

A New Record of *Asca bicornis* Canestrini & Fanzago, 1877 (Acari, Mesostigmata, Ascidae) from Hallasan Mountain in the Republic of Korea

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한라산에서 발견된 미기록 응애 *Asca bicornis* [응애아강, 중기문응애목, 떠돌이응애과]의 보고

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ABSTRACT: Mites in the family Ascidae are soil dwelling predators of small insects which would have potential to be used as biological control agent. In Korea, 10 genera of 24 species were recorded in the family. During the soil acarine biodiversity study, *Asca bicornis* Canestrini & Fanzago, 1877 was discovered from moss habitat on Muljangori crater lake 936 m alt in Hallasan mountain in Jeju which was designated as UNESCO Biosphere reserve and World herigate site. We reports this as a new record to Korean Mesostigmata fauna, and provide the morphological description. This species has morphologically characteristic as all dorsal setae nude and needle shaped, lateral caudal projection of Z4 shaped, which are different from the con-general species of *A. aphidioides*.

Key words: Biosphere reserve, Predator, Muljangori-oreum, Crater lake, Jeju

초 록: 중기문응애목 떠돌이응애과는 토양에 서식하는 포식성 응애로, 토양해충의 생물적 방제원으로 이용가치가 있다. 우리나라의 떠돌이응애과는 10속, 24종이 보고 되었다. 본 연구는 제주도 한라산천연보호구역 물장오리오름에서 토양응애 생물다양성 연구 중 이끼에서 우리나라 미기록종 *Asca bicornis* Canestrini & Fanzago, 1877을 발견하여 보고하는 바이다. 등판과 배판의 묘사를 통해서 형태적인 특징을 자세히 제공하였다. 근연종인 *A. aphidioides*는 등판 양쪽 말단에 돌출된 혹에서 각 1개의 센털이 있으나, *A. bicornis*는 2개가 나 있다.

검색어: 생물권보전지역, 포식응애, 물장오리오름, 화구호, 제주

Ascoid mites are important predators in many soil ecosystems (Walter, 1988; Kinnear, 1991) with organic soil, grasses, mosses, or dead organic matter on the soil surface and barks. Also these are often found from of forests, crop land and other habitats associated with humans and other animals (Lindquist and Evans, 1965; McMurtry et al., 2013, 2015).

The genus *Asca* of the family Ascidae are an ecologically diverse group and easily recognized by the presence of a pair of

tubercles projecting from the posterolateral corners of the posterior dorsal shield (Hurlbutt, 1963). The most diverse genus was *Asca*, the first numerous in the Oriental and Neotropical regions, and the second in the Nearctic region (Santos et al., 2018). This genus *Asca* was reported first as *Acarus aphidioides* (= *Asca aphidioides*) by Linnaeus (1758). They are predatory, feeding on other mites, insects, collembolans or nematodes (Hurlbutt, 1963; Walter et al., 1993).

Species diversity of Ascidae encompasses 17 genera, 372 species in the world (Moraes et al., 2016) and 10 genera 24 species in Korea (NIBR, 2013, Table 1). Among Ascidae, the

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Table 1. List and reference of recorded species of the family Ascidae from South Korea

| Species | References |
|---------------------------------|---|
| <i>Asca aphidioides</i> | Lee et al., 1996; Kaczmarek, 2000; Jung et al., 2010; Keum et al., 2010 |
| <i>A. garmani</i> | Lee et al., 1996; Jung et al., 2010 |
| <i>A. kosungensis</i> | Lee et al., 1997; Lee, 2009 |
| <i>A. nubes</i> | Lee, 1995; Lee, 2009 |
| <i>A. odowdi</i> | Lee et al., 1997; Lee, 2009 |
| <i>A. sculptrata</i> | Lee et al., 1996; Jung et al., 2010 |
| <i>Antennoseius imbricatus</i> | Choi, 1994; Kaczmarek, 2000 |
| <i>A. japonicas</i> | Choi, 1994 |
| <i>A. avius</i> | Keum et al., 2016 |
| <i>Arctoseius cetratus</i> | Keum et al., 2015 |
| <i>Blattisocius keegani</i> | KSSZ, 1997 |
| <i>Cheiroseius chibai</i> | Choi, 1994; Lee, 2009 |
| <i>C. phalangioides</i> | Lee, 2009 |
| <i>C. signatus</i> | Lee, 2009 |
| <i>Lasioseius lasiodactyli</i> | Lee and Lee, 1998; Lee, 2009; Jung et al., 2010; Keum et al., 2011; Keum and Jung, 2012 |
| <i>L. porulosus</i> | Lee and Lee, 1998; Lee, 2009 |
| <i>L. sugawarai</i> | Lee and Lee, 1998; Lee, 2009 |
| <i>L. tomokoae</i> | Kaczmarek, 2000 |
| <i>L. youcefi</i> | Lee and Lee, 1998; Lee, 2009 |
| <i>Leioseius brevisetosus</i> | Lee, 2009 |
| <i>L. insignis</i> | Lee, 2009; Keum et al., 2010 |
| <i>Proctolaelaps pygmaeus</i> | Lee, 2009 |
| <i>Protogamasellus micus</i> | Lim and Lee, 2005 |
| <i>Zerconopsis decemremiger</i> | Lee, 2003 |

