

New Record of *Arctoseius cetratus* (Sellnick, 1940) (Mesostigmata: Ascidae) Phoretic to Sciarid Fly from Mushroom Culture in Korea

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Abstract - The Mesostigmata is an order of Subclass Acari either parasiting to diverse invertebrates or free-living predatory in terrestrial ecosystem. Phoresy is one of the unique behaviors of wingless arthropod dispersal by attaching winged arthropods. We collected mites attached on the dorsal part of abdomen adult sciarid fly, from mushroom culture. The mites were identified as *Arctoseius cetratus* Sellnick, 1940 in the family of Ascidae. *Arctoseius cetratus* has short J2, Z1, Z2, and S1, S2 setae, not reaching the bases of following setae. Posterior half of dorsal shield with longitudinal garland of puncta between J and Z setae, peritremes extending anteriorly to mid-level of coxaII. The genus *Arctoseius* and species *Arctoseius cetratus* are the first record in Korea. We provided the detail description of the species including the identification key in the family with some ecological notes.

Key words: *Arctoseius cetratus*, Ascidae, mushroom, sciarid fly, phoresy, dispersal

INTRODUCTION

Phoresy is unique behaviors of wingless arthropod dispersal by attaching winged arthropods. Many species of mites take advantage of long distance dispersal from unfavorable environments utilizing the winged insects such as beetles, flies and even dragonflies. These phoretic mites often show mutualistic interaction with the phoretic hosts or parasitic to the host. In dung beetle and mesostigmatid mites system, beetles serve as a carrier vehicle of predatory mesostigmatid mites while those mites secure food and nest resources for beetles by attacking the eggs and larvae of flies which are one most important competitors of dung. However, in many of dipteran-mite interactions, antagonistic interaction prevails. *Arctoseius cetratus* (Ascidae) is known to phoretic

on the mushroom sciarid fly *Lycoriella auripila* (Diptera: Sciaridae) (Binns 1972, 1974; Dmoch 1995) and predatory of various dipteran eggs and early larvae resulted in 85% egg hatch failure of *L. auripila*.

The Ascidae is an important predator group that inhabits various microhabitats such as leaf litter, rotten wood, feeding sites of insects, anthills, and bird's nests. They are known to be useful biological indicator of microhabitat and potential biological control agents of various soil dwelling arthropod pests (Karg and Freier 1995; Ruf 2000). In Korea, 10 genus and 25 species are reported in the family Ascidae with taxa of *Antennoseius* (two species), *Asca* (6), *Blattisocius* (1), *Cheiroseius* (3), *Euryparasitus* (3), *Lasioseius* (5), *Leioseius* (2), *Protolaelaps* (1), *Protogamasellus* (1), *Zerconopsis* (1) (NLSK 2013). In the World, there are 39 genus and 558 species in the family Ascidae with dominant taxa of *Lasioseius* (142), *Cheiroseius* (76), *Asca* (61), *Protolaelaps* (54), *Antennoseius* (32) (Hallan 2008). During

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the study of sciard fly control in mushroom culture, mites attached on the fly was further identified as *Arctoseius cetratus* Sellnick 1940, which is new record from Korea. Here we detailed the first description of *Arctoseius cetratus* in Korea, and provide the identification key within the subfamily Arctoseiinae with some ecological notes.

MATERIALS AND METHODS

Sciarid flies, *Lycoriella mali* were collected from the bed of mushroom (*Agaricus bisporus*) cultures in Yangmok-myeon, Chilgok-gun, Gyeongsangbuk-do (36°02'03.89"N, 128°23'57.47"E) in Jun, 2014. The mites attached on the ventral part of flies were recovered. All specimens were preserved in 70% ethanol and mounted on slide glass in PVA mounting medium (polyvinyl alcohol-lactic acid) (Downs 1943; BioQuip, Rancho Dominguez, CA, USA). Species identification was based on Gwiazdowicz (2007) and Halliday *et al.* (1998). The collected original samples were deposited in the Mite Collection of Andong National University, Insect ecology lab.

