

First record of larval Hexathrombiini (Trombidiformes: Microtrombidiidae) with description of a new species from Iran

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Abstract

Hexathrombium osheydaensis Haddadi and Noei **sp. nov.** (Trombidiformes: Microtrombidiidae) is described from larvae ectoparasitic on an unidentified Tenebrionidae (Coleoptera: Polyphaga), *Pheropsophus catoirei* Dejean (Coleoptera: Adephegidae: Carabidae), *Chrotogonus trachypterus* (Blanchard) and *Schistocerca gregaria* (Forsskal, 1775) (Orthoptera: Pyrgomorphidae and Acrididae, respectively) in Sistan and Baluchestan Province, Iran. The tribe Hexathrombiini Fain and Drugmand is reported for the first time from Iran. An updated key to the world species of the genus *Hexathrombium* Cooreman, 1944 is presented.

Key words: *Hexathrombium*, new host, new species, Orthoptera, Sistan and Baluchestan

Introduction

The family Microtrombidiidae Thor, 1935 includes three subfamilies: Euthrombidiinae Thor, 1935; Microtrombidiinae Thor, 1935 and Valgothrombiinae Gabrys, 1999. The subfamily Eutrombidiinae consists of four tribes: Eutrombidiini Southcott, 1993 (with *Eutrombidium*, *Verdunella*, *Spinnitrombium* and *Araneothrombium*), Hexathrombiini Fain and Drugmand, 1993 (with *Hexathrombium*, *Hoplothrombium*, *Beronium* and *Alhamitrombium*), Milliotrombidiini Southcott, 1993 (with *Milliotrombidium* and *Kepongia*) and Phnompetrombiini Haitlinger, 2002 (*Phnompetrombium*) (Fain & Drugmand 1993; Southcott 1993; Haitlinger 2002; Mağol *et al.* 2017, 2021). In the latest study by Mağol *et al.* (2021) the tribe Hexathrombiini was redefined and *Hexathrombium abirami* Haitlinger, 1997 was redescribed based on the ectoparasitic larvae on a bright metallic tiger beetle, *Tetracha fulgida* (Klug) (Coleoptera: Carabidae: Cicindelinae) from Peru. Also, they provided the additional data of *H. lubomirae* (Haitlinger, 1994), *H. mamerti* Haitlinger, 1999 and *H. marittae* (Haitlinger, 1994). The genus *Hexathrombium* consists of 10 valid species, all of them have been described based on larvae worldwide so far (Mağol *et al.* 2021). The vast majority of hosts for *Hexathrombium* are Coleoptera (Felska *et al.* 2018; Mağol *et al.* 2021), however, the members of this genus were also recorded from Hymenoptera (Ichneumonidae: *Mesoleptus* sp.) by Zheng (1997). In the present study, *Hexathrombium osheydaensis* Haddadi and Noei **sp. nov.** is described as the third species from the Palearctic region (*H. southcotti* and *H. sorayae*) and the first report from Iran. The families Acrididae and Pyrgomorphidae (Insect: Orthoptera) and Tenebrionidae (Insect: Coleoptera) are recorded as new hosts for the tribe

Hexathrombiini. A key to the tribes of Eutrombidiinae is provided, and a key to world larval species of *Hexathrombium* are updated after Southcott (1993) and Mağol *et al.* (2021), respectively.

Material and Methods

In total, 576 larval specimens were collected from various region of Sistan and Baluchestan province, Iran. The ectoparasitic larvae were detached from their hosts (for attachment sites see Table 3) from the families Carabidae, Tenebrionidae (Insecta: Coleoptera) and Acrididae and Pyrgomorphidae (Insecta: Orthoptera) with an insect pin under a stereomicroscope and preserved in 75% ethanol. Most specimens ($n = 375$) were collected from the family Carabidae using direct host observation and by the ground tubular traps. Three specimens were collected by Berlese's funnel, light trap and sweep net (one for each). Other specimens ($n = 198$) were found in the vials, containing many different insects collected by the ground tubular traps, hence, it was not possible to explicitly identify the specific host. The specimens were cleared in lactophenol and mounted on microscope slides using Hoyer's medium (Walter & Krantz 2009). The metric and meristic data of 33 specimens were examined (see Table 1–2). Line drawings were prepared using a BX51 Olympus microscope equipped with a drawing tube and magnification changer. Photographs were taken with an AxioCam 506 color (Carl Zeiss, Germany) digital camera with an AxioImager A2 (Carl Zeiss, Germany) compound microscope with phase contrast and DIC illumination. All measurements are given in micrometers using a CH30 Olympus microscope. The terminology follows Southcott (1993) and Wohltmann *et al.* (2007).

Results

Systematics

Family Microtrombidiidae Thor, 1935

Subfamily Eutrombidiinae Thor, 1935

Tribe Hexathrombiini Fain & Drugmand, 1993

Genus *Hexathrombium* Cooreman, 1944

Type species. *Hexathrombium spatuliferum* Cooreman, 1944

***Hexathrombium osheydaensis* Haddadi & Noei sp. nov. (Figs. 1–15)**

Diagnosis of larva: Seta 3a present; pygidial shield (Q_5) divided; two solenidia on Ge I; four normal setae on Ge I; 13 normal setae on Ta III; PLN 15–22; Fe I 42–50; QL_4 50–65.

Description ($n = 33$)

Dorsum (Fig. 1). Idiosoma oval, dorsal surface with one scutum and four median shields (Q_1 – Q_5), scutum large and sparsely punctate and covering the entire anterior region of idiosoma (in unengorged specimens), anterolateral parts of scutum bent ventrally (stolascutum). Scutum rounded anteriorly, slightly convex posteriorly, bearing three pairs of normal setae (AM, AL and PL) and a pair of sensilla (S), AM at the most anterior part of the scutum and nude, AL and PL are barbed, PL is shorter than AL and AM. Sensilla nude, very long and setiform. Setae PL slightly posterior to S. Posterolaterally on each side of scutum two eyes situated on a common ocular plate, anterior lens

slightly larger than posterior one. Scutellum (Q_2) almost trapezoidal in shape, sparsely punctate, with rounded corners in anterior margin, larger than Q_3 and Q_4 , with a pair barbed setae (c_1). Scutellum (Q_3) rectangular in shape, sparsely punctate, narrower and smaller than Q_2 and Q_4 , with a pair of barbed setae (d_1), anterior border straight and slightly concave posteriorly. Scutellum (Q_4) rectangular in shape, sparsely punctate, with rounded corners, with a pair of barbed setae (e_1). Pygidial shield (Q_5) divided [in two paratypes, ARS-20250505-31 and ARS-20250505-32, the pygidial shield (Q_5) is entire, which is an abnormality (Figs. 11–12)], sparsely punctate, each sclerite with a long, barbed setae (h_1). Dorsal setae arranged in five rows (c_{1-3} - d_{1-3} - e_{1-3} - f_{1-3} - h_{1-2}), setae h_1 and h_2 longer than other setae and h_2 with long barbs, $fD = 4(2)-4(2)-4(2)-6-(1+1)2 = 28$.

