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## Description of Darlington's Peacock Spider (Araneae: Salticidae: Euophryinae: *Maratus* species A) from the Stirling Range National Park of Western Australia

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In a recent examination of Australian *Maratus* Karsch 1878 from the Peckham collection at the Harvard Museum of Comparative Zoology, we recognized a previously undescribed species of that genus that had been collected in the southern part of Western Australia by P. J. Darlington in 1931 (Hill & Otto 2011). Subsequently, we referred to this spider as *Maratus* species A and published photographs of live specimens from the Western Australian Stirling Range that we regard as the same species (Otto & Hill 2011). Although similar in many respects to *M. mungaich* Waldock 1995, and obviously closely related, this new species can be readily distinguished from *M. mungaich* by a number of defining characters. The main purpose of this paper is to document those characters by comparing this species with *M. mungaich*.

### *Maratus* species A

*Maratus* sp. : Żabka 1991 (Figure 20, p. 33, not #138, p. 40)

*Maratus* sp. : Framenau 2007

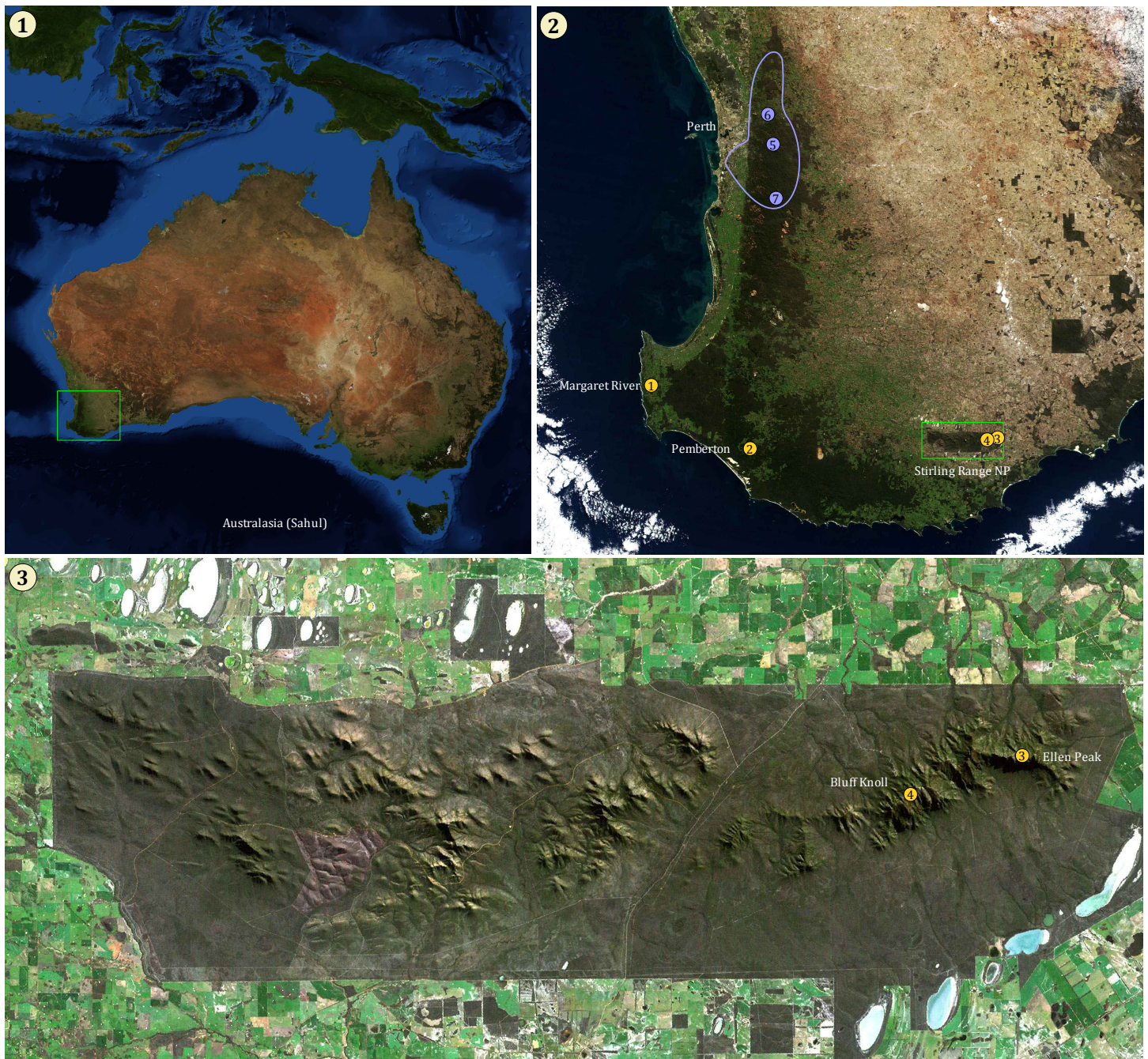
*Maratus* sp. : Hill & Otto 2011 (Darlington's Peacock Spider)