Key to subfamilies

Arctoseiinae Evans, 1963

Dorsal shield of adults entire, with or without lateral incisions; opisthotal region usually with maximum of four pairs of lateral S setae, S2 usually not added in change from larva to protonymph. Marginal (r-R) series of setae lacking r6 in podonotal region and often R6 posteriorly; marginal R setae on lateral soft cuticle on female, but variably on dorsal shield margin on male. Submarginal (UR) setae absent. Female sternal shield with third pair of lyrifissures on its posterior margin; fourth pair of sternal setae on soft cuticle. Sternal setae st5 usually on soft cuticle flanking female epigynal shield. Male sternitigenital shield free from, but sometimes abutting ventrianal shield, and often not fully integrated with endopodal strips alongside coxae III-IV. Maximum number of setae on genua I-II-III-IV, respectively, 12-10-8-7; on tibiae, 12-9-7-7; in change from protonymph to deutonymph, seta pd-3 not added to genu and tibia I, pl-2 not added to genu and tibia II, and al-2 not added to genua and tibiae III-IV. Plesiomorphic attributes of the Arctoseiinae include the following: Gnathotectum basically bi- or tri-ramous, each

process simple or denticulate; cheliceral movable digit bidentate in female, unidentate in male, without pointed process on mid-ventral surface, and with fringed arthrodial envelope basally; cheliceral fixed digit with small, setiform pilus dentilis, with usually few teeth restricted to apical half of masticatory surface, and without hyaline serrate rim near base on paraxial surface. Tarsus I usually with a conspicuously lanceolate-tipped seta dorsodistally. In change from protonymph to deutonymph, seta ad-3 added to genua I-II and tibia I, ad-2 added to tibia II, and al-2 added to tibia II ...
..... Arctoseiinae

Key to genera

1. Two shields on body dorsum 2
- One shield on body dorsum 5
2. Leg I with claws 3
2. Leg I without claws *Antennoseius*
3. None of the opisthotal setae on tubercles, but directly on shield 4
4. Line extending across podonotal shield in region of z6 setae and cross opisthotal shield in region of J1 setae ...
..... *Protogamasellus*
5. Dorsum without spatulate setae 6
6. Schizodorsal shield on body dorsum 7
7. Ventri-anal shield on body venter *Leioseius*
- Anal shield on body venter *Arctoseius*

Family Ascidae

Genus *Arctoseius* Thor, 1930

Synonyms: *Tristomus* Hughes, 1948; *Arctoseiulus* Willmann, 1949, *Arctotarseius* Willmann, 1949; *Arctoseiopsis* Evans, 1954.

Morphology

Dorsal: Dorsal idiosoma with schizodorsal shield, with well-defined medial incisions. Shield with 31 to 33 pairs of setae, 14 of them in the posterior region. Marginal setae on lateral integument. Dorsal setae smooth, simple none paddle-shaped. Ornamentation usually poorly defined and most frequently alveolate, areolate or colliculate.

Ventral: Sternal shield with three pairs of setae, seven denticulate rows. Epistome bi- or tri-ramous, margins smooth but with tips of processes denticulate in some species. Movable digit of chelicera usually bi-dentate but dentation of fixed

