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On linyphiid spiders from Sulawesi, Indonesia (Arachnida, Araneae)

Andrei V. TANASEVITCH[1] & Kathrin STENCHLY[2]
[1] Centre for Forest Ecology and Production, Russian Academy of Sciences, Profsoyuznaya Str. 84/32, Moscow 117997, Russia. E-mail: and-tan@mail.ru
[2] Tropenzentrum - Centre for International Rural Development, Kassel Universiy, Steinstrasse 19, D-37213 Witzenhausen, Germany. E-mail: stenchly@uni-kassel.de

On linyphiid spiders from Sulawesi, Indonesia (Arachnida, Araneae). - A small collection of linyphiid spiders from agrocenoses on the Indonesian island of Sulawesi contains four species, two of which are new: *Maorineta sulawesi* sp. n. and *Microbathyphantes celebes* sp. n. A new genus *Australophantes* gen. n. is established for *Agyneta laetesiformis* Wunderlich, 1976 (the type species) which was previously known from Queensland, Australia only. Based on the new data, the linyphiid fauna of Sulawesi is currently known to contain seven species, and it shows relations to the Australian and Oriental faunas.

Keywords: New genus - new species - new combination - new records - agrocenoses - Oriental & Australian regions.

INTRODUCTION

Sulawesi, lying between Wallace's and Weber's biogeographic lines, is of prime importance for biogeographers, since this island occurs in the area where Oriental and Australian biota overlap, and its long-term isolation has allowed the development of a characteristic flora (Moss & Wilson, 1998). The climate of Central Sulawesi is characterized by relatively constant temperatures at an average of 23°C while precipitation levels vary considerably with elevation and topography. In the study area at the eastern margin of the Lore Lindu National Park mean annual precipitation can be estimated to be around 2300 mm per year (rainy season from April to October). The vegetation is influenced by periodic drought events due to the El Niño-Southern Oscillation. Primary forests are dominated by Meliaceae, Lauraceae and Euphorbiaceae in the understory (Kessler *et al*., 2005). The increasing importance of agricultural export products, particularly cacao seeds (*Theobroma cacao*), led to strong immigration of local people into the Lore Lindu region which changed the landscape structure (Weber, 2006). Cacao agroforestry systems have replaced primary forest, and the ongoing trend towards simplifying the shade canopies of cacao plantations and the conversion to other agricultural land uses such as rice cultivation lead to the loss of structural complexity.

Only four linyphiid species have hitherto been listed from Sulawesi and all of them were described from the island: *Dumoga arboricola* Millidge & Russell-Smith,

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FIG. 1
Map of the study area in Sulawesi, Indonesia. Filled circle indicating Kulawi valley.

1992, *D. complexipalpis* Millidge & Russell-Smith, 1992, *Nesioneta sola* (Millidge & Russell-Smith, 1992) and *Plicatiductus storki* Millidge & Russell-Smith, 1992. New material from Sulawesi allows to add three species to that list, two of them are new to science, and one (*Agyneta laetesiformis* Wunderlich, 1976) is here recorded for the first time from outside the Australian continent.

MATERIAL AND METHODS

This paper is based on spider material collected by Kathrin Stenchly during her fieldwork on Sulawesi (formerly known as Celebes), Indonesia from 2007 to 2008. The spider material was caught at 22 differently managed cocoa agroforestry sites in the Kulawi Valley, along the eastern margin of Lore Lindu National Park in Central Sulawesi (see Fig. 1). At each site a 40m×40m plot was established. The plots are characterized by different levels of habitat complexity due to various management

practises of smallholders, such as leaf litter removal, weeding and shade tree cultivation.

Litter-dwelling spider communities were sampled using four roofed pitfall traps (diameter = 20 cm) per plot. Canopy-dwelling spiders were caught on five cacao trees per plot, each tree being fitted with one branch eclector (after Simon, 1993). Traps were emptied each month between May 2007 and March (litter samples) or April 2008 (canopy samples), resulting in 10 and 11 distinct samples per plot for the litter spiders and canopy spiders, respectively. A 1:1 mixture of ethylene glycol and water was used as preservation liquid in both types of traps.