Venter (Fig. 2). Idiosoma ventrally with one pair of nude setae ($3a$) (absent in one paratype larva, ARS-20250505-10, which is an abnormality), 14–16 barbed ventral setae ($fV = 6-4u-4-2 = 16$ in holotype) located on smooth sclerites, and an anus. Coxal plates I–II contiguous, coxa I with setae $1a$ and $1b$ and a Claparède's organ (clp) (Fig. 15); coxae II and III with setae $2b$ and $3b$ respectively, $1a$ setiform and nude; coxalae $1b$, $2b$ and $3b$ modified, bilobed transversely [one specimen (ARS-20250505-10) has two bilobed setae $3b$ on each coxa III, which is an abnormality (Fig. 15)] and striated. Anus without anal sclerites and with pre-anal tubercle. $NDV = 28 + 16 = 44$ (42–44 in paratypes).

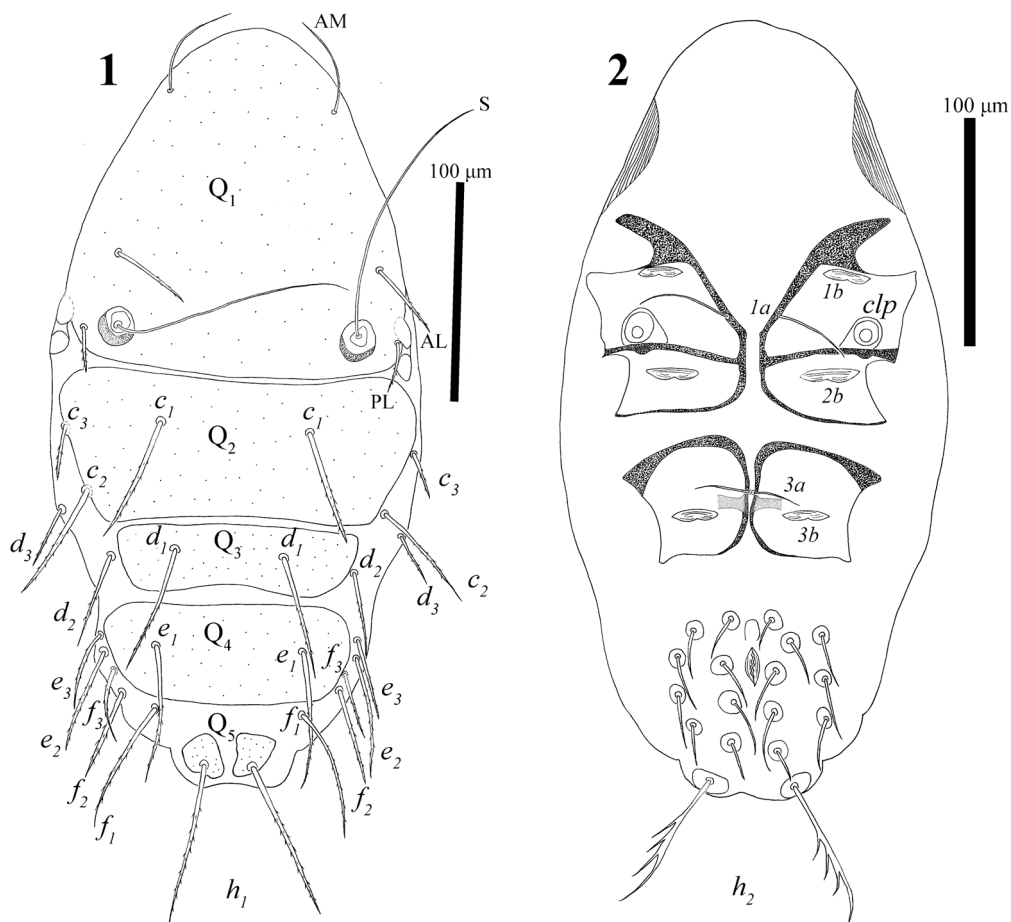


FIGURE 1–2. *Hexthrombium osheydaensis* Haddadi & Noei **sp. nov.** larva. 1. Dorsal view of idiosoma; 2. Ventral view of idiosoma.

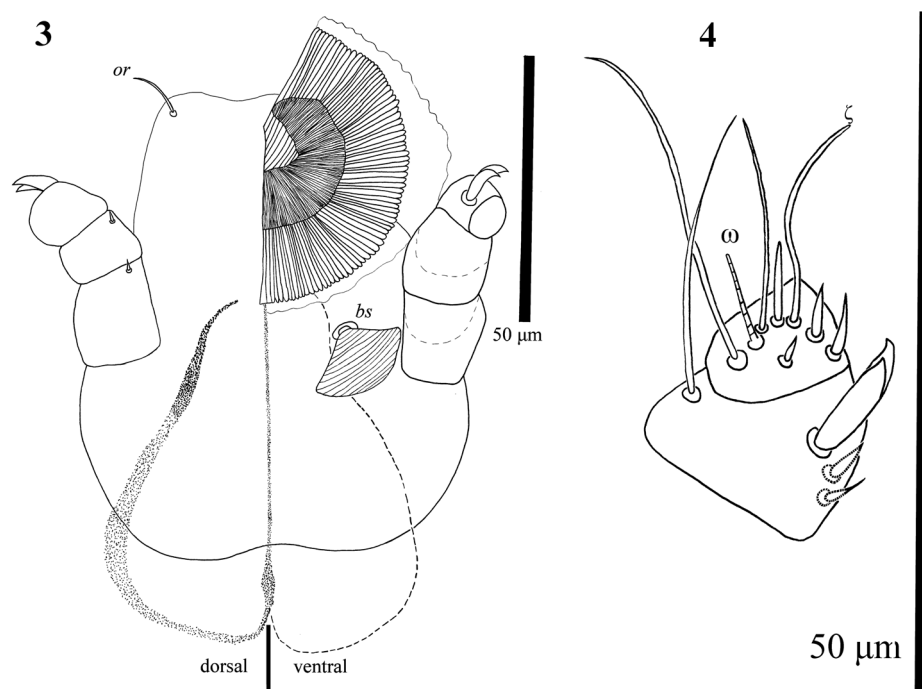


FIGURE 3–4. *Hexthrombium osheydaensis* Haddadi and Noei **sp. nov.** larva. 3. Gnathosoma, ventral (right) and dorsal (left) view (holotype); 4. Details of palp tibia and palp tarsus (paratype ARS-20250505-2).

Gnathosoma (Figs. 3–4). Gnathosoma located beneath anterior end of idiosoma. Stephanostome present (horseshoe-like, oral ring open anteriorly). Gnathosoma with a pair of striated reniform subcapitular setae (*bs*) and a pair of nude adoral setae (*or*). Cheliceral blade (broken in the holotype) curved and sickle-shaped (see Fig. 13 in paratype, ARS-20250505-32). Palp femur and palp genu each with one spine-like seta. Palp tibia bearing three nude setae, one seta long, two setae small and thick. Palp tibial claw (odontus) bifid entirely. Palp tarsus with six nude setae (two setae longer than the others), an eupathidia and a solenidion. fPp = 0-N-N-NNN₂-6Nωζ.

