	9.2-12.1	10.5	0.4
Caudal peduncle width	6.9-9.2	7.6	0.7	6.4-9.0	6.9	0.7
Caudal upper lobe length	13.3-26.6	18.0	5.9	12.4-25.8	19.3	4.8
Caudal lower lobe length	13.1-19.8	16.2	3.1	14.2-21.2	17.8	2.8
<b>In percent of head length</b>						
Head depth	72.8-85.5	81.9	4.2	68.0-82.6	78.1	4.3
Head width	47.5-56.3	52.1	3.8	46.7-55.9	50.2	4.5
Interorbital distance	29.1-35.5	32.8	1.5	30.3-38.0	34.7	1.7
Internasal distance	17.2-21.2	18.7	1.3	15.9-20.7	18.5	1.4
Eye diameter	22.6-30.3	26.5	2.8	24.6-35.5	31.4	3.3
Pupil diameter	11.3-16.4	13.3	1.6	13.5-18.6	15.5	1.5
Preorbital distance	19.5-28.2	23.3	2.6	19.2-29.1	24.8	2.9
Postorbital distance	47.2-56.0	51.4	2.9	43.1-48.5	45.0	1.6



**Fig. 6.** *Alburnoides nicolausi*; Iran, Nurabad Stream, VMFC AL201NI, (a) 67 mm SL, (b) 46 mm SL (Photograph by Arash Jouladeh-Roudbar).

7½ branched dorsal-fin rays; 8-11½ branched anal-fin rays; (43)43-47(48-50) total lateral line scales (42-48 scales to posterior margin of hypurals); commonly 2.5-4.2 or 2.4-4.2 pharyngeal teeth; commonly 39-40 total vertebrae. See Fig. 6 for general appearance, table 7 for morphometric data, and tables 2-4 for meristic and vertebral counts. See below for more details to distinguish *A. nicolausi* from the other Iranian *Alburnoides* species examined for this study.

**Distribution.** *Alburnoides nicolausi* is only known from its type locality, a stream in the Simareh River drainage at Nurabad. This species is restricted to the Tigris River basin. See Fig. 1 for the distribution of the species in Iran.

*Alburnoides petrubanarescui* Bogutskaya & Coad, 2009

**Material examined.** None.

**Diagnosis.** According to original diagnosis, *Alburnoides petrubanarescui* is distinguished from the other species of *Alburnoides* in Iran by a combination of characters, none of them unique. *Alburnoides petrubanarescui* is distinguished from the congeners in Iran by a small eye; the orbit width about equal to the snout length but markedly smaller than the interorbital width; caudal fin lobes rounded and the fin shallowly forked; a scaled ventral keel behind the pelvic fins along the abdomen to the anus, a deep head with a stout snout which is markedly rounded; a

tip of the mouth cleft on the level below the lower margin of the eye; commonly 7½ (less frequently 8½) branched dorsal-fin rays; 8-10½,

commonly 9½, branched anal-fin rays; 44-51 total lateral line scales (42-49 scales to posterior margin of hypurals); 2.5- 4.2 pharyngeal teeth

**Table 7.** Morphometric data of *Alburnoides nicolausi* (VMFC AL201NI,  $n = 38$ ), and *A. qanati* (VMFC AL201QA,  $n = 50$ ).

	<i>A. nicolausi</i>			<i>A. qanati</i>		
	Range	Mean	SD	Range	Mean	SD
Standard length (mm)	35.4-67.8			44.1-71.0		
<b>In percent of standard length</b>						
Head length	24.1-29.9	26.8	1.7	22.2-28.6	24.3	2.1
Body depth	27.5-32.7	29.9	1.5	24.2-30.1	26.8	1.7
Maximum body width	13.2-17.0	14.9	1.2	13.1-17.5	15.2	1.4
Dorsal-fin base	12.4-16.1	13.3	1.3	13.0-16.8	14.7	1.1
Dorsal-fin depth	15.5-22.0	18.0	1.8	18.2-25.8	22.0	1.7
Anal-fin base	12.4-18.6	15.4	1.9	11.2-18.1	13.7	1.9
Anal-fin depth	9.8-13.8	11.6	1.3	11.7-16.6	14.9	1.5
Pectoral-fin length	17.4-21.0	19.1	1.1	17.2-20.9	19.8	1.0
Pelvic-fin length	13.2-16.5	14.3	1.2	13.5-17.1	15.4	1.1
Predorsal distance	52.1-58.2	54.2	2.1	48.6-54.5	51.3	1.8
Preanal distance	62.7-67.1	64.8	1.7	62.2-68.0	65.1	1.5
Prepectoral length	23.1-29.5	26.3	1.9	21.2-27.7	23.8	2.4
Preventral distance	46.8-51.7	48.6	1.4	45.1-51.5	47.1	1.5
Dorsal-ventral distance	4.5-8.0	5.2	1.6	4.6-8.8	6.1	1.4
Pectoral-ventral distance	18.9-23.8	21.4	1.7	19.8-26.3	23.0	2.1
Ventral-anal distance	17.6-23.5	20.1	1.9	16.0-22.2	19.4	1.4
Caudal peduncle length	15.4-22.2	17.9	2.6	16.8-23.6	20.3	2.3
Caudal peduncle depth	13.5-17.0	15.8	1.0	10.0-12.7	11.1	0.6
Caudal peduncle width	7.1-9.5	8.0	0.6	6.8-9.2	7.4	0.8
Caudal upper lobe length	15.9-23.7	19.2	3.6	17.5-26.8	22.3	4.0
Caudal lower lobe length	15.7-23.0	18.1	2.8	16.0-23.4	18.9	2.4
<b>In percent of head length</b>						
Head depth	73.5-81.8	77.7	3.9	73.2-81.1	76.4	4.1
Head width	45.1-55.0	48.7	3.5	47.3-58.5	51.4	3.8
Interorbital distance	28.3-34.5	30.2	1.6	28.7-33.2	30.1	1.5
Internasal distance	15.5-20.2	17.4	1.4	15.7-21.0	17.8	1.5
Eye diameter	22.2-30.4	27.3	2.6	24.7-33.3	29.0	3.2
Pupil diameter	10.2-15.3	12.0	1.7	9.6-13.9	11.1	1.8
Preorbital distance	18.7-27.2	22.2	2.5	20.8-28.8	24.4	2.6
Postorbital distance	44.5-53.1	48.1	2.8	43.0-51.6	46.7	2.5

(or other variants with four teeth on the right ceratobranchial); commonly 40-41 total vertebrae. See tables 2-4 for meristic and vertebral counts. See below for more details to distinguish *A. petrubanarescui* from the other Iranian *Alburnoides* species examined for this study.

**Distribution.** *Alburnoides petrubanarescui* is only known from Qasemlou-Chay, Orumiyeh [Urmia] Lake basin.

This species is an endemic species to the Orumiyeh Lake basin and restricted to the basin. See Fig. 1 for the distribution of the species in Iran.

*Alburnoides qanati* Coad & Bogutskaya, 2009  
(Fig. 7)

**Material examined.** VMFC AL201QA1; 21 specimens, 45.7-70.3 mm SL, Iran: Fars province, Kor River, Kor River basin, 30°17' N, 52°18' E; coll. H. Mousavi-Sabet, S. Vatansoust. VMFC AL201QA2; 29, 44.1-71.0 mm SL, Iran: Fars province, Kor River, Kor River basin, 30°28' N, 52°05' E; coll. H. Mousavi-Sabet, S. Eagderi.

**Diagnosis.** According to original diagnosis, *Alburnoides qanati* is distinguished from the other species of *Alburnoides* in Iran by a combination of characters, none of them unique.



**Fig. 7.** *Alburnoides qanati*; Iran, Kor River, VMFC AL201QA, (a) 65 mm SL, (b) 59 mm SL.

*Alburnoides qanati* is distinguished from the congeners in Iran by a large eye, the orbit width exceeding both the snout length and the interorbital width; a scaled ventral keel behind the pelvic fins along the abdomen to the anus; commonly 43-47 lateral line scales to posterior margin of hypurals; 2.5-4.2 pharyngeal teeth; commonly 8½ branched dorsal-fin rays; 10½-12½ branched anal-fin rays; 40-41 total vertebrae. See Fig. 7 for general appearance, table 7 for morphometric data, and tables 2-4 for meristic and vertebral counts. See below for more details to distinguish *A. qanati* from the other Iranian *Alburnoides* species examined for this study.

**Distribution.** *Alburnoides qanati* is only known from Pulvar River drainage, Kor River endorheic basin. The type series was collected from a small stream which issues from a qanat near the archaeological site of Naqsh-e-Rostam to the northeast of Persepolis. This species is an endemic species and restricted to the Kor River basin. See Fig. 1 for the distribution of the species in Iran.

*Alburnoides tabarestanensis* Mousavi-Sabet,  
Anvarifar & Azizi, 2015  
(Fig. 8)

**Material examined.** VMFC AL201MH, 68.3 mm SL; Holotype. VMFC AL2049P, 45 specimens, 33.7-83.0 mm SL; GUIC ALT-P, 4 specimens, 36.4-65.2 mm SL Iran, Paratypes. Iran: Mazandaran Province, Tajan River, the southern Caspian Sea basin, 36°11' N, 53°19' E; coll. H. Mousavi-Sabet, S. Vatandoust & H. Anvarifar.

**Diagnosis.** According to original diagnosis, *A. tabarestanensis* is distinguished from the other species of *Alburnoides* in Iran by a combination of characters, none of them unique. *Alburnoides tabarestanensis* is distinguished from the congeners in Iran by a completely scaleless

ventral keel (most common); the lack of well-marked spots or dark pigmentation in the lateral line canal; terminal mouth with the tip of the mouth cleft between level of middle of pupil and lower margin of pupil; 47-52 lateral line scales to posterior margin of hypurals; typically 9 or 10 scale rows between lateral line and dorsal fin origin; 2.5-4.2 pharyngeal teeth; usually 4 or 5 scale rows between lateral line and anal fin origin; commonly 16-18 scales around caudal peduncle; typically 39-41 total vertebrae; usually 8½ branched dorsal-fin rays; commonly 12½ or 13½ branched anal fin rays; usually 7 branched pelvic fin rays; commonly 11-13 branched pectoral fin rays; usually 8 or 9 gill rakers in the outer row on first left arch. See Fig. 8 for general appearance, table 8 for morphometric data, and tables 2-4 for meristic and vertebral counts. See below for more details to distinguish *A. tabarestanensis* from the other Iranian *Alburnoides* species examined for this study.

