Persian J. Acarol., 2017, Vol. 6, No. 2, pp. 71–80.
http://dx.doi.org/10.22073/pja.v6i2.29406
Journal homepage: http://www.biotaxa.org/pja

PERSIAN JOURNAL OF ACAROLOGY

http://zoobank.org/urn:lsid:zoobank.org:pub:397C484D-DBA5-4654-A6BC-7B0B352E1BD2

Article

Second record of *Erythraeus* (*Zaracarus*) *coleopterus* (Acari: Erythraeidae) from Iran with new morphological data

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ABSTRACT
Erythraeus (Zaracarus) coleopterus Mortazavi, Hajiqanbar & Saboori, 2012 (Acari: Parasitengona: Erythraeidae) was described based on a single specimen from Kerman province, southeastern Iran, associated with a scarabaeid beetle, *Cyphonoxia* sp. (Coleoptera: Scarabaeidae). This species reports for the second time from stored grain (off host) in Saqqez and Baneh cities, Kurdistan province, western Iran and presents new morphological data. Finding some specimens help us to augment and correct the original description of *E.* (*Z.*) *coleopterus*. A key to world larval species group of *Erythraeus* (*Zaracarus*) is presented which is modified and corrected from Mahmoudi *et al.* (2014).

KEY WORDS: Erythraeinae; key; Kurdistan; larva; Parasitengona.

PAPER INFO.: Received: 7 March 2017, Accepted: 4 April 2017, Published: 15 April 2017

INTRODUCTION

Among the family Erythraeidae, the subfamily Erythraeinae Robineau-Desvoidy comprises 26 genera and 6 subgenera, which the subgenus *Erythraeus* (*Zaracarus*) is based on larval form only and includes 29 species (Mąkol and Wohltmann 2012, 2013; Mahmoudi *et al.* 2014; Haitlinger and Šundić 2015). Diagnostic characters for *Erythraeus* (*Zaracarus*) were presented by Southcott (1995), Fain and Ripka (1998) and Khanjani *et al.* (2010). Only 9 species of larval *Erythraeus* (*Zaracarus*) have been described from Iran hitherto (Mahmoudi *et al.* 2014).

Up to now, only one species, *E.* (*Z.*) *kurdistaniensis* Khanjani & Ueckermann, 2005 was collected from Kurdistan province. In this paper, we report *E.* (*Z.*) *coleopterus* as the second larval species from this province collected from stored grain (off host) and present new morphological data.

MATERIAL AND METHODS

Eight specimens were extracted by a Berlese funnel, cleared in Nesbitt's fluid and mounted on microscope slides using Hoyer's medium (Walter and Krantz 2009). Figures were drawn and

measurements (given in micrometers) were made using a BX51 phase contrast Olympus microscope (Japan) equipped with a drawing tube. The terminology and abbreviations are followed from Saboori *et al.* (2009).

Genus *Erythraeus* Latreille
Subgenus *Erythraeus* (*Zaracarus*) Southcott

Erythraeus (*Zaracarus*) *coleopterus* Mortazavi, Hajiqanbar & Saboori, 2012

Diagnosis of larva – AL with thin bases, fn BFe 3-3-3, fn Ti 14-15-15, fn Ta I–III 25–26, 23, 24.

Material examined

One specimen (ARS-20160707-1a) collected from stored grain (off host), Iran, Kurdistan province, Baneh city, Kani Sur village, 36° 03.34′ N, 45 °44.46′ E, 1484 m a.s.l., 27 June 2015, coll. F. Faizi; 3 specimens (ARS-20160707-1d, 1f, 1g), same data as first specimen (1a) except collected on 28 June 2015 in Saqqez city, Sarab village, 36° 22.31′ N, 46° 12.49′ E, 1538 m a.s.l., 3 specimens (ARS-20160707-1b, 1c and 1h), same data as first specimen except collected on 28 June 2015 in Saqqez city (Saqqez-Bukan Road), 36° 17.09′ N, 46° 15.13′ E, 1521 m a.s.l., one specimen (ARS-20160707-1e), same data as first specimen except collected on 28 June 2015 in Saqqez city (Saqqez-Bukan Road), 36° 18.20′ N, 46 °15.20′ E, 1565 m a.s.l.