*Maratus* species A : Otto & Hill 2011

**Localities.** The earliest known specimens of *Maratus* species A were collected in Western Australia by Dr. Philip Jackson Darlington Jr. during a Harvard University expedition to Australia in 1931. These two adult male specimens were found near Margaret River (OCT 1931, MCZ101302) and Pemberton (10 NOV 1931, MCZ101295), respectively. Both have been examined and reference photographs of the two have been published previously (Hill & Otto 2011). A photograph of a living specimen collected more recently by Michael Rix at Ellen Peak in the Stirling Range National Park of Western Australia (Framenau 2007) was included in that publication.

The individual *Maratus* species A figured in this paper were all found by Jürgen Otto at Bluff Knoll in the Stirling Range National Park (SEP-OCT 2011, S 34° 22' 35.5", E 118° 15' 14.8", elevation ~1036 m). Preserved specimens drawn from this group are presently in the collection of Jürgen Otto. For purposes of comparison, Jürgen Otto collected most of the *M. mungaich* illustrated here at Mt. Dale east of Perth (S 32° 07' 39.2", E 116° 17' 25.0", elevation ~414 m), and additional photographs of that species from the Talbot Road Nature Reserve (Bokhari 2012, Hort 2012) have also been reviewed.

For reference, these localities, as well as some of the *M. mungaich* localities represented in records of the Western Australian Museum (WAM; Waldock 1995, ALA 2012), are shown in Figure 1. Five WAM records in the southern areas where *Maratus* species A has been found may in fact represent this new species rather than *M. mungaich* but we have been unable to examine these records to verify whether this is the case. Thus we have only presented the known *M. mungaich* distribution in the area to the east of Perth.



**Figure 1.** Known distribution of *Maratus* species A compared to that of *M. mungaich*. **1**, Area of interest (inset rectangle) in the far southwestern corner of the Australasian faunal province. **2**, Magnification of the inset area from (1), showing locality records for *M. sp. A* (1-4) and *M. mungaich* (6-7). The known range of *M. mungaich* east of Perth is encircled. The inset at lower right includes the Stirling Range National Park. Localities for *M. sp. A* are as follows: 1- Margaret River, Darlington, 1931; 2- Pemberton, Darlington, 1931; 3- Ellen Peak, Rix, 2007; 4- Bluff Knoll, Otto, 2011. Numbered localities for *M. mungaich* are: 5- Mt. Dale, Otto, 2011; 6- Talbot Road Nature Reserve, Bokhari, 2012, Hort & Hort, 2012; 7- Holotype locality (Waldock 1995). The known range of *M. mungaich* east of Perth (outline) is based on records published by the Western Australian Museum (WAM; Waldock 1995, ALA 2012). **3**, Magnification of inset area from (2), showing localities in the eastern, elevated section of Stirling Range National Park. This park is a unique refuge for many unique plant species. As can be seen, it is surrounded on all sides and thus isolated by cultivated areas at lower elevations. Background maps courtesy of the NASA World Wind/Blue Marble projects (1), and the NASA Visible Earth project (2-3).

Presently it appears that *Maratus* species A may be confined to the southernmost part of Western Australia. Whether or not *M. mungaich*, with a distribution east of Perth, is completely allopatric remains to be seen. Photographs of the terrain and habitat occupied by these two spiders are presented here in Figure 2.





**Figure 2.** Views of the eastern part of the Stirling Range National Park associated with *Maratus* species A (1-5), and the wooded area of Mt. Dale, east of Perth, where *M. mungaich* has been found (6). Both species have been collected on or near the ground.