In the descriptions chaetotaxy is given in a formula, e.g., Ti I: 2-1-1-2(1), which means that tibia I has two dorsal spines, one pro-, one retrolateral spine, and two or one ventral spine (the apical spines are disregarded). The sequence of leg segment measurements is as follows: femur + patella + tibia + metatarsus + tarsus. All measurements are given in mm. All scale lines in the figures correspond to 0.1 mm unless indicated otherwise.

The terminology of genitalic structures follows that of Saaristo (1995) and Saaristo & Tanasevitch (1996).

By default, the material is deposited in the Muséum d'histoire naturelle, Geneva, Switzerland and it is not given registration numbers. Some paratypes and non-type specimens are in the collection of the Zoological Museum of the Moscow State University, Moscow, Russia (ZMMU).

ABBREVIATIONS

B	Bursa copulatrix
DSA	Distal suprategular apophysis
E	Embolus
EmP	Embolic plate
EP	Embolus proper
L	Lamella characteristica
LL	Lateral lobes
MM	Median membrane
MPS	Middle part of scape
PS	Proscape
SMF	Senckenberg Museum, Frankfurt a. M., Germany
St	Stretcher
TA	Terminal apophysis
Th	Thumb
ZMMU	Zoological Museum of the Moscow State University, Moscow, Russia

RESULTS

Australophantes Tanasevitch gen. n.

TYPE SPECIES: *Agyneta laetesiformis* Wunderlich, 1976.

ETYMOLOGY: The genus name *Australophantes* is a combination of "Australia" and "*phantes*" (from the Greek υφαίνω = hyphaino, which means "to weave"); the gender is masculine.

DIAGNOSIS: The new genus is characterized by the peculiar structure of its epigyne, notably by the modified distal part of the scape (see Saaristo & Tanasevitch, 1996): lateral lobes transformed into elongated pipes, terminating in a funnel-shaped bursa copulatrix; by the presence of a pair of flat lobes instead of a stretcher; as well as by the absence of a posterior median plate. The male is characterized by the hummingbird-beak-shaped distal suprategular apophysis, by the peculiar and complex shape of the embolus, as well as by the absence of the Fickert's gland in the embolic division.

DESCRIPTION: Small-sized micronetine, total length 1.70-1.95. Carapace unmodified, eyes normal, not enlarged. Chelicerae unmodified, stridulatory fields large, furrows fine. Chaetotaxy: FeI-IV: 0-0-0-0; TiI-IV: 2-0-0-0; MtI-II: 1-0-0-0, III-IV: 0-0-0-0. Metatarsus IV without trichobothrium. TmI 0.27-0.30. Palp (Figs 2-5): patella without special setae. Cymbium with a small and narrow posterodorsal process and a short posteroventral outgrowth. Paracymbium toothless, its anterior and apical pockets merged into a single deep pocket. Distal suprategular apophysis long, thin and slightly curved, resembling the beak of a hummingbird. Embolic division: embolus relatively large, elongated and complex in shape (Fig. 5); terminal apophysis consisting of two flat parts; lamella characteristica developed as a short and narrow band, broom-shaped distally. Fickert's gland absent. Epigyne (Figs 6): proscape long and narrow; lateral lobes extended into narrow pipes, terminating in a funnel-shaped bursa copulatrix; entrance grooves/tubes (?) in distal part of scape considerably wider than in middle part of scape and in proscape; a pair of flat lobes present instead of a stretcher; posterior median plate absent.

TAXONOMICAL REMARKS: The specific structure of the distal part of the scape (see above) in *Australophantes* gen. n. has no analogues in known Micronetinae. The relatives of this genus should be expected to occur in the Australian and Pacific regions.

SPECIES INCLUDED: Only the type species, *A. laetesiformis*.

