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Adelius aridus (Tobias, 1967) (Hym., Braconidae, Cheloninae) associated with a *Tamarix* leafminer (Lepidoptera: Nepticulidae), new for Iran

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ABSTRACT. *Adelius aridus* (Tobias, 1967) (Braconidae, Cheloninae) is recorded for the first time from Iran. It was collected among *Tamarix stricta* Boiss and *Tamarix aphylla* (L.) Karst. shrubs in Eastern Iran (Hamoon wetlands, Sistan), of which the latter was severely infested by an unknown nepticulid leaf miner (Lepidoptera, Nepticulidae). *Adelius aridus* is redescribed and its generic position is discussed.

Key words: *Adelius*, *Myriola*, Adeliini, Cheloninae, *Tamarix*, Hamoon wetlands, Eastern Iran

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Introduction

The genus *Adelius* Haliday, 1833 (Hymenoptera, Braconidae) was formerly classified within the separate subfamily Adeliinae (Quicke & van Achterberg, 1990; van Achterberg, 1993). It was ranked at tribal level until recently (van Achterberg & Berry, 2004; Quicke, 2015). On the basis of recent analyses, adeliines are derived Cheloninae and related within the Cheloninae probably to the Phanerotomini (Dowton & Austin, 1998; Kittel et al., 2016). Adeliines appear to be exclusively parasitoids of Nepticulidae (Lepidoptera), ovipositing into the egg stage of the host, as done by derived chelonines (Quicke, 2015).

Adeliini Viereck, 1918 are represented by four genera of which *Adelius* has a worldwide distribution. The three other genera are *Paradelius* de Saeger, 1942 (Afrotropical, Eastern Palaearctic, Nearctic, Oriental), *Sculptomyriola* Belokobylskij, 1988 (Eastern Palaearctic) and *Sinadelius* He & Chen, 2000 [*in* He et al., 2000] (Eastern Palaearctic, Oriental) (Yu et al., 2012). Acaelini (-inae) and *Acaelius* are unjustified emendations (Mason, 1985; Quicke, 2015). Only 21 species are now categorized within the genus *Adelius*, of which 17 species are distributed in the Palaearctic region (with about nine species in Central Asian area),

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but several species remain undescribed (van Achterberg, pers. comm.). A serie of taxonomic works have been done on the Iranian Cheloninae (Lashkari Bod et al., 2011; Ameri et al., 2012; Farahani et al., 2013, 2014), but nothing is well documented on Adeliini.

The character of the fused first two metasomal tergites is shared with typical chelonines, but the metasoma is not carapace-like and the fore wing venation is much reduced. In general, they can be recognized by the immovably joined three basal metasomal tergites that form shield like plate covers about two-thirds of metasoma, the robust hind legs, and vein 3-SR of the fore wing issued directly from pterostigma (van Achterberg, 1993). The fusion of the three first metasomal tergites has not led to strong sclerotization of the metasoma and the apical metasomal segments are well developed (Dudarenko, 1974).

The Hamoon wetlands in the Sistan region (Zabol, North of Sistan-Baluchestan province, E. Iran) were sampled from May 2014 to October 2015. The area is dominated by opportunistic salt cedar trees, *Tamarix stricta* Boiss and *Tamarix aphylla* (L.) Karst. (Figs 1A–B), of which the latter was heavily infested by a nepticulid leaf miner. A pale species of *Adelius* was found, that proved to be *Adelius aridus* (Tobias, 1967) and most likely used the nepticulid leaf miner as host. This is the first record outside its type locality (Turkmenistan) and is a new record for Iran. It was originally described in the genus *Myriola* Shestakov, 1932, because of having vein 3-SR of fore wing separated from pterostigma and the light body colouration (Tobias, 1986). Muesebeck & Walkley (1951) synonymized *Myriola* Shestakov with the genus *Adelius* without any explanation.

