

## Exasperating taxonomy of the colourful ant-mimic *Myrmarachne exasperans* (Araneae: Salticidae: Astioida: Myrmarachinae)

David E. Hill<sup>1</sup> and Jürgen C. Otto<sup>2</sup>

<sup>1</sup> 213 Wild Horse Creek Drive, Simpsonville, SC 29680-6513, USA, *email* platycryptus@yahoo.com

<sup>2</sup> 19 Grevillea Avenue, St. Ives, New South Wales 2075, Australia, *email* jurgenotto@optusnet.com.au

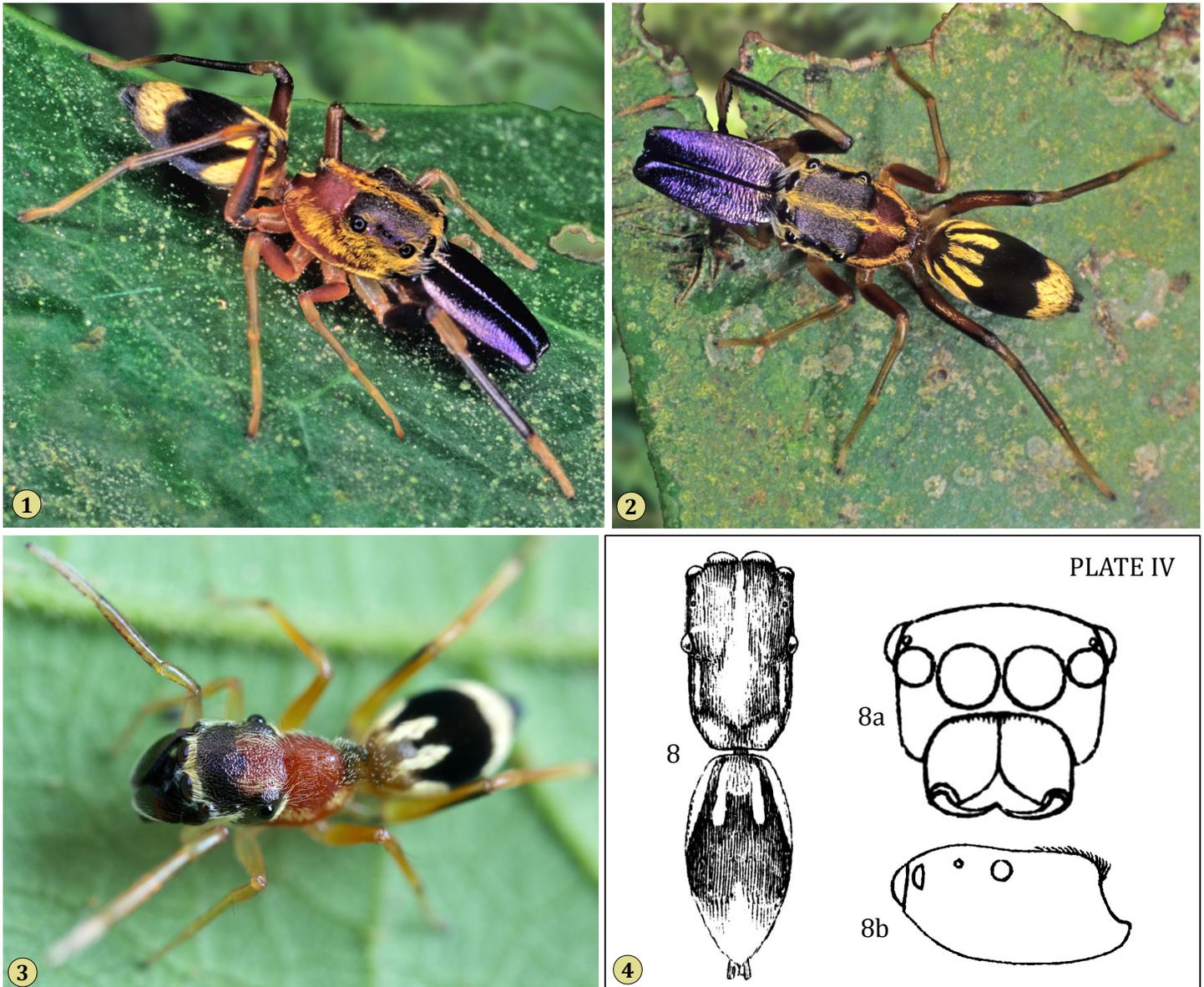
**Key words:** ant-mimic, *Emertonius*, *Emertonius exasperans*, jumping spider, salticid