Legs (Figs. 5–10). Leg segmentation formula 6-6-6. Leg setal formula in holotype: Leg I: Ta- 1ω, 2ζ, 1ε, 18n; Ti- 2φ, 1κ, 6n; Ge- 2σ, 4n; Fe- 6n; Tr- 1n; Cx-2n (Figs. 2 & 5–6). Leg II: Ta- 1ω, 1ε, 15/14n; Ti- 2φ, 5n; Ge- 1σ, 2n; Fe- 5/6n; Tr- 1n (Figs. 2 & 7–8); Cx-1n. Leg III: Ta- 13n; Ti- 5n; Ge- 1σ, 2n; Fe- 4n; Tr- 1n; Cx-1n (Figs. 2 & 9–10) (see Table 1 for paratypes). Normal setae on legs mostly nude and some with few fine barbs. Tarsi I and II each with a pair of claws and an empodium, each claw with few fine ciliations on each side. Tarsus II with one robust, fan-like seta in distal part. Tarsus III with two claws, outer claw long and falciform and inner claw small and thick (smilum), each with fine ciliations, no empodium. At the most distal part of tarsus III a fully branched (5–7 branches) lophotrix (Fig. 10 & 14).

Measurements are given in Table 2.

Etymology: The specific epithet is derived from Osheyda, a historical place in the Hamun Lake, Sistan region, Sistan and Baluchestan Province, Iran.

Type material: The holotype larva (ARS-20250505-1) was collected ectoparasitic on Coleoptera (Carabidae) and 32 paratype larvae (ARS-20250505-2-33) were collected ectoparasitic on Orthoptera (Acrididae and Pyrgomorphidae) and Coleoptera (Carabidae and Tenebrionidae), IRAN: Sistan and Baluchestan province (Southeastern Iran), coll. A. R. Arjmandi-Nezhad, K. Mohammadi Bakhshani & M. Haddadi. (Table 3).

TABLE 1. Leg chaetotaxy of *Hexathrombium osheydaensis* Haddadi and Noei **sp. nov.** (larva). 1, holotype; 2–33, paratypes.

Character	1	2	3, 5, 6, 7, 9, 11, 12, 4 14, 15, 16, 17, 18, 21, 22, 23, 25, 26, 27, 28, 32, 33	8	10	13	19
Cx I	2n	2n	2n	2n	2n	2n	2n
Tr I	1n	1n	1n	1n	1n	1n	1n
Fe I	6n	6n	6n	6n	6n	6/5n	6n
Ge I	4n, 2σ	4n, 2σ	4n, 2σ	4n, 2σ	4n, 2σ	4n, 1/2σ	4/5n, 2σ
Ti I	6n, 2φ, 1κ	6n, 2φ, 1κ	6n, 2φ, 1κ	6n, 2φ, 1κ	6n, 2φ, 1κ	6n, 2φ, 1κ	6n, 2φ, 1κ
Ta I	18n, 1ω, 2ζ, 1ε	18n, 1ω, 2ζ, 1ε	18n, 1ω, 2ζ, 1ε	19/18n, 1ω, -/18n, 1ω, 2ζ, 2ζ, 1ε	17/18n, 1ω, 18n, 1ω, 2ζ, 2ζ, 1ε	18n, 1ω, 2ζ, 1ε	18n, 1ω, 2ζ, 1ε
Cx II	1n	1n	1n	1n	1n	1n	1n
Tr II	1n	1n	1n	1n	1n	1n	1n
Fe II	5/6n	5n	5n	5n	5n	5n	5n
Ge II	2n, 1σ	2n, 1σ	2n, 1σ	1/2n, 1σ	2n, 1σ	2n, 1σ	2n, 1σ
Ti II	5n, 2φ	5n, 2φ	5n, 2φ	5n, 2φ	5n, 2φ	5n, 2φ	5n, 2φ
Ta II	15/14n, 1ω, 1ε	14n, 1ω, 1ε	14n, 1ω, 1ε	14n, 1ω, 1ε	14n, 1ω, 1ε	14n, 1ω, 1ε	14n, 1ω, 1ε
Cx III	1n	1n	1n	1n	1n	2n	1n
Tr III	1n	1n	1n	1n	1n	1n	1n
Fe III	4n	4n	4n	4n	4n	4n	4n
Ge III	2n, 1σ	2/3n, 1σ	2n, 1σ	2n, 1σ	2n, 1σ	2n, 1σ	2n, 1σ
Ti III	5n	5n	5n	5n	5n	5n	5n
Ta III	13n	13n	13n	13n	13n	13n	13n
Character	20	24	29	30	31	Range	
Cx I	2n	2n	2n	2n	2n	2n	
Tr I	1n	1n	1n	1n	1n	1n	
Fe I	6n	6n	6n	5/6n	6n	5-6n	
Ge I	4n, 2σ	4n, 2σ	4n, 2σ	4n, 2σ	4n, 2σ	3-5n, 1-2σ	
Ti I	6n, 2φ, 1κ	6n, 2φ, 1κ	6n, 2φ, 1κ	6n, 2φ, 1κ	6n, 2φ, 1κ	6n, 2φ, 1κ	
Ta I	18/19n, 1ω, 2ζ, 1ε	18n, 1ω, 2ζ, 1ε	18n, 1ω, 2ζ, 1ε	18n, 1ω, 2ζ, 1ε	18n, 1ω, 2ζ, 1ε	18-19n, 1ω, 2ζ, 1ε	
Cx II	1n	1n	1n	1n	1n	1n	
Tr II	1n	1n	1n	1n	1n/-	1n	
Fe II	5n	6/5n	5n	5n	5n/-	5-6n	
Ge II	2n, 1σ	2n, 1σ	2n, 1σ	2/-n, 1σ	-	1-2n, 1σ	
Ti II	5n, 2φ	5n, 2φ	5n, 2φ	5/-n, 2φ	-	5n, 2φ	
Ta II	14n, 1ω, 1ε	14n, 1ω, 1ε	14/13n, 1ω, 1ε	14/-n, 1ω, 1ε	-	13-15n, 1ω, 1ε	
Cx III	1n	1n	1n	1n	1n	1-2n	
Tr III	1n	1n	1n	1n	1n	1n	
Fe III	4n	4n	4n	4n	4n	4n	
Ge III	2n, 1σ	2n, 1σ	2n, 1σ	2n, 1σ	2n, 1σ	2-3n, 1σ	
Ti III	5n	5n	5n	5n	5n	5n	
Ta III	13n	13n	13/12n	13n	13n	12-13n	

“- “ Damaged.