Material and methods

The specimens of *Adelius aridus* were collected by using light traps, beating sheets and Malaise traps. The sampling were carried in the Hamoon wetlands in the Sistan region (Zabol, North of Sistan-Baluchestan province, Iran) from May 2014 to October 2015 (Figs 1A–B). During the sampling period two Malaise traps were mounted among the canopy of the *Tamarix* shrubs (Fig. 1C); the collector filled with 70% ethyl alcohol. Additional specimens were collected by a modified strong sweep net, which acts as a beating sheet with a collecting chamber (Fig. 1D). Finally, a light source composed of actinic fluorescent tubes and incandescent bulb was mounted in the front of a white sheet at 120cm height from the ground. Tiny specimens attracted by the light were carefully collected by a hand-held pooter and preserved in 75% ethanol.

All specimens were then treated according to AXA method (van Achterberg, 2009), mounted on triangular cards and labelled. The external morphology of specimens was studied using a Nikon® SMZ645 stereomicroscope and photographed using a Digital Microscope Keyence® VHX-2000 and then processed in Adobe Photoshop®. Microscopic slides were prepared from the dissected specimen and illustrated using Biological-i4 Infinity™ Microscope, equipped with IS 1000 digital camera (LW Scientific). For the terminology of the morphological features, sculpture and measurements, see van Achterberg (1993). The following abbreviations are used for morphological terminology: POL: postocellar line; OOL: ocular-ocellar line; OD: maximum diameter of lateral ocellus. Measurements for the aspect ratio were taken in TPSdig ver 2.05 (Rohlf, 2006) using linear measurements option with a series of captured images.