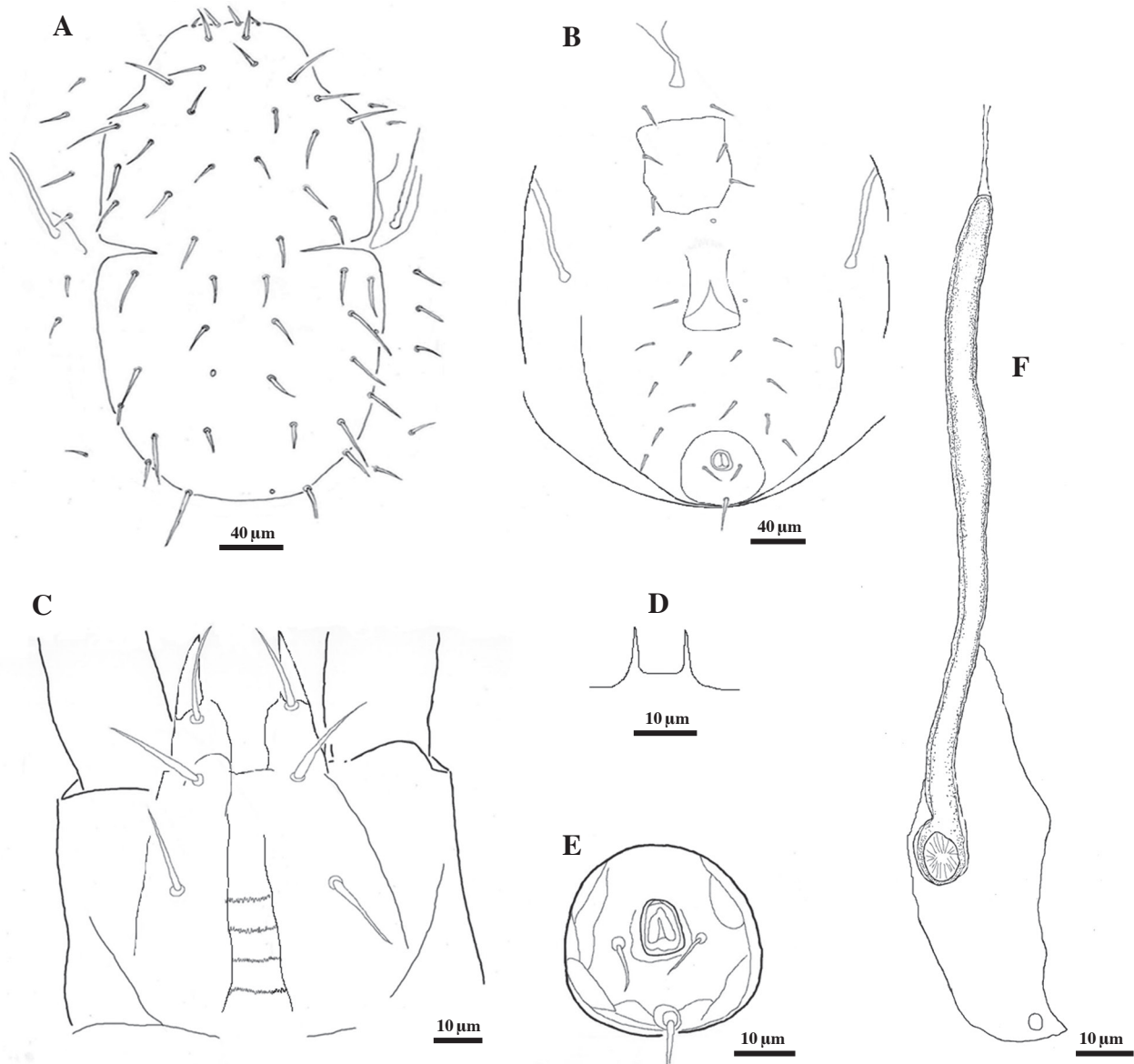


Fig. 1. *Arctoseius cetratus*, A, dorsal shield; B, venter; C, ventral of view of ganathosoma; D, epistome; E, anal shield; F, pretrema. Scale bars: A, B = 40 μm , C-F = 10 μm .

digit variable, three well-separated teeth to row of small closely-set teeth. Palp without macroseta on tarsus.

***Arctoseius cetratus* (Sellnick, 1940)**

Synonyms: *Arctoseius cetratus* (Sellnick)

Lasioseius cetratus Sellnick, 1940: 99.

Arctoseius bispinatus Weis-Fogh, 1948: 255. Synonymy by Evans (1955).

Arctoseius halophilus Willmann, 1949: 354. Synonymy by Karg (1971).

Arctoseius erlangensis Sellnick, 1958: 23. Validation of a manuscript name from unpublished dissertation of a name from unpublished dissertation of Hirschmann (1951). Synonymy by Karg (1971).

Iphidozercon erlangensis.-Hirschmann, 1962: 30. Synonymy by Karg (1971).

Arctoseius cetratus.-Evans, 1958: 186; Karg, 1993: 264; Walter and Lidquist, 1995: 430.