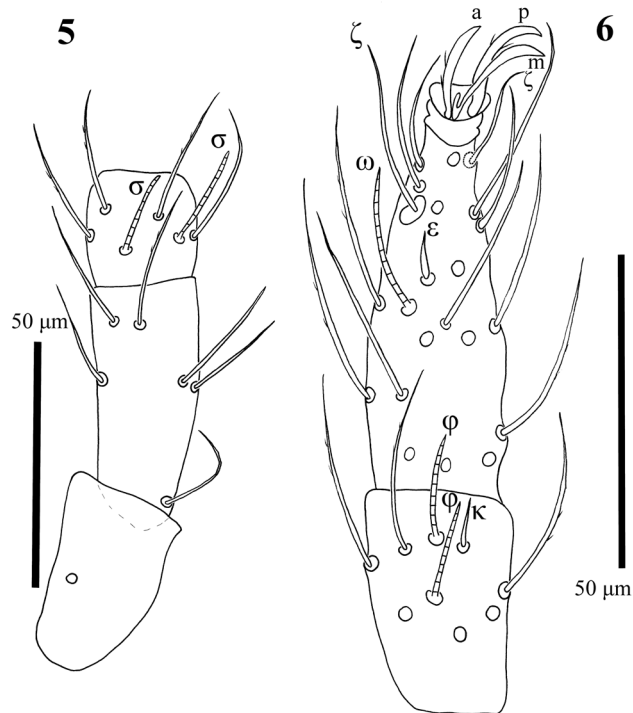


FIGURE 5–6. *Hexthrombium osheydaensis* Haddadi and Noei **sp. nov.** larva. Leg I: 5. Tr–Ge; 6. Ti–Ta.

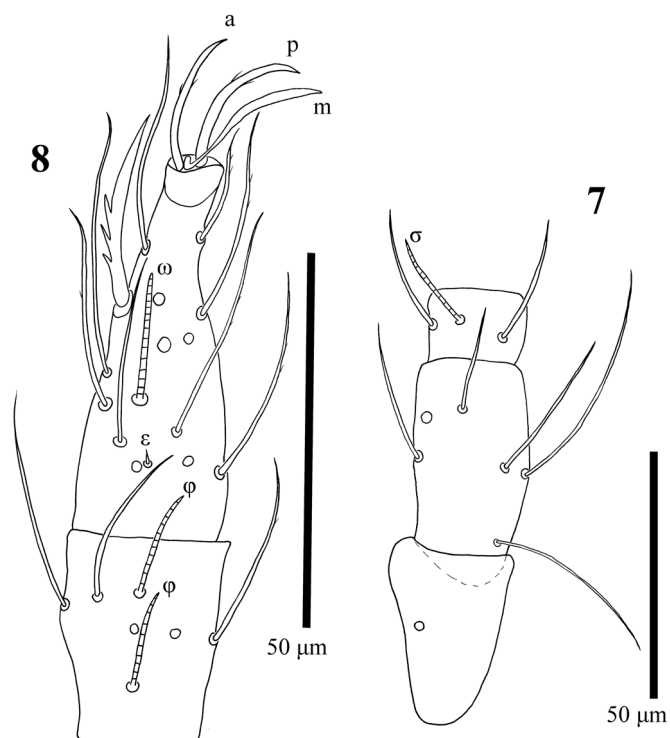


FIGURE 7–8. *Hexthrombium osheydaensis* Haddadi and Noei **sp. nov.** larva. Leg II: 7. Tr–Ge; 8. Ti–Ta.

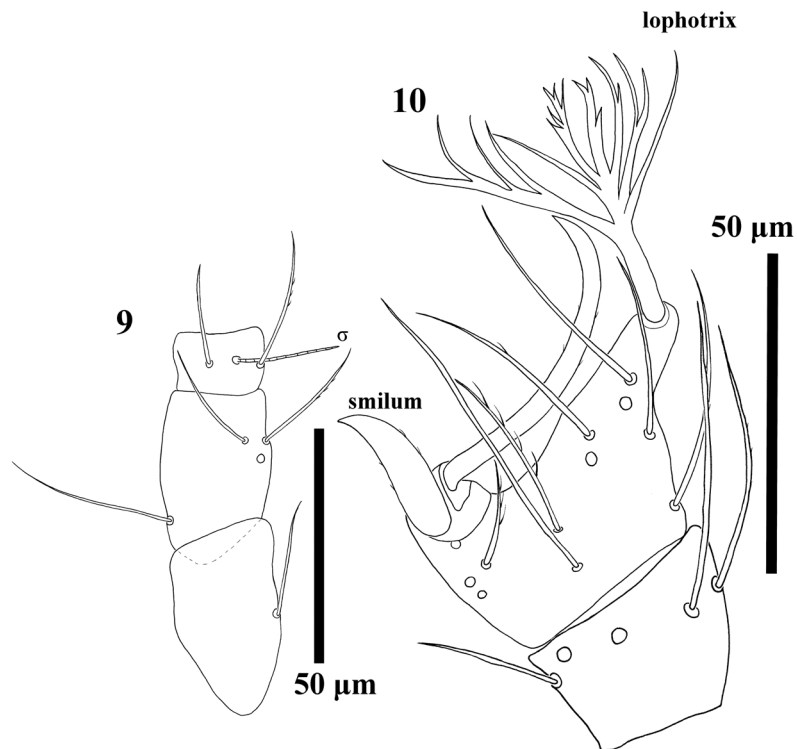


FIGURE 9–10. *Hexthrombium osheydaensis* Haddadi and Noei **sp. nov.** larva. Leg III: 9. Tr–Ge; 10. Ti–Ta (Ti in holotype, Ta in paratype ARS-20250505-2).



FIGURE 11–12. *Hexthrombium osheydaensis* Haddadi and Noei **sp. nov.** (larva). Microphotograph of entire pygidial shield (Q_5), 11. in paratype larva, ARS-20250505-31, 12. in paratype larva ARS-20250505-32. (Not to scale).

Type deposition. The holotype (ARS-20250505-1) and 19 paratype larvae (ARS-20250505-2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20) are deposited in the Acarological Collection, Jalal Afshar Zoological Museum, Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran; 13 paratype larvae (ARS-20250505-21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33) in the Acarological Collection, Acarological Society of Iran, Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran.

TABLE 2. Metric and meristic data of *Hexathrombium osheydaensis* Haddadi and Noei **sp. nov.** (larva), 1, holotype; 2–33, paratypes.