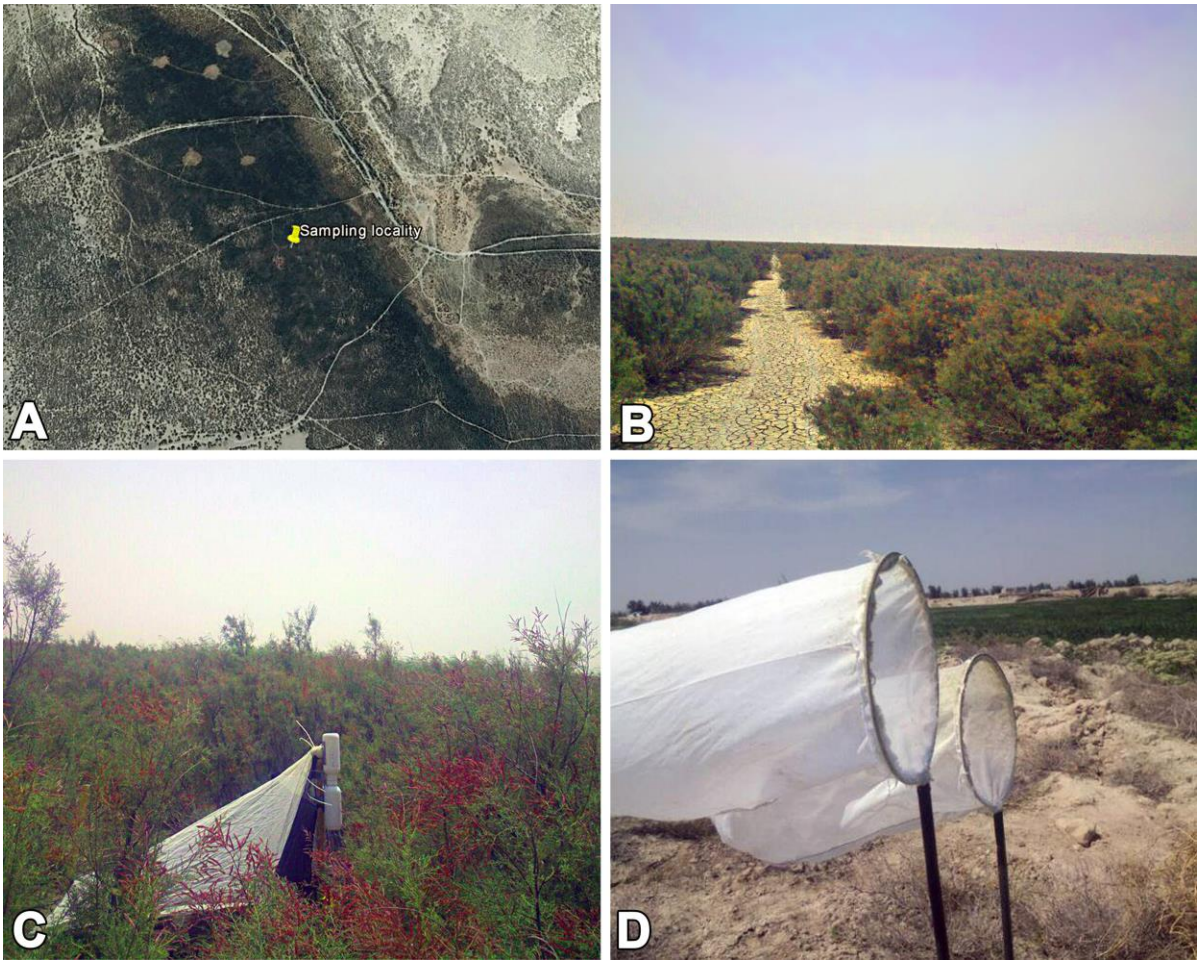

Figure 1. Sampling site of *Adelius aridus* (Tobias, 1967), Sistan, Hamoon wetland, represented by natural and planted *Tamarix stricta* and *Tamarix aphylla*: **A.** Map of the sampling locality (31°10'40.29"N; 61°19'45.10"E); **B.** Sampling site; **C.** Malaise trap among Tamarix shrubs; **D.** Modified sweep net with the metal ring of 70 cm in diameter.

The studied specimens are deposited in the collections of Agricultural Research Education and Extension Organization (Tehran, Iran; AERO), Collection of Department of Plant Protection, University of Zabol (Zabol, Iran; DPPZ) and Zoological Institute of the Russian Academy of Sciences (St. Petersburg, Russia; ZISP).

Results

Genus *Adelius* Haliday, 1837

***Adelius aridus* (Tobias, 1967)** (Figs 2–5)

Myriola arida Tobias, 1966: 1809; 1967: 392.

Acaelius arida Shenefelt, 1973: 670.

Adelius arida Tobias, 1986: 591.

Material examined: 3♀♀ 2♂♂ (DPPZ), IRAN, Sistan-o Baluchestan province, Zabol, Hamoon wetlands (31°12'03.2"N, 61°20'47.04" E, 477m), swept on *Tamarix stricta*, 20.09.2015, Nim 12; 2♀♀ (DPPZ), same locality label, swept on *Tamarix stricta*, 20.09.2016, Nim 242; 4♀♀ 2♂♂ (DPPZ), same locality label, 25.08.2016, Nim 237; 1♀ (AERO), same locality lable, swept on *Tamarix stricta*, 20.09.2015, Nim: 124; 3♀♀ (DPPZ), IRAN, Sistan-o Baluchestan province, Zabol, Hamoon wetlands (31°12'03.2"N, 61°20'47.04" E, 477m), Malaise trap, 20–24.09.2015, Nim 125; 1♀ (DPPZ), same locality label, Malaise trap, 28.08–03.09.2015, Nim 237; 2♂♂

(AERO), same locality lable, Malaise trap, 28.08–03.09.2015, Nim 116; 1♀ 1♂ (ZISP), 2♀♀ 2♂♂ (DPPZ) IRAN, Sistan-o Baluchestan province, Zabol, Hamoon wetlands (31°12'03.2"N, 61°20'47.04" E, 477m), Light trap among *Tamarix aphylla* shrubs, 19.09.2016, Nim 240; 4♀♀ (DPPZ), same locality label, 25.08.2016, Nim 247; H.A. Derafshan, leg.