**Distribution.** *Alburnoides tabarestanensis* is only known from Tajan River in the south-eastern Caspian Sea basin. This species is an endemic species and restricted to the Caspian Sea basin. See Fig. 1 for the distribution of the species in Iran.

*Alburnoides coadi*, new species  
(Figs. 9-11)

**Holotype.** VMFC-ALK2-H, 107.9 mm SL; Iran, Tehran Province, Namroud River, Hableroud River drainage, Kavir basin, 35°43' N, 52°39' E; coll. H. Mousavi-Sabet & S. Vatandoust, 15 September 2012.

**Paratypes.** VMFC-ALK2-P1 to VMFC-ALK2-P45, 45 specimens, 55.2-81.4 mm SL; collected with holotype. GUIC-ALK2-P1 to GUIC-ALK2-P4, 4 specimens, 58.2-66.0 mm SL; collected with holotype.





**Fig. 8.** *Alburnoides tabarestanensis*; Iran, Tajan River, (a) VMFC AL201MH, 68 mm SL, (b) VMFC AL2049P, 66 mm SL.

**Diagnosis:** *Alburnoides coadi*, sp. n., is distinguished from the other species of *Alburnoides* in Iran diagnosed above by a combination of the following characters: an eye of a relatively small size, the orbit diameter larger than the snout length and markedly smaller than the interorbital width; caudal fin lobes rounded and fin moderately forked; a variably scaled ventral keel though most commonly scaled along about 2/3 of its length, or a completely scaled ventral keel; a deep head with a markedly rounded and stout snout; a small mouth which is between terminal and

subterminal; a tip of the mouth cleft on a level from the lower margin of the pupil or somewhat below it; the lack of well-marked spots or dark pigmentation in the lateral line canal; 47-52 lateral line scales to posterior margin of hypurals; typically 9 or 10 scale rows between lateral line and dorsal fin origin; usually 5 or 6 scale rows between lateral line and anal fin origin; 2.5-4.2 pharyngeal teeth; commonly 17-19 scales around caudal peduncle; typically 39-41, with a mode of 40, total vertebrae; 13-14 predorsal vertebrae, 19-20 abdominal vertebrae, 19-21 caudal vertebrae; caudal vertebral region

equal or slightly longer than an abdominal region (vertebral formulae 19 + 20, 20 + 20 and 20 + 21); usually 8½ branched dorsal-fin rays; commonly 12½-13½ branched anal fin rays;

usually 8 or 9 gill rakers in the outer row on first left arch. Detailed comparisons with congeners found in Iranian waters are given in the comparative remarks.

**Table 8.** Morphometric data of *Alburnoides tabarestanensis* (paratypes: VMFC AL2049P,  $n = 45$ ; GUIC ALT-P,  $n = 4$ ), and *A. coadi* sp. n. (holotype VMFC-ALK2-H, paratypes: VMFC-ALK2-P,  $n = 45$ ; GUIC-ALK2-P,  $n = 4$ ). H, holotype.

	<i>A. tabarestanensis</i>			<i>A. coadi</i> sp. n.			
	Range	Mean	SD	H	Range	Mean	SD
Standard length (mm)	34.0-83.0			107.9	55.2-81.4		
<b>In percent of standard length</b>							
Head length	24.7-27.9	26.1	0.8	23.8	23.8-29.7	25.9	1.9
Body depth	23.7-33.7	29.0	2.6	33.8	28.9-33.8	30.8	1.6
Maximum body width	10.4-15.5	12.3	1.1	17.1	14.3-17.1	15.7	1.0
Dorsal-fin base	12.6-16.6	14.1	1.0	13.4	13.2-16.4	14.7	1.2
Dorsal-fin depth	22.2-27.5	24.3	1.2	19.5	19.5-24.1	22.1	1.5
Anal-fin base	14.7-21.0	17.5	1.2	19.5	14.3-19.8	17.5	2.2
Anal-fin depth	14.0-19.6	17.2	1.0	14.5	13.9-16.7	15.7	1.1
Pectoral-fin length	19.0-23.6	21.4	1.0	17.5	17.5-20.9	19.1	1.2
Pelvic-fin length	14.3-18.4	16.5	0.8	13.6	13.6-16.8	14.8	1.2
Predorsal distance	50.5-56.0	53.4	1.3	53.9	52.2-57.8	54.0	1.9
Preanal distance	61.8-68.7	65.6	1.7	64.8	64.8-69.0	66.8	1.6
Prepectoral length	23.7-27.0	25.2	0.8	23.0	23.0-29.8	26.8	2.3
Preventral distance	42.2-51.3	47.5	1.5	47.9	47.3-52.0	49.5	2.0
Dorsal-ventral distance	5.8-7.7	6.9	0.5	5.5	4.8-9.1	6.1	1.4
Pectoral-ventral distance	20.5-25.8	23.1	1.2	27.6	22.9-27.6	25.7	2.0
Ventral-anal distance	17.1-21.9	19.3	1.3	16.2	16.2-20.7	18.9	1.5
Caudal peduncle length	16.1-22.9	19.1	1.5	20.7	17.2-24.6	19.7	2.5
Caudal peduncle depth	10.3-14.4	12.2	0.9	11.9	11.7-12.6	12.0	0.3
Caudal peduncle width	5.9-9.4	7.8	0.8	7.4	7.0-9.3	7.7	0.8
Caudal upper lobe length	18.8-24.9	21.6	1.8	15.7	15.7-26.9	22.1	2.8
Caudal lower lobe length	18.1-24.3	21.1	1.5	17.3	17.3-23.7	21.1	2.0
<b>In percent of head length</b>							
Head depth	71.4-81.0	75.7	2.4	73.9	67.1-80.7	75.5	4.6
Head width	47.4-57.3	53.7	2.1	60.3	49.4-60.3	53.9	4.1
Interorbital distance	31.1-41.8	36.9	2.2	36.2	34.1-38.6	36.4	1.4
Internasal distance	19.5-27.1	22.3	2.0	21.4	18.7-22.1	20.4	1.2
Eye diameter	23.6-34.0	28.0	2.5	21.4	21.4-30.5	27.4	3.0
Pupil diameter	12.8-17.4	14.8	1.0	14.8	14.4-18.2	15.7	1.3
Preorbital distance	24.8-31.9	28.9	1.4	27.6	21.6-29.4	25.7	2.8
Postorbital distance	44.3-54.8	49.6	2.6	56.4	47.6-56.4	52.4	3.4



**Fig. 9.** *Alburnoides coadi* sp. n.; Iran, Tehran Province, Namroud River, holotype, VMFC-ALK2-H, 107.9 mm SL.

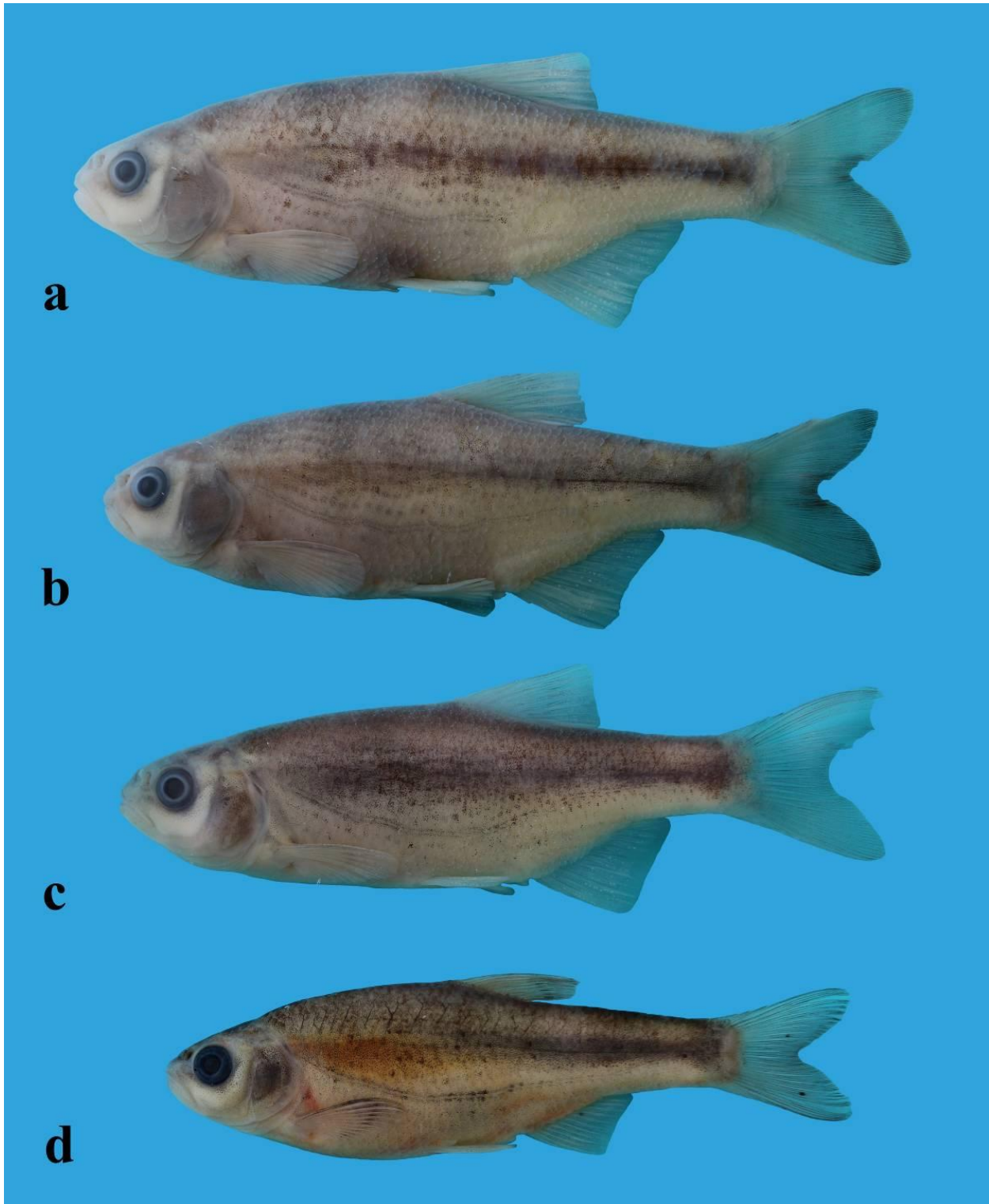
**Description:** General appearance shown in Figs. 9-11. Morphometric data presented in table 8. Meristic and vertebral counts presented in tables 2-4. Body is moderately compressed, upper body profile convex to slightly straight; lower profile convex. The ventral keel between the pelvics and anal fin is variably scaled: scaled along about 2/3 of its length or completely scaled. Anal-fin origin is in front of a vertical from posterior end of the dorsal fin base. Snout markedly stout and rounded. Mouth terminal to subterminal; tip of the mouth cleft on a level from the lower margin of the pupil or somewhat below it. Mouth cleft oblique, upper jaw slightly to moderately longer than lower jaw, junction of lower jaw and quadrate at vertical through the lower part of anterior eye margin. Dorsal-fin origin behind a vertical through pelvic-fin origin. Pectoral fin short, not reaching pelvic fin origin (pectoral fin 3-5 scale rows shorter than pectoral-pelvic distance), its outer margin convex. Pelvic fin rounded, its tip not reaching to anus. Caudal fin moderately forked, its lobes rounded.