DISTRIBUTION: Australian Region and Wallacea: Australia (Queensland) and Sulawesi (Kulawi Valley).

Australophantes laetesiformis (Wunderlich, 1976) comb. n. Figs 2-6

Agyneta (?) *laetesiformis* Wunderlich, 1976: 127, figs 8-17 (description of male and female).

TYPE MATERIAL EXAMINED: SMF 29067; ♂ holotype of *Agyneta laetesiformis*; AUSTRALIA, Cairns; leg. Wunderlich, det. Wunderlich; 1975. – SMF 29068; 2 ♀ paratypes with same label data.

NEW MATERIAL: 1 ♂, 1 ♀; INDONESIA, Sulawesi, Kulawi Valley, Wangka (1°36.458'S, 120°1.304'E), 500 m a.s.l., cacao plantation, pitfall trap; III.2008. – 1 ♀; Kulawi Valley, Tompibugis (1º37.524'S, 120º2.039'E), 400 m a.s.l., cacao plantation, pitfall trap; VII.2007.

VARIABILITY: The specimens from Sulawesi are smaller than the types but not significantly; the genitalia of all specimens of the same sex are essentially identical.

REMARKS: The species was described well on the basis of specimens of both sexes from Cains, northern Queensland, Australia (Wunderlich, 1976), and after that it has never been recorded again.

DISTRIBUTION: See above.

FIGS 2-6

Australophantes laetesiformis (Wunderlich, 1976), ♂. (2) Right palp, retrolateral view. (3, 4) Paracymbium, different aspects. (5) Embolic division, not to scale. (6) Scape, posterodorsal view, not to scale.

Dumoga complexipalpis Millidge & Russell-Smith, 1992

MATERIAL: 2 ♂ (one of them in ZMMU); INDONESIA, Sulawesi, Kulawi Valley, Bolapapu (1°26.105'S, 119°59.552'E), 650 m a.s.l., cacao plantation, branch eclector; VI.-VII.2007.

REMARKS: This species was described and is still only known from males collected in the Dumoga-Bone National Park, Sulawesi (Millidge & Russell-Smith, 1992).

Maorineta sulawesi Tanasevitch sp. n. Figs 7-16

ETYMOLOGY: The specific name, a noun in apposition, is taken from the name of the Indonesian Island where the new species was found.

HOLOTYPE: 1 ♂; INDONESIA, Sulawesi, Kulawi Valley, Watukilo (1°36.029'S, 120°2.062'E), 475 m a.s.l., cacao plantation, pitfall trap; VII.2007.

PARATYPES: 1 ♂; INDONESIA, Sulawesi, Kulawi Valley, Oo-Marena (1°32.49'S, 120° 1.045'E), 575 m a.s.l., cacao plantation, pitfall trap; VI.2007. – 7 ♂, 3 ♀; Kulawi Valley, Marena (1°33.132'S, 120°1.212'E), 585 m a.s.l., cacao plantation, pitfall trap; VIII-X.2007 & III.2008. – 4 ♂, 1 ♀ (ZMMU); Kulawi Valley, Wangka (1°36.458'S, 120°1.304'E), 500 m a.s.l., cacao plantation, pitfall trap; III.2008. – 2 ♂; Kulawi Valley, Toro (1°30.049'S, 120°1.723'E), 925 m a.s.l., cacao plantation, pitfall trap; VII.2007. – 1 ♂; Kulawi Valley, Sungku (1°31.167'S, 120°0.654'E), 650 m a.s.l., cacao plantation, litter, pitfall trap; VII.2007. – 1 ♂; Kulawi Valley, Bolapapu (1°26.105'S, 119°59.552'E), 650 m a.s.l., cacao plantation, pitfall trap; VI.2007. – 1 ♀; Kulawi Valley, Pilimakujawa (1°38.998'S, 120°2.842'E), 400 m a.s.l., cacao plantation, pitfall trap; VI.2007.

