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RESEARCH ARTICLE - ANTS

New Records of Ants (Hymenoptera: Formicidae) from Sri Lanka, Including Four Tramp Species

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Abstract

Five ant species are reported for the first time from Sri Lanka: *Ooceraea alii* (Bharti & Akbar, 2013); *O. biroi* (Forel, 1907); *Prionopelta kraepelini* Forel, 1905; *Strumigenys emmae* (Emery, 1890) and *S. membranifera* Emery, 1869. Among the newly reported species, four species (*O. biroi*, *S. membranifera, S. emmae* and *P. kraepelini*) are known for their invasive and tramping nature, spreading via human commerce and have attained broad cosmopolitan distribution. Impact of these ants on regional fauna is not known and needs immediate attention. A brief diagnosis, distribution, and illustrations are provided for each species.

Introduction

Sri Lanka is one of the 25 biodiversity hotspots in the world (Myers, 2000). It is relatively a large island (66,000 km^2); a shallow continental shelf as India; been able to maintain a largely distinct fauna from that of the Indian mainland (Bossuyt, 2004). The country has the highest biodiversity density in Asia with 27% of the 3,210 flowering plants and 22% of the mammals being endemic to Sri Lanka (Mittermeier et al., 2000; Gunawardene et al., 2007). These distinct elements are established not only because of regional isolation as an Island but also because of the establishment of finest local endemic niches. Patterns of such local endemism at the finest scale, at which they may occur, should form basis for all future conservation programs.

Ant diversity and distribution greatly influence faunal community dynamics; understanding such patterns is pre-requisite for all conservational programs (Lach et al., 2010). Ant fauna of Sri Lanka is highly diverse with high Indo-Malayan affinity and a high degree of endemism. The Sri Lankan ants include 11 of the 17 known extant subfamilies with 355 valid ant species in 78 genera (AntWeb, 2018a; Dias et al., in press). The region is home to many endemic ant species; more than 30 % of the regional ants are endemic including relict Sri Lankan ant *Aneuretus simoni* Emery, sole extant representative of the subfamily Aneuretinae and several genera and species, which are only reported from Sri Lanka.

In Sri Lanka, the documentation and cataloguing of ants has been fragmentary, with few earlier studies being largely focused on systematic accounts and mere species enumeration. However, recognizing the importance of ants as major ecosystem players, several significant initiatives for cataloguing this important group of insects have been taken in the recent past (Dias, 2006, 2014; Dias & Chaminda, 2000; Gunawardene et al., 2008). The regional centre for ant research attached to the Department of Zoology and Environmental Management, University of Kelaniya, Sri Lanka is pioneering these efforts. The centre intends to establish and maintain an ant repository for the ants of Sri Lanka and is currently encouraging young ant researchers with practical experience to explore many unknown ant species in the region. These findings of the present paper form part of the surveys conducted by the centre in recent years.

We report here five newly recorded species, *Ooceraea alii*, *O. biroi*, *Prionopelta kraepelini*, *Strumigenys emmae* and *S. membranifera* from Sri Lanka. A brief diagnosis of each newly reported species including notes on distribution is provided along with illustrations.

Material and Methods

Specimens used in this study were collected by hand-searching, soil sifting and Winkler's leaf litter extractor, and are preserved in the ant repository ZEMK. The morphology was examined under an Optika SZM-LED2 stereo-microscope. For digital images, ProgRes0 CapturePro v.2.8.0. evolution digital camera was used on the same microscope with Combine ZP-Montage software. Later, images were cleaned with Adobe Photoshop CS6. All measurements were recorded in millimeters to three significant figures and are presented to two significant figures due to measurement error and/ or variation in specimen orientation. Morphological definitions for measurements are followed as per generic standards and mainly include:

HL Head length, length of head capsule from anterior clypeal margin to mid-point of posterior head margin in full-face view.

HW Head width, maximum width of head, excluding eyes, in full-face view.

SL Scape length, maximum length of scape, excluding the basal neck and condyle.

ML Mesosomal length in profile, from the anteriormost border of the pronotum, excluding the pronotal cervix to the posterior basal angle of the metapleuron.

PL Petiole length, maximum length of petiole from anterior process to posteriormost point of tergite, where it articulates with helcium.

PW Petiole width, maximum width of petiole in dorsal view.

TL Total outstretched length of a specimen, from mandibular apex to gastral apex.

CI Cephalic index, HW / HL × 100.

SI Scape index, SL / HW × 100.