Body depth enters standard length 3.0-3.5 times, head length enters 3.7-4.2, predorsal length 1.7-1.9, caudal peduncle depth 8.0-8.5, and caudal

peduncle length 4.8-5.8. Orbit width enters head length 3.5-4.7 times, snout length enters 3.6-4.6, and interorbital width 2.6-2.9. Pectoral fin length enters pectoral fin origin to pelvic fin origin distance 0.7-0.9 times, and pelvic fin length enters pelvic fin origin to anal fin origin distance 0.7-0.8 times.

Dorsal fin unbranched rays 3, dorsal fin branched rays  $7\frac{1}{2}$  (4) or  $8\frac{1}{2}$  (46) (mean 7.92, standard deviation 0.27), anal fin unbranched rays 3, anal fin branched rays  $11\frac{1}{2}$  (2),  $12\frac{1}{2}$  (26),  $13\frac{1}{2}$  (19) or  $14\frac{1}{2}$  (3) (mean  $12.46 \pm 0.68$ ), pectoral fin branched rays 11(8), 12(17), 13(23) or 14(2) (mean  $12.38 \pm 0.81$ ), pelvic fin branched rays 6(3) or 7(47) (mean  $6.94 \pm 0.24$ ). Pelvic axillary scale present, its length is about 3-4 scale rows. Dorsal and anal fins outer margins truncate to slightly concave.

Lateral line complete with 0, 1 or 2 unpored scales at the posterior end of the lateral series; lateral line scales to posterior margin of hypurals 47(2), 48(18), 49(19), 50(6) or 51(5) (mean  $48.88 \pm 1.02$ ); scales above lateral line to dorsal fin origin 9(10), 10(38) or 11(4) (mean  $9.92 \pm 0.49$ ); scales below lateral line to anal fin origin 4(19), 5(24) or 6(7) (mean  $4.76 \pm 0.69$ ); scales below lateral line to pelvic fin origin 4(29),



**Fig. 10.** *Alburnoides coadi* sp. n.; Iran, Tehran Province, Namroud River, paratype; **a**, VMFC-ALK2-P1, 81 mm SL; **b**, VMFC-ALK2-P3, 76 mm SL; **c**, VMFC-ALK2-P4, 71 mm SL; **d**, VMFC-ALK2-P5, 64 mm SL.

5(20) or 6(1) (mean  $4.44 \pm 0.54$ ); total scale radii 16(7), 17(10), 18(28) or 19(5) (mean  $17.62 \pm 0.85$ ).

Total gill rakers at outer row on first left arch number 8(25), 9(23) or 10(2) (mean  $8.54 \pm 0.58$ ).

Total vertebrae including four Weberian vertebrae and last hypural complex centrum 39(15), 40(26) or 41(9) (mean  $39.88 \pm 0.69$ ). Thirteen to 14 predorsal vertebrae; 19-20 abdominal vertebrae, 19-21 caudal vertebrae; caudal vertebral region most commonly equal to the abdominal region; most common vertebrae formulae 19 + 20, 20 + 20, or 20 + 21. Pharyngeal teeth 2.5-4.2 in 10 examined specimens.

**Colouration:** In living specimens (Fig. 11), overall colouration is silvery, with the bases of the pectoral (markedly), pelvic and anal fins (slightly) orange. Dorsum and top of head are light to dark grey, with a pale olive hue. Facial bones and opercle silvery, top of head light grey. The lower portion of head and body are pearly-white. The flanks above lateral line may have a golden hue. Faint yellow spots occur in rows along the flanks in some specimens. Pigmentation of preserved specimens fixed in 10% formalin and stored in 70% alcohol (Figs. 9-10) overall tan, darker dorsally; horizontal rows of dark blotches formed by dark pigmentation concentrated on middle of scales, moderately conspicuous, above the lateral line; lateral line

with some scales with pores outlined with dark pigmentation, especially the anterior-most scales; narrow dark mid-lateral stripe along lateral septum, more discernible from vertical through dorsal fin onwards; a faint, broad grey mid-lateral stripe; fins mostly hyaline, with some black pigmentation lining caudal fin rays.

**Distribution and notes on biology:** *Alburnoides coadi* is known only from Namroud River, Hableroud River drainage, in Kavir basin, northern part of Iran (Fig. 1). The upstream portion of Namroud River at the type locality at time of the collection of the type specimens (Fig. 12) had clear water, with medium to fast water flow. The stream width was about 3 m and maximum depth was up to 1 m, with grassy shores, submergent plants, and the stream bed was gravel and mud. Other species collected syntopically were *Barbus* sp., *Capoeta aculeata* (Valenciennes, 1844), *Capoeta buhsei* Kessler, 1877, *Carassius auratus* (Linnaeus, 1758), *Carassius gibelio* (Bloch, 1782), *Squalius* cf. *orientalis* (Nordmann, 1840), *Paracobitis malapterura* (Valenciennes, 1846), and *Oncorhynchus mykiss* (Walbaum, 1792).



**Fig. 11.** *Alburnoides coadi* sp. n., holotype, VMFC-ALK2-H, 107.9 mm SL.



**Fig. 12.** Namroud River, Kavir basin; type locality of *A. coadi* sp. n.

**Etymology:** The species name *coadi* is in honor of Brian W. Coad (the Canadian Museum of Nature, Ottawa), the most famous ichthyologist who studied Iranian freshwater fishes, especially the genus *Alburnoides*.

**Comparative remarks:** *Alburnoides coadi* differs from *A. eichwaldii*, *A. holciki*, *A. namaki*, *A. nicolausi* and *A. tabarestanensis* by its completely or almost completely scaled ventral keel (vs. most commonly 2/3 or completely scaleless ventral keel). *Alburnoides coadi* is further distinguished from *A. holciki*, *A. parhami* and *A. qanati* by having a rounded snout (vs. pointed), and the tip of the mouth cleft on a level with the lower margin of the pupil to below the lower margin of the eye (vs. a tip of the mouth on a level with the upper half of the pupil).

*Alburnoides coadi* is further distinguished from *A. eichwaldii* by having less scales above lateral line to dorsal fin origin (commonly 9-10 vs. 11), less scales below lateral line to anal fin origin (typically 4-5 vs. 7), precaudal and caudal vertebrae equal in number or precaudal one vertebrae longer than it (vs. the caudal region is commonly one vertebrae shorter than the abdominal region), mid fins located at more posterior levels (predorsal 52.2-57.8, mean 54.0 in SL, vs. 47.5-53.7, mean 50.6 in SL, preanal 64.8-69.0, mean 66.8 in SL, vs. 60.2-65.8, mean 62.8 in SL, prepectoral 23.0-29.8, mean 26.8 in SL, vs. 17.2-23.5, mean 20.8 in SL, and preventral 47.3-52.0, mean 49.5 in SL, vs. 41.6-47.3, mean 44.2 in SL), and tip of the mouth cleft commonly at level of the lower margin of the eye or below (vs. at level of the middle of the eye).

*Alburnoides coadi* further differs from *A. holciki* by having fewer anal fin branched rays (commonly  $12\frac{1}{2}$ - $13\frac{1}{2}$  vs.  $14\frac{1}{2}$ - $16\frac{1}{2}$ ), less numerous total vertebrae (commonly 39-40 vs. 41-42), shorter anal fin base (14.3-19.8, mean 17.5 in SL, vs. 17.4-21.8, mean 19.4 in SL), mid fins located at more posterior levels, and the tip of the mouth cleft commonly at level of the lower margin of the eye or below (vs. at level with the upper half of the pupil).

*Alburnoides coadi* is further distinguished from *A. idignensis* by having more anal fin branched rays (commonly  $12\frac{1}{2}$ - $13\frac{1}{2}$  vs.  $11\frac{1}{2}$ - $12\frac{1}{2}$ ), 39-41 total vertebrae (vs. 38-40), 47-51 lateral line scales (vs. 41-46 lateral line scales), total scale radii 16-19, median 18 (vs. 12-17, median 15), mid fins located at more posterior levels, and normally  $12\frac{1}{2}$ - $13\frac{1}{2}$  anal fin branched rays (vs.  $11\frac{1}{2}$ - $12\frac{1}{2}$ ).