Material deposition

Four specimens (ARS-20160707-1a, 1b, 1c, 1d) are deposited in the Acarological collection, Jalal Afshar Zoological Museum, Faculty of Agriculture, University of Tehran, Karaj, Iran and four specimens (ARS-20160707-1e, 1f, 1g, 1h) in the Acarological Collection, Acarological Society of Iran, Karaj, Iran.

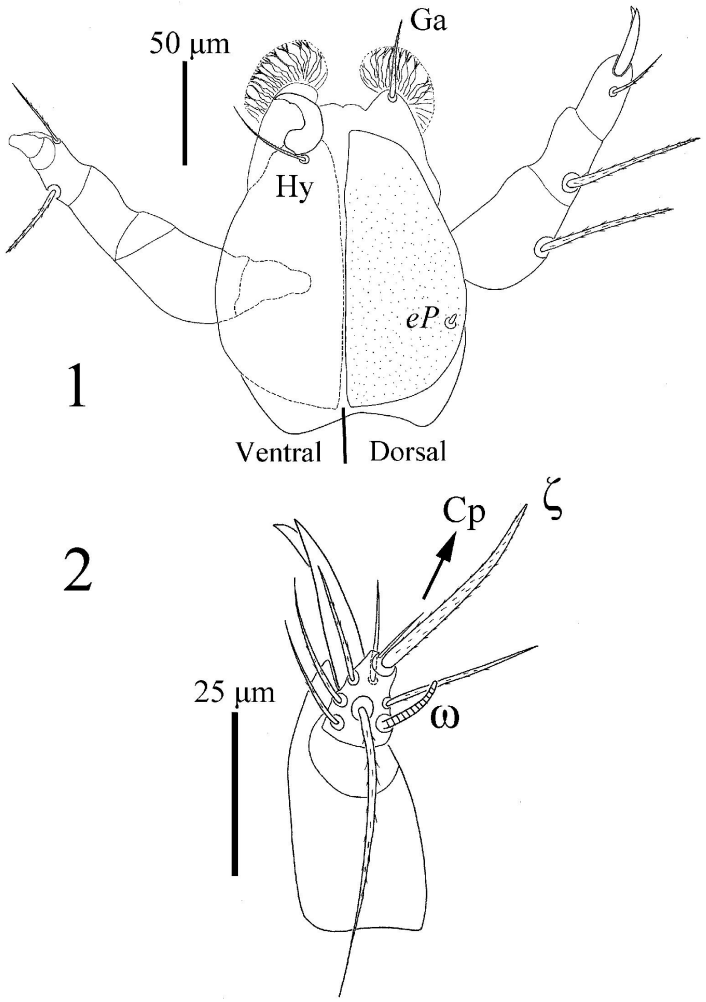
Remarks

The subgenus of *Erythraeus* (*Zaracarus*) divided in two species groups: one group has AL without swelling near bases which 6 species have basifemoral setal formula 3-3-3, including *E.* (*Z.*) *kastaniensis* Haitlinger, 2006, *E.* (*Z.*) *passidonicus* Haitlinger, 2006, *E.* (*Z.*) *soleimanii* Khanjani, Miromayedi, Rezai-Nahad & Fayaz, 2010, *E.* (*Z.*) *bibadakiensis* Haitlinger, 2011, *E.* (*Z.*) *coleopterus* Mortazavi, Hajiqanbar & Saboori, 2012 and *E.* (*Z.*) *hafezi* Saboori, Hakimitabar & Mahmoudi, 2014 (Haitlinger 2006a, 2011; Khanjani *et al.* 2010; Mortazavi *et al.* 2012; Mahmoudi *et al.* 2014) and 5 species including, *E.* (*Z.*) *tehranicus* Haitlinger & Saboori, 1996, *E.* (*Z.*) *didonae* Haitlinger, 2000, *E.* (*Z.*) *kharrazii* Saboori, 2000, *E.* (*Z.*) *monrealicus* Haitlinger, 2012, and *E. (Z.) tuzicus* Haitlinger & Šundić, 2015 have basifemoral setal formula 2-2-2 (Haitlinger and Saboori 1996; Haitlinger 2000, 2012; Saboori 2000; Haitlinger and Šundić 2015).