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
IL	340	380	500	520	410	360	400	380	340	340	350	440	330	360	320	450	350
IW	150	210	300	310	245	190	190	160	160	160	170	270	170	180	160	220	170
L	157	155	152	147	155	150	162	147	155	137	160	-	162	162	145	157	157
W	150	160	147	147	150	142	160	155	147	137	145	145	150	155	137	160	147
AM	40	-	25	20	27	25	32	37	25	21	35	25	37	25	32	37	37
AA	75	80	62	67	65	62	75	70	67	63	70	75	65	75	62	72	72
MA	79	85	90	84	87	77	87	85	80	67	82	-	87	87	75	80	80
AL	36	-	40	41	45	37	45/37	37	37	40	36	30	42	47	42/-	37	37
AW	117	117	115	115	117	112	117	115	112	100	112	110	110	117	107	117	105
PL	20	20	25	20	20	25	25	20	22	20	20	-	20	22	22	22	22
PW	142	142	137	147	135	132	145	145	137	127	142	137	137	147	125	147	137
AP	31	27	30	31	27	25	37	32	35	27	35	27	37	30	30	40	30
S	98/110	-	-	95	97	-/87	122	112	102	100	100	-	117	-	80	107	105
SB	110	112	100	110	102	97	110	112	120	92	105	105	102	112	100	112	110
ASB	137	130	127	125	137	125	140	125	135	112	135	-	125	137	125	137	130
PSB	20	22	25	25	22	25	22	22	20	20	25	20	25	22	22	25	25
PSL	65	60	50	57	57	50	62	55	55	56	60	60	60	55	60	60	65
PSW	160	152	150	-	145	145	157	160	152	140	157	150	150	150	137	155	155
PLN	20	17	15	15	15	17	17	17	17	20	20	22	22	20	15	25	15
QL	52	-	42	47	42	50	50	50	52	48	50	52	50	50	47	50	45
QW	65	60	60	67	55	60	62	65	65	55	62	60	62	65	55	65	62
L ₃	32	35	30	27	23	35	35	25	25	29	30	32	35	32	30	35	37
W ₃	105	102	102	107	89	95	105	110	102	90	100	102	107	95	95	110	97
PLN ₃	12	12	12	15	10	15	15	10	15	15	15	17	15	15	15	17	15
QL ₃	55	-	50	45	50	55	55	50	55	49	50	57	52	52	52	52	52
QW ₃	50	40	42	50	35	39	42	50	42	40	37	40	45	37	37	50	35
L ₄	42	37	37	40	37	37	40	40	35	37	42	37	40	37	35	37	40
W ₄	102	95	112	112	92	92	102	112	102	87	107	102	97	92	90	102	100
PLN ₄	17	15	12	15	15	16	20	15	17	16	17	20	17	15	12	20	17
QL ₄	60	57	52	57	55	60	60	52	62	52	55	-	62	60	60	62	55
QW ₄	65	52	62	67	52	55	60	67	67	50	65	62	52	50	57	67	62
L ₅	22/25	17	25	25	25/27	-	17	25	22	17	22/25	12/15	27	20/15	20	17	22/20
W ₅	17/20	22	17	20	20/22	-	22	20	22	20	20	20/22	22	17	20	20	20
PLN ₅	15	15	12	15	15	-	-	15	17	10	15	-	17	15/20	15	12	15
QL ₅ =h ₁	75	75	72/75	70/72	75	69	62	75	77	77	75	80	82	77	70	85	77
QW ₅	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
h ₂	67/70	57	50	67	50	55	72	62	65	62	60	50	72	62	62	60	67
fV	16	14	14	14	15	-	14	16	14	13	14	16	14	-	14	14	14
fD	28	28	27	24	28	28	28	28	28	28	28	28	28	28	28	28	28
Or	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	12
3a	26	12	15	25	15	15	25	25	20	absent	22	15	17	17	15	20	absent

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TABLE 2. (Continued)

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>Ia</i>	32	22	25	27	20	22	30	31	27	30	30	20	27	27	20	22	25
DS min.	25	25	25	25	27	25	32	30	22	16	26	25	25	30	27	27	25
DS max.	60	55	55	50	55	57	55	52	52	50	55	60	62	57	55	60	55
A lens	12	-	10	-	10	-	15	-	-	-	-	12	-	-	-	-	-
P lens	10	-	8	-	-	-	-	-	-	-	-	10	-	-	-	-	-
Ocular sclerite (L)	30	30	27	-	30	-	27	27	27	25	27	25	27	27	27	27	25
Ta I (L)	62	62	59	60	58	55	62	59	57	57	60	57	57	57	52	62	57
Ti I	33	30	32	31	36	31	33	35	30	31	35	32	32	32	30	35	35
Ge I	23	22	22	22	20	22	20	21	22	22	21	20	20	22	20	20	20
Fe I	50	50	50	45	45	45	50	45	50	50	47	45	50	47	47	50	42
Tr I	36	43	35	35	30	37	37	40	32	37	35	37	37	37	30	37	45
Cx I	71	82	61	61	65	70	60	73	62	70	70	72	75	75	75	75	75
Leg I	275	294	259	254	254	260	262	273	253	267	268	263	271	270	264	279	274
Ta II (L)	50	50	50	50	45	45	50	49	43	46	45	50	47	45	42	50	47
Ti II	26	25	25	25	26	25	25	25	25	25	25	25	27	25	25	25	25
Ge II	15	15	18	15	14	15	15	17	13	15	15	15	17	15	15	15	15
Fe II	43	38	40	32	40	40	40	40	37	39	40	42	40	40	37	42	37
Tr II	35	40	35	35	35	33	35	37	37	33	34	37	37	35	30	37	47
Cx II	55	65	53	55	45	50	50	60	52	49	50	60	52	55	50	60	55
Leg II	224	233	221	212	205	208	215	228	207	207	209	229	220	215	199	229	226
Ta III (L)	35	35	35	38	35	35	35	35	37	35	35	32	37	37	37	32	32
Ti III	20	20	20	20	20	20	20	20	20	20	20	20	20	20	17	17	17
Ge III	14	15	15	15	13	12	15	15	15	15	15	15	15	12	12	15	15
Fe III	37	35	35	35	35	30	35	35	30	30	35	32	37	32	37	37	35
Tr III	40	37	40	40	35	35	42	40	40	39	37	35	37	35	30	37	40
Cx III	55	56	50	55	50	50	55	50	50	50	50	52	52	50	50	55	50
Leg III	201	198	191	203	153	182	202	195	192	189	192	186	198	186	183	193	189
IP	700	725	671	669	612	650	679	696	652	663	669	678	689	671	646	701	689

TABLE 2. (Continued)

Character	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Range
IL	370	330	400	300	320	480	360	360	-	420	330	430	350	550	350	480	320-550
IW	190	160	180	150	160	250	190	170	-	200	160	200	170	330	180	280	150-330
L	165	150	165	160	142	142	155	150	162	155	152	152	146	144	153	138	138-165
W	150	142	150	150	140	152	157	150	150	157	145	147	156	158	146	148	137-160
AM	37	40	35	-	-	30	35	-	32	37	37	30	27	30	25	25	20-40
AA	70	67	75	80	62	75	65	65	80	75	73	70	71	67	77	73	62-80
MA	87	75	87	77	82	85	85	92	87	80	75	72	84	82	77	73	67-92
AL	37	41	-	40	42	37	42	42	-	40	40	-	40	-	40	38	30-47
AW	115	115	122	112	107	122	122	112	107	125	110	112	111	121	111	110	100-125

.....continued on the next page

TABLE 2. (Continued)