*Alburnoides coadi* is further distinguished from *A. namaki* by having less branched anal fin rays (commonly  $11\frac{1}{2}$ - $12\frac{1}{2}$ , vs.  $12\frac{1}{2}$ - $13\frac{1}{2}$ ), smaller scales (commonly 47-51, median 49, vs. 46-49, median 47), more numerous gill rakers (commonly 8-9 vs. 6-8), scales above lateral line to dorsal fin origin (commonly 9-10 vs. 10-11), a relatively smaller eye (21.4-30.5, mean 27.4 in HL, vs. 24.6-35.5, mean 31.4 in HL), deeper caudal peduncle (caudal peduncle depth 11.7-12.6, mean 12.0 in SL, vs. 9.2-12.1, mean 10.5 in SL), and longer post orbital distance (47.6-56.4, mean 52.4 in HL, vs. 43.1-48.5, mean 45.0 in HL). *Alburnoides coadi* is further differs from *A. nicolausi* by having more branched dorsal-fin rays (commonly  $8\frac{1}{2}$  vs.  $7\frac{1}{2}$ ), more branched anal-fin rays ( $12\frac{1}{2}$ - $13\frac{1}{2}$  vs.  $9\frac{1}{2}$ - $11\frac{1}{2}$ ), more gill rakers (8-9 vs. 7-8), smaller scales (commonly 47-51, median 49, vs. 42-50, median 44), total scale radii 16-19, median 18 (vs. 13-17, median 15), and completely or almost completely scaled ventral keel (vs. most commonly 2/3 or completely scaleless ventral keel).

*Alburnoides coadi* is further distinguished from *A. petrubanarescui* by having more branched dorsal-fin rays (commonly  $8\frac{1}{2}$  vs.  $7\frac{1}{2}$ ), more branched

anal-fin rays (commonly  $12\frac{1}{2}$ - $13\frac{1}{2}$  vs.  $9\frac{1}{2}$ - $10\frac{1}{2}$ ), and more gill rakers counts (8-9 vs. 7-8).

*Alburnoides coadi* further differs from *A. qanati* by having more branched anal-fin rays (commonly  $12\frac{1}{2}$ - $13\frac{1}{2}$  vs.  $11\frac{1}{2}$ - $12\frac{1}{2}$ ), smaller scales (commonly 48-49 vs. 43-47), more gill rakers (commonly 8-9 vs. 6-8), and total scale radii commonly 16-19 (vs. 11-16).

*Alburnoides coadi* is further distinguished from *A. tabarestanensis* by having 13-14, median 13 predorsal vertebrae (vs. 12-13, median 12), shorter snout (21.6-29.4, mean 25.7 in HL, vs. 24.8-31.9, mean 28.9 in HL), and completely or almost completely scaled ventral keel (vs. most commonly 2/3 or completely scaleless ventral keel). See below for more details to distinguish *A. coadi* from the other Iranian *Alburnoides* species described in this study.

#### *Alburnoides parhami*, new species

(Figs. 13-15)

**Holotype.** VMFC-ALP3-H, 66.5 mm SL; Iran, Khorasan-e-Shomali Province, Baba-Aman Stream, Atrak River drainage, the south-eastern Caspian Sea basin,  $37^{\circ}29'$  N,  $57^{\circ}26'$  E; coll. H. Mousavi-Sabet, B. Ganjbakhsh & A. Jouladeh-Roudbar, 10 Noveber 2013.

**Paratypes.** VMFC-ALP3-P1 to VMFC-ALP3-P45, 45 specimens, 39.9-62.0 mm SL; collected with holotype. GUIC-ALP3-P1 to GUIC -ALP3-P4, 4 specimens, 43.1-53.5 mm SL; collected with holotype.

**Diagnosis:** *Alburnoides parhami* is distinguished from the other species of *Alburnoides* in Iran diagnosed above by a combination of the following characters: most commonly a sharp, scaleless ventral keel; a long, slightly pointed snout; a terminal mouth with the tip of the mouth cleft on a level with the upper half of the pupil; the lack of well-marked spots or dark pigmentation in the lateral line canal; a large eye



**Fig. 13.** *Alburnoides parhami* sp. n.; Iran, Khorasan-e-Shomali Province, Baba-Aman Stream, Atrak River drainage, holotype, VMFC-ALP3-H, 66.5 mm SL.

(orbit width about equal to interorbital width); 46–51 lateral line scales to posterior margin of hypurals; commonly 2.5–5.2 pharyngeal teeth; commonly  $8\frac{1}{2}$  branched dorsal-fin rays; commonly  $12\frac{1}{2}$  or  $13\frac{1}{2}$  branched anal fin rays; typically 10 scale rows between lateral line and dorsal fin origin; 39–41, usually 40–41, total vertebrae; caudal vertebral region equal or slightly longer than abdominal region (most frequent vertebral formulae  $20 + 20$  and  $20 + 21$ ); and usually 12 or 13 predorsal vertebrae. Detailed comparisons with congeners found in Iranian waters are given in the comparative remarks.

**Description:** General appearance shown in Figs. 13–15. Morphometric data presented in table 9. The body is markedly compressed. The upper body profile is moderately rounded while the lower profile is more convex or both profiles are about equally convex. The ventral keel between the pelvic and anal fins is well-developed, sharp, protruding, and most commonly scaleless (rarely scaled along  $1/4$  of its length). The eye is large, orbit width about equal to interorbital width. The snout is relatively long, and slightly pointed. The mouth is terminal, with the tip of the mouth cleft on a level with the upper half of the pupil. The mouth cleft is always turned upward, and the junction of the lower jaw and

the quadrate is on about a vertical through the anterior eye margin. Anal-fin origin at vertical through dorsal-fin base end, its outer margin truncate to slightly concave. Dorsal fin located behind vertical through pelvic fin insertion, its outer margin truncate to slightly round.

Pectoral fin long, commonly reaching pelvic fin insertion, its outer margin convex.

Pelvic fin rounded, its tip normally reaching or slightly behind anus, in some specimens reaching anal fin base. Pelvic axillary scale present. Caudal-fin lobes are pointed, the fin is clearly forked.

Body depth enters standard length 3.4–4.0 times, head length enters 3.6–4.0, predorsal length 1.9–2.1, caudal peduncle depth 8.7–9.8, and caudal peduncle length 4.6–4.9. Orbit width enters head length 3.1–3.5 times, snout length enters 3.1–3.7, and interorbital width 3.0–3.5. Pectoral fin length enters pectoral fin origin to pelvic fin origin distance 0.9–1.2 times, and pelvic fin length enters pelvic fin origin to anal fin origin distance 0.9–1.1 times.

Dorsal fin unbranched rays 3, dorsal fin branched rays  $7\frac{1}{2}$  (2),  $8\frac{1}{2}$  (47) or  $9\frac{1}{2}$  (1) (mean 7.98, standard deviation 0.25), anal fin unbranched rays 3, anal fin branched rays  $11\frac{1}{2}$  (4),  $12\frac{1}{2}$  (25),  $13\frac{1}{2}$  (19) or  $14\frac{1}{2}$  (2) (mean  $12.38 \pm 0.70$ ), branched pectoral fin rays 11(18), 12(24),



13(7) or 14(1) (mean  $11.82 \pm 0.75$ ), pelvic fin branched rays 6(6) or 7(44) (mean  $6.88 \pm 0.33$ ). Lateral line complete with 0, 1 or 2 unpored scales at the posterior end of the lateral series; lateral line scales to posterior margin of hypurals 46(1), 47(4), 48(23), 49(12), 50(5), 51(4) or 52(1) (mean  $48.64 \pm 1.21$ ); scales above lateral line to dorsal fin origin 8(1), 9(8), 10(39) or 11(2) (mean  $9.84 \pm 0.51$ ); scales below lateral line to anal fin origin 3(1), 4(47) or 5(2) (mean  $4.02 \pm 0.25$ ); scales below lateral line to pelvic fin origin 3(3), 4(45) or 5(2) (mean  $3.98 \pm 0.32$ ). Total scale radii 16(7), 17(26), 18(14) or 19(3) (mean  $17.26 \pm 0.78$ ). Total gill rakers at outer row on first left arch number 6(2), 7(18), 8(27) or 9(3) (mean  $7.62 \pm 0.67$ ). Total vertebrae including four Weberian vertebrae and last hypural complex centrum 39(3), 40(32) or 41(15) (mean  $40.24 \pm 0.56$ ). Twelve to 13 predorsal vertebrae; 19(1), 20(57) or 21(2) abdominal vertebrae, 19(2), 20(42) or 21(16) caudal vertebrae; caudal vertebral region most commonly equal to the abdominal region; most common vertebrae formulae  $20 + 20$  or  $20 + 21$ . Pharyngeal teeth 2.5-5.2 (8) and 2.5-4.2 (2) in 10 examined specimens.

