Taxonomic Study of the Spider Subfamily Argyrodinae (Arachnida: Araneae: Theridiidae) in Korea

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ABSTRACT

The kleptoparasitic spider subfamily Argyrodinae in Korea is reviewed with detailed illustrations and SEM photographs of male palpal organs. Five species belonging to four genera of Korean Argyrodinae spiders are redescribed and *Argyrodos miltosus* Zhu and Song, 1991 is synonymized with *A. miniaceus*. A key to the species of the Korean Argyrodinae spiders are also provided.

Key words: taxonomy, morphology, Argyrodinae, spiders, Korea

INTRODUCTION

The subfamily Argyrodinae is one of fascinating spider taxa for kleptoparasitism and found worldwide in the webs of the largest known orb-weavers, *Nephila* spp. (Tetragnathidae), and numerous other spiders (Exline and Levi, 1962). The biology of these spiders (Vollrath, 1987; Cangialosi, 1990; Eberhard et al., 1993; Elgar, 1993; Withehouse and Jackson, 1993; Higgins and Buskirk, 1998; Tso and Severinghaus, 1998; Henaut, 2000; Agnarsson, 2002; Whitehouse et al., 2002), their distribution among their host webs (Elgar, 1989; Grostal and Walter, 1999; Miyashita, 2001, 2002; Agnarsson, 2003) and phylogenetic relationships (Arnedo et al., 2004; Agnarsson, 2004; Agnarsson et al., 2007) are areas of active research. In recent years, many genera of old *Argyrodos* related groups have newly established or resurrected for the family Theridiidae (Wunderlich, 1987, Zhu, 1998; Knoflach, 1999; Yoshida, 2001, 2003; Agnarsson, 2004; Platnick, 2007). These taxa are characterized by an array of synapomorphies: sperm duct reverse switchback, cheliceral furrow denticulated, cypeal projection, dense field of setae in ocular area, silvery pick on ridge, parallel with pedicel, ventrolateral supradicellate setal proprioceptors absent, female fourth tarsal central claw much longer than laterals, abdomen extending beyond the spinnerets, huge and elongated, strongly grooved, CY spigots, PLS FL absent, simple nonsnare webs, and egg case stalked and modified (Agnarsson, 2004). Namkung (2001, 2003) presented simple illustrations of six species [*Argyrodos bonadea* (Kars-

ch, 1881); *Argyrodos flavescens* O.P.-Cambridge, 1880; *Argyrodos fur* Boesenberg and Strand, 1906; *Argyrodos miniaceus* (Doleschall, 1857); *Ariamnes cylindrogaster* Simon, 1889; *Rhomphaea sagana* (Doenitz and Strand, 1906)], but these species cannot be reliably identified from his illustrations. Furthermore, *A. flavescens* appears to be a misidentification of *A. miniaceus*.

During the survey of the spider of fauna of Korea, spiders Argyrodinae were collected in several localities. In this paper, five Korean Argyrodinae spiders are redescribed and *Argyrodos miltosus* Zhu and Song, 1991 is synonymized with *A. miniaceus*.

MATERIALS AND METHODS

Specimens were collected in several localities and were examined morphologically. Drawings were prepared with an Olympus drawing tube, mounted on an Olympus SZX 12 and BX51 interference contrast microscope. The male palp was expanded by quick immersion (5 min) in concentrated KOH (0.2 g/mL H₂O) and specimens were fixed and preserved in 70% ethanol. Before dissection, the total body was drawn and body length measurements were made from whole specimens temporarily mounted in lactophenol. The genitalia of specimens were dissected in lactophenol, and the parts individually mounted in lactophenol under cover slips subsequently sealed with Glyceel or transparent nail varnish. If necessary, SEM photographs were used for the analysis of details. Scale bars in figures are in millimeters. Specimens examined in this paper will be deposited in the Arachnological Institute of Korea (AIK) and the Laboratory

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The descriptive terminology follows that of Kim and Lee (2006, 2007). Abbreviations: AER, anterior eye row; ALE, anterior lateral eye; AME, anterior median eye; AMEI, anterior median eyes interval; CY, cylindrical gland; FL, flagelliform gland; NEISL, natural environmental indicator species level; PER, posterior eye row; PLE, posterior lateral eye; PLS, posterior lateral spinneret; PME, posterior median eye; PMEI, posterior median eyes interval; RTA, retrolateral tibial apophysis; I, II, III, IV, first, second, third, forth legs.

SYSTEMATIC ACCOUNTS

Family Theridiidae Sundevall, 1833
Subfamily Argyrodoinae Simon, 1894

Diagnosis. This subfamily is distinguished from theridiid spiders by a hooked paracymbium of male palp, large colulus, cheliceral posterior tooth, modified head region of males, variously elongated abdomen (Exline and Levi, 1962).

For further citation see Yoshida (2001, 2003) and Agnarsson (2004).

Key to the species of subfamily Argyrodoinae in Korea

1. Abdomen elongated posteriorly and kleptoparasite 2 (Argyrodoinae)
 - Abdomen ellipse-type and no kleptoparasite other subfamilies
2. Abdomen vermiform, more than ten times as long behind as anterior to spinnerets *Ariamnes cylindrogaster*
 - Abdomen short or tapering, not more than six times as long behind as anterior to spinnerets 3
3. Male palp with a setae bearing clypeal projection and genitalia with copulation ducts curved the upper of spermatheca; abdomen with two tip *Neospintherus fur*
 - Male otherwise; epigynum otherwise; abdomen with one tips 4
4. Male carapace with a projection of eye area; genital pores situated on the center of atrium and copulation duct twisted *Rhomphaea saganus*
 - Male with projection of eye area bearing eyes anteriorly; genital pores situated on the lateral part of atrium and copulation duct twisted 5
5. Abdomen a large black spot in posterior and embolus slender and long; copulation duct longer than the diameter of spermatheca *Argyroides miniaceus*
 - Abdomen without a large black spot and embolus thick; copulation duct shorter than the diameter of spermatheca *Argyroides bonadea*

Genus *Argyroides* Simon, 1864

Type species: *Linyphia argyroides* Walckenaer, 1842

Argyroides Simon, 1864, Histoire naturelle des araignees (araneides). Paris, p. 253; Levy, 1985, pp. 95-97; Yaginuma, 1986, p. 51; Zhu, 1998, pp. 195-197. TS: *Linyphia argyroides*.