The jumping spider originally described as *Emertonius exasperans* by Peckham & Peckham (1892) retains that name in two comprehensive catalogs (Metzner 2015, Prószyński 2015), but in a third catalog (WSC 2015), and several recent publications on the large genus *Myrmarachne* MacLeay 1839 (Edwards & Benjamin 2009, Edwards 2013), this spider is known as *Myrmarachne exasperans* (Peckham & Peckham 1892). Errors related to the naming of this colourful ant-mimic began when the Peckhams (1892) described a female from Java as a male (Table 1, [1]). This error may have been the result of confusion due to the fact that the black pedipalps of the female are enlarged and cover the chelicerae in life (Figure 1:3). Simon (1901) did not correct this error in gender, but added a second species from Madagascar, *E. rufescens* (Simon 1900), to the genus *Emertonius*. Wanless later (1978) dedicated a paper to his resolution of the identity and generic placement of this species, and he recognized that the Peckhams had in fact described a female, which he designated as the lectotype (also [1]). Wanless listed a second female from Java ([2]), but it is not known whether the female in his figures was this specimen, or [1]. Wanless also described a male from Palawan ([3]) that he considered to be the same species. More than 30 years later Prószyński & Deeleman-Reinhold (2010) recognized three spiders similar to *E. exasperans* from colour photographs of a live male ([4]; Figure 1:1-2), a female specimen from Bali ([5]), and a female specimen from Sabah ([6]). We have identified two more records from photographs ([7], [8]).

Table 1. Records associated with *Myrmarachne exasperans*, with their published interpretations. It appears that Prószyński & Deeleman-Reinhold thought that Wanless had listed two specimens from the Peckham collection.

record	description	Peckham & Peckham 1892	Wanless 1978	Prószyński & Deeleman-Reinhold 2010	Otto & Hill 2015 (this paper)
[1]	♀ specimen from Java (MCZ, Harvard)	examined, described as ♂ in error	examined, designated as ♀ lectotype from Bantam	listed as ♂♀, "original series of specimens" including ♀ lectotype	single ♀ from Bantan, W. Java ( <i>M. exasperans</i> ), now missing epigynum
[2]	♀ specimen from Mt. Tenggu (Gunung Tenggu), Java (MNHN, Paris)		examined, may be the ♀ specimen that he drew (if not [1])	may be ♀ specimen drawn by Wanless	♀ <i>M. exasperans</i> (perhaps)
[3]	♂ specimen from Palawan Manialingajan Pinigisan, Philippines (BMNH)		examined and drawn with abdominal fringes	♂ <i>Emertonius</i> sp.	♂ <i>M. exasperans</i> (perhaps)
[4]	♂ photographs in life by David Knowles, from Alas Kedaton, Bali			♂ <i>Emertonius</i> sp., listed with <i>E. exasperans</i>	♂ <i>M. exasperans</i> (likely)
[5]	♀ photographs of specimen from Ambengan, Bali			♀ <i>E. exasperans</i>	♀ <i>M. exasperans</i> (likely)
[6]	♀ photographs of specimen from Rafflesia garden, Perkasa Hotel, Tenom, Sabah			related to <i>E. exasperans</i>	♀ may represent local variety of <i>M. exasperans</i>
[7]	♀ photograph in life from Cat Tien NP, Vietnam, by Paul Bertner (Figure 1:3)				♀ <i>M. exasperans</i> (likely)
[8]	♂ photograph in life by Tiziano Hurni-Cranston, from Bali (Hurni-Cranston 2010)				♂ <i>M. exasperans</i> (likely)

It is not known how the Peckhams came up with the species name '*exasperans*', but this Latin word can be interpreted as either 'exasperating', 'irritating', or 'rough'. It may be a reference to a 'rough' tract of setae on the postero-median dorsal ridge behind the eye region of the female. The type drawing of the Peckhams closely matches a recent photograph of a living female from Vietnam (Figure 1:3-4). According to Edwards (personal communication; reported by Prószyński & Deeleman-Reinhold 2010) the epigynum has been removed from the lectotype and lost.