Diagnostic characters (female, Iran)

Head. Head in dorsal view 1.8 times as wide as its median length (Fig. 2A), equal or slightly narrower (0.95–1.0X) than mesosoma at level of tegulae. Temple rounded. Eye in lateral view 1.4 times as wide as temple medially. POL: OD:OOL as 5:2:8. Face 1.1–1.2 times wider than high (Fig. 2B). Clypeus 2.2–2.3 times wider than high. Antenna (Fig. 2C) filiform, 20-segmented, slightly shorter than body. Length of scape 2.6–2.7 times longer than pedicel and 2.1–2.2 times first flagellar segment (F1), pedicel small, subquadrate. First flagellar segment 2.0–2.1 times longer than its maximum width, 1.2 times longer than second segment; flagellar segments with long erected setae at apex of each segment, penultimate segments 1.25–1.30 times longer than maximum width, apical segment 1.65–1.70 times as long as its maximum width, with distinct spine at apex (Fig. 4A). Malar space about as long as basal width of mandible (Fig. 2D). Maxillary palp 5-segmented, 5th segment 1.6 times longer than 4th segment and labial palp 3-segmented.

Mesosoma. Width/length ratio of mesoscutum (Fig. 2A) 1.42–1.50, smooth, uniformly setose. Notauli mainly absent on horizontal surface of mesoscutum; scutellar sulcus sculptured. In lateral view mesosoma 1.48–1.52 times longer than high (Fig. 3A); precoxal sulcus smooth; posterior mesopleural furrow crenulated. Propodeum (Fig. 3B) smooth, with distinct transverse carinae dividing the propodeum into almost equal portions. Fore wing (Fig. 3D) as long as or slightly shorter than body; pterostigma well developed and enlarged, 2.4–2.5 times longer than its maximum width; 1-R1 reduced, SR1+3-SR partly unsclerotized, not reaching wing marginal as a tubular vein, 1-SR+M straight; 1-M slightly curved, twice as long asm-cu (Fig. 4B). Hind wing (Figs 3D, 4C) at most 4.0 times as long as wide, with only one closed cell (basal cell), SC+R1 2.8 times as long as 1r-m. Hind femur (Fig. 3C, 4D) enlarged, 2.7–2.8 times longer than wide; posterior half of hind tibia (Fig. 4D) flattened, 3.1–3.2 times longer than basitarsus. Hind tarsus 1.1 times as long as hind tibia; hind basitarsus 2.0–2.1 times longer than second segment; tarsal claws simple. Femur, tibia and tarsus densely setose.

Metasoma. First and second metasomal segments fused (Fig. 3E). Ovipositor sheath (Fig. 3F) as long as or slightly shorter than hind basitarsus, sharply pointed, with 2–3 very long setae both on dorsal and ventral sides.

Measurements: Body length 1.4–1.5 mm; fore wing length 1.0–1.1 mm; hind wing length 0.75–0.80 mm.

Colour. Body light brown to yellowish (Fig. 5A). Maxillary and labial palpomers pale yellow; antenna dark brown, but scape and pedicel yellowish. Legs light brown but tibia and tarsus slightly darker. Wings hyaline, slightly infuscated below pterostigma and extended posteriorly; pterostigma brown; basal half of metasoma whitish yellow and remainder dark brown. Ovipositor sheath dark brown.

Male. (Fig. 5B). Length of body 1.2–1.3 mm, similar to female, with relatively shorter metasoma. First flagellar segment 1.80–1.90 times its maximum width. Otherwise similar as female.

Distribution: Iran, Turkmenistan.

Biology: Unknown, but the leaves of *Tamarix aphylla* (L.) Karst. were severely infested by an unknown nepticulid leaf miner which most likely is its host.