For further citation see Platnick (2007)

Diagnosis. This genus *Argyroides* is different from argyrodine species by cymbial distal promargin with apophysis, embolic terminal apophysis, male median eyes on tubercle, and male triplet absent (Exline and Levi, 1962; Chikuni, 1989; Yoshida, 2003; Agnarsson, 2004). A taxonomic revision was published by Exline and Levi (1962) and kleptoparasitic habits were studied by Vollrath (1984).

Argyroides bonadea (Karsch, 1881) (Figs. 1, 7A)

Conopistha bonadea Karsch, 1881, p. 39 (D♂♀): Namkung, 1976, p. 84; Namkung, 1978b, p. 88.

Argyroides bonadea: Boesenberg and Strand, 1906, p. 129, pl. 5, fig. 52, pl. 12, fig. 264 (♂♀); Chikuni, 1989, p. 34, fig. 21 (Ph♂♀, ♂♀); Zhu, 1998, p. 209, fig. 136A-D (♂♀, S); Song et al., 1999, p. 95, fig. 45C-D, L (♂♀, S); Namkung, 2001, p. 134, fig. 13.51a-c (♂♀); Yoshida, 2003, p. 145, figs. 391-293 (♂♀).

For further citation see Platnick (2007).

Previous records in Korea. Cave Samseonggul, Jeju-do, 2 ♀♀, 4 Aug. 1971, 5 ♂♂ 6 ♀♀, 2 Aug. 1972 (J. Namkung); Jejusi, Jeju-do, 1 ♂ 1 ♀ (LBHU, material examined in this study), 2 Aug. 1992 (J. Namkung).

Diagnosis. This species is similar to *A. flavescens* (O. P.-Cambridge, 1880) and *A. argentatus* O. P.-Cambridge, 1880, but can be distinguished from the latters by the clypeus projection with hairs, curved triangular radix and genitalia with bended fertilization ducts.

Description. Measurement (mm). Male/female: habitus length 2.0/2.8; carapace length 1.1/1.1, carapace width 0.6/0.8; cephalothorax height 0.8/0.8; cheliceral length 0.5/0.6, cheliceral width 0.2/0.2, cheliceral fang length 0.2/0.2; sternum length 0.6/0.6, sternum width 0.6/0.6; endite length 0.4/0.3, endite width 0.2/0.3; labium length 0.1/0.1, labium width 0.3/0.2; clypeus height 0.5/0.2; AER 0.50/0.31, PER 0.50/0.31, AME 0.07/0.07, ALE 0.06/0.05, PME 0.07/0.05, PLE 0.07/0.05; AMEI 0.14/0.08, PMEI 0.08/0.08. First leg 6.5/5.8 (2.0/1.9, 0.4/0.4, 1.7/1.4, 1.6/1.4, 0.8/0.7), second leg 4.0/3.6 (1.2/1.1, 0.3/0.3, 0.9/0.7, 0.9/0.9, 0.7/0.6), third leg 2.4/2.1 (0.7/0.7, 0.3/0.3, 0.4/0.3, 0.5/0.4, 0.5/0.4), fourth leg 3.4/3.3 (1.2/1.1, 0.3/0.3, 0.7/0.6, 0.7/0.8, 0.5/0.5).

Male. Small-sized and irregular-web building spiders slightly shorter than female, found in the web of araneid spiders.

Fig. 1. *Argyrodes bonadea*: A. Female, habitus, lateral view. B-D. Female, epigynum, ventral view (B), genitalia, ventral (C), dorsal (D). E. Male, habitus, lateral view. F-H. Male palpal organ, prolateral view (F), ventral (G), retrolateral (H). Scale bars=1 mm (A, E), 0.25 mm (B-D), 0.5 mm (F-H).

Carapace elongate, 1.9 times as long as wide (carapace index 53%), slightly narrowed in eye area, (light brown,

slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, slightly longer than wide

(sternal index 97%) and not projected between 4th coxae. Abdomen spherical-shaped, 1.7 times as high as long (abdominal index 76%; abdominal height index 170%) and whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; ALE smaller than other eyes and eye formula $PLE=AME>PME>ALE$. AME separation twice their diameter, PME separation 1.3 times their diameter. AER slightly seven times as long as AME diameter and PER slightly seven times as long as PME diameter. Eye area index 88%; median eye index 58%; eye row index 100%. Clypeus height 7.6 times as long as one AME diameter and without chillum. Chelicerae without scopula and lateral condyle; three promarginal teeth, middle one largest and one marginal tooth, one retromarginal tooth; cheliceral index 41%. Endites reddish brown, widest at mid part, without serrula and twice as long as wide (endite index 50%). Labium rectangular, (light brown, slightly darker at margins) and 2.2 times as wide as long (labial index 215%). Legs reddish brown, covered with many setae and leg formula I II IV III. Femur I slightly two times as long as cephalothorax.

Male palp (Figs. 1F-H, 7A): cymbial hook modified at the distal cymbium; patellar apophysis and RTA absent; theridiid tegular apophysis situated on the upper of median apophysis; embolus curved, hook-shaped with embolus apophyses; conductor twisted, situated on the outer of embolus; median apophysis rounded, situated on the center of tegulum.