PI Petiole index, PW / PL × 100.

Repositories

MHNG Muséum d'Histoire Naturelle, Geneva, Switzerland.

MSNG Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy.

NHMW Natural History Museum, Vienna, Austria.

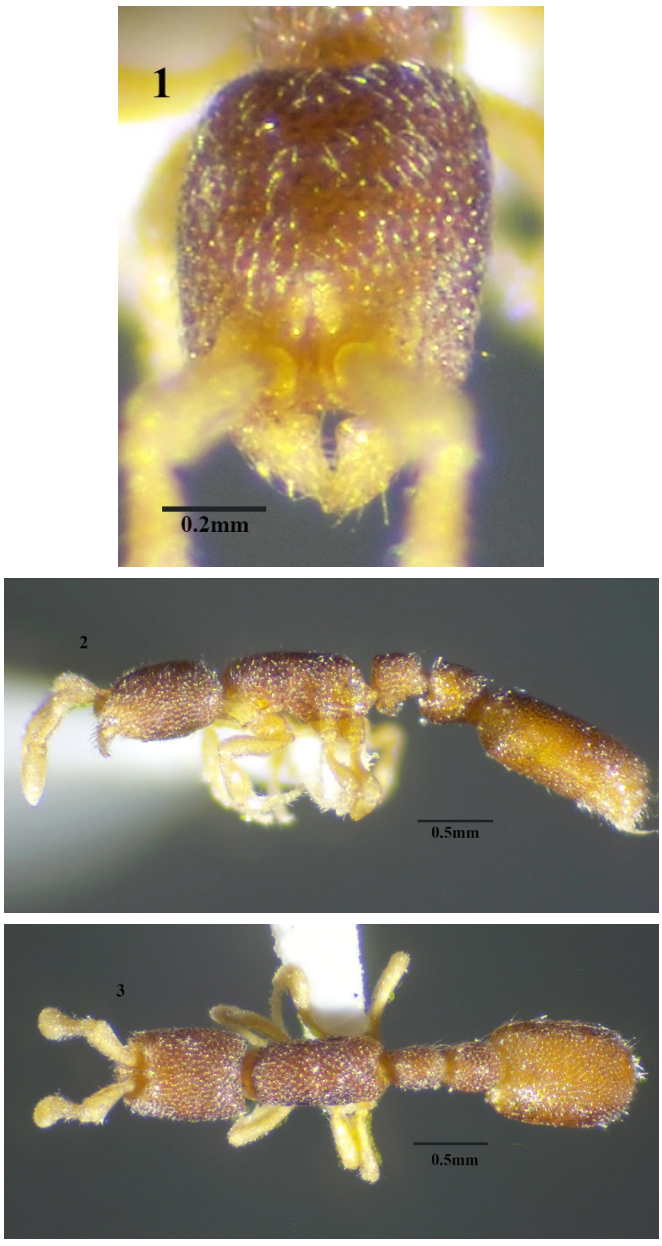
PUAC Punjabi University Patiala Ant Collection, Punjab, India.

ZEMK Department of Zoology and Environmental Management, University of Kelaniya, Sri Lanka.

Systematic accounts

***Ooceraea alii* (Bharti & Akbar, 2013a) (Figures 1-3)**

Cerapachys alii Bharti and Akbar, 2013: 86, figs. 2B, 11, 12, 13, table 1 (w.) Holotype worker: Kerala, Salim Ali Bird Sanctuary, India [PUAC]. Combination in *Ooceraea*: Borowiec, 2016: 198.



Figures 1-3. *Ooceraea alii* (Bharti & Akbar, 2013), (1) Head, frontal view; Habitus, (2) lateral view; (3) dorsal view.

Worker measurements: HL 0.47-0.51; HW 0.37-0.38; SL 0.20-0.21; ML 0.47-0.49; PL 0.16-0.18; PW 0.16-0.18; TL 2.42-2.74 mm. Indices: CI 77-80; SI 56-57; PI 97-104 (n=5).

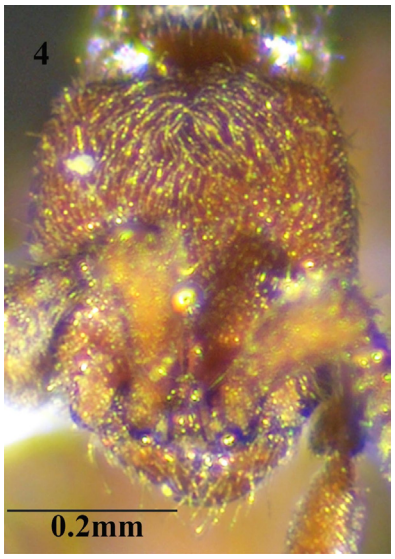
Diagnosis: Indomalayan species with 9 segmented antennae; head width less than 0.40 mm; sculpture predominantly foveate; anterolateral shoulders of the first gastral segments as seen from above broadly rounded and gradually widening caudad (Bharti & Akbar, 2013a).