Character	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Range
PL	22	22	25	20	20	20	25	25	22	22	25	-	20	22	22	20	20–25
PW	140	137	147	137	137	147	150	137	140	150	137	137	144	139	136	130	127–150
AP	35	32	35	32	30	27	32	32	35	35	30	35	30	37	37	28	27–40
S	112	112	-	95	85	-	100	95	-	100	100	100	104	-	77	90	80–122
SB	105	105	112	95	102	112	112	100	105	112	105	95	101	104	104	95	92–120
ASB	135	122	142	140	132	132	130	127	142	142	127	135	129	124	131	113	112–142
PSB	25	25	27	25	22	25	20	25	22	22	22	20	20	25	22	25	20–27
PSL	52	62	57	62	62	62	62	62	65	62	60	55	50	59	57	-	50–65
PSW	150	155	155	150	150	152	170	157	152	157	155	150	-	163	146	-	137–170
PLN	20	20	22	22	20	17	22	22	20	22	17	22	-	22	20	20	15–22
QL	47	50	50	50	50	47	55	-/55	-	50	51	55	-	-	50	40	42–55
QW	50	62	60	60	62	62	77	62	57	65	60	62	-	62	57	58	50–67
L ₃	35	30	32	32	27	27	35	35	35	30	30	27	35	35	32	30	23–37
W ₃	105	100	97	102	97	100	112	100	105	110	105	100	-	111	89	88	87–112
PLN ₃	15	15	17	15	15	15	17	15	17	15	12	12	12	20	15	15	10–20
QL ₃	57	52	55	57	52	50	52	55	-	55	55	55	50	-/40	57	50	40–57
QW ₃	42	42	37	37	42	42	50	42	42	45	40	42	40	50	52	35	35–50
L ₄	42	42	40	42	40	35	37	37	42	45	40	35	-	45	32	-	30–45
W ₄	100	97	97	105	97	95	110	100	107	110	105	95	-	106	94	100	87–112
PLN ₄	17	17	17	15	17	12	17	20	22	17	15	20	-	20	12	13	12–20
QL ₄	57	60	57	60	55	52	65	62	-	65	55	59	-	54	50	53	50–65
QW ₄	57	62	55	57	57	52	52	57	57	60	60	56	-	57	57	48	48–67
L ₅	17	22	22	32	22	15/20	20	17	35	20	20/22	17	25	37	25	25	17–37
W ₅	22/20	15/17	20/17	20/22	17	22/17	20	20/17	20	20/17	22	15	-	52	45	20	15–52
PLN ₅	15	15	15	15	15	12	12	12/15	17	12	12/15	10	10	20	12	13	10–17
QL ₅ =h ₁	75	75	77	75	67	70	77	75	77	75	83	-	71	71/74	-	63	62–85
QW ₅	-	-	-	-	-	-	-	-	-	-	-	-	-	20	22	-	20–27
h ₂	70	55	65	72	57	60	65	62	62	70	75	55	52	75	-	45	42–75
Fv	14	14	-	15	14	-	16	14	14	16	14	15	-	-	14	14	13–16
fD	29	28	-	28	28	-	28	28	28	26	28	28	-	28	28	28	24–29
Or	12	10	10	10	10	10	10	10	10	10	10	10	10	12	12	10	10–12
3a	17	17	17	15	22	17	15	12	15	12	20	15	12	12	15	15	12–26
1a	27	27	25	22	27	17	25	22	25	17	20	25	17	22	27	18	17–32
DS min.	30	22	17	12	27	22	27	30	32	32	27	25	27	32	27	25	16–32
DS max.	55	55	52	55	57	50	62	67	50	57	60	70	62	54	54	63	50–70
A lens	-	10	15	-	-	12	12	-	-	12	-	-	10	12	-	13	10–15
P lens	-	12	12	-	-	8	10	-	-	10	-	-	-	-	-	8	8–10
Ocular sclerite (L)	30	25	27	27	27	25	27	27	25	27	27	27	27	-	27	28	25–30
Ta I (L)	60	60	57	62	60	55	65	62	57	60	55	59	57	59	62	53	55–65
Ti I	35	30	32	32	32	30	35	32	32	32	32	35	32	32	35	25	30–36

.....continued on the next page

TABLE 2. (Continued)

Character	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	Range
Ge I	22	22	20	20	20	22	22	22	22	20	23	20	20	22	22	18	18–23
Fe I	47	50	50	47	45	45	42	50	47	50	47	45	52	54	50	45	42–50
Tr I	35	35	32	37	32	32	35	45	42	45	35	35	35	27	37	30	30–45
Cx I	75	75	70	67	67	67	75	80	77	75	67	61	64	74	77	78	60–82
Leg I	274	272	261	265	256	251	274	291	277	282	259	255	260	268	283	249	249–294
Ta II (L)	47	47	45	50	45	45	52	50	47	47	45	45	50	50	50	40	40–52
Ti II	27	25	25	25	25	25	27	27	25	25	27	26	-	20	25	20	20–35
Ge II	15	15	15	17	15	15	20	15	17	15	17	17	-	17	17	13	13–20
Fe II	40	42	40	42	40	37	50	42	47	45	40	45	37	50	45	30	30–47
Tr II	37	30	32	32	30	30	35	42	30	37	35	33	32	37	37	25	25–47
Cx II	52	55	50	52	55	52	62	62	40	55	55	55	50	57	50	55	40–65
Leg II	218	214	207	218	210	204	244	238	206	224	219	181	-	231	224	183	181–244
Ta III (L)	37	37	37	40	35	35	40	37	37	35	35	35	37	37	35	28	28–40
Ti III	22	20	20	22	20	17	22	25	20	17	20	20	17	22	20	15	15–25
Ge III	12	12	12	12	12	15	15	15	12	12	15	15	12	15	15	13	11–15
Fe III	37	35	32	35	32	32	37	37	35	37	35	35	32	37	32	33	30–37
Tr III	42	37	37	40	32	37	47	47	35	37	40	40	35	37	37	33	30–47
Cx III	57	50	60	52	52	52	60	60	55	55	50	55	50	52	50	50	50–60
Leg III	207	191	198	201	183	188	221	221	194	193	195	200	183	200	189	172	153–221
IP	699	677	666	684	649	643	739	750	677	699	673	636	-	699	696	604	604–739



FIGURE 13. *Hexthrombium osheydaensis* Haddadi and Noei **sp. nov.** (larva). Microphotograph of the chelicera in paratype larva, ARS-20250505-32.

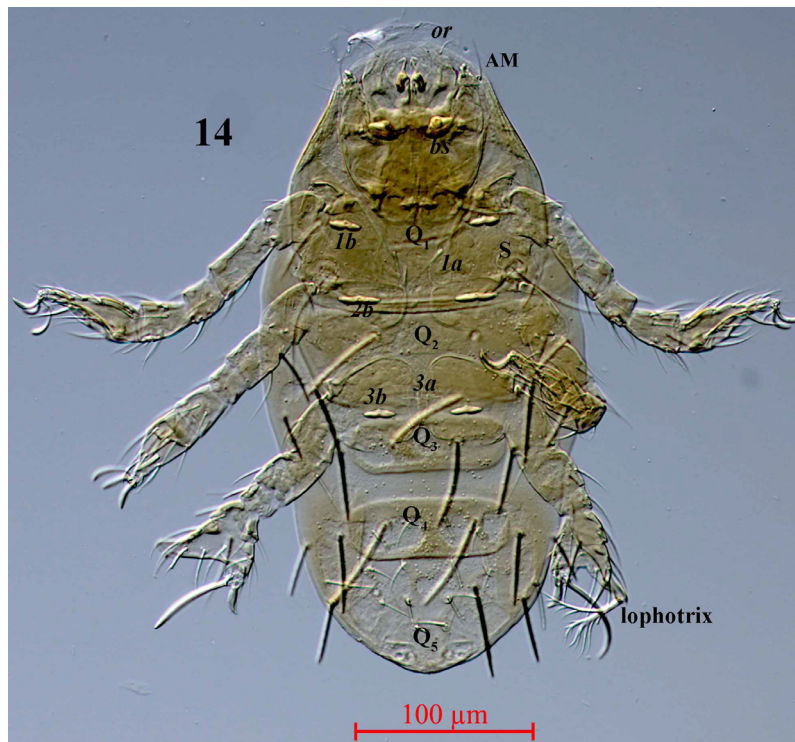


FIGURE 14. *Hexthrombium osheydaensis* Haddadi and Noei **sp. nov.** (larva). Microphotograph of lophotrix in paratype larva, ARS-20250505-32.