Diagnosis: Dorsal shield with lateral incisions and 31 pairs of setae, posterior dorsal-shield setae short, not reaching

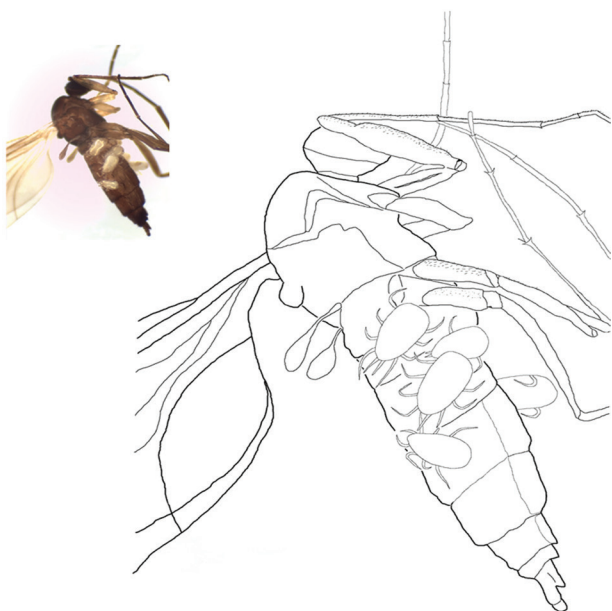


Fig. 2. Photographic illustration of *Arctoseius cetratus* inhabiting in dorsal part of abdomen of sciarid fly (*Lycoriella mali*).

insertions of following setae; posterior half of dorsal shield with longitudinal garland of puncta between J and Z setae; peritremes extending anteriorly to mid-level of coxae II; epistome 2-tined; fixed chela with a row of 6-8 teeth; male leg II with tarsal seta al-2 modified, swollen basally and trichoid distally.

Habits and world distribution: North America (Chant 1963); Europe (Bregetova 1977; Karg 1993; Salmane and Heldt 2001; Kaluz and Fenda 2005); Western Europe (Bregetova 1977); Russia: soil (Petrova 1982; Makarova 2000); Western Siberia (Davydova and Nikolsky 1986); Middle Ural (Russia): fallow land (Khomjakov 1988); Australia: dung-baited, pitfall trap, New South Wales: cow dung, Victoria: compost (Halliday *et al.* 1998); Poland: nest of Greater spotted Eagle (*Aquila clanga*) (Gwiazdowicz *et al.* 2000), soil (Seniczak *et al.* 2000), rotten wood, leaf litter and other microhabitats (Gwiazdowicz and Klemm 2004), sod, stuffing from nests of (*Larus ridibundus*) (Gwiazdowicz and Kmita 2004), litter, rot wood, moss (Gwiazdowicz and Matysiak 2004), litter, rotting wood, sod, meadow, bark beetles galleries (Gwiazdowicz 2004), Nests of formicidae (*Formica polyctena*), (*Lasius niger*) (Gwiazdowicz 2008a), associated with Scolytidae (Gwiazdowicz 2008b), soil (Gabrys *et al.* 2008); Sakhalin and Kuril Islands: manure (Marchenko and Mapyehko 2002); Slovakia: various habitats (Kaluz and Fen-

da 2005), nests of mound-building mouse (*Mus mus*) (Masan and Stanko 2005), birds' nests (Fenda and Schnierova 2010); Central Argentina: Soil (Bedano and Ruf 2007); Saudi Arabia: fruit and timber trees (Al-Atawi 2011); Austria: roots and soil of plants (Wissuwa *et al.* 2012); Iran: Soil (Montazeri *et al.* 2011; Nemati 2011, 2012a).

Food: Gamsid mites in Mesostigmata in general and mites of the genus *Arctoseius* specially are predatory, feeding on the immature forms of Astigmata, Oribatida, Collembola and Nematoda, as well as the eggs and larvae of Diptera (Weis-Fogh 1947; Kargi 1961; Hussey 1968; Binns 1972, 1973 (II), 1974) for biological control of sciarid pests in mushroom production, species in genus of *Hypoaspis* such as *H. aculeifer* and *H. miles* are often preferred (Jess and Bingham 2004) but also, *Arctoseius* has a great potential (Binns 1974; Dmoch 1995; Jess and Bingham 2004).

Dispersal: In the soil habitats, ambulatory movement is the main dispersal mechanism of *Arctoseius cetratus* in relatively shorter distance, while it exhibits phoretic dispersal on sciarid flies as carrier mostly in mushroom farms (Binns 1972, 1974; Rudzinska 1998).

Deposition: Andong National University, Insect Ecology Lab.

Identifier: Eunsun Keum.

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