Distribution: India (Bharti & Akbar, 2013a; Borowiec, 2016); Sri Lanka (new record).

Material examined: Sri Lanka, Ihakuluwewa, Polonnaruwa District; 7°59′N, 80°58′E, 50 m a.s.l., 5 (workers), 16.xi.2008, soil sifting, leg. HAWS Peiris & RKS Dias.

Remarks: The doryline cryptic ant was collected in soil and leaf litter samples from a coconut plantation.

***Ooceraea biroi* (Forel, 1907) (Figures 4-6)**



Figures 4-6. *Ooceraea biroi* (Forel, 1907), (4) Head, frontal view; Habitus, (5) lateral view; (6) dorsal view.

Cerapachys (Syscia) biroi Forel, 1907: 7 (w.) Lectotype worker: Singapore [MHNG]. Combination in *Ooceraea*: Borowiec, 2016. Status as species: Ogata, 1983: 136. Senior synonym of *Ooceraea ierensis, Ooceraea seini, Ooceraea silvestrii, Ooceraea sinensis*: Brown, 1975: 22, 73.

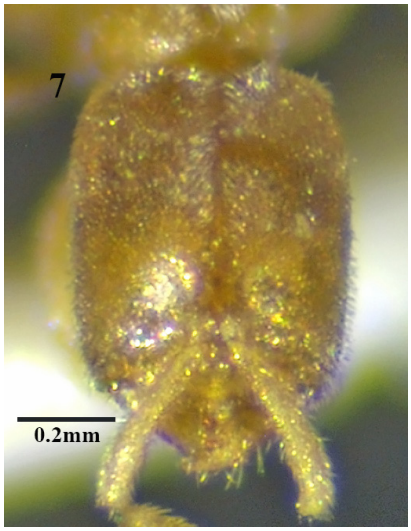
Worker measurements: HL 0.56-0.57; HW 0.46-0.47; SL 0.26-0.30; ML 0.57-0.62; PL 0.18-0.21; PW 0.21-0.24; TL 2.45-2.75. Indices: CI 82-83; SI 56-63; PI 114-116 (n = 4).

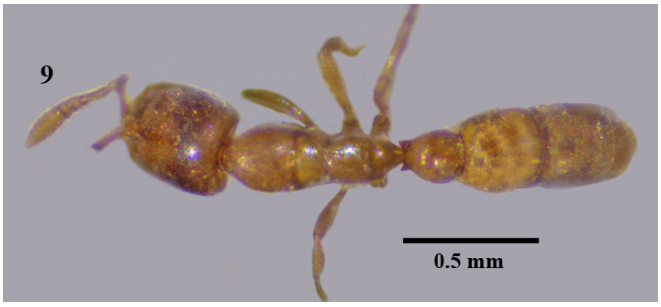
Diagnosis: The species appears robust with opaque body having closely spaced piligerous punctures and dense pilosity. The species displays a great variation in colour and we also observed that the colour of specimens mostly corresponds to the colour of soil they inhabit. Mandibles subtriangular, dentate; antennae 9-segmented; scapes short and clavate reaching up to half of posterior head margin; eyes and ocelli absent; anterior clypeal margin entire and convex; vertex deflexed and flat.

Distribution: Afrotropical Region: Comoros; Indo-Australian Region: Guam, Hawaii, Marshall Islands, Northern Mariana Islands, Philippines, Samoa, Singapore; Malagasy Region: Madagascar, Mayotte, Seychelles; Neotropical Region: Guadeloupe, Lesser Antilles, Puerto Rico, Trinidad and Tobago, Turks and Caicos Islands; Oriental Region: India, Nepal, Sri Lanka (new record), Taiwan, Vietnam,; Palaearctic Region: China, Japan (Wetterer et al., 2012).

Material examined: Sri Lanka, Watinapaha, Gampaha District, 7°16′N, 80°01′E, 30 m a.s.l., 12 (workers), 8.iv.2017, 24.ii.2018, hand collecting, leg. W.S. Udayakantha.