**Figure 1.** 'Likely' male (1-2), 'likely' female (3), and drawing of the lectotype female (4) *Myrmarachne exasperans*. 1-2, Two views of a male from Alas Kedaton, a small forest located in the middle of a rice field in Tabanan regency in west Bali. The bright colouration and sharp posterior middorsal ridge of the carapace are distinctive. 3, Photograph of a female from Cat Tien National Park, an ecotourism center in a lowland tropical rainforest to the northeast of Ho Chi Minh City, Vietnam. Note the rough appearance of setae projecting from the dark posterior median of the carapace (drawn in 4:8b), and the wide, black, bordered pedipalps that cover the chelicerae. 4, Original drawings by J. H. Emerton of the female, mislabelled as a male (Peckham & Peckham 1892). The genus name *Emertonius* was without doubt meant to honor Emerton's work. Original photographs by David Knowles (1-2; <http://spinelesswonders.smugmug.com/>) and Paul Bertner (3), used with permission.



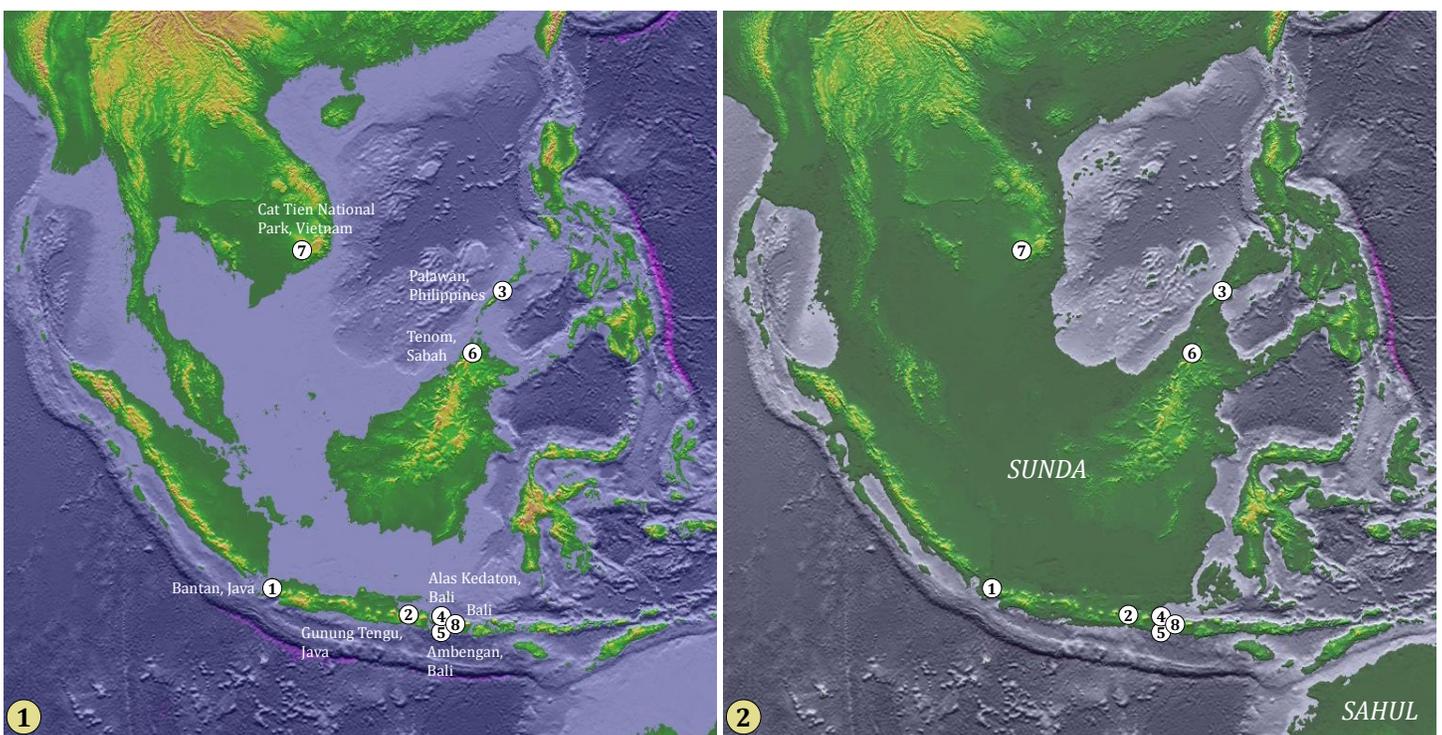
**Figure 2.** Males representing six different species of *Myrmarachne*. **1**, *M. plataleoides* (O. Pickard-Cambridge 1869) from Makunda Christian Hospital, Karimganj District, Assam (5 MAR 2014). This well-known species, with swollen distal chelicerae and a distinct constriction of the pedicel, is widely distributed in tropical south and southeast Asia. **2**, *M. smaragdina* Cecarelli 2010, recently described from northern Queensland. This species is very similar to *M. plataleoides*, but the distal chelicerae are not as swollen. Before it was named, *M. smaragdina* was the subject of several published behavioural studies (Ceccarelli 2008, 2009). **3**, *M. maxillosa* (C. L. Koch 1846) from Lombok (15 JUL 2014). **4**, *M. cornuta* Badcock 1918 from Kuala Selangor, Selangor, Malaysia (3 FEB 2015). **5**, *Myrmarachne* sp. from Fraser's Hill, Pahang, Malaysia (6 APR 2015). This species, with iridescent and colourful chelicerae, resembles *M. exasperans*, even to details of leg colouration. **6**, *Myrmarachne* sp. from Fraser's Hill, Pahang, Malaysia (10 JUN 2010). See Hill (2010) for more photographs of *Myrmarachne* species. Original photographs by Vijay Anand Ismavel (1), Robert Whyte (2), Jürgen Otto (3), Shamsul Hidayat Omar (4), Nicky Bay (5), and Farhan Bokhari (6), used with permission.