genus *Asca* have been reported 148 species in the world (Moraes et al., 2016; Santos et al., 2018). However, until now, six species of the genus *Asca* have been reported in Korea: *Asca aphidioides* (Lee et al., 1996; Kaczmarek, 2000; Jung et al., 2010; Keum et al., 2010), *A. garmani* (Lee et al., 1996; Jung et al., 2010), *A. kosungensis* (Lee et al., 1997; Lee, 2009), *A. nubes* (Lee, 1995; Lee, 2009), *A. odowdi* (Lee et al., 1997; Lee, 2009) and *A. sculptrata* (Lee et al., 1996; Jung et al., 2010). From the moss samples collected near Muljangori crae lake 936 m alt. which is located on the eastern slope of Hallasan Mountain in Jeju, we firstly discovered unrecorded one species, *Asca bicornis* Canestrini & Fanzago, 1877. So, in this study, we report this as a new record to Korean Mesostigmata fauna by providing the morphological illustration and description. In addition, we provide identification key about the genus *Asca* distributed in Korea.

Materials and Methods

We collected soil and other organic materials from Muljangori-oreum (E126°31', N33°22', alt. 936 m) in Jeju, Korea. Muljangori-oreum is one of 370 parasitic cones of Hallasan volcanic mountain, with crater lake on top. Mite specimens were extracted using Berlese-Tullgren funnels (30 W, 72 h) from soil samples and preserved in 70% ethyl alcohol. Mites were mounted on slide glass in polyvinyl alcohol (PVA) mounting medium (Downs, 1943) and further identified. The line drawings and examination of the specimens were performed with an Olympus BX50 phase contrast microscope equipped with a drawing tube and traced over using Adobe Illustrator CS 2014® program. New record species are deposited in Insect Ecology Lab, Department of Plant Medicine, Andong National University (ANU), Andong, Korea.

Taxonomic accounts

Family Ascidae Oudemans, 1905

Genus *Asca* von Heyden

Asca von Heyden, 1826: 610.

Type species: *Gamasus aphidioides*, Fab. (*sic*), 1805 (= *Acarus aphidioides* Linnaeus, 1758: 616), by original designation.

Ceratozercon Berlese, 1910: 246 (Synonymy by Vitzthum, 1929: 30; Ryke, 1962: 157; Hurlbutt, 1963: 481; Farrier & Hennessey, 1993: 26; Halliday et al., 1998: 17).

Ceratozercon. - Berlese, 1913: 204; 1918: 188.

Asca. - Vitzthum, 1929: 30; Oudemans, 1936: 366; Hirschmann, 1959: 4; Ryke, 1961: 127; 1962: 158; Karg, 1962: 36; 1965: 203; 1971: 253; Bernhard, 1963: 19; Evans, 1963: 286; Hurlbutt, 1963: 481; Lindquist & Evans, 1965: 42; Athias-Henriot, 1968: 243; 1969: 126; Genis et al., 1969: 86; Evans & Till, 1979: 198; Farrier & Hennessey, 1993: 26; Walter et al., 1993: 1330; Halliday et al., 1998: 17; De Leon-Facundo & Corpuz-Raros, 2004: 202; Kalúz & Fend'a, 2005: 42; Gwiazdowicz, 2007: 58; Beard et al., 2011: 8.

Asca (Asceseius) Karg, 1979: 257.

Diagnosis. Dorsal shield divided into podosomal and opisthosomal shield, both usually ornamented (smooth or with slight ornamentation in few species), without transverse and nearly straight lines or delineated strip along lateral margins. Anterior end of podosomal shield not strongly deflexed; podosomal shield usually with 17 pairs of setae (rarely with 16, 18 or 19; always without z1). With pair of posterior projections (horns) on opisthosomal shield usually bearing setae Z4 and S5. Three pairs of sternal setae on the sternal shield and fourth pair free. Genital shield not wide enough to include iv5, but including st5; posteriorly truncate. Opisthogaster with eight pairs of setae in addition to circumanal setae. Peritreme extending from stigma to region between j1 and j2, narrower than diameter of stigma. Peritrematic shield wide usually fused with dorsal shield between level of s1 - r2; posteriorly truncate and broadly fused with exopodal shield beside coxa IV.