Remarks: The species is native to the Asian mainland and has become invasive on tropical and subtropical islands throughout the world (Borowiec, 2016). Also called as clonal raider ant; a queenless clonal ant exhibiting the lytokous parthenogenesis means of reproduction. The specimens were collected while they were foraging near a coconut tree leaf litter.





Figures 7-9. *Prionopelta kraepelini* Forel, 1905, (7) Head, frontal view; Habitus, (8) lateral view; (9) dorsal view.

***Prionopelta kraepelini* Forel, 1905 (Figures 7-9)**

Prionopelta kraepelini Forel, 1905: 3 (w.q.) Syntype workers: Tjompea, near Bogor, Java, Indonesia [MHNG]. Bharti and Wachkoo, 2012: 818 (m.). See also: Shattuck, 2008: 23.

Worker measurements: HL 0.46-0.47; HW 0.34-0.36; SL 0.24-0.26; ML 0.53-0.57; PL 0.14-0.15; PW 0.19-0.20; TL 1.80-2.02 mm. Indices: CI 74-77; SI 71-72; PI 133-136 (n=2).

Diagnosis: Mandibles short and narrow, closing tightly against the clypeus and armed with only 3-teeth, of which the median tooth is the smallest (although sometimes with a few very small denticles as well) that are grouped together near the tip. Dorsal pronotal sculpturing finely punctate which contrast markedly with widely spaced foveae on mesonotum and propodeum, the foveae on the propodeum varying in density across its width (weakest medially, stronger laterally); head width less than 0.48 mm; petiole relatively narrow, PW less than 0.21 (Shattuck, 2008).

Distribution: Widely distributed in Australasia, Indomalaya, Oceania and Palearctic regions; regional records from Borneo, Fiji, Indonesia, Krakatau Islands, Malaysia, Micronesia, Palau, Philippines, Samoa. This species is here recorded for the first time from Sri Lanka (Wilson & Taylor, 1967; Shattuck, 2008; Bharti & Wachkoo, 2012).

Material examined: Sri Lanka, Pompekelle, Ratnapura, Sabaragamuwa Province; 6°41.152′N, 80°24.221′E, 85-110 m a.s.l., 2 (workers), 27.xi.2004, soil sifting, leg. RKS Dias.

Remarks: The species has a wide distributional range and is suspected to have been introduced in some locations (Wilson & Taylor, 1967).

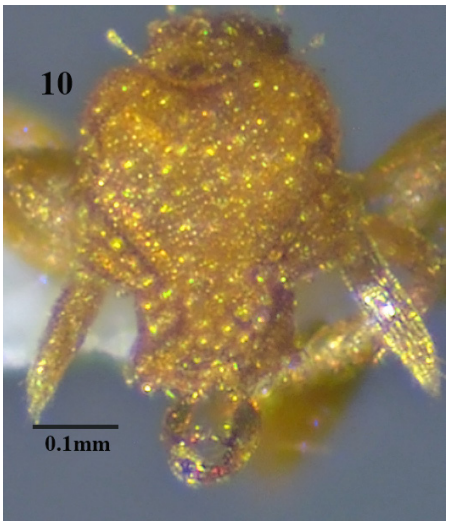
***Strumigenys emmae* (Emery, 1890) (Figures 10-12)**

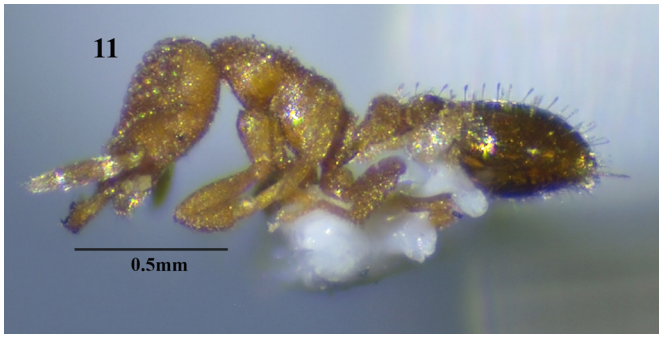
Epitritus emmae Emery, 1890: 70, pl. 8, fig. 6 (w.) Syntype workers: Virgin Islands, Antilles [MSNG]. Wheeler, W.M. 1908: 149 (q.). Combination in *Quadristruma*: Brown, 1949: 48; in *Strumigenys*: Bolton, 1999: 1674. Senior synonym of *clypeatus, malesiana, wheeleri*: Brown, 1949: 48. See also: Bolton, 1983: 400; Bolton, 2000: 950.