DIAGNOSIS: The new species is characterized by the peculiar shape of the palpal tibia which carries a conical, darkened outgrowth dorsally, by the complicated structure of the distal part of the lamella characteristica in males, as well as by the shape of the proscape in females.

DESCRIPTION: Male (paratype from Marena). Total length 1.40 (1.35-1.55). Carapace 0.58 long, 0.48 wide, pale yellow, unmodified. Eyes normal, not enlarged. Sternum grey. Chelicerae 0.28 long, stridulatory area small, furrows fine. Legs pale yellow. Leg I 2.35 long (0.63+0.18+0.58+0.53+0.43), IV 2.19 long (0.58+0.18 +0.58+0.50+0.35). Chaetotaxy: Femora and metatarsi spineless, tibiae with only two weak dorsal spines each; length of spines about 1.5-2 diameter of segment. TmI 0.20 (0.20-0.26). Metatarsus IV without trichobothrium. Palp (Figs 7-13): patella without special setae. Tibia with a large, conical, pointed, slightly curved, darkened outgrowth dorsally. Paracymbium toothless, its anterior and apical pockets merged into a single shallow pocket. Lamella characteristica long and narrow, with a pointed, curved, ventral branch distally; apically with a long straight tooth and several black teeth of different sizes. Embolus relatively large, thumb and carina present, both well developed. Abdomen 0.75 long, 0.50 wide, ventrally grey, dorsally pale, almost white, with a grey tip.

Female (paratype from Marena). Total length 1.45 (1.34-1.48). Carapace 0.63 long, 0.43 wide. Chelicerae 0.25 long. Leg I 1.93 long (0.50+0.15+0.48+0.45+0.35), IV 1.85 long (0.50+0.15+0.50+0.40+0.30). TmI 0.26 (0.22-0.26). Abdomen 0.75 long, 0.58 wide. Epigyne dark brown (Figs 14-16): proscape rounded, with a short narrow base; distal part of scape, lateral lobes and stretcher strongly reduced; posterior median plate absent. Body and leg coloration, and chaetotaxy as in male.

TAXONOMIC REMARKS: At present, the genus *Maorineta* Millidge, 1988 comprises seven New Zealand species (Millidge, 1988) and one Pacific species which occurs in the Caroline, Marshall and Cook Islands (Beatty *et al.*, 1991). The new species is clearly distinguished from all known congeners by the complicated shape of the distal part of the lamella characteristica, which in the other species is of one piece. The female is clearly distinguished by the shield-shaped proscape with a short narrow base.

DISTRIBUTION: Currently known from Kulawi Valley, Sulawesi only.

FIGS 7-13

Maorineta sulawesi sp. n., ♂ paratype from Wangka. (7) Left palp, retrolateral view. (8, 9) Palpal tibia, lateral and dorsal view, respectively. (10) Paracymbium. (11) Embolic division, not to scale. (12) Lamella characteristica. (13) Distal part of lamella characteristica.

Microbathyphantes celebes Tanasevitch sp. n. Figs 18-27

ETYMOLOGY: The specific name, a noun in apposition, is taken from the historical name of the island where the new species was found.

HOLOTYPE: ♂; INDONESIA, Sulawesi, Kulawi Valley, Oo (1°33.54'S, 120°1.343'E), 550 m a.s.l., cacao tree, branch trap; VIII.2007.

PARATYPES: 2 ♀; INDONESIA, Sulawesi, Kulawi Valley, Oo (1°33.54'S, 120°1.343'E), 550 m a.s.l., cacao tree, branch trap; VIII.2007. – 1 ♂; same locality, cacao plantation, pitfall trap; III.2008. – 2 ♂; Kulawi Valley, Oo-Marena (1°32.49'S, 120°1.045'E), 575 m a.s.l., cacao plantation, pitfall trap; VI.2007, IX.2007. – 5 ♂; Kulawi Valley, Marena (1°33.132'S,

FIGS 14-17

Epigynes of *Maorineta sulawesi* sp. n., ♀ paratype from Wangka (14-16) and of *Nesioneta sola* (Millidge & Russell-Smith, 1992) (17, not to scale). (14, 17) Ventral view. (15) Lateral view. (16) Dorsal view.