Female. Small-sized and irregular-web building spiders slightly longer than male, found in the web of araneid spiders. Carapace elongate, 1.5 times as long as wide (carapace index 68%), slightly narrowed in eye area, (light brown, slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, slightly longer than wide (sternal index 93%) and not projected between 4th coxae. Abdomen spherical-shaped, 1.5 times as high as long (abdominal index 97%; abdominal height index 150%) and whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; eye formula $AME=PLE=PME=ALE$. AME separation 1.3 times their diameter, PME separation 1.6 times their diameter. AER slightly 4.6 times as long as AME diameter; PER slightly 4.8 times as long as AME diameter. Eye area index 41%; median eye index 93%; eye row index 96%. Clypeus height 3.1 times as long as one AME diameter and without chillum. Chelicerae without scopula and lateral condyle; three promarginal teeth, middle one largest and one marginal tooth, one retromarginal tooth; cheliceral index 24%. Endites reddish brown, widest at mid part, without serrula and 1.1 times as long as wide (endite index 89%). Labium rectangular, (light brown, slightly darker at margins) and 1.8 times as wide as long

(labial index 183%). Legs reddish brown, covered with many setae and leg formula I II IV III. Femur I 1.7 times as long as cephalothorax. Egg-laying period July to September; about 2-3 mm egg sacs, 2-5, suspended in the web with the female and each contained about 30-50 eggs; no predator host spider.

Female epigynum and genitalia (Fig. 1B-D): epigynal teeth and atrial septum absent; atrial slits or two true copulatory openings deep, linear on inner retrolateral part of atrium; cupulation duct linear, shorter than spermathecal diameter; spermatheca spherical, not overlapped, with indistinct stalks and bases; fertilization ducts arising from the posterior margin of spermathecae.

Habitat. Web of host spiders [*Argiope bruennichi* (Scopoli, 1772), *Nephila clavata* L. Koch, 1878, *Cyclosa* spp., and *Agelena* spp. etc.].

Maturity. July to August.

Distribution. Korea, Japan, China, Taiwan, Philippines.

Remarks. Since Namkung (1976) recorded this species for the first time, it has not been reported. In this paper, *A. bonadea* (Karsch, 1881) is redescribed with palpal organs, genitalia, and ecological characteristics.

***Argyrodes miniaceus* (Doleschall, 1857) (Figs. 2, 7B-C)**

Theridion miniaceum Doleschall, 1857, Nat. Tijdschr. Neder.-Ind., 13(3): 408 (D).

Argyrodes miniaceus: Thorell, 1878, Ann. Mus. civ. stor. nat. Genova 13, p. 138 (D♂♀); Paik, 1953, p. 19; Namkung, 2001, p. 136, fig. 13.53a-d (♂♀); Yoshida, 2003, p. 148, figs. 397-399 (♂♀).

Argyrodes flavescens: Namkung, 2001, p. 137, fig. 13-54a-c (♂♀). Minidentified.

Previous records in Korea. Jeju, Jeju-do, 1♀, 25 Jul. 1937, Mt. Harasan, 1♂, 26-27 Jul. 1937, Seoguiposi, 4♂♂ 23♀♀, 30 Jul. 1937 (K.Y. Paik); Isl. Geojedo, 1♀, 24 Jul. 1964, 3♀♀, 7 Jul. 1970, 1♂, 7 Aug. 1970 (K.Y. Paik); Isl. Hongdo, Jeollanam-do, 1♂4♀♀, 29 Jul. 1979, Daeheuksando, 1♂1y♂2♀♀3y♀♀, 30 Jul. 1979 (T.H. Jo); Mt. Ungilsan, Gyeonggi-do, 1♂1♀ (LBHU, material examined in this study), 3 May 1996 (B.W. Kim)

Diagnosis. This species is closely similar to *A. flavescens* O. P.-Cambridge, 1880 but can be distinguished from the latter by abdomen with a large black spot in posterior part and slender embolus, and female with genital pore in lateral part and connecting duct only stretched to spermatheca.

Description. Measurement (mm). Male/female: habitus length 4.4/5.0; carapace length 1.9/1.9, carapace width 1.1/1.3; cephalothorax height 1.4/1.2; cheliceral length 0.8/0.7, cheliceral width 0.4/0.3, cheliceral fang length 0.4/0.3; sternum length 0.7/0.9, sternum width 0.7/0.8; endite length

Fig. 2. *Argyrodes miniceus*: A. Female, habitus, lateral view. B-D. Female, epigynum, ventral view (B), genitalia, ventral (C), dorsal (D). E. Male, eye area, dorsal view. F. Male, habitus, lateral view. G-H. Male palpal organ, prolateral view (G), ventral (H). Scale bars=1 mm (A, F), 0.5 mm (B-E, G, H).

0.4/0.5, endite width 0.3/0.3; labium length 0.2/0.2, labium width 0.3/0.4; clypeus height 0.6/0.3; AER 0.63/0.58, PER

0.63/0.56, AME 0.10/0.11, ALE 0.08/0.09, PME 0.08/0.10, PLE 0.08/0.09; AMEI 0.14/0.15, PMEI 0.10/0.12. First leg

13.3/20.6 (4.0/2.6, 0.6/1.3, 3.3/6.5, 3.7/7.3, 1.7/2.9), second leg 13.0/14.4 (3.9/4.4, 0.7/1.0, 3.2/3.3, 3.5/3.8, 1.7/1.9), third leg 4.4/8.0 (1.4/2.5, 0.4/0.8, 0.8/1.5, 1.0/1.9, 0.8/1.3), fourth leg 6.6/12.3 (2.2/4.1, 0.4/0.8, 1.4/2.7, 1.7/3.2, 0.9/1.5). *Male*. Small-sized and irregular-web building spiders slightly shorter than female, found in the web of araneid spiders. Carapace elongate, 1.8 times as long as wide (carapace index 57%), slightly narrowed in eye area, (light brown, slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, slightly longer than wide (sternal index 97%) and not projected between 4th coxae. Abdomen spherical-shaped, 0.8 times as high as long (abdominal index 62%; abdominal height index 80%) and whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; ALE and PLE smaller than other eyes and eye formula $AME > PME > ALE = PLE$. AME separation 1.5 times their diameter, PME separation 1.1 times their diameter. AER slightly 6.6 times as long as AME diameter; PER slightly 6.6 times as long as AME diameter. Eye area index 58%; median eye index 66%; eye row index 100%. Clypeus height six times as long as one AME diameter and without chillum. Chelicerae without scopula and lateral condyle; two promarginal teeth, one retromarginal tooth; Cheliceral index 49%. Endites reddish brown, widest at mid part, without serrula and 1.6 times as long as wide (endite index 63%). Labium rectangular, (light brown, slightly darker at margins) and 1.3 times as wide as long (labial index 127%). Legs reddish brown, covered with many setae and leg formula I II IV III. Femur I two times as long as cephalothorax. Living with 2-5 individuals on the host web and eating to take away from host spider.