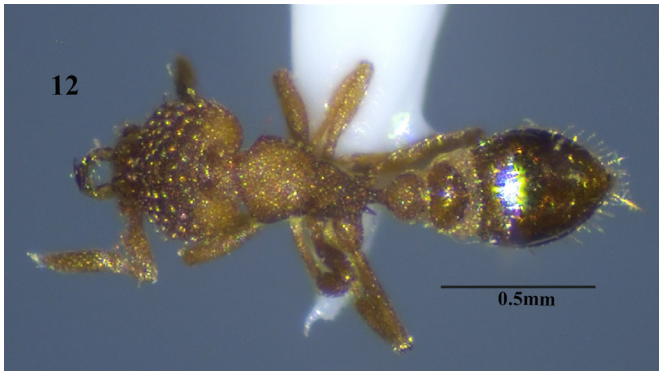
Worker measurements: HL 0.42-0.44, HW 0.34-0.38, EL 0.02-0.03, SL 0.12-0.15, ML 0.41-0.43, PL 0.25, PPL 0.15, PW 0.12, PPW 0.18, TL 1.11-1.18. CI 80-86, SI 35-39 (n=6).

Diagnosis: Head roughly triangle shaped, strongly converging anteriorly, broadest posteriorly; antennae 4-segmented consisting of large apical segment and smaller indistinct 3-segments; scapes clavate, broadest distally and narrow at base near antennal sockets; mandibles elongate, sickle shaped with a large apical and preapical teeth; Cephalic dorsum consist of small orbicular hairs, prominent; small reclinate hairs also prominent. Based on their colonization, adaptive and behavioral modifications, these ants remain inconspicuous and people remain unaware of their presence even in area where they are common (Wetterer, 2012).

Distribution: Afrotropical Region: Comoros, Equatorial Guinea, Ghana, United Republic of Tanzania, Yemen; Australasian Region: Australia, New Caledonia; Indo-Australian



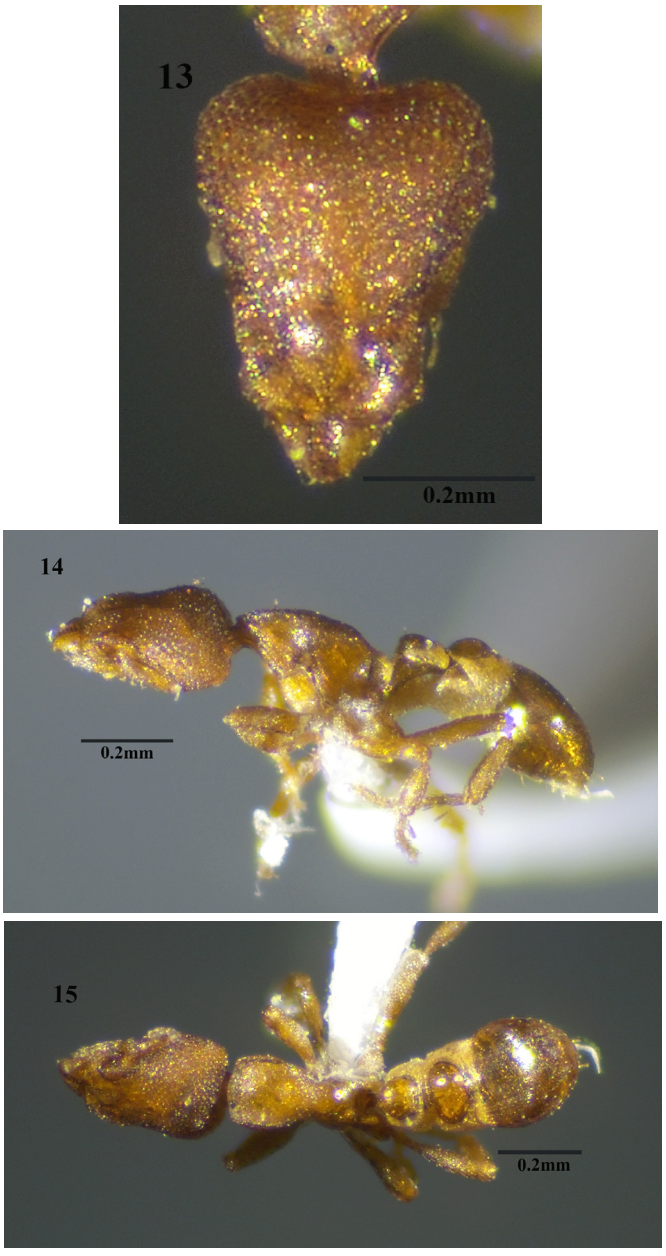




Figures 10-12. *Strumigenys emmae* (Emery, 1890), (10) Head, frontal view; Habitus, (11) lateral view; (12) dorsal view.