*M. exasperans* is a very colourful species, quite unlike most *Myrmarachne* (Figure 2) that usually closely resemble the ants with which they associate (Figure 2:1-4). It lacks the very long carapace, the long pedicel, and the opisthosomal constriction seen in species like *M. plataleoides*. The chelicerae of the male are similar to those of other species with transverse ridges on the dorsal surface of each paturon, but are brightly coloured and iridescent (Figure 1:1-2). There are similar species from Sunda, perhaps not named, that also exhibit bright or bold colour patterns (Figure 2:5-6).

The very large genus *Myrmarachne* is part of the Myrmarachinae subfamily or clade within a larger Australasian (Sahulian) clade termed the Astioida (Maddison *et al.* 2008). It is likely that many of the Indonesian or Papuan species within this genus have not yet been collected or named (Hill 2010). *M. exasperans* is not associated with any of the hypothetical sub-genus clades or groups within *Myrmarachne*, and may represent a new '*exasperans* group' (Edwards & Benjamin 2009). Should the genus *Myrmarachne* be divided in the future, the genus name '*Emertonius*' remains available and may once again be associated with this species (Edwards 2013).

The ant associations of many *Myrmarachne* species are well-known (Ceccarelli 2008, 2013; Jackson 1982; Nelson 2010; Nelson & Jackson 2007; Nelson *et al.* 2005, 2006). Presently the ant or arthropod associations of *M. exasperans*, and the reason for its colouration, remain a mystery.

**Distribution.** The localities associated with *M. exasperans* (or closely related forms; Table 1, [1] to [8]) represent part of the now largely submerged Sunda region of southeastern Asia (Figure 3). The lectotype female specimen was associated with "Java, Bantam" (Prószyński and Deeleman-Reinhold 2010), probably a reference to Bantam in West Java. The greatest number of records for this species are from Bali.



**Figure 3.** Distribution of *Myrmarachne exasperans* (or closely related species) in Sunda. **1**, Localities plotted on a modern-day relief map, with numbers corresponding to those shown in Table 1. The type female is from Bantan in West Java. **2**, The same localities plotted on a relief map of Sunda during the Last Glacial Maximum (LGM, 15-22Ka) when the sea level was 110 m lower than it is today. Relief maps courtesy of NOAA.

## Acknowledgments

We first 'discovered' this remarkable species in the colourful photographs of David Knowles (Figure 1:1-2; <http://spineless.wonders.smugmug.com>). We thank Nicky Bay, Paul Bertner, Farhan Bokhari, Vijay Anand Ismavel, David Knowles, Shamsul Hidayat Omar and Robert Whyte for allowing us to present their photographs here. We also thank G. B. Edwards for his review of our manuscript.