FIGURE 15. *Hexthrombium osheydaensis* Haddadi and Noei **sp. nov.** (larva). Microphotograph of coxalae 3b in paratype larva, ARS-20250505-10. (Not to scale)

TABLE 3. The hosts, location and sampling method of *Hexathrombium osheydaensis* Haddadi and Noei **sp. nov.** (larva). 1, holotype; 2–33, paratypes.

Type specimens	Host and attachment sites	Date	Location details/ collector	Sampling method
ARS-20250505-1, 5, 28, 30	Coleoptera: Carabidae/ abdominal surface	2022/03/08	Sib va Suran county, Rahmatabad village, 27.39604111N, 61.81389928E/ K. Mohammadi Bakhshani	Tubular trap
ARS-20250505-8, 11, 22	Carabidae/metathorax	2022/03/23	Sib va Suran county, Rahmatabad village, 27.39604111N, 61.81389928E/ K. Mohammadi Bakhshani	Direct host observation
ARS-20250505-2, 9, 14, 18, 32	Carabidae/elytra	2022/04/07 2022/05/10	Saravan county, Shamsabad village, 27.46308075N, 62.21181035E/ K. Mohammadi Bakhshani	Direct host observation
ARS-20250505-12, 16, 23, 24, 25, 29	Carabidae/head	2022/05/17 2022/05/12	Saravan County, Bakshan village, 27.36525019N, 62.33815312E/ K. Mohammadi Bakhshani	Direct host observation
ARS-20250505-15	Carabidae/head	2022/08/15	Mehrestan county, 27.12992086N, 61.67210698E/ K. Mohammadi Bakhshani	Direct host observation
ARS-20250505-6	Carabidae/right leg tarsus	2022/03/14	Saravan county, Gosht village, 27.78916243N, 61.95225835E/ K. Mohammadi Bakhshani	Direct host observation
ARS-20250505-3, 4, 10, 31	Carabidae/mesothorax	2022/05/08	Saravan county, Dezak village, 27.34299004N, 62.36699224E/ K. Mohammadi Bakhshani	Direct host observation
ARS-20250505-13, 17, 19, 21, 27	Carabidae, elytra	2022/08/27	Sib va Suran county, 27.24016945N, 62.07516789E/ K. Mohammadi Bakhshani	Direct host observation
ARS-20250505-20	Carabidae/abdomen	2023/05/10	Zabol county, 31.03870479N, 61.53134465E/ M. haddadi	Tubular trap
ARS-20250505-33	Tenebrionidae/right leg tarsus	2022/05/18	Mehrestan county, 27.12992086N, 61.67210698E/ K. Mohammadi Bakhshani	Light trap
ARS-20250505-7	Orthoptera (Acrididae)/ left leg tibia	2019/05/06	Chabahar county, Zarabad, 25.57701439N, 59.38386083E/ A.R. Arjmandi-Nezhad	Direct host observation
ARS-20250505-26	Pyrgomorphidae /left leg tibia	2022/08/17	Iranshahr county, kaj village, 27.40457569N, 60.82787633E/ K. Mohammadi Bakhshani	Direct host observation

Differential diagnosis. The new species belongs to the genus *Hexathrombium* Cooreman, 1944 in having five dorsal idiosomal shields, $fn\ Cx = 2-1-1$, medial coxala I–III bilobed and with diverged processes, pre-anal tubercle present, seta *3a* absent or present between coxal plates III [see Mağol *et al.* (2021)]. Two species-groups can be distinguished in *Hexathrombium* known as larvae, based on the presented identification key. One group with entire pygidial shield (Q5) including *H. lubomirae* (Haitlinger, 1994), *H. marittae* (Haitlinger, 1994) and *H. willisi* Southcott, 1993 [*3a* absent in *H. lubomirae* and *H. marittae* and present in *H. willisi*] and the other group with divided pygidial shield including *H. abirami* Haitlinger, 1997, *H. cicindelae* (Floch and Abonnenc, 1941), *H. fageli* Fain and Drugmand, 1993, *H. mamerti* Haitlinger, 1999, *H. sorayae* (Haitlinger, 1994), *H. southcotti* Zheng, 1997 and *H. spatuliferum* Cooreman, 1944 [*3a* absent in *H. sorayae* but present in the others]. The new species belongs to the species group with divided pygidial shield and it has seta *3a*.

The new species differs from *H. abirami* in the number of solenidia on Ge I (2σ vs. 1σ in *H. abirami**), number of normal setae on Ge I (4n vs. 5n) and Ta III (13n vs. 11n), in the shorter PLN (15–22 vs. 26–38), PLN₅ (10–17 vs 20–26), L₅ (17–37 vs 36–47), Fe I (42–50 vs. 49–60), in the

longer QL₄ (50–65 vs. 41–52), shape of lophotrix (proximal branch long and setulated vs. proximal branch long and nude on one side) and shape of the scutum (lateral borders convex vs. lateral borders concave); from *H. fageli* in leg setae (nude or a little barbed vs. setulated), in the longer W (137–160 vs. 120–135), AA (62–80 vs. 45–47), AW (100–125 vs. 43–90), PL (20–25 vs. 25–38), AP (27–40 vs. 39–45), S (80–122 vs. 65–75), PSW (137–170 vs. 128–130), QL (42–55 vs. 36–39), W₃ (87–112 vs. 75–86), W₄ (87–112 vs. 57–64), QL₄ (50–65 vs. 42–48), QW₄ (48–67 vs. 24–35), in the shorter PLN (15–22 vs. 36–39), Fe III (30–37 vs. 42–45); from *H. mamerti*** in a elongate and needle-shaped seta on tarsus I, tarsus II and femur III (absent vs. present), in the number of solenidia on Ge I (2σ vs. 1σ), number of normal setae on Ge I (4 vs. 5), W₃ (87–112 vs. 72–86), W₄ (87–112 vs. 74–74), in the shorter Ta III (28–40 vs. 52–56); from *H. southcotti* in the position of PL setae (PL posterior of S vs. PL at level of S), in the shorter W (137–160 vs. 170), MA (67–92 vs. 98), PW (127–150 vs. 155), QL (42–55 vs. 70), QL₃ (40–57 vs. 70), in the longer PSB (20–27 vs. 10), PSW (137–170 vs. 120), QW₄ (48–67 vs. 30); from *H. sorayae* in 3a (present vs. absent), in the number of solenidia on Ge I (2σ vs. 1σ), Ge II (2σ vs. absent), Ge III (2σ vs. absent), in the number of normal setae on Ge I (4 vs. 5), Ge II (4 vs. 3), Ge III (4 vs. 3), Ta III (13 vs. 10), in the position of PL setae (PL posterior of S vs. PL at level of S), in the shorter L (138–165 vs. 184–208), W (137–160 vs. 166–190), MA (67–92 vs. 96–104), AW (100–125 vs. 134–142), PW (127–150 vs. 164–180), SB (92–120 vs. 128–140), ASB (112–142 vs. 154–184), PSL (50–65 vs. 68–82), Ta III (28–40 vs. 44–48); from *H. spatuliferum* in the position of PL setae (PL posterior of S vs. PL at level of S), in the shorter W (137–160 vs. 166–177), L (138–165 vs. 165–180), PL (20–25 vs. 32–36), AW (100–125 vs. 153–165), PW (127–150 vs. 153–165), AP (27–40 vs. 42–45), ASB (112–142 vs. 140–150), QW₅ (20–27 vs. 35–36), Fe I (42–50 vs. 50–54), Ti I (30–36 vs. 36–39), Fe III (30–37 vs. 45), Ta III (28–40 vs. 50–55) in the longer S (80–122 vs. 76–85), QW₄ (48–67 vs. 47–48); differs from *H. cf. cicindela**** in the shorter PLN (15–22 vs. 28–30), PLN₄ (12–20 vs. 20–23), PLN₅ (10–17 vs. 20–25), in the longer QL (42–55 vs. 35–40), QL₄ (50–65 vs. 38–45), Ta I (55–65 vs. 50–53).