Region: Borneo, Guam, Hawaii, Indonesia, Malaysia, Marshall Islands, Micronesia, New Guinea, Northern Mariana Islands, Philippines, Samoa, Solomon Islands, Tonga, Vanuatu; Malagasy Region: Madagascar, Mayotte, Réunion, Seychelles; Nearctic Region: United States; Neotropical Region: Anguilla, Aruba, Barbados, Belize, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominican Republic, Ecuador, Galapagos Islands, Greater Antilles, Guadeloupe, Mexico, Netherlands Antilles, Puerto Rico, Saint Lucia, Suriname; Oriental Region: India, Vietnam, Sri Lanka (new record); Palaearctic Region: China, Japan (Wetterer, 2012; Bharti & Akbar, 2013b).

Material examined: Sri Lanka, Colombo District, Indikada Mukalana Forest Reserve, 06 87°N, 80 16°E, 159m a.s.l., 3(w.), 2.ii. 2016, soil sifting, Kegalle District, Lenagala Forest Reserve, 07 07°N, 80 14°E, 100m a.s.l., 5(w.), soil



Figures 13-15. *Strumigenys membranifera* Emery, 1869, (13) Head, frontal view; Habitus, (14) lateral view; (15) dorsal view.

sifting, Watinapaha, Gampaha District, 7°16´N, 80°01´E, 30 m a.s.l., 6 (w.), 8.iv.2017, 3 (w.), 1 (q.), 24.ii.2018, hand collecting, leg. W.S. Udayakantha

***Strumigenys membranifera* Emery, 1869 (Figures 13-15)**

Strumigenys (Trichoscapa) membranifera Emery, 1869: 24, fig. 11 (w.) Syntype workers: Napoli, Portici, Italy [MSNG]. Emery, 1916: 205 (q.); Wheeler, G. C. and Wheeler, J., 1991: 93 (l.). Combination in *S.* (*Cephaloxys*): Emery, 1916: 205; in *Trichoscapa*: Brown, 1948: 113; in *Pyramica*: Bolton, 1999: 1673. Senior synonym of *foochowensis, marioni, santschii, silvestriana, simillima, vitiensis, williamsi*: Brown, 1948: 114. See also: Brown, 1949: 6; Wilson, 1954: 483; Bolton, 1983: 319; Bolton, 2000: 322.

Worker measurements: HL 0.47, HW 0.40, SL 0.25, ML 0.49, PL 0.25, PPL 0.17, PW 0.14, PPW 0.20, TL 1.89 mm. Indices: CI 85, SI 62, PI 56 (n = 1).

Diagnosis: The species can be easily distinguished from other members of the genus by the characteristic form of the mandibles, intermediate worker size (1.9-2.1 mm), strongly marginate pronotum, absence of standing hairs. The species is close to *S. disjuncta* Bolton, 2000 but with mesopleuron and metapleuron smooth and shiny, petiole with a deep spongiform curtain, first gastral tergite with sparse minute appressed pubescence.

Distribution: Afrotropical Region: Cameroun, Comoros, Saudi Arabia, Sierra Leone, South Africa, United Arab Emirates; Australasian Region: Australia; Indo-Australian Region: Fiji, Guam, Hawaii, Indonesia, Marshall Islands, Micronesia, New Guinea, Northern Mariana Islands, Samoa, Solomon Islands, Tonga, Wallis and Futuna Islands; Malagasy Region: Mayotte, Seychelles; Nearctic Region: United States; Neotropical Region: Barbados, British Virgin Islands, Cuba, Dominican Republic, Ecuador, Galapagos Islands, Greater Antilles, Mexico, Puerto Rico, Turks and Caicos Islands; Oriental Region: Bhutan, India, Nepal, Sri Lanka (new record), Taiwan; Palaearctic Region: Algeria, Balearic Islands, China, Egypt, Greece, Iberian Peninsula, Israel, Italy, Japan, Malta, Qatar, Spain, Tunisia (Wetterer, 2011).

Material examined: Sri Lanka, Watinapaha, Gampaha District, 7°16´N, 80°01´E, 30 m a.s.l., 1 (worker), 24.ii.2018, hand collecting, leg. S.A. Akbar.