The other group has AL with swelling near bases which 1 species including *E.* (*Z.*) *plumatus* Tseng *et al.*, 1976 has basifemoral setal formula 3-3-2 (Tseng *et al.* 1976; Beron 2008; Mąkol & Wohltmann 2012), 12 species including, *E.* (*Z.*) *eleonorae* Haitlinger, 1987, *E.* (*Z.*) *lancifer* Southcott, 1995, *E.* (*Z.*) *fabiolae* Haitlinger, 1997, *E.* (*Z.*) *budapestensis* Fain & Ripka, 1998, *E.* (*Z.*) *rajabii* Saboori, 2000, *E.* (*Z.*) *longipedus* Saboori & Nowzari, 2001, *E.* (*Z.*) *aydinicus* Saboori, Cakmak & Nouri-Gonbalani, 2004, *E.* (*Z.*) *sibuljinicus* Haitlinger, 2004, *E.* (*Z.*) *jinkaensis* Haitlinger, 2006, *E.* (*Z.*) *ruizporterae* Mayoral & Barranco, 2008, *E.* (*Z.*) *perpusillus* Kamran, Afzal, Raza, Irfanullah, Bashir & Ahmad, 2009 and *E.* (*Z.*) *adrianicus* Haitlinger, 2012 have basifemoral setal formula 3-3-3 (Haitlinger 1987, 1997, 2004, 2006b, 2012; Southcott 1995; Fain & Ripka 1998; Saboori 2000; Saboori & Nowzari 2001; Saboori *et al.* 2004; Mayoral & Barranco 2008; Kamran *et al.* 2009) and 5 species including, *E.* (*Z.*) *preciosus* Goldarazena & Zhang, 1998, *E.* (*Z.*) *iranicus* Saboori & Akrami,

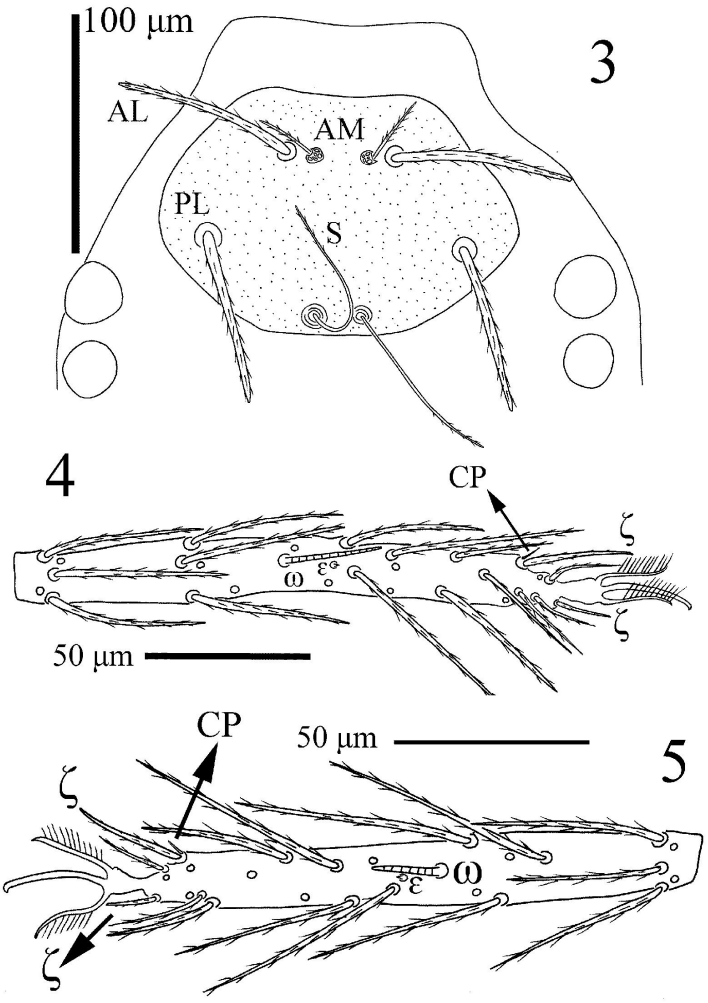
2001, *E.* (*Z.*) *ueckermanni* Saboori, Nowzari & Bagheri-Zenouz, 2004, *E.* (*Z.*) *kurdistaniensis* Khanjani & Ueckermann, 2005 and *E.* (*Z.*) *arminouensis* Haitlinger & Łupicki, 2011 have basifemoral setal formula 2-2-2 (Goldarazena and Zhang 1998; Saboori and Akrami 2001; Saboori *et al.* 2004; Khanjani and Ueckermann 2005; Haitlinger & Łupicki 2011).