Asca bicornis Canestrini & Fanzago, 1877 쌍털뿔응애(신칭)

Gamasus (Sejus) bicornis Canestrini & Fanzago, 1877: 103.

Laelaps bicornis. - G. Canestrini & R. Canestrini, 1882: 78.

Sejus bicornis. - Canestrini, 1885: 91.

Ceratozercon bicornis. - Berlese, 1913: 204; Halbert, 1923: 375.

Asca bicornis. - Buitendijk, 1945: 309; Willmann, 1949: 112; Evans, 1958: 584; Halaskova, 1959: 17; Ryke, 1961: 129; Schweizer, 1961: 137; Bernhard, 1963: 72; Hurlbutt, 1963: 495; Karg, 1965: 221; 1971: 274; 1993: 283; Pinchuk, 1976: 54; Kalúz & Fend'a, 2005: 122; Gwiazdowicz, 2007: 61; Çakmak et al., 2011: 581; Kontschan & Ujvari, 2013: 79.

Asca (Asca) bicornis. - Karg, 1979: 258.

Asca nova Willmann, 1939: 246 (Synonymy by Willmann, 1949: 112; Evans, 1958: 584; Karg, 1993: 283).

Asca nova. - Womersley, 1956: 511; Ryke, 1961: 132; Hurlbutt, 1963: 495; Dziuba, 1972: 165.

Asca (Asca) nova. - Karg, 1979: 258; Farrier & Hennessey, 1993: 28.

Specimens examined: 31 females, Muljangori-oreum, Hallasan national park, Jeju island, Republic of Korea, N33°22', E126°31', alt. 936 m, 22 April 2017, C. Jung coll., from moss habitat.

Diagnosis. Epistomes with a triramous apex. Peritremes long, reaching coxae I, peritremal shield broad (Fig. 1). Lateral caudal projection of with pair of posterior projections (horns) on opisthosomal shield usually bearing setae Z4 and S5. All dorsal setae nude, needle shaped j1 and other frontal setae shorter, caudal part of body with longer setae. Proximal part of sternal shield 167 µm long and 193 µm wide, with reticulate pattern in front-lateral sides, wearing 17 pairs of setae. Opisthosomal part of dorsal shield 157 µm long and 201 µm wide, with fine and big scale-like pattern in medio-proximal part, shield wearing 16 pairs of nude setae, Z5 = 54 µm, J1 = 15 µm, J3 = 31 µm long. Sternal shield without structure, shield with expressive proximal corners, presternal sclerites confluence with sternal shield. Metasternal shield on soft cuticle or on genital shield, St1 - 3 on sternal shield Tritosternum with trapezoidal base and sparsely pilose laciniae. Genital shield caudally broad-ended, with straight caudal margin, pair of genital setae on lateral margins. Sternal and genital shields smooth. Two pairs of narrow, oblonged postgenital sclerites and two pairs of short needle-shaped setae between genital and ventrianal shields. Ventrianal shield big, proximally slightly concaved and caudally rounded, with cross-running parallel



Fig. 1. Distribution of *Asca bicornis* Canestrini & Fanzago, 1877 in the world.