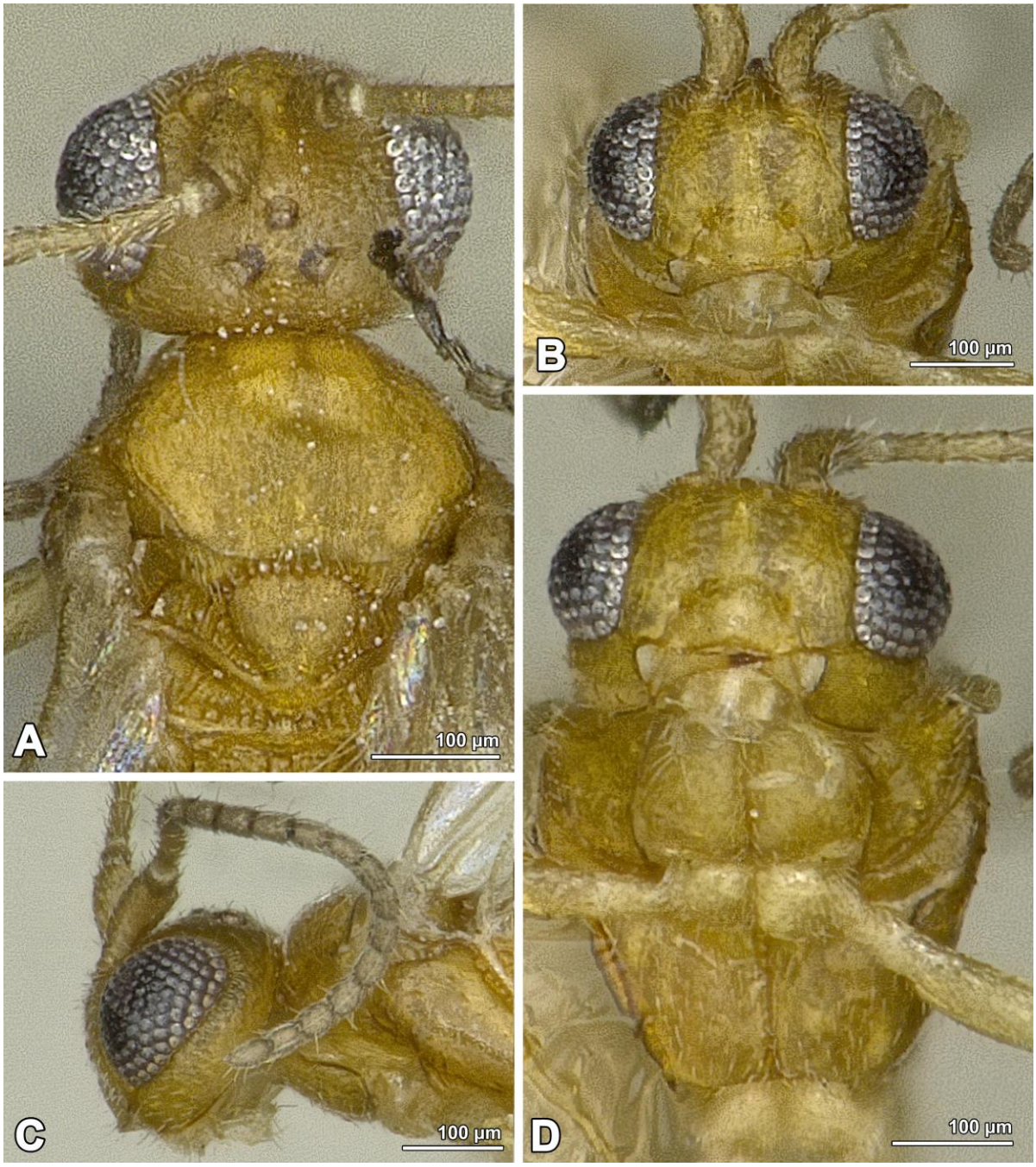

Figure 2. *Adelius aridus* (Tobias, 1967), female: **A.** Head and mesonotum, dorsal view; **B.** Head, frontal view; **C.** Head and antenna, lateral view; **D.** Head antero-ventral view, prosternum and mesosternum, ventral view.