120°1.212'E), 585 m a.s.l., cacao plantation, pitfall trap & branch eclector; VI.-IX.2007. – 1 ♂; same locality; I.2008. – 1 ♂; same locality, cacao plantation, pitfall trap; VI.2007. – 1 ♂; Kulawi Valley, Toro (1°30.586'S, 120°1.157'E), 700 m a.s.l., cacao plantation, pitfall trap; VII.2007. – 1 ♂; same locality; I.2008. – 2 ♂; Toro (1°30.049'S, 120°1.723'E), 925 m a.s.l., cacao plantation, pitfall trap; VII.2007. – 2 ♂ (ZMMU); Kulawi Valley, Sungku (1°27.845'S, 119°59.564'E), 725 m a.s.l., cacao plantation, pitfall trap; VIII-IX.2007. – 1 ♂; Sungku (1°31.167'S, 120°0.654'E), 650 m a.s.l., cacao plantation, pitfall trap; 2008. – 1 £; same locality; IX.2007. – 1 ♂; Sungku (1°30.161'S, 120°0.454'E), 675 m a.s.l., cacao plantation, pitfall trap; IV.2007. – 1 ♂; Sungku (1°29.439'S, 120°0.385'E), 750 m a.s.l., cacao plantation, pitfall trap; IX.2007. – 1 ♂; Sungku (1°32.109'S, 120°0.799'E), 625 m a.s.l., cacao plantation, pitfall trap; VII.2007. – 1 ♂; Kulawi Valley, Bolapapu (1°26.105'S, 119°59.552'E), 650 m a.s.l., cacao plantation, pitfall trap; VI.2007. – 1 ♂; Kulawi Valley, Watukilo (1°36.029'S, 120°2.062'E), 475 m a.s.l., cacao tree, branch eclector; VIII.2007. – 1 ♂; Kulawi Valley, Lawua (1°36.651'S, 120°2.035'E), 425 m a.s.l., cacao plantation, pitfall trap; VII.2007. – 1 ♂; Kulawi Valley, Tompibugis (1°37.524'S, 120°2.039'E), 400 m a.s.l., cacao plantation, pitfall trap; IX.2007. – 1 ♂; Kulawi Valley, Pilimakujawa (1°38.998'S, 120°2.842'E), 400 m a.s.l., cacao plantation, pitfall trap; VII.2007. – 1 ♂; Kulawi Valley, Wangka (1°36.458'S, 120°1.304'E), 500 m a.s.l., cacao plantation, pitfall trap; III.2008. – 1 ♂; Kulawi Valley, Bolapapu (1°26.105'S, 119°59.552'E), 650 m a.s.l., cacao plantation, pitfall trap; VIII.2007.

FIGS 18-23

Microbathyphantes celebes sp. n., ♂ paratype from Sungku (18, 19, 21-23) and ♂ paratype from Mareva (20). (18, 19) Right palp, retrolateral and proventral view, respectively. (20) Palpal tibia, retrolateral view. (21) Distal suprategular apophysis. (22) Embolic division. (23) Embolic plate.

DIAGNOSIS: The new species is characterized by the peculiar shape of its embolic plate (sensu Beatty *et al*., 1991; Saaristo, 1995) (= lamella or lamella characteristica auct.) and by the hook-like outgrowth resembling a pit-hook structure on the suprategular apophysis in males, as well as by the trapeziform shape of the shallow epigynal cavity in females.