Male palp (Figs. 2G-H, 7B-C): cymbial hook modified at the distal cymbium; patellar apophysis and RTA absent; theridiid tegular apophysis situated on the upper of median apophysis; embolus rounded linear, semicircle-shaped with embolus apophysis at the inner part; conductor indistinct; median apophysis hooked, situated at the lateral part of tegulum.

Female. Small-sized and irregular-web building spiders slightly longer than male, found in the web of araneid spiders. Carapace elongate, 1.5 times as long as wide (carapace index 65%), slightly narrowed in eye area, (light brown, slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, 1.1 times as long as wide (sternal index 88%) and not projected between 4th coxae. Abdomen spherical-shaped, 1.2 times as high as long (abdominal index 87%; abdominal height index 121%) and whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; PLE and ALE smaller than other eyes and eye formula $AME > PME > PLE = ALE$. AME separation 1.4 times their diameter, PME separation

1.3 times their diameter. AER slightly 5.4 times as long as AME diameter; PER slightly 5.2 times as long as AME diameter. Eye area index 46%; median eye index 80%; eye row index 104%. Clypeus height 2.5 times as long as AME diameter and without chillum. Chelicerae without scopula and lateral condyle; three promarginal teeth, middle one largest and one marginal tooth, one retromarginal tooth; cheliceral index 47%. Endites reddish brown, widest at mid part, without serrula and 1.6 times as long as wide (endite index 64%). Labium rectangular, (light brown, slightly darker at margins) and 1.7 times as wide as long (labial index 171%). Legs reddish brown, covered with many setae and leg formula I II IV III. Femur I 1.3 times as long as cephalothorax. Living with 2-5 individuals on the host web and eating to take away from host spider.

Female epigynum and genitalia (Fig. 2B-D): epigynal teeth and atrial septum absent; copulatory opening circle-shaped, situated at the lateral part of epigynum; cupulation duct curved, linear longer than spermathecal diameter; spermatheca spherical, not overlapped, with indistinct stalks and bases; fertilization ducts small, arising from the posterior margin of spermathecae.

Habitat. Web of host spiders (*Argiope bruennichi* and *Cyclosa* spp. etc.).

Maturity. July to August

Distribution. Korea, Japan, China, Taiwan, New Guinea.

Remarks. Since Paik (1953) recorded this species, it has not been reported. In this paper, a Chinese endemic species, *Argyrodes miltosus* Zhu and Song 1991 is synonymized with *A. miniaceus* (Doleschall, 1857).

Genus *Ariamnes* Thorell, 1869

Type species: *Ariadne flagekum* Doleschall, 1857

Diagnosis. The genus *Ariamne* is different from other argyrodine taxa by very slender abdomen (10 times as long as interval length of spinnerets), elongate spermatheca, embolus terminal apophysis, carapace pars stridens (sternocoxal tubercle) irregular and prey-catching strategy (Exline and Levi, 1962; Eberhard, 1979; Chikuni, 1989; Zhu, 1998; Yoshida, 2003; Agnarsson, 2004).

Ariamnes cylindrogaster (Simon, 1889) (Figs. 3, 6A-B)

Ariamnes cylindrogaster Simon, 1889, Ann. Soc. ent. Fr., (6)8: 251 (D♂ ♀); Yoshida, 2003, p. 160, figs. 437-439, 546, 591 (transferred from *Argyrodes*); Namkung, 2003, p. 134, fig. 13.50a-c (♂ ♀).

Argyrodes cylindrogaster: Yaginuma, 1986, p. 51, fig. 28.7 (♂ ♀); Chikuni, 1989, p. 35, fig. 28 (Ph♂ ♀, ♂ ♀); Namkung, 2001, p. 132, fig. 13.50a-c (♂ ♀)

For further citation see Platnick (2007).

Fig. 3. *Ariamnes cylindrogaster*: A. Female, habitus, lateral view. B-E. Female, epigynum, ventral view (B), lateral (C), genitalia, ventral (D), dorsal (E). F. Male, habitus, dorsal view. G-H. Male palpal organ, prolateral view (G), ventral (H). Scale bars=1 mm (A, F), 0.25 mm (B-E), 0.5 mm (G, H).

Previous records in Korea. Isl. Wando, Jeollanam-do, ?♂? ♀, 3-10 Aug. 1935 (H. Doi); Mt. Joryeongsan, Chung-

cheongbuk-do, 1 ♀, 2-5 Aug. 1959, 2 ♂♂ 5 ♀♀, 1-6 Aug. 1962, 3 ♀♀, 22 Jul. 1963, 1 ♂ 5 ♀♀, 6 Aug. 1964, 1 ♂, 15