Finding some specimens help us to augment and correct the original description of *E.* (*Z.*) *coleopterus*. We re-examined the type of *E.* (*Z.*) *coleopterus* and compared with Kurdistan specimens. The corrected characters are as follows: fn Ta I–III 25–26, 23, 24, presence of companion seta (Cp) with tectal eupathidia on Ta I and II (Figs. 4–5), presence of Cp on palptarsus and fPp = 0-B-B-BBB$_2$-5BNωζCp (Figs. 1–2). The specimens collected in Kurdistan province fit the data for the species given by Mortazavi *et al.* (2012) except for the length of AL setae (70–85 vs. 119 in type specimen), PW (95–107 vs. 119) and the shape of posterior border of dorsal scutum (straight vs. concave) (Fig. 3, Table 1), which these differences are interpreted as within the range of species variability. Furthermore, Mortazavi *et al.* (2012) have mentioned which the "subcapitulum with smooth hypostomal setae and galeal setae" in the text, which is typographical error and based on their figure (Fig. 3, page 113) and our study these setae have minute barbs (Fig. 1).



Figures 1–2. *Erythraeus* (*Z.*) *coleopterus* Mortazavi, Hajiqanbar & Saboori, 2012 (larva, Kurdistan specimens) – 1. Dorsal (right) and ventral (left) view of gnathosoma; 2. Ventral view of palpal tarsus.

In the key to species of the subgenus *Erythraeus* (*Zaracarus*) of the world (larva) presented by Mahmoudi *et al.* (2014), *E.* (*Z.*) *eleonorae* is missed. They set *E.* (*Z.*) *kastaniensis*, *E.* (*Z.*) *soleimanii*, *E.* (*Z.*) *bibadakiensis*, *E.* (*Z.*) *coleopterus* and *E.* (*Z.*) *monrealicus* in the group AL with swelling near bases whereas these species belong to the species group of the subgenus *Erythraeus* (*Zaracarus*) with AL with thin bases (Haitlinger 2006a, 2011, 2012; Khanjani *et al.* 2010; Mortazavi *et al.* 2012). Thus, the corrected key of larval species of this subgenus is presented here. We added *E.* (*Z.*) *tuzicus* in the identification key which was described after Mahmoudi *et al.* (2014). Also, Mahmoudi *et al.* (2014) mentioned in their paper a range for *E.* (*Z.*) *passidonicus* whereas this species was described based on single specimen.



Figures 3–5. *Erythraeus (Z.) coleopterus* Mortazavi, Hajiqanbar & Saboori, 2012 (larva, Kurdistan specimens) – 3. Scutum; 4. Tarsus I; 5. Tarsus II

Leg setal formula in type and Kurdistan specimens are as follows: Leg I: Ta – 1ω, 1ε, 2ζ, 1Cp, 25–26n [24n in type specimen only on the right side, 26n in two Kurdistan specimens (ARS-20160707-1c, 1g)] (Fig. 4); Ti – 2φ, 1Cp, 1κ, 14n; Ge – 1σ, 1κ, 8n; TFe – 5n; BFe – 3n; Tr – 1n. Leg II: Ta – 1ω, 1ε, 2ζ, 1Cp, 23n [22n in two Kurdistan specimens only on the right side (ARS-20160707-1a, 1h) and 24n in one Kurdistan specimen (ARS-20160707-1f) only on the right side] (Fig. 5); Ti – 2φ, 15n; Ge – 8n, 1κ; TFe – 5n; BFe – 3n; Tr – 1n. Leg III: Ta – 1ζ, 24n [22n in one

Kurdistan specimen (ARS-20160707-1h) only on the left side]; Ti –1φ, 15n; Ge – 8n; TFe – 5n; BFe – 3n; Tr – 1n.

IP = 2870–3188 in Kurdistan specimens (3003 in type specimen).

Metric data is given in Table 1.

Table 1. Metric data for *Erythraeus (Zaracarus) coleopterus* larvae.