*, ** Based on Maḳol *et al.* (2021); *** based on Almada & Cédola (2017)

Key to the tribes of Eutrombinae [Updated after Southcott (1993)]

1. With five median dorsal idiosomal shields Hexathrombiini Fain & Drugmand, 1993
- With two median dorsal idiosomal shields. 2
2. AL scutalae rod-shaped and anteromedially to sensillary setae, coxae I with one large seta *1b* bearing four lobes Phnompetrombiini Haitlinger, 2002
- AL scutalae normal and anterolaterally to sensillary setae, seta *1b* on coxae I not large 3
3. Sensillary setae of anterior dorsal scutum clavate, PL scutalae reduced to minute hairs and well forward to PL angles Milliotrombidiini Southcott, 1993
- Sensillary setae of anterior dorsal scutum filiform, PL scutalae at or near PL angles of scutum, well behind level of sensillary setae. Eutrombidiini Thor, 1935

Key to the world larval species of *Hexathrombium* [Updated after Maḳol *et al.* (2021)] (excluding *H. cicindela* and *H. spatuliferum* because of incomplete description)

1. Pygidial shield (Q₅) entire, at most with medial incision at posterior border 2
- Pygidial shield (Q₅) divided 4
2. Setae *3a* present between coxal plates III, coxalae *1b*, *2b*, *3b* with rounded, not widely divergent lobes. *H. willisi* Southcott, 1993
- Setae *3a* absent, coxalae *1b*, *2b*, *3b* with pointed, widely divergent lobes 3
3. Pygidial shield incised posteriorly; AP 28–32; MA 98–114; QL₅ 102–114 *H. lubomirae* (Haitlinger, 1994)

- Pygidial shield oblong; AP 55–61; MA 73–75; QL₅ 49–57. *H. marittae* (Haitlinger, 1994)
- 4. Setae 3a absent *H. sorayae* (Haitlinger, 1994)
- Setae 3a present 5
- 5. Elongate, needle-shaped seta, much longer than other leg setae, present on tarsus I, tarsus II and femur III *H. mamerti* Haitlinger, 1999
- Elongate, needle-shaped seta absent 6
- 6. Leg setae setulated *H. fageli* Fain & Drugmand, 1993
- Leg setae barbed or nude 7
- 7. Setae PL levelled with S *H. southcotti* Zheng, 1997
- Setae PL posterior of S 8
- 8. Ge I with one solenidion and five normal setae, proximal branch of lophotrix long and nude on one side, lateral borders of scutum concave *H. abirami* Haitlinger, 1997
- Ge I with two solenidia and four normal setae, proximal branch of lophotrix long and setulated, lateral borders of scutum convex *H. osheydaensis* Haddadi & Noei **sp. nov**

Discussion: Based on the description, species of *Hexathrombium*, coxae I and II are contiguous. But, contrary to the original description (Haitlinger, 1997) of *Hexathrombium abirami*, Mağol *et al.* (2021) re-described and illustrated it with separated coxae I and II without any explanation.

In this study, the specimens of *Hexathrombium* were collected from across the vast Sistan and Baluchestan Province using various sampling methods. Sistan and Baluchestan Province is one of the driest regions of Iran, with a slight increase in rainfall from east to west, and a rise in humidity in the coastal regions. The Province is subject to seasonal winds from different directions.

Species of the genus *Hexathrombium* are primarily found ectoparasite on beetles (Coleoptera), often in large numbers- more than 20 individuals per host- which aligns with previous findings on *Hexathrombium* host associations. In this study, Orthoptera (Acrididae, Pyrgomorphidae) and Tenebrionidae (Coleoptera) are recorded as new hosts for the first time for *Hexathrombium*. This occurred in the southern region of the province (Zarabad, Chabahar county) during the annual locust migration. This finding suggests that the members of *Hexathrombium* may have initially entered Iran along with the migratory locusts and later settled and spread throughout the province. According to the previous studies, other species of *Hexathrombium* were described based on fewer specimens. But in the present study, 576 specimens from different hosts (mostly Carabidae) were collected from different areas of Sistan and Baluchestan with diverse climatic conditions and using different sampling methods, which indicates the diversity in habitat and host preference of *Hexathrombium*. The metric data of 33 specimens are shown in Table 2. Specimens show minor variations in metric data. Most specimens (n = 375) were collected from the family Carabidae using direct host observation and by the ground tubular traps. Among these, two specimens, ARS-20250505-31 (Q5 with medial incision at posterior border, Fig. 11) and ARS-20250505-32 (Q5 with medial incision at anterior and posterior border, Fig. 12) have entire pygidial shield (Q5). Also, two specimens, ARS-20250505-10 and ARS-20250505-17 have not seta 3a (see Table 2) and the first one has two bilobed setae on Cx III (fn Cx = 2-1-2) (Fig. 15, Table 1), which they can be abnormalities. Since these specimens (n = 4) were collected from similar hosts and locations and due to low sample size, lack of differences in leg setal formula and metric data, it is not adequate to regard them as different species and presence these abnormalities in some specimens in the large population (n= 576) is usual. Therefore, based on this research, it is recommended to avoid describing new species from the genus based on a single specimen. Furthermore, abnormal character states in *Parasitengona* have been reported often in laboratory rearing (stress induced by laboratory conditions) and less frequently in wild-caught specimens (possibly due to unfavorable rearing conditions or physiological aspects) (Costa, *et al.*, 2019). This information could be considered in future studies for host selection or to investigate different larval rearing conditions in the laboratory and their effect on metric and meristic characteristics of species of this genus and to test hypotheses on *Parasitengona* biology.

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