## References

- Badcock, A. D. 1918.** Ant-like spiders from Malaya collected by the Annandale-Robinson Expedition 1901-02. Proceedings of the Zoological Society of London 1917: 277-321.
- Ceccarelli, F. S. 2008.** Behavioral mimicry in *Myrmarachne* species (Araneae, Salticidae) from North Queensland, Australia. The Journal of Arachnology 36: 344-351.
- Ceccarelli, F. S. 2009.** Ant-mimicking spider, *Myrmarachne* species (Araneae : Salticidae), distinguishes its model, the green ant, *Oecophylla smaragdina*, from a sympatric Batesian *O. smaragdina* mimic, *Riptortus serripes* (Hemiptera : Alydidae). Australian Journal of Zoology 57: 305-309.
- Ceccarelli, F. S. 2010.** New species of ant-mimicking jumping spiders of the genus *Myrmarachne* MacLeay, 1839 (Araneae: Salticidae) from north Queensland, Australia. Australian Journal of Entomology 49: 245-255.
- Ceccarelli, F. S. 2013.** Ant-mimicking spiders: strategies for living with social insects. Psyche 839181: 1-6.
- Edwards, G. B. 2013.** A review of the synonyms of *Myrmarachne* (Araneae: Salticidae), with comments on the availability of each genus name. Peckhamia 110.1: 1-9.
- Edwards, G. B. and S. P. Benjamin. 2009.** A first look at the phylogeny of the Myrmarachninae, with rediscovery and redescription of the type species of *Myrmarachne* (Araneae: Salticidae). Zootaxa 2309: 1-29.
- Hill, D. E. 2010.** Sunda to Sahul: Trans-Wallacean distribution of recent salticid genera (Araneae: Salticidae). Peckhamia 80.1: 1-60.
- Hurni-Cranston, T. 2010.** (photograph taken by Tiziano Hurni-Cranston, 29 AUG 2010, posted on FLICKR at <https://www.flickr.com/photos/55592390@N04/18657365729>)
- Jackson, R. R. 1982.** The biology of ant-like jumping spiders: intraspecific interactions of *Myrmarachne lupata* (Araneae, Salticidae). Zoological Journal of the Linnean Society 76 (4): 293-319.
- Koch, C. L. 1846. Die Arachniden.** Nürnberg, Dreizehnter Band, pp. 1-234, Vierzehnter Band, pp. 1-88.
- MacLeay, W. S. 1839.** On some new forms of Arachnida. Annals of Natural History 2: 1-14.
- Maddison, W. P., M. R. Bodner and K. M. Needham. 2008.** Salticid spider phylogeny revisited, with the discovery of a large Australasian clade (Araneae: Salticidae). Zootaxa 1893: 49-64.
- Metzner, H. 2015.** Jumping spiders (Arachnida: Araneae: Salticidae) of the world (accessed 28 AUG 2015). *Online at:* <http://www.jumping-spiders.com/>
- Nelson, J. 2010.** Visual cues used by ant-like jumping spiders to distinguish conspecifics from their models. The Journal of Arachnology 38: 27-34.
- Nelson, X. J. and R. R. Jackson. 2007.** Vision-based ability of an ant-mimicking jumping spider to discriminate between models, conspecific individuals and prey. Insectes Sociaux 54 (1): 1-4.
- Nelson, X. J., R. R. Jackson, G. B. Edwards and A. T. Barrion. 2005.** Living with the enemy: jumping spiders that mimic weaver ants. The Journal of Arachnology 33: 813-819.
- Nelson, X. J., R. R. Jackson and D. Li. 2006.** Conditional use of honest signalling by a Batesian mimic. Behavioral Ecology 17: 575-580.
- Peckham, G. W. and E. G. Peckham. 1892.** Ant-like spiders of the family Attidae. Occasional Papers of the Natural History Society of Wisconsin 2(1): 1-84.
- Pickard-Cambridge, O. 1869.** Descriptions and sketches of some new species of Araneida, with characters of a new genus. Annals and Magazine of Natural History (4) 3: 52-74.
- Prószyński, J. 2015.** Global Species Database of Salticidae. Chapter II. Monograph of Salticidae (Araneae) of the World 1995-2014. Version July 15th, 2015 (accessed 28 AUG 2015). *Online at:* <http://www.peckhamia.com/salticidae/>
- Prószyński, J. and C. L. Deeleman-Reinhold. 2010.** Description of some Salticidae (Araneae) from the Malay Archipelago. I. Salticidae of the Lesser Sunda Islands, with comments on related species. Arthropoda Selecta 19: 153-188.
- Simon, E. 1900.** Descriptions d'arachnides nouveaux de la famille des Attidae. Annales de la Société Entomologique de Belgique 44: 381-407.
- Simon, E. 1901.** Histoire naturelle des araignées. Paris 2, 381-668.
- Wanless, F. R. 1978.** On the identity of the spider *Emertonius exasperans* Peckham & Peckham (Araneae: Salticidae). Bulletin of the British Museum of Natural History, Zoology 33: 235-238.
- WSC. 2015.** World Spider Catalog. Version 16.5 (accessed 28 AUG 2015). Natural History Museum Bern. *Online at:* <http://www.wsc.nmbe.ch/>