Character	from Kurdistan (present study)									Mortazavi *et al.* 2012
	1a	1b	1c	1d	1e	1f	1g	1h	Range	
IL	350	340	347	327	357	367	342	367	327–367	408
IW	245	240	252	250	255	262	265	280	240–280	303
SD	102	97	97	94	95	95	95	90	90–102	93
W	152	151	151	145	144	157	137	151	137–157	147
AW	45	45	40	40	41	45	40	42	40–45	40
PW	107	105	102	100	97	104	95	105	95–107	119
AA	27	26	25	21	21	25	21	25	21–27	20
SB	19	17	15	15	15	17	16	17	15–19	16
ISD	67	64	66	62	70	62	65	62	62–70	60
AP	47	50	52	44	44	52	42	52	44–52	53
AL	75	85	82	75	80	80	70	74	70–85	119
PL	72/70	67	70	64	65	65	65	60	60–72	79
AM	27	27	29	27	26	30	27	25	25–30	25
S	77	80	87	84	77	75	70	75	70–87	79
DS Min.	57	52	60	47	55	52	55	55	47–60	60
DS Max.	62	75	75	67	70	77	62	65	62–77	71
PDS Min.	65	75	57	50	55	47	42	50	42–65	50
PDS Max.	65	75	57	50	55	47	52	60	47–65	62
1a	46	50	45/50	40	45	50	37	42	37–50	50
3a	30	35	32	?	30	35	30	32	30–35	42
1b	110/100	110	102	92	97	110/101	92	100	92–110	108
2b	37	40	35	35	35	40	36	35	35–40	39
3b	45	51	57	50	47	55	42	45	42–57	61
GL	165	162	162	145	157	165	162	160	145–165	138
PSFd	65	62	62	59	62	69	60	57	57–69	64
PSGd	62	65	67	61	62	61	57	57	57–67	67
Ga	35	37	35	32	30	32	35	32	30–37	37
Hy	42	45	42	45	45	52	45	42	42–52	46
Ta I (L)	170	167	160	155	162	170	157	155	155–170	184
Ta I (H)	20	20	20	20	20	20	20	20	20	19
Ti I	265	265	260	242	252	257	252	252	242–265	226
Ge I	182	192	190	170	185	187	182	177	170–192	163
TFe I	130	132	135	115	135	127	125	127	115–135	121
BFe I	142	152	147	137	130	137	140	137	130–152	111
Tr I	72	75	75	67	74	75	65	70	65–75	68
Cx I	75	72	75	66	67	77	70	75	66–77	76
Leg I	1036	1055	1042	952	1005	1030	991	993	952–1055	949
Ta II (L)	150	147	140	137	142	150	137	125	125–150	163
Ta II (H)	19	20	20	20	20	20	20	20	19–20	14
Ti II	250	247	240	227	237	237	237	237	227–250	205
Ge II	142	150	147	131	140	142	145	140	131–150	137
TFe II	120	120	115	102	122	110	117	109	102–122	105
BFe II	127	127	130	115	119	125	120	125	115–130	116
Tr II	72	72	62	62	70	70	67	65	62–72	63
Cx II	90	85	85	80	95	95	75	90	75–95	84
Leg II	951	948	919	854	925	929	898	891	854–951	873

Table 1. Continued.

Character	from Kurdistan (present study)									Mortazavi *et al.* 2012
	1a	1b	1c	1d	1e	1f	1g	1h	Range	
Ta III (L)	170	172	162	150	160	167	160	147	147–172	200
Ta III (H)	15	15	15	15	15	15	15	15	15	15
Ti III	365	370	352	332	350	362	347	352	332–370	358
Ge III	177	182	180	160	175	182	177	174	160–182	189
TFe III	155	157	155	135	155	157	152	157	135–157	137
BFe III	162	152	157	135	142	160	150	150	135–162	142
Tr III	70	72	72	65	67	72	65	67	65–72	63
Cx III	85	80	85	87	95	90	80	87	80–95	92
Leg III	1184	1185	1163	1064	1144	1190	1131	1134	1064–1190	1181
IP	3171	3188	3124	2870	3074	3149	3020	3018	2870–3188	3003
fD	40	46	43	42	40	46	?	44	40–46	42
fV	12	12	12	12	12	12	13	12	12–13	15
NDV	52	58	55	54	52	58	?	56	52–58	57
Anterior eye	27	27	25	22	25	22	22	22	22–27	18
Posterior eye	24	25	20	20	24	20	22	20	20–25	16
PaFe	60	55	67	57	55	55	61	62	55–67	–
PaGe	35	37	35	30	32	36	35	34	30–37	–
PaTi	40	42	40	37	40	40	35	37	35–42	–
PaTa	12	12	12	12	12	12	12	12	12	–
PaTi claw	35	35	31	29	32	32	30	30	29–35	–