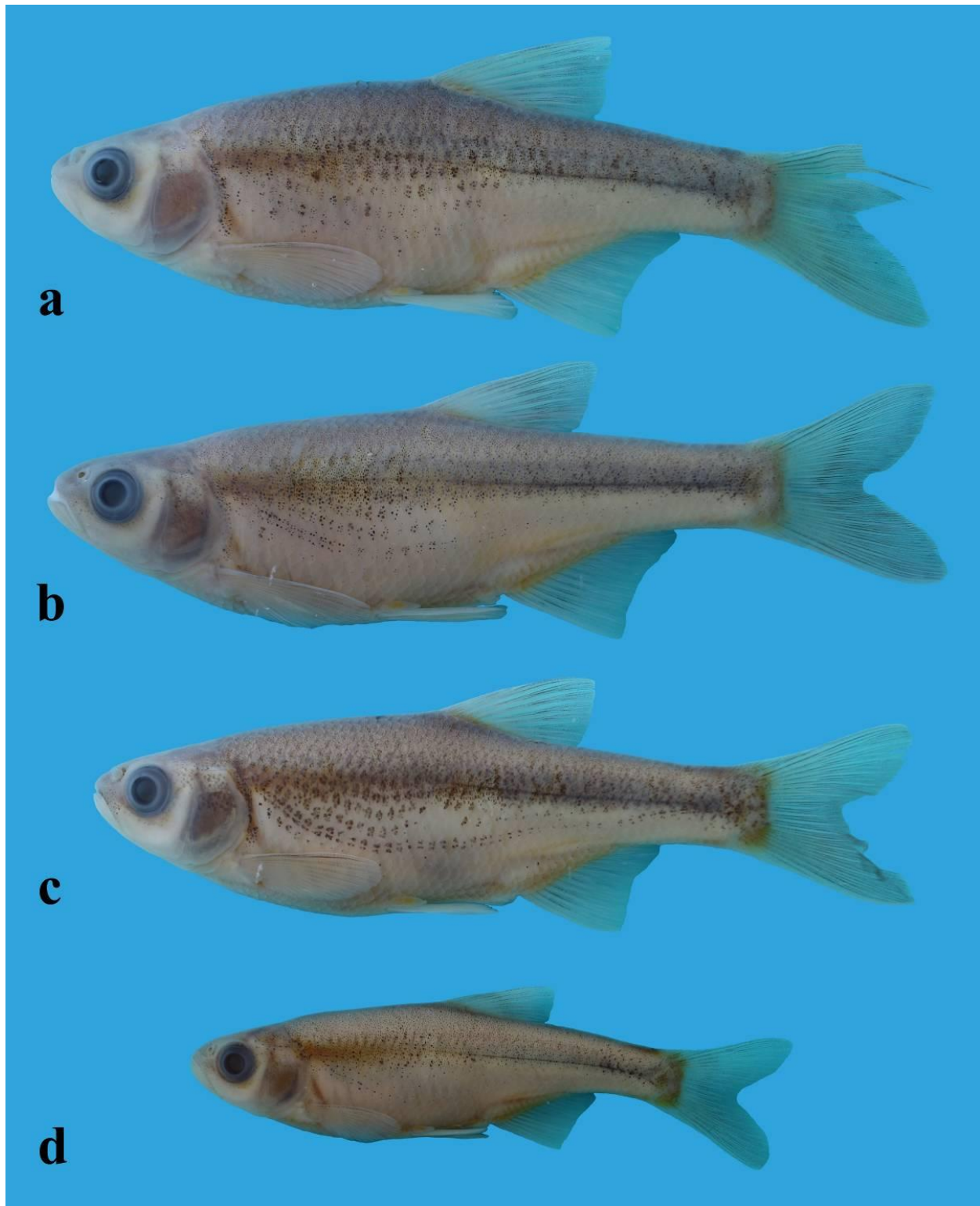
**Colouration:** In living specimens, overall colouration is silvery; darker at upper flank; facial bones and opercle silvery; the bases of the pectoral, pelvic and anal fins orange. Dorsum and top of head are light to dark grey, with an olive hue. The lower portion of head and body are pearly-white. The flanks above lateral line may have a golden hue. Faint yellow spots occur in rows along the flanks. Rows of dark blotches along scales rows, formed by dark pigmentation concentrated on center of scales, more conspicuous above lateral line and present only as scattered dark pigmentation below it; a diffuse, relatively narrow dark stripe at caudal peduncle; lateral-line outlined by dark pigmentation, forming a weakly developed, often interrupted but conspicuous longitudinal dark stripe. Faint dark pigmentation on flank scales above the lateral line forming diffuse

stripes. Dorsal and caudal fins either with some grey pigmentation or dark grey. Pigmentation of preserved specimens fixed in 10% formalin and stored in 70% alcohol (Figs. 13-14) overall tan, darker dorsally; horizontal rows of dark blotches formed by dark pigmentation concentrated on middle of scales, moderately conspicuous, above the lateral line; lateral line with some scales with pores outlined with dark pigmentation, especially the most anterior scales; narrow dark middle lateral stripe along lateral septum, more discernible from vertical through dorsal fin onwards. Fins mostly hyaline, with some black pigmentation lining dorsal and caudal fins rays, dorsal most pectoral-fin rays and the most anterior anal fin rays.

**Distribution and notes on biology:** *Alburnoides parhami* is known from Baba-Aman Stream, Atrak River drainage, in the south-eastern Caspian Sea basin (Fig. 1). The stream Baba-Aman at the type locality at time of the collection of the type specimens (Fig. 16) had none-clear water, water flow was medium to fast, the stream width was about 3-5 m and maximum depth was up to 1.5 m, with grassy shores, submergent plants, and the stream bed was gravel and mud. Other species collected syntopically were *Capoeta gracilis* (Keyserling, 1861), *Luciobarbus mursa* (Guldenstadt, 1773), and *Paracobitis atrakensis*, Esmaeili et al., 2014.

**Etymology:** The species name *parhami* is generally in honor of all the Iranian conservative officers who sacrificed their lives in order to keep the wild environment, and especially for Mr. Saeid Parham (1980 - 2009), the conservative officer in Khorasan-e-Shomali Province, who was killed in a battle with illegal hunters near the type locality of *Alburnoides parhami* (near the border of Turkmenistan).

**Comparative remarks:** *Alburnoides parhami* differs from *A. coadi*, *A. idignensis*, *A. petrubanare-*



**Fig. 14.** *Alburnoides parhami* sp. n.; Iran, Khorasan-e-Shomali Province, Baba-Aman Stream, Atrak River drainage, paratype; **a**, VMFC-ALP3-P1, 62 mm SL; **b**, VMFC-ALP3-P2, 61 mm SL; **c**, VMFC-ALP3-P3, 56 mm SL; **d**, VMFC-ALP3-P5, 41 mm SL.



**Fig. 15.** *Alburnoides parhami* sp. n., above: holotype, VMFC-ALP3-H, 66.5 mm SL; below: paratype, VMFC-ALP3-P7, 60 mm SL.

-*scui* and *A. qanati* by its completely or almost completely scaleless ventral keel (vs. most commonly scaled ventral keel). *Alburnoides parhami* is distinguished from *A. coadi*, *A. idignensis*, *A. namaki*, *A. nicolausi* and *A. petrubanarescui* by having a short, slightly pointed snout (vs. stout and rounded), a terminal mouth with the tip of the mouth cleft on a level with the upper half of the pupil (vs. almost or completely subterminal with a tip of the mouth on a level with the lower margin of the pupil to below the lower margin of the eye), a clearly forked caudal-fin with pointed lobes (vs. shallowly forked with rounded lobes), and

orbit width about equal to interorbital width (vs. smaller). *Alburnoides parhami* is further distinguished from *A. coadi* by an upturned mouth with a tip of the mouth cleft on a level with the upper half of the pupil (vs. a more horizontal, slightly curved or straight but never upturned mouth, with a tip of the mouth cleft on a level with the middle of the eye or below); a pointed snout (vs. slightly to markedly rounded); 12-13 with a mode of 12 predorsal vertebrae (vs. 13-14, median 13); shallower head (head depth 61.3-74.9, mean 67.9 in HL, vs. 67.1-80.7, mean 75.5 in HL); and orbit width about equal to interorbital width (vs. smaller).

*Alburnoides parhami* can be further distinguished from *A. eichwaldii* by having an upturned mouth with a tip of the mouth cleft on a level with the upper half of the pupil (vs. a more horizontal, slightly curved or straight but never upturned mouth, with a tip of the mouth cleft on a level with the middle of the eye or below), a pointed snout (vs. slightly to markedly rounded), less scales above lateral line to dorsal fin origin (commonly 10 vs. 11), less scales below lateral line to anal fin origin (commonly 4 vs. 7), abdominal and caudal vertebrae equal in number or abdominal one vertebrae shorter than it vs. the caudal region is commonly one vertebrae shorter than the abdominal region, 12-13 predorsal vertebrae (vs. 13-15), longer head (19.6-25.0, mean 21.2 in SL, vs. 25.1-29.9, mean 27.2 in SL), and longer paired fins (pectoral and pelvic fins reaching pelvic and anal fins respectively, vs. not reaching).

*Alburnoides parhami* is further distinguished from *A. holciki* by having commonly 5 pharyngeal teeth in the long row on the 5th ceratobranchial (vs. 4); 12½-13½ branched anal-fin rays (vs. 14½-15½); 39-41, usually 40, total vertebrae (vs. 40-42, usually 41); 12-13 with a mode of 12 predorsal vertebrae (vs. 13-14, with a mode of 13); a shorter caudal vertebral region, containing 19-21, with a mode of 20 vertebrae (vs. 20-22, with a mode of 21); and 20 + 20 most usual vertebral formula (vs. 20 + 21).

*Alburnoides parhami* is further distinguished from *A. idignensis* by having 39-41, usually 40, total vertebrae (vs. 37-40, usually 39); commonly 12½-13½ anal fin branched rays (vs. 11½-12½); 46-51 lateral line scales (vs. 41-46); and 16-19 total scale radii, median 17 (vs. 12-17, median 15).

*Alburnoides parhami* is further distinguished from *A. namaki* by having commonly 40-41 total vertebrae (vs. 39-40); commonly 7-8 gill rakers, median 8 (vs. 6-8, median 7); smaller scales (commonly 48-49, median 48 lateral line scales, vs. 46-49, median 47); commonly 9-10

scales above lateral line to dorsal fin origin (vs. 10-11); and commonly 4 scale rows between lateral line and anal fin origin (vs. 5).

*Alburnoides parhami* is further distinguished from *A. nicolausi* by having commonly 8½ branched anal-fin rays (vs. 7½); commonly 12½-13½ branched anal-fin rays (vs. 9½-11½); commonly 40-41 total vertebrae, median 40 (vs. 38-40, median 39); and relatively longer snout (21.9-32.4, mean 28.6 in HL, vs. 18.7-27.2, mean 22.2 in HL).

*Alburnoides parhami* is further easily distinguishable from *A. petrubanarescui* by having a usually scaleless ventral keel (vs. completely scaled); commonly 12½-13½ branched anal-fin rays (vs. 8½-10½); 12-13 with a mode of 12 predorsal vertebrae (vs. 13-14, with a mode of 13); and an abdominal region equal with or shorter than a caudal vertebral region, most frequent vertebral formulae 20 + 20 or 20 + 21 (vs. longer, usually 21 + 19 and 21 + 20).