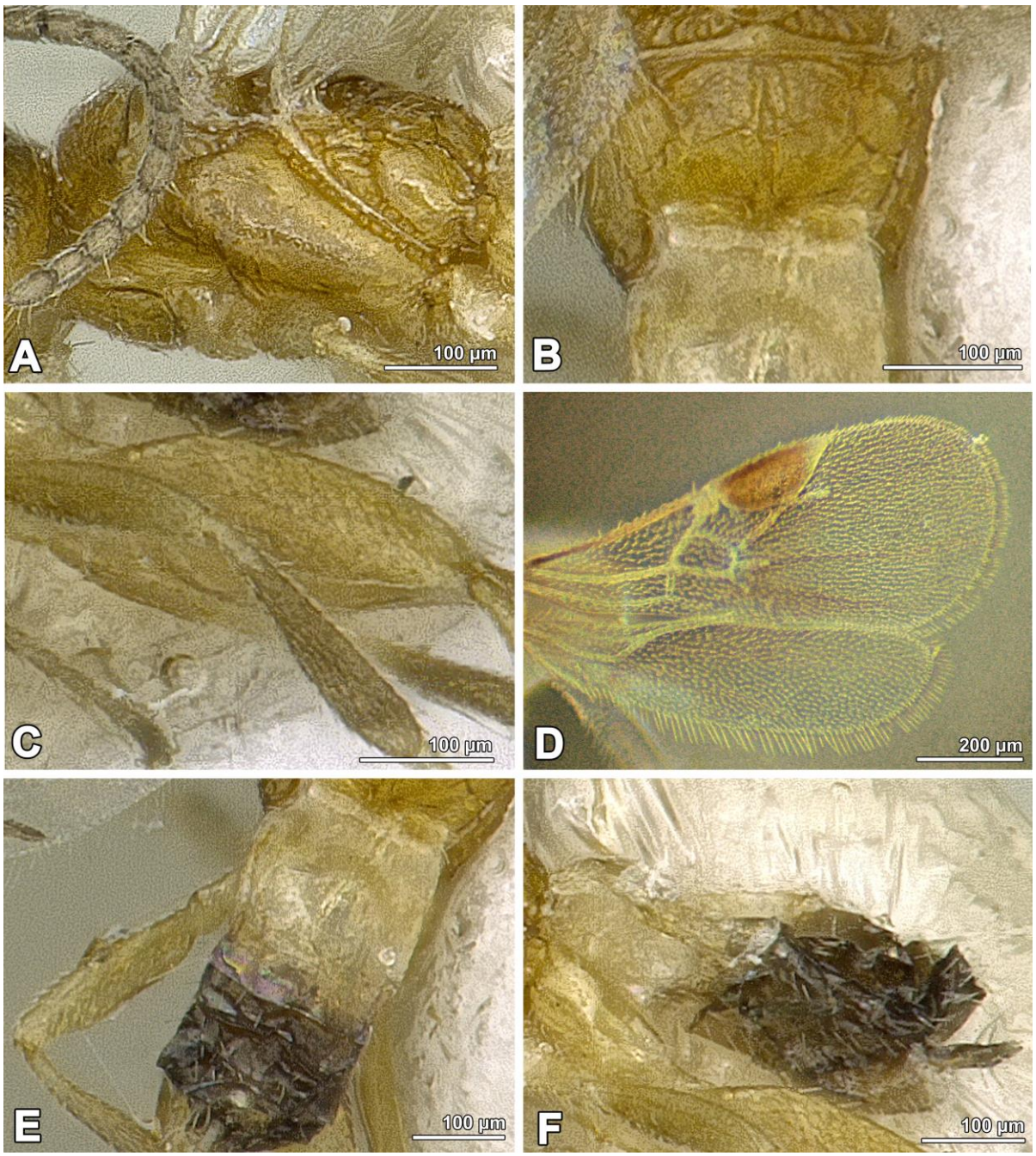

Figure 3. *Adelius aridus* (Tobias, 1967), female: **A.** Mesosoma, lateral view; **B.** Propodeum; **C.** Hind femur, lateral view; **D.** Wings; **E.** Metasomal tergites, dorsal view; **F.** Metasoma and ovipositor sheath, lateral view.