Oct. 1964 (J. Namkung); Mt. Palgongsan, Gyeongsangbuk-do, 1 ♀ 5y ♀ ♀, 27 Aug. 1964 (A.K. Kim), 1 ♀, 11 Aug. 1977, 1y ♂ 17 Sep. 1977, 1y ♂, 22 Sep. 1977 (Y.M. Shin); Mt. Songnisan, Boeun, Chungcheongbuk-do, 2 ♀ ♀, 16 May 1965, 1 ♂ 1 ♀, 20, 30 Jul. 1965, 2 ♀ ♀, 4 Aug. 1965, 1 ♀, 6 Aug. 1965, 7 ♀ ♀, 8 Aug. 1965 (J. Namkung); Mt. Chiaksan, Gwangju-do, 2y ♀ ♀, 7-9 Aug 1975 (J. Namkung and K.I Yoon); Temple Buryeungsa, Gyeongsangbuk-do, 3y ♀ ♀, (18-24) Aug. 1975 (K.Y. Paik); Isl. Daebudo, Gyeonggi-do, 2 ♀ ♀, 13 Jun. 1973, Isl. Deojeokdo, 1 ♂ 1 ♀, 3-6 Jul. 1976 (J. Namkung, N.K. Paik and M.S. Im); Temple Bogeonsa, Gyeongsangbuk-do, 1 ♀, 26 Aug. 1977, 2 ♀ ♀ 2y ♀ ♀ 2y ♂ ♂, 15 Oct. 1977 (K.Y. Paik); Mt. Geumhosan, Gyeongsangbuk-do, 1y ♀, 18 Jul. 1979, 4y ♀ ♀, 16 Sep. 1979, 3y ♀ ♀, 21 Oct. 1979 (J. Namkung); Bugu area, Uljin-gun, Gyeongsangbuk-do, 1 ♀, 6 Jun. 1980, 1 ♀, 13-14 Jun. 1980 (J. Namkung and N.K. Paik); Mt. Ungilsan, Gyeonggi-do, 1 ♂ (LBHU, material examined in this study), 28 Apr. 1984 (H.S. Yoo), 1 ♀ (LBHU, material examined in this study), 15 Aug. 1995 (B.W. Kim).

Description. Measurement (mm). Male/female: habitus length 17.1/22.3; carapace length 2.1/2.4, carapace width 1.1/1.2; cephalothorax height 0.8/1.0; cheliceral length 0.2/0.3, cheliceral width 0.4/0.4, cheliceral fang length 0.2/0.2; sternum length 1.2/1.6, sternum width 0.7/0.8; endite length 0.3/0.4, endite width 0.3/0.3; labium length 0.2/0.3, labium width 0.3/0.4; clypeus height 0.5/0.2; AER 0.39/0.41, PER 0.42/0.41, AME 0.12/0.10, ALE 0.07/0.08, PME 0.08/0.08, PLE 0.06/0.07; AMEI 0.08/0.12, PMEI 0.13/0.13. First leg 14.7/18.2 (5.2/6.7, 0.4/0.8, 2.1/2.4, 5.5/6.8, 1.5/1.5), second leg 8.4/10.3 (2.8/3.4, 0.6/0.7, 1.8/2.1, 2.1/2.8, 1.1/1.3), third leg 4.7/5.4 (1.6/1.8, 0.5/0.5, 0.9/1.0, 1.0/1.3, 0.7/0.8), fourth leg 14.7/19.7 (4.8/6.7, 0.7/0.8, 3.3/4.5, 4.3/5.8, 1.6/1.9).

Male. Small-sized and irregular-web building spiders slightly shorter than female. Carapace elongate, 1.9 times as long as wide (carapace index 54%), slightly narrowed in eye area, (light brown, slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, 1.9 times as long as wide (sternal index 55%) and not projected between 4th coxae. Abdomen long and cylindrical, 21 times as long as high (abdominal index 5%; abdominal height index 5%) and whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; PLE smaller than other eyes and eye formula AME > PME > ALE > PLE. AME separation 0.7 times their diameter, PME separation 1.6 times their diameter. AER slightly 3.3 times one AME diameter; PER slightly 3.5 times one AME diameter. Eye area index 38%; median eye index 158%; eye row index 94%. Clypeus height 4.5 times as long as one AME diameter and without chillum. Chelicerae without scopula and lateral

condyle; three promarginal teeth, middle one largest and one marginal tooth, one retromarginal tooth; cheliceral index 171%. Endites reddish brown, widest at mid part, without serrula and as long as wide (endite index 100%). Labium rectangular, (light brown, slightly darker at margins) and 1.3 times as wide as long (labial index 125%). Legs reddish brown, covered with many setae and leg formula I IV II III. Femur I 2.5 times as long as cephalothorax.

Male palp (Figs. 3G-H, 6A-B): cymbial hook modified at the distal cymbium; patellar apophysis and RTA absent; theridiid tegular apophysis developed, situated on the upper of median apophysis; embolus large elongated, not curved, with indistinct embolus apophyses at the inner part; conductor vague morphologically; median apophysis rounded, situated on the lateral part of tegulum.

Female. Small-sized and irregular-web building spiders slightly longer than male. Carapace elongate, 2.1 times as long as wide (carapace index 48%), slightly narrowed in eye area, (light brown, slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, 1.9 times as long as wide (sternal index 52%) and not projected between 4th coxae. Abdomen long and cylindrical, 0.1 times as high as long (abdominal index 7%; abdominal height index 6%) and whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; PLE smaller than other eyes and eye formula AME > PME = ALE > PLE. AME separation 1.3 times their diameter, PME separation 1.7 times their diameter. AER slightly 4.6 times as long as AME diameter; PER slightly 4.6 times as long as AME diameter. Eye area index 35%; median eye index 110%; eye row index 100%. Clypeus height 2.2 times as long as one AME diameter and without chillum. Chelicerae without scopula and lateral condyle; three promarginal teeth, middle one largest and one marginal tooth, one retromarginal tooth; cheliceral index 169%. Endites reddish brown, widest at mid part, without serrula and 1.3 times as long as wide (endite index 80%). Labium rectangular, (light brown, slightly darker at margins) and 1.3 times as wide as long (labial index 132%). Legs reddish brown, covered with many setae and leg formula IV I II III. Femur I 2.8 times as long as cephalothorax. Catch prey by only single viscous silk; egg-laying period May to October; about 6-15 mm one egg sac, suspended in the web with the female and contained about 50-60 eggs.