Key to species of the subgenus *Erythraeus* (*Zaracarus*) of the world (larva) [modified from Mahmoudi *et al.* (2014) with corrections]

1. fn BFe 3-3-3 or 3-3-2 2
– fn BFe 2-2-2 18
2. BFe 3-3-2 ..... *E.* (*Z.*) *plumatus* Beron, 2008
– BFe 3-3-3 3
3. Ti III ≤ 242 ..... *E.* (*Z.*) *jinkaensis* Haitlinger, 2006
– Ti III ≥ 271 4
4. Ti III ≥ 420 5
– Ti III ≤ 370 8
5. Ti III ≤ 424 6
– Ti III ≥ 439 7
6. Ti III 420, Ti II with 14 normal setae ..... *E.* (*Z.*) *fabiolae* Haitlinger, 1997
– Ti III 424, Ti II with 15 normal setae ..... *E.* (*Z.*) *longipedus* Saboori & Nowzari, 2001
7. Ti III 439–511, Ti II and III with 14 normal setae, AL with swelling near bases ..... *E.* (*Z.*) *adrianicus* Haitlinger, 2012
– Ti III 470–484, Ti II and III with 15 normal setae, AL without swelling near bases ..... *E.* (*Z.*) *hafezi* Saboori, Hakimitabar & Mahmoudi, 2014
8. Ti III 271–278, Ti III with 16 normal setae ..... *E.* (*Z.*) *perpusillus* Kamran *et al*., 2009
– Ti III ≥ 346, Ti III with less than 16 setae 9
9. NDV 68, fD 54 ..... *E.* (*Z.*) *kastaniensis* Haitlinger, 2006
– NDV ≤ 61, fD ≤ 42 10
10. AL without swelling near bases 11

– AL with swelling near bases ……..……..……. 14
11. fn Ti 14-14-14 ……..……..……... 12
– fn Ti 14-15-15 or 14-15-14 …..…..……... 13
12. W 160, AW 48, PW 122, scutum convex posteriorly…….. *E.* (*Z.*) *bibadakiensis* Haitlinger, 2011
– W 120–146, AW 26–34, PW 94–100, scutum straight posteriorly……..……. ……..… *E.* (*Z.*) *passidonicus* Haitlinger, 2006*
13. Ti III with 15 normal setae, W 137–147, AW 40–45 …… ……..…… *E.* (*Z.*) *coleopterus* Mortazavi, Hajiqanbar & Saboori, 2012**
– Ti III with 14 normal setae, W 170–203, AW 53–58 …..... *E.* (*Z.*) *soleimanii* Khanjani *et al*., 2010
14. Ti II with 14 normal setae …… *E.* (*Z.*) *sibuljinicus* Haitlinger, 2004
– Ti II with 15 normal setae ……..……. 15
15. fn Ti 13-15-12 ……..…….... *E.* (*Z.*) *rajabii* Saboori, 2000
– fn Ti 14-15-15 ……..……..…... 16
16. Ta I 144–164, Ta II 128–144, Ta III 140–164 ……..... *E.* (*Z.*) *lancifer* Southcott, 1995
– Ta I ≥ 170, Ta II ≥ 163, Ta III ≥ 181 ……..…… 17
17. W 138–146, ISD 61–66, AL 165–167 ……..…… *E.* (*Z.*) *aydinicus* Saboori *et al*., 2004
– W 160–163, ISD 75, AL 145–150 ……..... *E.* (*Z.*) *ruizporterae* Mayoral & Barranco, 2008
18. NDV 60–80, fD 44–58 ……..... *E.* (*Z.*) *tuzicus* Haitlinger & Šundić, 2015
– NDV ≤ 56, fD ≤ 39 ..……... 19
19. AL without swelling near bases ……..…… 20
– AL with swelling near bases ……..…… 23
20. fn Ti 14-14-15, Ti III 180, Ti II 122 ……..……... *E.* (*Z.*) *tehranicus* Haitlinger & Saboori, 1996
– fn Ti otherwise, Ti III ≥ 215, Ti II ≥ 135 ……..……..... 21
21. Ti II & III with 14 normal ……..... 22
– Ti II & III with 15 normal setae …… *E.* (*Z.*) *didonae* Haitlinger, 2000
22. Ti III 215, AL 110–124, *1a* 55 …… *E.* (*Z.*) *kharrazii* Saboori, 2000
– Ti III 256–268, AL 168–182, *1a* 82–98 ……..... *E.* (*Z.*) *monrealicus* Haitlinger, 2012
23. Ti II with 14 normal setae ……..…..... *E.*(*Z.*) *arminouensis* Haitlinger & Łupicki 2011
– Ti II with 15 normal setae ……..…… 24
24. Ti III with 16 normal setae ……..……..…. 25
– Ti III with 14 or 15 normal setae …… 26
25. Ti I with 14 normal setae, SD 123–154, W 186–216, ISD 64–80…… ……... *E.* (*Z.*) *eleonorae* Haitlinger, 1987
– Ti I with 15 normal setae, SD 94–104, W 134–162, ISD 42–48 ……..... ……..…… *E.* (*Z.*) *budapestensis* Fain & Ripka, 1998***
26. Ti III with 14 normal setae ……..…… 27
– Ti III with 15 normal setae ……..……..…… 28
27. ISD 50, Ge III 121, Ta III 124, *1b* 91 …..……... *E.* (*Z.*) *iranicus* Saboori & Akrami, 2001
– ISD 27–48, Ge III 72–111, Ta III 90–114, *1b* 65–74 ……..... ……..… *E.* (*Z.*) *preciosus* Goldarazena & Zhang, 1998
28. Ti III 290–297, SD 106–115, W 166, PW 140–150 ……..……..…….. ……..……..… *E.* (*Z.*) *kurdistaniensis* Khanjani & Ueckermann, 2005
– Ti III 199, SD 87, W 133, PW 102 ……..……..… *E.* (*Z.*) *ueckermanni* Saboori *et al*., 2004