*Alburnoides parhami* is further distinguished from *A. qanati* by having commonly 12½-13½, median 12½ branched anal-fin rays (vs. 11½-12½, median 11½); smaller scales (commonly 48-49 lateral line scales, vs. 43-47); 12-13 with a mode of 12 predorsal vertebrae (vs. 13-14, median 13); 16-19 total scale radii, median 17 (vs. 11-16, median 12); and scaleless ventral keel (vs. completely scaled).

*Alburnoides parhami* is further distinguished from *A. tabarestanensis* by the shape of the mouth which is upturned with a pointed snout and a tip of the mouth cleft on a level with the upper half of the pupil (vs. a more horizontal, slightly curved mouth with a rounded snout and a tip of the mouth on a level with the lower margin of the pupil); and 5 pharyngeal teeth in the long row on the 5th ceratobranchial (vs. usually 4).

See below for more details to distinguish *A. parhami* from the other Iranian *Alburnoides* species described in this study.



**Fig. 16.** Baba-Aman Stream, Atrak River, the southeastern Caspian Sea basin; type locality of *A. parhami* sp. n.

***Alburnoides samiii*, new species**

(Figs. 17-19)

**Holotype.** VMFC-ALS4-H, 75.9 mm SL; Iran, Guilan Province, upper Sefidroud River drainage, Tutkabon Stream, 36°50.756'N, 49°35.021'E; coll. H. Mousavi-Sabet, 15 October 2013.

**Paratypes.** VMFC-ALS4-P1 to VMFC-ALS4-P45, 45 specimens, 52.9-81.5 mm SL; collected with holotype. GUIC-ALS4-P1 to GUIC -ALS4-P4, 4 specimens, 56.2-63.5 mm SL; collected with holotype.

**Diagnosis:** *Alburnoides samiii* is distinguished from the other species of *Alburnoides* in Iran

diagnosed above by a combination of the following characters: a terminal mouth, with a tip of the mouth cleft on a level with the middle of the eye or below; a mostly or completely scaled ventral keel; the lack of well-marked spots or dark pigmentation in the lateral line canal; the lack of strong spots or dark outline to the lateral line canal; dorsal fin outer margin truncate to slightly concave; anal fin outer margin markedly concave; a large eye (eye diameter about equal to interorbital width); 2.5-4.2 pharyngeal teeth; a long and shallow caudal peduncle (its length 22.8-26.5, mean 24.5 in SL); a shallow head (head depth 61.2-74.6, mean 68.9 in HL); caudal-fin lobes are pointed, the fin is clearly forked; commonly 8½ branched dorsal fin rays; commonly 12½-14½, branched anal-fin



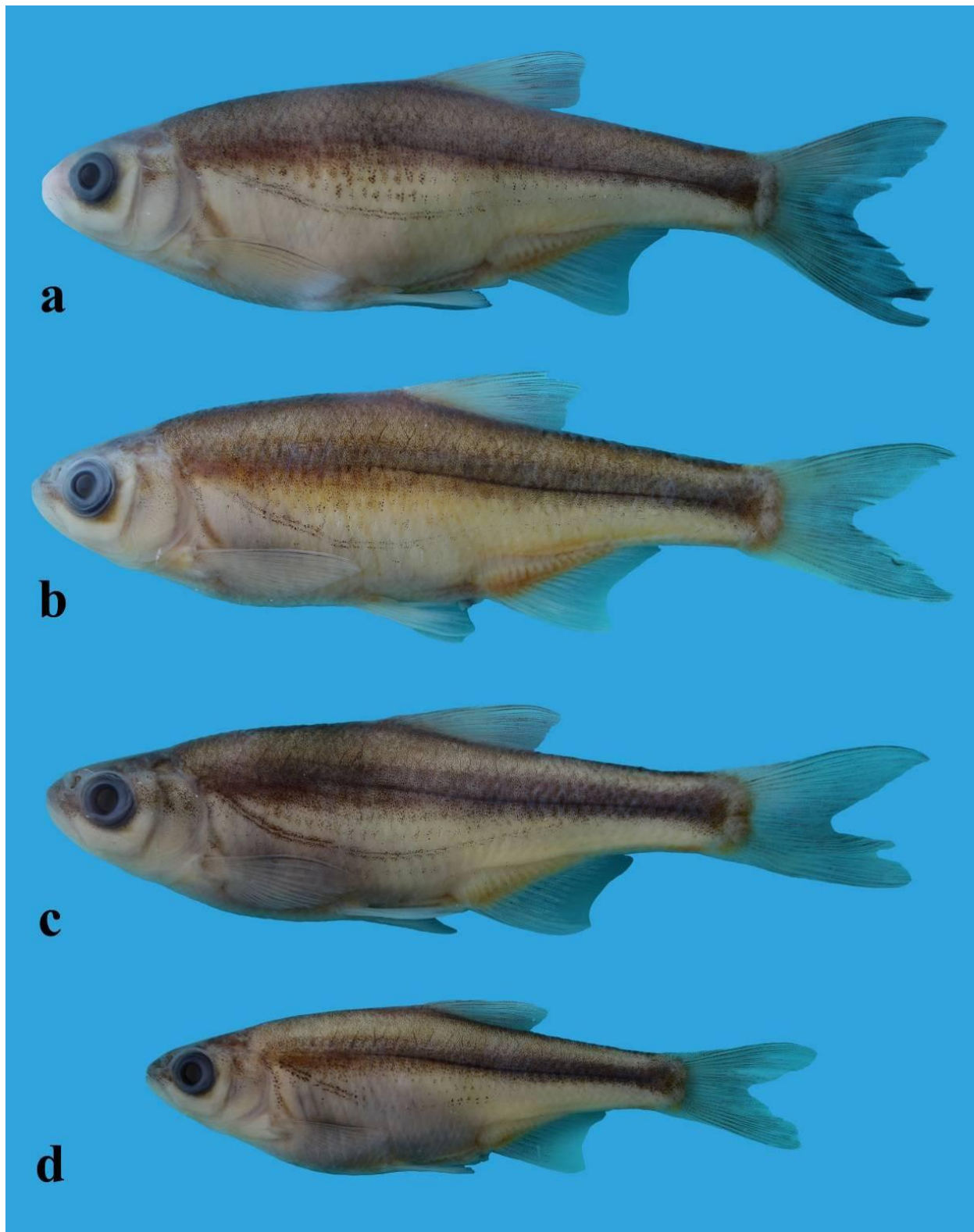
**Fig. 17.** *Alburnoides samiii* sp. n.; Iran, Guilan Province, Sefidroud River, holotype, VMFC-ALS4-H, 75.9 mm SL.

rays; commonly 40-41 total vertebrae; commonly 12-13 predorsal vertebrae; 19-20 abdominal vertebrae and 20-21 caudal vertebrae.

**Description:** General appearance shown in Figs. 17-19. Morphometric data presented in table 9. Body compressed, upper body profile slightly convex to straight, lower profile convex. The body is relatively shallow (depth at the dorsal fin origin is 26.5-29.7, mean 28.1 in SL). Snout short, slightly to markedly rounded. Mouth terminal, slightly curved or straight, tip of the mouth cleft on a level with the middle of the eye or below. Junction of lower jaw and quadrate at vertical through the lower part of anterior pupil margin. Ventral keel between the pelvic and the anal fins is mostly or completely scaled. Pelvic axillary scale developed, its length about three scale rows. Anal-fin origin at vertical through dorsal-fin base end. Dorsal fin located behind vertical through pelvic fin origin. Dorsal fin outer margin truncate to slightly concave; anal fin outer margin markedly concave. Pectoral fin long, commonly reaching pelvic fin insertion, its outer margin slightly convex. Pelvic fin rounded, its tip normally not reaching to anal fin origin, slightly behind anus. Caudal fin clearly forked, lobes slightly to markedly pointed.

Body depth enters standard length 3.4-3.8 times, head length enters 3.8-4.0, predorsal length 1.9-2.1, caudal peduncle depth 8.5-9.7, and caudal peduncle length 4.3-5.2. Orbit width enters head length 2.8-3.5 times, snout length enters 3.6-4.4, and interorbital width 2.8-3.4. Pectoral fin length enters pectoral fin origin to pelvic fin origin distance 1.0-1.2 times, and pelvic fin length enters pelvic fin origin to anal fin origin distance 1.1-1.3 times.

Dorsal fin unbranched rays 3, dorsal fin branched rays  $7\frac{1}{2}$  (2),  $8\frac{1}{2}$  (46) or  $9\frac{1}{2}$  (2) (mean 8.00, standard deviation 0.29), anal fin unbranched rays 3, anal fin branched rays 11(2), 12(18), 13(19), 14(10) or 15(1) (mean  $12.80 \pm 0.88$ ), branched pectoral fin rays 11(8), 12(19), 13(22) or 14(1) (mean  $12.32 \pm 0.77$ ), pelvic fin branched rays 6(5) or 7(45) (mean  $6.90 \pm 0.30$ ). Lateral line complete with 0, 1 or 2 unpored scales at the posterior end of the lateral series; lateral line scales to posterior margin of hypurals 47(3), 48(19), 49(14), 50(7), 51(5) or 52(2) (mean  $48.96 \pm 1.24$ ); scales above lateral line to dorsal fin origin 8(3), 9(35) or 10(12) (mean  $9.18 \pm 0.52$ ); scales below lateral line to anal fin origin 3(8), 4(38) or 5(4) (mean  $3.92 \pm 0.49$ ); and scales below lateral line to pelvic fin origin 3(3), 4(43) or 5(4) (mean  $4.02 \pm 0.38$ ). Total scale radii 15(4), 16(14), 17(14), 18(16) or 19(2) (mean  $16.96 \pm$



**Fig. 18.** *Alburnoides samiii* sp. n.; Iran, Guilan Province, Sefidroud River, paratype; **a**, VMFC-ALS4-P2, 75 mm SL; **b**, VMFC-ALS4-P3, 76 mm SL; **c**, VMFC-ALS4-P4, 68 mm SL; **d**, VMFC-ALS4-P5, 53 mm SL.