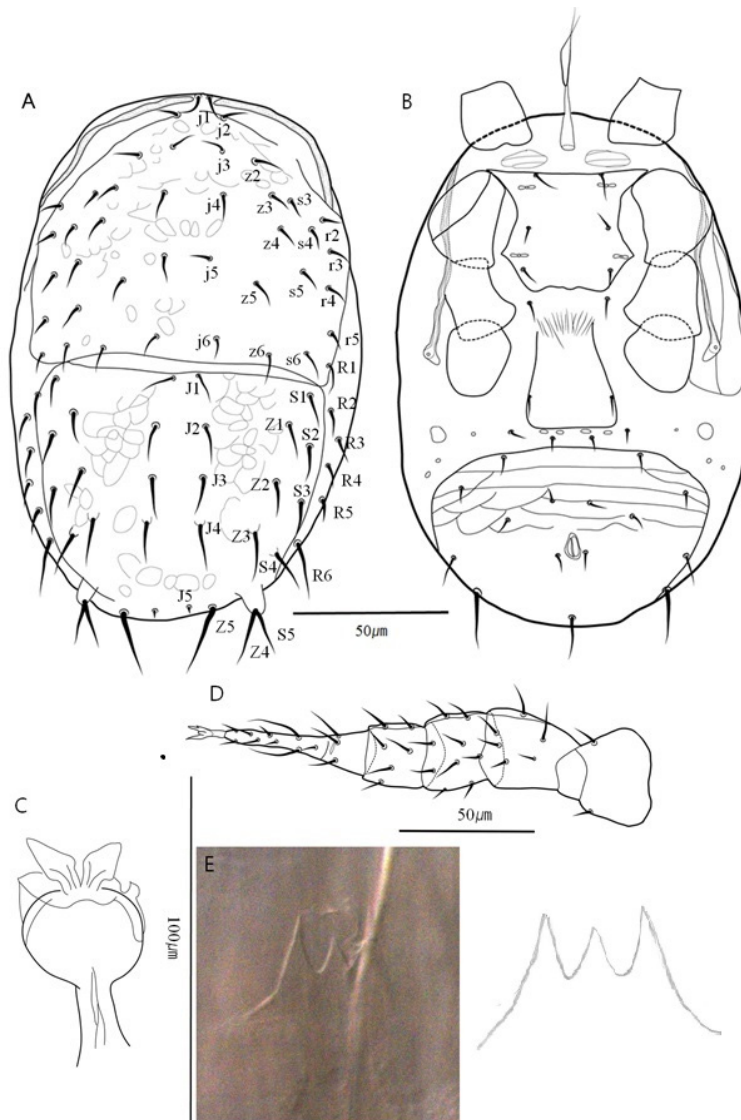


Fig. 2. *Asca bicornis* Canestrini & Fanzago, 1877, female: A, dorsal idiosoma; B, ventral idiosoma; C, spermathecal apparatus; D, leg II; E, epistome.

pattern in proximal part. Shield wearing 7 pairs of nude setae, two caudal pairs (Jv4, 5) longer. Leg setae short blunt.

Distribution. USSR, Western Europe (Bregetova, 1977), Germany (Karg, 1979), Slovakia (Kaluz and Fenda, 2005), Poland (Gwiazdowicz, 2007), Hungary (Kontschán and Ujvari, 2013) and is now recorded in Korea (Fig. 2).

Remarks. *Asca bicornis* was found from diverse habitats from dry to wet soils and even from mosses. Specimens for this report were from moss and humus in soil near the crater lake of Muljangori-oreum, Hallasan national park, Jeju Island in Korea. This is the first record of this species in the Eastern Asia.

Notes. *Asca aphidioides* is a cosmopolitan species with a single conspicuous pinnate seta on each posterior horn, but *Asca bicornis* is elongate posterior horns, each bearing two nude setae.

Key of the genus *Asca* to species distributed in Korea.

1. Postero-lateral horns each with 1 conspicuous seta; small, tooth-like ornamentation (microtubules) on posterior dorsal shield (*aphidioides* species-group). 2
 - Postero-lateral horns with 2 conspicuous, subequal setae; posterior microtubules absent. 3
2. Majority of dorsal setae strongly hairy (R2 and J5 nude only), lateral caudal projection of Z4 wearing one hairy seta. *Asca aphidioides* (Linnaeus, 1758)
 - Dorsal shield setae pilose, S5 with long, fine pilosity; setae z5, z6 similar in size to adjacent setae; a row of microtubules lateral seta J4. *Asca garmani* Hurlbutt 1963
 - Cylindrical tubercle-like projection of posterior corner bears only one pinnate seta S5; seta Z4 minute. Setae r4 to r7 strongly pilose, while setae R1 slightly pilose and remainder is simple. *Asca nubes* Ishikawa, 1969
 - Anterior dorsal shield having 17 pairs of simple setae; a pair of round sculptures found between the tubercles anterior to J5. *Asca sculptrata* Aoki, 1968
 - Posterior dorsal shield with 17 pairs of setae, most of simple, but those on posterior idiosoma more barbed in posterior ones. J3 and J4 with or without minute barbs, Z3 and S4 with distinct barbs. Setae on tubercle as long as J5 and pinnate. *Asca odowdi* Lee, 1997
 - Posterior dorsal shield with 15 pairs of setae. J3 reaches the base of J4. Two pairs of setae on postero-lateral tubercles as

- long as J5 and pinnate. *Asca kosungensis* Lee, 1997
- 3. Setae J5 small to minute; dorsal shield setae tapering, finely to densely pilose or smooth (*bicornis* species-group).
 - All dorsal setae nude and needle shaped, lateral caudal projection of Z4 wearing two nude setae.
..... *Asca bicornis* Canestrini & Fanzago, 1877

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