Remarks: This myrmicine ant was collected from a disturbed home garden of Watinapaha, Gampaha District during training course on field sampling and identification of ants, February 23-25th, 2018, organized by University of Kelaniya. The specimens were found beneath a 2 year old coconut log.

Discussion

Biological invasion by ants is one of the leading threats to biodiversity, agriculture and the economy (Clavero & Berthou, 2005; Antweb, 2018b). Mass extinctions by these invaders to the native mesofauna (largely undescribed) may be rampant, but simply going on undocumented and unappreciated (Calcaterra & Cabrera, 2016; Santos, 2016). Invasive predatory ants can be particularly efficient at exterminating local arthropod species (Wetterer, 2012). Out of the five newly reported species from Sri Lanka, four are predatory in nature and may act as “keystone species” with a disproportionate impact on the make up of the community. Studies should focus on impact of these ants on regional fauna and test with similar studies carried across the globe.

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References

AntWeb, (2018a). Bolton World Catalog. https://www.antweb.org/taxonomicPage.do?rank=genus&images=true&project=worldants. Accession date: 29 January 2018.

AntWeb, (2018b). Ants of Port of Entry. Available from: https://www.antweb.org/project.do?name=poeants. Accessed 14 May 2018.

Bharti, H. & Akbar, S.A. (2013a). Taxonomic studies on the ant genus *Cerapachys* Smith (Hymenoptera, Formicidae) from India. ZooKeys, 336: 79-103.

Bharti, H. & Akbar, S.A. (2013b). Taxonomic studies on the ant genus *Strumigenys* Smith, 1860 (Hymenoptera: Formicidae) with report of two new species and five new records including a tramp species from India. Sociobiology, 64: 387-396.

Bharti, H. & Wachkoo, A.A. (2012). First record of *Prionopelta kraepelini* (Hymenoptera: Formicidae) from India, with description of male caste. Sociobiology, 59: 815-821.

Bolton, B. (1983). The Afrotropical dacetine ants (Formicidae). Bulletin of the British Museum (Natural History). Entomology, 46: 267-416.

Bolton, B. (1999). Ant genera of the tribe Dacetonini (Hymenoptera: Formicidae). Journal of Natural History, 33: 1639-1689.

Bolton, B. (2000). The ant tribe Dacetini. Memoirs of the American Entomological Institute, 65: 1-1028.

Borowiec, M.L. (2016). Generic revision of the ant subfamily Dorylinae (Hymenoptera, Formicidae). ZooKeys, 608: 1-280. doi: 10.3897/zookeys.608.9427 http://zookeys.pensoft.net

Bossuyt, F., Meegaskumbura, M., Beenaerts, N., Gower, D.J., Pethiyagoda, R., Roelants, K., Mannaert, A., Wilkinson, M., Bahir, M.M., Manamendra-Arachchi, K., Ng, P.K.L., Schneider, C.J., Oommen, O.V. & Milinkovitch, M.C. (2004). Local endemism within the Western Ghats-Sri Lanka biodiversity hotspot. Science, 306: 479-481.

Brown, W. L., Jr. (1948). A preliminary generic revision of the higher Dacetini (Hymenoptera: Formicidae). Transactions of the American Entomological Society, 74: 101-129.

Brown, W. L., Jr. (1949). A few ants from the Mackenzie River Delta. Entomological News, 60: 99.

Brown, W. L., Jr. (1975). Contributions toward a reclassification of the Formicidae. V. Ponerinae, tribes Platythyreini, Cerapachyini, Cylindromyrmecini, Acanthostichini, and Aenictogitini. Agriculture, 5: 1-115.

Calcaterra, L., Cabrera, S. & Briano, J. (2016). Local co-occurrence of several highly invasive ants in their native range: are they all ecologically dominant species? Insectes Sociaux, 63: 407-419. doi: 10.1007/s00040-016-0481-3.

Clavero, M. & Garcia-Berthou, E. (2005). Invasive species are a leading cause of animal extinctions. Trends in Ecology and Evolution, 20: 110.

Dias, R.K.S. & Chaminda, K.M.G.R. (2000). A preliminary study on the taxonomy of Sri Lankan ants. Proceedings of the Second ANeT seminar held at University Sabah Malaysia, Kota Kinabalu, East Malaysia: 16pp.