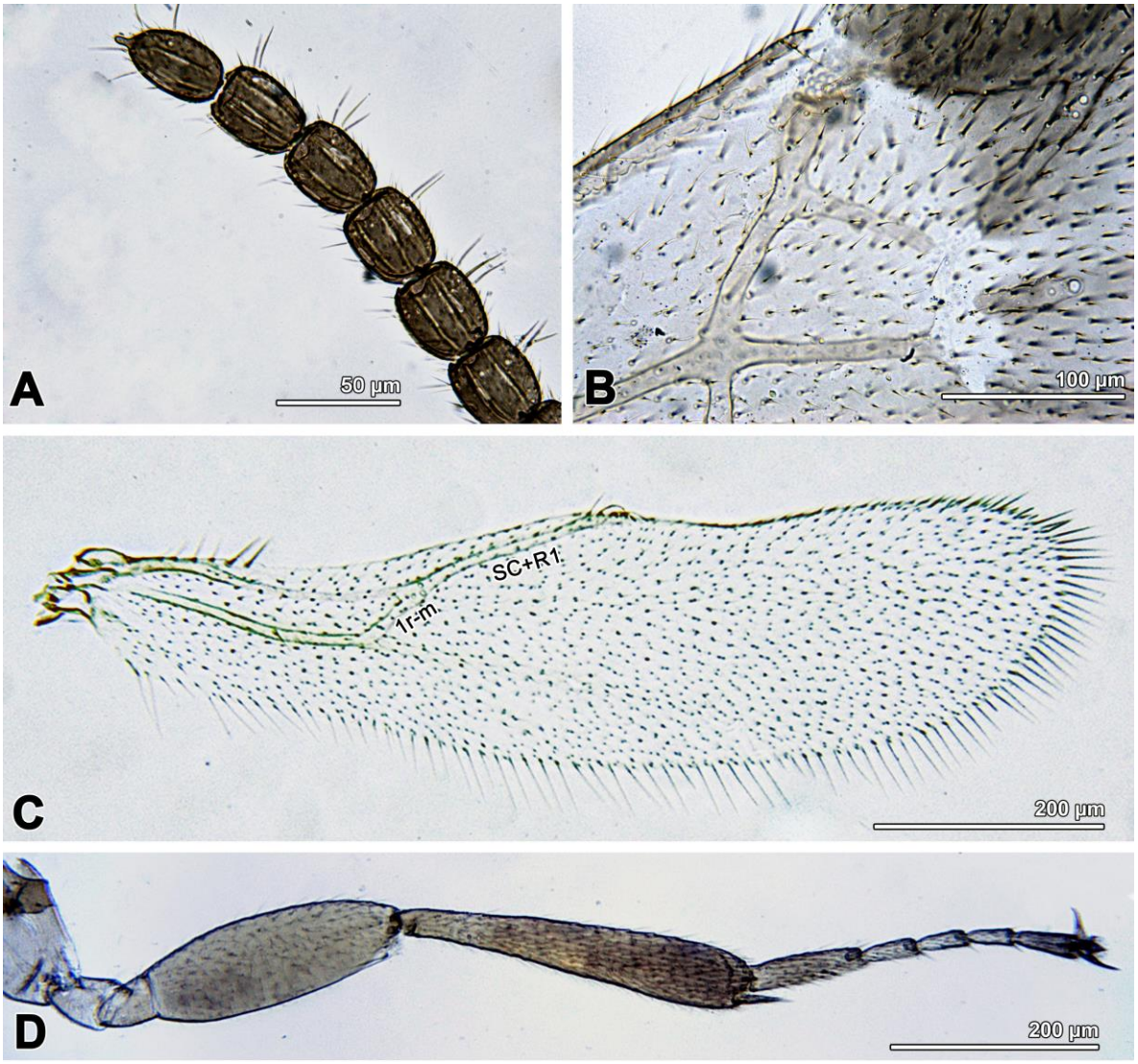

Figure 4. Microscopic photographs of *Adelius aridus* (Tobias, 1967), female: **A.** Apical flagellar segments; **B.** Fore wing, central area; **C.** Hind wing; **D.** Hind leg.