Female epigynum and genitalia (Fig. 3B-E): epigynal teeth and atrial septum absent; two copulatory openings small, situated at the center of rounded atrium; cupulation duct twisted, slightly equal in size of spermathecal diameter; spermatheca long oval, not overlapped; fertilization ducts arising from the posterior margin of spermathecae.

Habitat. Among leaves of the pine tree on the beach.

Fig. 4. *Neospintharus fur*: A. Female, habitus, dorsal view. B-E. Female, epigynum, ventral view (B), lateral (C), genitalia, ventral (D), dorsal (E). F. Female, abdomen, retrolateral view. G. Female, spinnerets, ventral view. H. Male, lateral view. I-J. Male, palpal organ, prolateral view (I), ventral (J). Scale bars=1 mm (A, H), 0.5 mm (B-E, G, I, J).

Maturity. May to October.

Distribution. Korea, Japan, China, Taiwan.

Remarks. Since Doi (1935) recorded this species, it has not been reported until the present study.

Genus *Neospintharus* Exline, 1950

Type species: *Neospintharus parvus* Exline, 1950

Neospintharus Exline, 1950, p. 112.

For further citation see Agnarsson (2004)

Diagnosis. The genus *Neospintharus* is different from other argyrodines by conductor entire, embolus not ridged, clypeal projection elongate, modified setae on clypeal as well as ocular projections, male ceohalic modifications, AME in clypeal groove, a single triplet spigot, teapot-shaped embolus, and a distally broad TTA (Exline and Levi, 1962; Zhu, 1998; Yoshida, 2003; Agnarsson, 2004)

***Neospintharus fur* (Boesenberg and Strand, 1906)**

(Figs. 4, 6C-D)

Argyrodes fur Boesenberg and Strand, 1906, p. 133, pl. 11, fig. 226 (D♂♀); Namkung, 2001, p. 135, fig. 13.52a-b (♂♀).

Argyrodes gansuensis Zhu, 1998, p. 202, fig. 131A-C (♂).

Conopistha fur: Namkung et al., 1972, p. 92, fig. 2 (♀).

N. fur: Agnarsson, 2004, p. 479 (transferred male and female from *Argyrodes*)

Previous records in Korea. Mt. Joryeongsan, Chungcheongbuk-do, 2♂♂2♀♀, 22 Jun. 1963, 1♂1y♀, 7 May 1967 (J. Namkung); Mt. Songnisan, Chungcheongbuk-do, 1♀, 20 Jun. 1965, 1♀, 8 Aug. 1965, 1♀, 30 Aug. 1965 (J. Namkung); Mt. Geumosan, Gyeongsangbuk-do, 1♀, 24 Jul. 1979, 1y♀, 16 Sep. 1979, 1y♀, 21 Oct. 1979 (K.Y. Paik); Mt. Chiaksan, Gangwon-do, 1♀, 8 Aug. 1979, 1♀, 9 Aug. 1979 (J. Namkung and K.I. Yoon); Mt. Ungilsan, Gyeonggi-do, 1♀ (LBHU, material examined in this study), 3 Aug. 2000, 1♂ (LBHU, material examined in this study), 4 Jun. 2001 (B.W. Kim).

Diagnosis. This species closely resembles *A. flavescens* O. P.-Cambridge, 1880 but can be distinguished from the latter by male with a setae-bearing clypeal projection and a projection of parallel eye area or hump bearing setae, female epigynum with a longitudinal ridge bearing indistinct genital pore, and abdomen with two tips.

Description. Measurement (mm). Male/female: habitus length 2.4/2.9; carapace length 1.2/1.2, carapace width 0.7/0.9; cephalothorax height 0.8/0.8; cheliceral length 0.4/0.4, cheliceral width 0.2/0.2, cheliceral fang length 0.2/0.2; sternum length 0.7/0.7, sternum width 0.5/0.6; endite length 0.3/0.4, endite width 0.2/0.2; labium length 0.2/0.2, labium

width 0.2/0.3; clypeus height 0.2/0.2; AER 0.42/0.43, PER 0.45/0.46, AME 0.05/0.11, ALE 0.07/0.07, PME 0.07/0.07, PLE 0.07/0.07; AMEI 0.17/0.13, PMEI 0.12/0.13. First leg 5.8/6.0 (1.9/2.1, 0.4/0.4, 1.7/1.7, 1.1/1.2, 0.7/0.6), second leg 4.2/4.1 (1.3/1.3, 0.3/0.4, 1.1/1.0, 0.9/0.9, 0.6/0.5), third leg 2.4/2.6 (0.8/0.9, 0.3/0.3, 0.4/0.5, 0.5/0.5, 0.4/0.4), fourth leg 3.7/4.6 (1.3/1.6, 0.3/0.4, 0.9/0.9, 0.7/1.1, 0.5/0.6).

Male. Small-sized and irregular-web building spiders slightly shorter than female, found in the web of araneid spiders. Carapace elongate, 1.6 times as long as wide (carapace index 63%), slightly narrowed in eye area, (light brown, slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, 1.3 times as long as wide (sternal index 77%) and not projected between 4th coxae. Abdomen spherical-shaped, 1.4 times as high as long (abdominal index 82%; abdominal height index 135%) and whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; PLE smaller than other eyes and eye formula AME>PME=ALE>PLE. AME separation 0.3 times their diameter, PME separation 1.7 times their diameter. AER slightly 0.8 times as long as AME diameter; PER slightly 0.9 times as long as AME diameter. Eye area index 61%; median eye index 71%; eye row index 92%. Clypeus height 0.5 times as long as AME diameter and without chillum. Chelicerae without scopula and lateral condyle; three promarginal teeth, middle one largest and one marginal tooth, one retromarginal tooth; cheliceral index 34%. Endites reddish brown, widest at mid part, without serrula and 1.7 times as long as wide (endite index 61%). Labium rectangular, (light brown, slightly darker at margins) and 1.5 times as wide as long (labial index 147%). Legs reddish brown, covered with many setae and leg formula I II IV III. Femur I 1.6 times as long as cephalothorax. Attack host spiders or their predator; 2-5 mm sized, two egg-sacs and each contained 30-40 eggs; overwintering in host web or falling leaves.