Dias, R.K.S. (2006). Current taxonomic status of ants (Hymenoptera: Formicidae) in Sri Lanka. In: C.N.B. Bambaradeniya (Ed.), The fauna of Sri Lanka - status of taxonomic Research and Conservation, Colombo: IUCN, pp. 43-52.

Dias, R.K.S. (2014). Ants of Sri Lanka. First Edition, Colombo: Biodiversity Secretariat, Ministry of Environment and Renewable Energy, Sri Lanka.

Dias, R.K.S., Yamane, S., Akbar, S.A., Peiris, H.A.W.S., Wachkoo, AA. (2018). Discovery of the worker caste of *Protanilla schoedli* Baroni Urbani & De Andrade (Formicidae: Leptanillinae) in Sri Lanka. Oriental Insects, In Press. doi: 10.1080/00305316.2018.1476273.

Emery, C. (1869). Enumerazione dei formicidi che rinvengonsi nei contorni di Napoli con descrizioni di specie nuove o meno conosciute. Annali dell'Accademia degli Aspiranti Naturalisti. Secunda Era, 2: 1-26.

Emery, C. (1890). Studii sulle formiche della fauna neotropica. Bullettino della Società Entomologica Italiana, 22: 38-80.

Emery, C. (1916). Fauna entomologica italiana. I. Hymenoptera-Formicidae. Bullettino della Società Entomologica Italiana, 47: 79-275.

Forel, A. (1905). Ameisen aus Java. Gesammelt von Prof. Karl Kraepelin 1904. Mitteilungen aus dem Naturhistorischen Museum in Hamburg, 22: 1-26.

Forel, A. (1907). Formicides du Musée National Hongrois. Annales Historico-Naturales Musei Nationalis Hungarici, 5: 1-42.

Gunawardene, N.R., Daniels, A.E.D., Gunatilleke, I.A.U.N., Gunatilleke, C. V.S., Karunakaran, P.V., Nayak, K.G., Prasad, S., Puyravaud, P., Ramesh, B.R., Subramanian, K.A. & Vasanthy, G. (2007). A brief overview of the Western Ghats–Sri Lanka biodiversity hotspot. Current Science, 93: 1567-1572.

Gunawardene, N.R., Majer, J.D. & Edirisinghe, J.P. (2008). Diversity and richness of ant species in a lowland wet forest reserve in Sri Lanka. Asian Myrmecology, 2: 71-83. doi: 10.20362/am.002007.

Lach, L., Parr, C.L. & Abbott, K.L. 2010. Ant Ecology, Oxford University Press, Oxford.

Mittermeier, R., Myers, N. & Mittermeier, C. (2000). Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions. Arlington, Virginia: Conservation International. ISBN 978-968-6397-58-1.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. & Kent, J. (2000). Biodiversity hotspots for conservation priorities. Nature, 403: 853-858.

Ogata, K. (1983). The ant genus *Cerapachys* F. Smith of Japan, with description of a new species (Hymenoptera, Formicidae). Esakia, 20: 131-137.

Santos, M.N. (2016). Research on urban ants: approaches and gaps. Insectes Sociaux, 63: 359-371. doi: 10.1007/s00040-016-0483-1.

Shattuck, S.O. (2008). Revision of the ant genus *Prionopelta* (Hymenoptera: Formicidae) in the Indo-Pacifc region. Zootaxa, 1846: 21-34.

Wetterer, J. (2011). Worldwide spread of the membraniferous dacetine ant, *Strumigenys membranifera* (Hymenoptera: Formicidae). Myrmecological News, 14: 129-135.

Wetterer, J. (2012). Worldwide spread of Emma's dacetine ant, *Strumigenys emmae* (Hym.: Formicidae). Myrmecological News, 16: 69-74.

Wetterer, J.K., Kronauer, D.J.C. & Borowiec, L. (2012). Worldwide spread of *Cerapachys biroi* (Hymenoptera: Formicidae: Cerapachyinae). Myrmecological News, 17: 1-4.

Wheeler, G. C. & Wheeler, J. (1991). Instars of three ant species. Psyche (Cambridge), 98:89-99.

Wheeler, W. M. (1908). The ants of Porto Rico and the Virgin Islands. Bulletin of the American Museum of Natural History, 24: 117-158.

Wilson, E.O. & Taylor, R.W. (1967). The ants of Polynesia (Hymenoptera: Formicidae). Pacific Insects Monograph, 14: 1-109.

Wilson, E.O. (1954). The ecology of some North American dacetine ants. Annals of the Entomological Society of America, 46: 479-495.