**Table 9.** Morphometric data of *Alburnoides parhami* sp. n. (holotype VMFC-ALP3-H, paratypes: VMFC-ALP3-P,  $n = 45$ ; GUIC-ALP3-P,  $n = 4$ ), and *A. samiii* sp. n. (holotype VMFC-ALS4-H, paratypes: VMFC-ALS4-P,  $n = 45$ ; GUIC-ALS4-P,  $n = 4$ ). H, holotype.

	<i>A. parhami</i> sp. n.				<i>A. samiii</i> sp. n.			
	H	Range	Mean	SD	H	Range	Mean	SD
Standard length (mm)	66.5	39.9-62.0			75.9	52.9-81.5		
<b>In percent of standard length</b>								
Head length	25.1	25.1-29.9	27.2	1.5	26.5	25.1-26.5	25.8	0.5
Body depth	29.5	25.1-30.4	28.1	1.8	28.7	26.5-29.7	28.1	1.2
Maximum body width	15.2	12.0-15.2	13.7	1.2	13.7	13.5-15.6	14.0	0.8
Dorsal-fin base	13.4	13.4-16.9	14.5	1.4	15.3	13.0-15.9	14.8	1.1
Dorsal-fin depth	26.5	24.4-28.0	26.4	1.1	25.8	24.0-25.8	24.8	0.7
Anal-fin base	14.9	14.9-18.3	16.8	1.0	17.0	15.5-18.3	17.0	1.1
Anal-fin depth	16.8	14.1-19.0	16.6	1.7	17.5	15.8-17.5	16.6	0.6
Pectoral-fin length	21.4	20.1-23.2	21.8	1.1	20.8	20.2-22.5	21.2	0.8
Pelvic-fin length	17.0	16.6-18.7	17.3	0.7	15.8	14.8-17.2	16.0	1.0
Predorsal distance	51.0	48.8-53.9	52.1	1.8	49.8	46.8-52.1	49.8	2.0
Preanal distance	62.6	62.6-65.4	63.9	1.1	65.1	61.3-65.4	63.3	1.7
Prepectoral length	25.4	25.3-32.3	27.7	2.6	25.2	24.5-26.8	25.6	0.9
Preventral distance	46.3	45.0-49.9	47.6	1.7	45.6	44.7-48.0	45.9	1.2
Dorsal-ventral distance	9.2	6.8-10.8	8.7	1.5	5.9	4.2-8.9	6.8	1.8
Pectoral-ventral distance	25.0	22.1-25.9	23.9	1.5	20.9	20.9-26.2	23.1	2.4
Ventral-anal distance	18.8	17.0-20.5	18.9	1.4	18.8	17.8-21.0	19.2	1.2
Caudal peduncle length	21.8	20.2-23.5	21.4	1.2	22.1	19.3-24.3	21.9	1.8
Caudal peduncle depth	11.1	9.3-12.5	11.0	1.0	11.7	9.5-11.7	10.7	0.8
Caudal peduncle width	6.0	4.3-6.5	5.4	0.7	5.7	4.5-6.6	5.4	0.8
Caudal upper lobe length	22.7	21.9-26.0	23.9	1.8	23.1	22.8-26.5	24.5	1.5
Caudal lower lobe length	24.2	24.0-28.4	26.3	2.1	25.4	24.8-26.3	25.5	0.5
<b>In percent of head length</b>								
Head depth	74.9	61.3-74.9	67.9	5.0	74.6	61.2-74.6	68.9	4.5
Head width	54.5	44.0-54.5	49.0	3.4	52.7	48.6-52.7	50.5	1.6
Interorbital distance	34.7	28.1-35.8	32.3	3.3	32.8	29.6-35.4	32.1	2.3
Internasal distance	18.0	17.9-24.3	20.5	2.4	21.9	17.9-21.9	20.1	1.5
Eye diameter	30.5	28.1-33.3	30.9	1.8	28.9	28.9-35.2	31.6	2.3
Pupil diameter	15.6	14.3-17.4	15.9	1.2	14.4	13.0-19.6	15.8	2.5
Preorbital distance	28.7	21.9-32.4	28.6	3.5	22.9	22.9-31.1	25.9	3.0
Postorbital distance	48.5	36.7-49.7	44.0	5.0	45.3	40.8-53.0	45.9	4.1

1.05). Total gill rakers at outer row on first left arch number 7(2), 8(19), 9(25) or 10(4) (mean  $8.62 \pm 0.70$ ). Total vertebrae including four Weberian vertebrae and last hypural complex centrum 39(1), 40(32) or 41(17) (mean  $40.32 \pm 0.51$ ). Twelve to 13 predorsal vertebrae; 19-20

abdominal vertebrae, 20-21 caudal vertebrae; caudal vertebral region most commonly equal to the abdominal region or one vertebrae longer than it; most common vertebrae formulae 19 + 20, 19 + 21, 20 + 20, or 20 + 21. Pharyngeal teeth 2.5-4.2 in 10 examined specimens.



**Colouration:** In living specimens, overall colouration is silvery, with the bases of the pectoral, pelvic and anal fins orange. Dorsum and top of head are light to dark grey, with an olive hue. The lower portion of head and body are pearly-white. Facial bones and opercle silvery.

The flanks above lateral line may have golden and/or cobalt-blue hues. Faint yellow spots occur in rows along the flanks. Faint dark pigmentation on flank scales above the lateral line forming diffuse stripes, and present only as scattered dark pigmentation below it. Dorsal, anal and caudal fins either with some grey

pigmentation or dark grey. Pigmentation of preserved specimens fixed in 10% formalin and stored in 70% alcohol (Figs. 17 & 18) overall tan to cream, darker dorsally; horizontal rows of dark blotches formed by dark pigmentation concentrated on middle of scales, moderately conspicuous, above the lateral line; lateral line with some scales with pores outlined with dark pigmentation, especially the anterior-most scales; a relatively thick dark stripe at caudal peduncle; narrow dark mid-lateral stripe along lateral septum, less discernible from vertical through dorsal fin onwards; fins mostly hyaline, with some black pigmentation lining dorsal and



**Fig. 19.** *Alburnoides samiii* sp. n., none-types, above: 67 mm SL; below: 59 mm SL.

caudal fins rays, dorsal-most pectoral-fin rays and anterior-most anal fin rays.

**Distribution and notes on biology:** *Alburnoides samiii* is known only from Sefidroud River drainage in the south-eastern Caspian Sea basin (Fig. 1). The upstream portion of Sefidroud River at the type locality (Fig. 20) at time of the collection of the type specimens had clear water, water flow was medium, the stream width was about 5-15 m and maximum depth was up to 1.5 m, and the stream bed was rocky and gravel. Other species collected syntopically were *Capoeta gracilis* (Keyserling, 1861), *Luciobarbus mursa* (Guldenstadt, 1773), *Barbus lacerta* Heckel (1843), *Luciobarbus capito* (Guldenstadt, 1773), *Squalius* cf. *orientalis* (Nordmann, 1840), *Cobitis keyvani* Mousavi-Sabet *et al.*, 2012, *Oxynoemacheilus bergianus* (Derzhavin, 1934) and *Ponticola iranicus* Vasil'eva, Mousavi-Sabet, Vasil'ev, 2015.

**Etymology:** The species name *samiii* is in honor of "Professor Doctor Majid Samii" the world famous Iranian neurosurgeon and medical scientist. He is currently the President of the International Neuroscience Institute (INI), also in 2014 he was named the world top neurosurgeon garnered Golden Neuron Award by World Academy of Neurological Surgery. Professor Majid Samii born (19 June 1937) in Rasht, the capital city of Guilan Province, the region where the type locality (Sefidroud River) of the new species is located.

**Comparative remarks:** *Alburnoides samiii* differs from *A. eichwaldii*, *A. holciki*, *A. namaki*, *A. nicolausi*, *A. parhami* and *A. tabarestanensis* by its completely or almost completely scaled ventral keel (vs. most commonly 2/3 or completely scaleless ventral keel). *Alburnoides samiii* is further distinguished from *A. holciki*, *A. parhami* and *A. qanati* by having a rounded snout (vs. pointed), and a subterminal mouth with the tip

of the mouth cleft on a level with the lower margin of the pupil to below the lower margin of the eye (vs. almost or completely terminal with a tip of the mouth on a level with the upper half of the pupil).

*Alburnoides samiii* is further distinguished from *A. coadi* by having 12-13 predorsal vertebrae (vs. 13-14); shallower head (head depth 61.2-74.6, mean 68.9 in HL, vs. 67.1-80.7, mean 75.5 in HL); shallower body (body depth 26.5-29.7, mean 28.1 in SL, vs. 28.9-33.8, mean 30.8 in SL); eye located in the mid of head vs. in anterior half (postorbital distance 40.8-53.0, mean 45.9 in HL, vs. 47.6-56.4, mean 52.4 in HL); and orbit width about equal to interorbital width (vs. smaller).

*Alburnoides samiii* is further distinguished from *A. eichwaldii* by having a larger eye (eye diameter about equal to interorbital width vs. significantly smaller than interorbital width); commonly 40-41, median 40 total vertebrae (vs. 41-42, median 41); commonly 12-13, median 13 predorsal vertebrae (vs. 13-14, median 14); commonly 19-20, median 20 abdominal vertebrae (vs. 20-21, median 21); less scales above lateral line to dorsal fin origin (commonly 9-10 vs. 11); less scales below lateral line to anal fin origin (typically 4 vs. 7); precaudal and caudal vertebrae equal in number or precaudal 1-2 vertebrae longer than it vs. the caudal region is commonly one vertebrae shorter than the abdominal region; longer head (HL 25.1-26.5, mean 25.8 in SL, vs. 19.6-25.0, mean 21.2 in SL); and shallower head (head depth 61.2-74.6, mean 68.9 in HL, vs. 79.1-92.7, mean 87.6 in HL).