* Measurements are based on *E.* (*Z.*) *passidonicus* from Greece (Haitlinger 2006a) and Turkey (Haitlinger 2010).
** Measurements are based on Mortazavi *et al.* (2012) and present study.
*** Measurements are based on *E.* (*Z.*) *budapestensis* from Hungary (Fain and Ripka 1998) and Crotia (Haitlinger 2004).

ACKNOWLEDGEMENT

We thank Prof. Alireza Saboori (Jalal Afshar Zoological Museum, Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran) for his kind help in this study and also appreciate for valuable comments which improved the manuscript English considerably. This project is supported by grants from Department of Plant Protection, Faculty of Agriculture, University of Kurdistan (4/10237).

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دومین گزارش کنهٔ ***Erythraeus* (*Zaracarus*) *coleopterus* (Acari: Erythraeidae)** از ایران همراه با داده‌های جدید ریخت‌شناسی

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چکیده

کنهٔ *Erythraeus* (*Zaracarus*) *coleopterus* Mortazavi, Hajiqanbar & Saboori, 2012 (Acari: Parasitengona: Erythraeidae) بر اساس یک نمونه از استان کرمان، جنوب شرقی ایران، در ارتباط با سوسکی اسکارابئید (*Cyphonoxia* sp.) از خانواده Scarabaeidae و راستهٔ سخت‌بالپوشان (Coleoptera) توصیف شد. این گونه برای دومین بار از ایران و از انبار برنج (بدون میزبان) در غرب ایران، استان کردستان، شهرهای بانه و سقز با داده‌های جدید ریخت‌شناسی گزارش می‌شود. پیدا کردن نمونه‌های اضافی افزون بر نمونه‌های تایپ، کمک می‌کند تا توصیف اصلی کنه *E. (Z.) coleopterus* تکمیل و تصحیح شود. کلید شناسایی برای گونه‌های لارو زیرجنس *Erythraeus* (*Zaracarus*) ارائه می‌شود که کلید تغییر یافته و اصلاح شده محمودی و همکاران (۲۰۱۴) است.

واژگان کلیدی: Erythraeinae؛ کلید؛ کردستان؛ لارو؛ پارازیتنگونا.

اطلاعات مقاله: تاریخ دریافت: ۱۳۹۵/۱۰/۱۸، تاریخ پذیرش: ۱۳۹۶/۱/۱۵، تاریخ چاپ: ۱۳۹۶/۱/۲۶