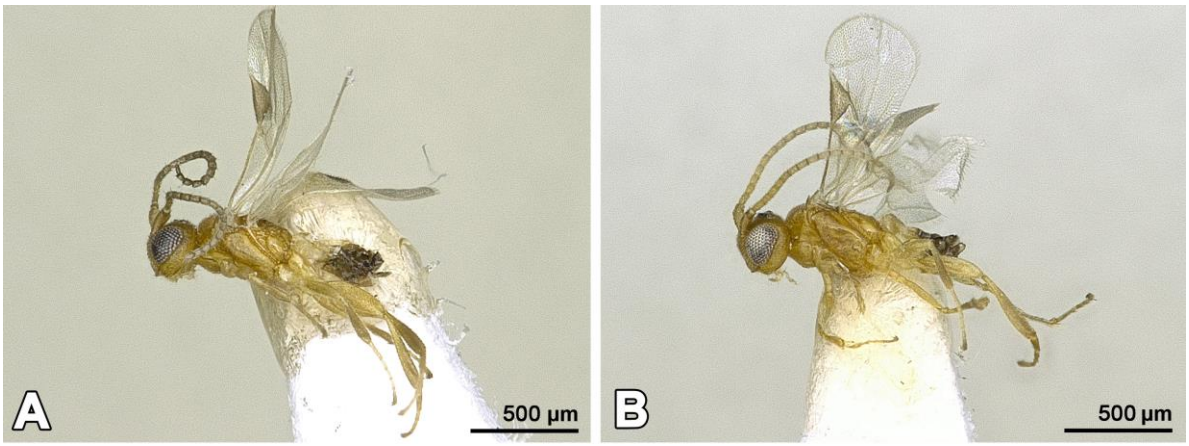

Figure 5. *Adelius aridus* (Tobias, 1967): **A.** Female; **B.** Male.

Discussion

This is the first well documented record of the genus *Adelius* Haliday from Iran, the first record of *Adelius aridus* (Tobias, 1967) outside its type locality and the species is new for the fauna of Iran. The association with a nepticulid leafminer on *Tamarix* spp. is new, but needs to be proven by rearing of the leafminer. *Tamarix* species occur widely in Central Asia (Baum, 1978), and *A. aridus* is expected to occur in adjacent countries, e.g. Afghanistan, where the same *Tamarix* species occur as in the sampled area. Adeliini are parasitoids of Nepticulidae (Yu et al., 2012) and most likely *A. aridus* is associated with the nepticulid leaf miner present on *Tamarix aphylla* (L.) Karst. Future research is needed to prove this assumption.

The presence of substantial variation in the morphological characters, including colour and wing venation (Eriksson, 2013) is causing complications in the systematics of *Adelius* species. The position of *Myriola* is uncertain and it may deserve subgeneric status because the eyes are glabrous (finely setose in other *Adelius*), the propodeum has an areola (absent) and vein 1-R1 of forewing absent (present). In addition, many species are described from a single or few specimens and some of them are now listed as synonyms (Beirne, 1945; Muesebeck & Walkley, 1951; Tobias, 1966, 1986; Yu et al., 2012). A revision of type specimens is need to confirm the identity of many recorded species in the Palaearctic, as well as synonymy of the *Myriola* with *Adelius*.

Acknowledgments

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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گزارش گونهٔ *Adelius aridus* (Tobias, 1967) (Hym., Braconidae, Cheloninae) مرتبط با مینوز درختچه گز (Lepidoptera: Nepticulidae)، برای اولین بار از ایران

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چکیده: زنبور *Adelius aridus* (Tobias, 1967) (Braconidae, Cheloninae) برای اولین بار از ایران گزارش شد. این گونه در مجاورت دو گونه درختچه گز شامل *Tamarix stricta* Boiss و *Tamarix aphylla* (L.) Karst در مناطق شرقی ایران (سیستان، دریاچه هامون) جمع‌آوری شد. برگ‌های درختچه گز، *Tamarix aphylla* به شدت آلوده به یک گونه ناشناخته از پروانه‌های nepticulid (Lepidoptera, Nepticulidae) بود. زنبور *Adelius aridus* مجدداً توصیف و موقعیت تاکسونومیک جنس *Adelius* مورد بحث قرار گرفت.

واژگان کلیدی: *Adelius*، *Myriola*، Adeliini، Cheloninae، *Tamarix*، دریاچه هامون، شرق ایران.