Male palp (Figs. 4I-J, 6C-D): cymbial hook modified at the distal cymbium; patellar apophysis and RTA absent; theridiid tegular apophysis modified, situated on the upper of median apophysis; embolus not curved, spiral-shaped; conductor membranous, situated on the upper of embolus; median apophysis rounded, situated on the center of tegulum. **Female.** Small-sized and irregular-web building spiders slightly longer than male, found in the web of araneid spiders. Carapace elongate, 1.3 times as long as wide (carapace index 74%), slightly narrowed in eye area, (light brown, slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, 1.3 times as long as wide (sternal index 77%) and not projected between 4th coxae. Abdomen spherical-shaped, 1.4 times as high as long (abdominal index 80%; abdominal height index 136%) and

Fig. 5. *Rhophaea saganus*: A. Female, habitus, lateral view. B-D. Female, epigynum, ventral view (B), genitalia, (C), dorsal (D). E. Male, habitus, lateral view. F-G. Male palpal organ, ventral (F), retrolateral (G). H-I. Male, eye area, prolateral view (H), dorsal (I). Scale bars=3 mm (A, E), 0.5 mm (B-D, F-I).

whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; AME larger than other

eyes and eye formula $AME > PLE = PME = ALE$. AME separation 1.2 times their diameter, PME separation 1.8

Fig. 6. SEM photographs of three Korean Argirodinae speices. A-B. *Ariamnes cylindrogaster*, male palp (A) and embolus tip (B). C-D. *Neospintharus fur*, male palp (C) and embolus tip (D). E-F. *Rhompaea saganus*, male palp (E) and embolus (F).

times their diameter. AER slightly four times as long as AME diameter and PER slightly 4.3 times one AME diameter. Eye area index 52%; median eye index 100%; eye row index 92%. Clypeus height 2.2 times as long as one AME diameter and without chillum. Chelicerae without scopula and lateral condyle; two promarginal teeth, one

retromarginal tooth; cheliceral index 50%. Endites reddish brown, widest at mid part, without serrula and twice as long as wide (endite index 50%). Labium rectangular, (light brown, slightly darker at margins) and 1.3 times as wide as long (labial index 133%). Legs reddish brown, covered with many setae and leg formula I IV II III. Femur I 1.7 times as

Fig. 7. SEM photographs of two Korean Argyrodinae species. A. *Argyrodes bonadea*, male palp. B-C. *Argyrodes miniaceus*, male palp (B) and embolus (C).

long as cephalothorax. Attack host spiders or their predator; 2-5 mm sized, two egg-sacs and each contained 30-40 eggs; overwintering in host web or falling leaf.

Female epigynum and genitalia (Fig. 4B-E): epigynal teeth and atrial septum absent; copulatory openings small, situated on the center of roundedly depressed atrium; cupulation duct curved to the upper direction of copulatory pore, equal in size of spermathecal diameter; spermatheca spherical, not overlapped, with indistinct stalks and bases; fertilization ducts arise from the anterior margin of spermathecae.

Habitat. Web of host spiders (linyphiid spiders and *Agelena* spp. etc.).

Maturity. June to August.

Distribution. Korea, Japan, China.

Remarks. Namkung et al. (1972) recorded *Conopistha fur* without a description. In this paper, we provide redescription of palpal organ and genitalia, and ecological characteristics.

Genus *Rhomphae* L. Koch, 1872

Type species: *Rhomphaea cometes* L. Koch, 1872

Rhomphaea L. Koch, 1872, p. 289; Yoshida, 2001, p. 185;

Agnarsson, 2004, p. 479.

Diagnosis. The genus *Rhomphae* is different from other argyrodines by abdomen triangular and elongate, epigynum with a ventrally membranous projection, tibia elongate, but not scoop-shaped, epiandrous gland spigots absent, egg sac rhomboid-shaped, embolus tip elongate and strongly ridged basally, ocular projection elongate, abdomen boomerang-shaped, posterior tip of abdomen with modified sturdy setae, and possibly unique prey-capture strategy (Exline and Levi, 1962; Whitehouse, 1987; Zhu, 1998; Yoshida, 2003; Agnarsson, 2004)

***Rhomphae saganus* (Doenitz and Strand, 1906)**

(Figs. 5, 6E-F)

Ariamnes saganus Doenitz and Strand, in Boesenberg and

Strand, 1906, p. 378, pl. 5, fig. 46 (Df).

Argyrodes saganus: Paik, 1978, p. 432; Zhu, 1998, p. 212, fig. 138A-D (♂ ♀); Namkung, 2001, p. 138, fig. 13.55a-b (♂ ♀).

Rhomphaea sagana (Doenitz & Strand, 1906): Namkung, 1972, p. 130; Yoshida, 2001, p. 185, figs. 1-5 (♂ ♀); Namkung, 2003, p. 140, fig. 13.55a-b (♂ ♀); Agnarsson, 2004, p. 480 (transferred from *Argyrodes*).

For further citation see Platnick (2007).

Previous records in Korea. Mt. Joryeongsan, Chungcheongbuk-do, 1 ♀, (31 Jul.)-(4 Aug.) 1958 (J. Namkung); Mt. Songnisan, Chungcheongbuk-do, 1 ♀, 16 May 1965, 1 ♂, 19 Jun. 1965, 1 ♂, 20 Jun. 1965, 1 ♀, 5 Aug. 1965 (J. Namkung); Mt. Chiaksan, Gangwon-do, 1 ♀, 1y ♀, 7 Aug. 1975 (J. Namkung and K.I. Yoon); Mungyeongsejae, Gyeongsangbuk-do, 1 ♂ (AIK, material examined in this study), 25 Aug. 1991, 1 ♀ (AIK, material examined in this study), 23 Jun. 1990 (J.P. Kim).