DESCRIPTION: Male (paratype from Sungku). Total length 1.63 (1.60-1.68). Carapace unmodified, 0.75 long, 0.60 wide, greyish yellow to pale brown, with a narrow grey margin; in some specimens carapace with a grey polygonal spot in post-ocular area and with indistinct radial stripes. Eyes normal, not enlarged. Sternum grey. Chelicerae 0.45 long. Stridulatory fields absent. Legs pale yellow, leg I 3.83 long (1.00+0.23+1.00+0.95+0.65), IV 3.64 long (0.98+0.20+1.00+0.88+0.58). Chaetotaxy:

FIGS 24-27

Epigynes and vulvae of *Microbathyphantes celebes* sp. n., ♀ paratype from Sungku (24, 25) and ♀ paratype from Oo (26, 27). (24, 26) Ventral view. (25, 27) Dorsal view. Arrows indicate which details belong to the same specimen.

FeI: 1-1-0-0, II: 1-0-0-0, III-IV: 0-0-0-0; TiI 2-1-1-0, II: 2-0-1-0, III-IV: 2-0-0-0. All metatarsi spineless. TmI 0.20 (0.18-0.22). Metatarsus IV without trichobothrium. Palp (Figs 18-23): Tibia slightly elongated, unmodified. Paracymbium simple, U-shaped, pockets absent. Suprategular apophysis short and wide. Embolic division complex, consisting of two parts: embolic plate and coiled embolus with a narrow radix. Embolic plate with a long anterior projection ending in a hook-like outgrowth. Abdomen 0.78 long, 0.50 wide, grey, dorsal pattern absent.

Female (paratype from Sungku). Total length 1.75 (1.68-1.75). Carapace 0.75 long, 0.55 wide. Chelicerae 0.35 long. Leg I 3.31 long (0.85+0.23+0.85+0.80+0.58), IV 3.19 long (0.88+0.18+0.85+0.78+0.50). TmI 0.23. Abdomen 1.10 long, 0.70 wide. Epigyne (Figs 24-27) small, epigynal cavity shallow, trapeziform, receptacles spherical. Body and leg coloration, and chaetotaxy as in male.

VARIABILITY. The males show variability in the length of the palpal tibia (Fig. 18 cf. Fig. 20).

TAXONOMIC REMARKS: The new species is most similar to the Oriental-Pacific M. palmarius (Marples, 1955), but differs well by the shape of the anterior projection of the embolic plate in males, as well as by the trapeziform epigynal cavity in females.

DISTRIBUTION: Currently known from Kulawi Valley, Sulawesi only.

Nesioneta sola (Millidge & Russell-Smith, 1992) Fig. 17

MATERIAL: 1 ♀; INDONESIA, Sulawesi, Kulawi Valley, Toro (1°30.443'S, 120° 2.474'E), 800 m a.s.l., cacao tree, branch trap; IX.2007.

REMARKS: This species was described and was previously known from a female from the Dumoga-Bone National Park, Sulawesi only (Millidge & Russell-Smith, 1992).

CONCLUSION

Lying at, and partly forming, the border between two major realms, the Oriental and the Australian, Sulawesi can soundly be expected to support faunistic elements from both these zoogeographical regions also among spiders. The Sulawesi spider fauna currently contains seven linyphiid species. Six of them have been described from the island and remain unknown beyond it. Only one, *Australophantes laetesiformis*, has also been reported from Australia. *Nesioneta sola* and *Microbathyphantes celebes* sp. n. are clearly evidence of Oriental relationships in belonging to genera of Oriental origins. Judging from secondary genitalic characters, *Dumoga arboricola*, *D. complexipalpis* and *Plicatiductus storki* most probably also have Oriental relations. The remaining species, *Maorineta sulawesi* sp. n. and *Australophantes laetesiformis*, both demonstrate Australian ties. *M. sulawesi* sp. n. belongs to a genus currently encompassing eight species, seven of which are known only from New Zealand, while one more occurs on some of the other Pacific islands (Beatty *et al*., 1991). *Australophantes laetesiformis*, a unique micronetine earlier recorded only in Queensland, Australia, is here reported from outside the Australian continent for the first time. Further studies on Sulawesi spiders will probably provide a better idea about the different origins of the island's fauna.

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