*Alburnoides samiii* is further differs from *A. holciki* by having fewer anal fin branched rays (commonly 12½-14½, median 13½ vs. 14½-15½, median 15½); less numerous total vertebrae (commonly 40-41, median 40 vs. 41-42, median 41); shorter anal fin base (15.5-18.3, mean 17.0 in SL, vs. 17.4-21.8, mean 19.4 in SL); and the tip of the mouth cleft commonly at level of the lower margin of the eye or below (vs. at level with the upper half of the pupil).

*Alburnoides samiii* is further distinguished from *A. idignensis* by having more anal fin branched rays (commonly  $12\frac{1}{2}$ - $14\frac{1}{2}$ , median  $13\frac{1}{2}$  vs.  $11\frac{1}{2}$ - $12\frac{1}{2}$ , median  $11\frac{1}{2}$ ); 40-41, median 40 total vertebrae (vs. 38-40, median 39); 47-52 lateral line scales (vs. 41-46 lateral line scales); and total scale radii 16-19, median 18 (vs. 12-17, median 15).

*Alburnoides samiii* is further distinguished from *A. namaki* by having less branched anal fin rays (commonly  $12\frac{1}{2}$ - $14\frac{1}{2}$ , median  $13\frac{1}{2}$  vs.  $14\frac{1}{2}$ - $15\frac{1}{2}$ , median  $15\frac{1}{2}$ ); smaller scales (commonly 47-52, median 48 lateral line scales, vs. 46-49, median 47); more numerous gill rakers (commonly 8-9 vs. 6-8), scales above lateral line to dorsal fin origin (commonly 9-10 vs. 10-11); longer medial fins; longer caudal peduncle (caudal peduncle length 19.3-24.3, mean 21.9 in SL, vs. 14.9-22.3, mean 18.1 in SL); and shallower head (head depth 61.2-74.6, mean 68.9 in HL, vs. 68.0-82.6,

mean 78.1 in HL). *Alburnoides samiii* is further differs from *A. nicolausi* by having more branched dorsal-fin rays (commonly  $8\frac{1}{2}$  vs.  $7\frac{1}{2}$ ); more branched anal-fin rays ( $12\frac{1}{2}$ - $14\frac{1}{2}$  vs.  $9\frac{1}{2}$ - $11\frac{1}{2}$ ); more gill rakers (8-9 vs. 7-8); smaller scales (commonly 47-52, median 48 lateral line scales, vs. 42-50, median 44); total scale radii 15-19, median 18 (vs. 13-17, median 15); and completely or almost completely scaled ventral keel (vs. most commonly  $\frac{2}{3}$  or completely scaleless ventral keel).

*Alburnoides samiii* is further distinguished from *A. petrubanarescui* by having more branched dorsal-fin rays (commonly  $8\frac{1}{2}$  vs.  $7\frac{1}{2}$ ); more branched anal-fin rays (commonly  $12\frac{1}{2}$ - $14\frac{1}{2}$  vs.  $9\frac{1}{2}$ - $10\frac{1}{2}$ ); commonly 12-13 predorsal vertebrae (vs. 13-14); commonly 19-20, median 20 abdominal vertebrae (vs. 20-22, median 21); commonly 19-20 caudal vertebrae (vs. 20-21); and more gill rakers (8-9 vs. 7-8).



**Fig. 20.** Sefidroud River, the southern Caspian Sea basin; type locality of *A. samiii* sp. n.

*Alburnoides samiii* is further differs from *A. parhami* by having a horizontal mouth, with a tip of the mouth cleft on a level with the middle of the eye or below (vs. an upturned mouth with a tip of the mouth cleft on a level with the upper half of the pupil); a slightly to markedly rounded snout (vs. pointed); and a completely or almost completely scaled ventral keel (vs. mostly or completely scaleless ventral keel).

*Alburnoides samiii* is further differs from *A. qanati* by having more branched anal-fin rays (commonly 12½-14½, median 13½ vs. 10½-12½, median 11½); smaller scales (commonly 48-49 lateral line scales vs. 43-47); more gill rakers (commonly 8-9 vs. 6-8); longer anal fin base (15.5-18.3, mean 17.0 in SL, vs. 11.2-18.1, mean 13.7 in SL); and total scale radii commonly 16-18 (vs. 11-16). *Alburnoides samiii* is further distinguished from *A. tabarestanensis* by a shallower head (head depth 61.2-74.6, mean 68.9 in HL, vs. 71.4-81.0, mean 75.7 in HL); orbit width about equal to interorbital width (vs. smaller); and a completely or almost completely scaled ventral keel (vs. mostly or completely scaleless ventral keel).

As a result of conducted comparative analysis the key to the recently accepted *Alburnoides* species from Iran can be presented.

#### Key to the *Alburnoides* species in Iran (adopted from Coad & Bogutskaya, 2009)

**1a** - 15-20 total gill rakers in outer row on first gill arch.

..... *A. taeniatus*  
[not recorded in Iran but may eventually reach the Caspian Sea basin and the Tedzhen (= Hariroud) River drainage of Iran from the Tedzhen River and Karakum Canal in Turkmenistan]

**1b** - 5-10 total gill rakers in outer row on first gill arch.

..... 2

**2a** - Snout pointed or slightly rounded; mouth terminal or upturned, tip of mouth cleft on level from slightly above middle of eye to upper margin of pupil; lower jaw slightly to moderately projecting relative to upper jaw; junction of lower jaw and quadrate on about vertical through anterior eye margin.

..... 3

**2b** - Snout slightly to markedly rounded; mouth terminal to subterminal, tip of mouth cleft on level from middle of eye to below lower margin of eye; upper jaw slightly to moderately projecting relative to lower jaw; junction of lower jaw and quadrate on about vertical through about middle of eye.

..... 5

**3a** - Ventral keel completely scaled.

..... *A. qanati*

**3b** - Ventral keel completely or almost completely scaleless.

..... 4

**4a** - 4 pharyngeal teeth in the long row on the 5th ceratobranchial; 14½-15½ branched anal-fin rays.

..... *A. holciki*

**4b** - 5 pharyngeal teeth in the long row on the 5th ceratobranchial; 12½-13½ branched anal-fin rays.

..... *A. parhami*

**5a** - 8½-11½, commonly 9½-10½ branched anal fin rays; 7½, rarely 8½, branched dorsal fin rays.

..... 6

**5b** - 10½-15½, commonly 11½-13½ branched anal fin rays; 8½, rarely 7½, branched dorsal fin rays.

..... 7

**6a** - Ventral keel completely scaled; commonly 40-41 total vertebrae; 20-22, commonly 21, abdominal vertebrae.

..... *A. petrubanarescui*

**6b** - Ventral keel scaleless along from 1/3 to whole keel length; 38-40, commonly 39, total vertebrae; 19-20, commonly 20, abdominal vertebrae.

..... *A. nicolausi*

**7a** - Ventral keel completely or partly scaled.

..... **8**

**7b** - Ventral keel completely or almost completely scaleless.

..... **10**

**8a** - Commonly 11½-12½ anal fin branched rays; 41-46 lateral line scales; 12-17 total scale radii.

..... *A. idignensis*

**8b** - Commonly 12½-14½ anal fin branched rays; 47-52 lateral line scales; 16-19 total scale radii.

..... **9**

**9a** - Eye located in the anterior half of head; 13-14 predorsal vertebrae; orbit width smaller than interorbital width; deep body and head.

..... *A. coadi*

**9b** - Eye located in the mid of head; 12-13 predorsal vertebrae; orbit width about equal to interorbital width; shallow body and head.

..... *A. samiii*

**10a** - Lateral line in live and preserved fish delineated by dark pigment dots above and below; 13-15 predorsal vertebrae; typically 7 scales below lateral line to anal fin origin.

..... *A. eichwaldii*

**10b** - Lateral line in live and preserved fish somewhat darker than surrounding flank but no strong dark dots outline canal; 11-13 predorsal vertebrae; typically 4-6 scales below lateral line to anal fin origin.

..... **11**

**11a** - 46-49 lateral line scale; 6-8 gill rakers; eye relatively large (27.7-34.5, mean 31.3 in

HL); commonly 10-11 scales above lateral line to dorsal fin origin; typically 5 scale rows between lateral line and anal fin origin.

..... *A. namaki*

**11b** - 48-52 lateral line scale; 8-9 gill rakers; eye relatively small (23.6-34.0, mean 27.9 in HL); commonly 9-10 scales above lateral line to dorsal fin origin; typically 4 scale rows between lateral line and anal fin origin.

..... *A. tabarestanensis*

**Comparative material:** *Alburnus caeruleus*: VMFC ALB37SV, 7 specimens, 67.1-82.1 mm TL, Iran, Ilam Province, Chardaval River, the Tigris River drainage, the Persian Gulf basin, 33°41'34.50" N, 46°42'56.84" E; VMFC ALB316KA, 16 specimens, 50.0-92.1 mm TL, Iran, Kermanshah Province, Gamasiab River, the Tigris River drainage, the Persian Gulf basin, 34°11' N, 48°20' E.

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مروری بر جنس *Alburnoides* Jeitteles, 1861 (شعاع بالگان، کپور ماهیان) در ایران، همراه با توصیف سه گونه جدید از حوضه‌های آبریز دریای خزر و کویر

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#### چکیده

جنس *Alburnoides* Jeitteles, 1861 در ایران مورد بازبینی قرار گرفت، و خصوصیات تشخیصی برای همه هشت گونه شناسایی شده، ارائه شده است. *A. nicolausi*، *A. namaki*، *A. idignensis*، *A. holciki*، *Alburnoides eichwaldii*، *A. qanati*، *A. petrubanarescui* و *A. tabarestanensis* به عنوان گونه‌های معتبر در نظر گرفته شدند و سه گونه جدید توصیف شدند: *Alburnoides coadi*، از رودخانه نمرود در حوضه آبریز کویر، *A. parhami*، از رودخانه اترک در جنوب شرق حوضه آبریز دریای خزر و *A. samiii*، از رودخانه سفیدرود در جنوب حوضه آبریز دریای خزر. تصاویر و خصوصیات ریخت‌شناختی همه گونه‌ها، به غیر از گونه مطالعه نشده *A. petrubanarescui*، ارائه شده است.

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