Diagnosis. This species closely resembles *R. labiatus* (Zhu and Song, 1992) and *R. hyrcanus* (Longunov and Marusik, 1990) but can be distinguished from these species by male carapace with a projection of eye area, and female abdomen tapering to a single tip and four to six times as long behind as anterior to spinnerets.

Description. Measurement (mm). Male/female: habitus length 5.5/5.5; carapace length 1.7/1.7, carapace width 0.9/1.0; cephalothorax height 1.1/1.0; cheliceral length 0.4/0.4, cheliceral width 0.2/0.2, cheliceral fang length 0.1/0.2; sternum length 0.9/1.0, sternum width 0.6/0.6; endite length 0.2/0.4, endite width 0.2/0.2; labium length 0.2/0.2, labium width 0.2/0.3; clypeus height 0.3/0.2; AER 0.44/0.43, PER 0.44/0.46, AME 0.12/0.11, ALE 0.07/0.08, PME 0.10/0.10, PLE 0.07/0.08; AMEI 0.20/0.17, PMEI 0.16/0.17. First leg 17.9/15.8 (6.7/6.4, 1.0/0.5, 5.7/4.8, 3.1/2.9, 1.4/1.2), second leg 9.4/9.1 (3.4/3.3, 0.5/0.5, 2.6/2.5, 2.1/2.0, 0.8/0.8), third leg 5.2/4.8 (1.9/1.8, 0.4/0.4, 1.1/1.0, 1.2/1.0, 0.6/0.6), fourth leg 13.0/12.2 (5.4/5.1, 0.5/0.6, 3.0/2.8, 3.1/2.8, 1.0/0.9).

Male. Small-sized and irregular-web building spiders slightly shorter than female. Carapace elongate, 1.9 times as long as wide (carapace index 52%), slightly narrowed in eye area, (light brown, slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, 1.5 times as long as wide (sternal index 66%) and not projected between 4th coxae. Abdomen like a lance, 0.8 times as high as long (abdominal index 21%; abdominal height index 75%) and whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; ALE and PLE smaller than other eyes and eye formula AME > PME > ALE = PLE. AME separation 1.7 times their diameter, PME separation 1.6 times their diameter. AER slightly 3.7 times

as long as AME diameter; PER slightly 3.7 times as long as AME diameter. Eye area index 49%; median eye index 77%; eye row index 100%. Clypeus height 2.8 times as long as AME diameter and without chillum. Chelicerae without scopula and lateral condyle; three promarginal teeth, middle one largest and one marginal tooth, one retromarginal tooth; cheliceral index 43%. Endites reddish brown, widest at mid part, without serrula and 1.3 times as long as wide (endite index 79%). Labium rectangular, (light brown, slightly darker at margins) and 1.4 times as wide as long (labial index 141%). Legs reddish brown, covered with many setae and leg formula I IV II III. Femur I 3.9 times as long as cephalothorax. Eating prey to take away from host spider or host predator; egg-laying period July to September; several brown-color egg-sacs and each contained 50-80; NEISL C (Shinkai, 1998).

Male palp (Figs. 5F-G, 6E-F): cymbial hook modified at the distal cymbium; patellar apophysis and RTA absent; theridiid tegular apophysis largely modified, situated on the lateral part of embolus; embolus very elongated, slightly curved, without distinct embolus apophysis; conductor vague, obliquely situated on the center of tegulum; median apophysis rounded, indistinct on tegulum.

Female. Small-sized and irregular-web building spiders slightly longer than male, found in the web of araneid spiders. Carapace elongate, 1.7 times as long as wide (carapace index 57%), slightly narrowed in eye area, (light brown, slightly darker at margins) and without fovea. Sternum shield-shaped, widest at second coxae, 1.7 as long as wide (sternal index 60%) and not projected between 4th coxae. Abdomen like a lance, 0.8 times as high as long (abdominal index 43%; abdominal height index 79%) and whitish with a dark gray pattern. AER straight and PER slightly procurved in frontal view; ALE and PLE smaller than other eyes and eye formula AME > PME > ALE = PLE. AME separation 1.6 times their diameter, PME separation 1.8 times their diameter. AER slightly five times as long as AME diameter; PER slightly 4.3 times as long as AME diameter. Eye area index 49%; median eye index 104%; eye row index 92%. Clypeus height 1.9 times as long as AME diameter and without chillum. Chelicerae without scopula and lateral condyle; two promarginal teeth, retromarginal tooth absent; cheliceral index 45%. Endites reddish brown, widest at mid part, without serrula and 1.6 times as long as wide (endite index 62%). Labium rectangular, (light brown, slightly darker at margins) and 1.3 times as wide as long (labial index 127%). Legs reddish brown, covered with many setae and leg formula I IV II III. Femur I 3.8 times as long as cephalothorax. Eating prey to take away from host spider or host predator; egg-laying period July to September; several brown-color egg-sacs and each contained 50-80; NEISL C

(Shinkai, 1998).

Female epigynum and genitalia (Fig. 5B-D): epigynal teeth and atrial septum absent; copulatory opening one small circle, situated on the center of atrium; copulation duct twisted to the lower direction of copulatory pore, longer than spermathecal diameter; spermatheca spherical, not overlapped, with indistinct stalks and bases; fertilization ducts arised from the posterior margin of spermathecae.

Habitat. Web of host spiders (linyphiid spiders, *Agelena* spp. etc.).

Maturity. May to August.

Distribution. Korea, Japan, China, Russia, Philippines, Azerbaijan.

Remarks. Since Namkung (1972) firstly recorded *Rhomphaea sagana* Doenitz and Strand, 1906 in spider fauna, this species has not been reported. In this paper, *R. saganus* is redescribed palpal organ and genitalia, and ecological characteristics.

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