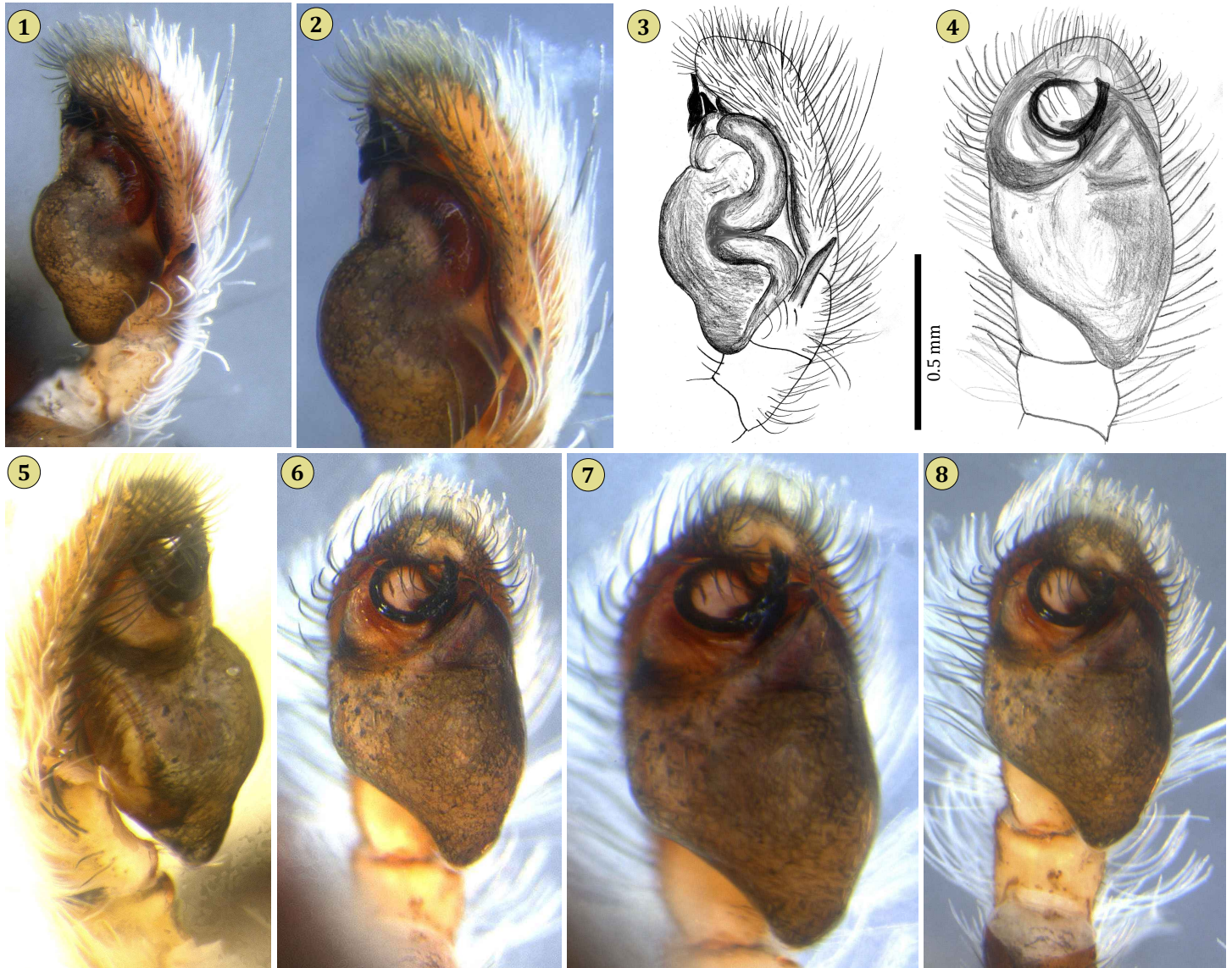
*Identification of Maratus species.* In general, the male pedipalp and female epigynum of *Maratus* species are of limited use in identification, as they vary slightly, and it is quite possible that differences between the individuals of one species may in some cases be greater than interspecific differences. *Maratus* ('Peacock spiders') males bear distinctive plates (often with lateral flaps) of coloured and/or iridescent scales on the dorsal opisthosoma, comprising a 'fan' that plays an important role in intraspecific communication. This fan provides us with the most useful field marks for identification.



### Description of the male

In this section a single male *Maratus* species A (reference #5) is described and compared to *M. mungaich*.

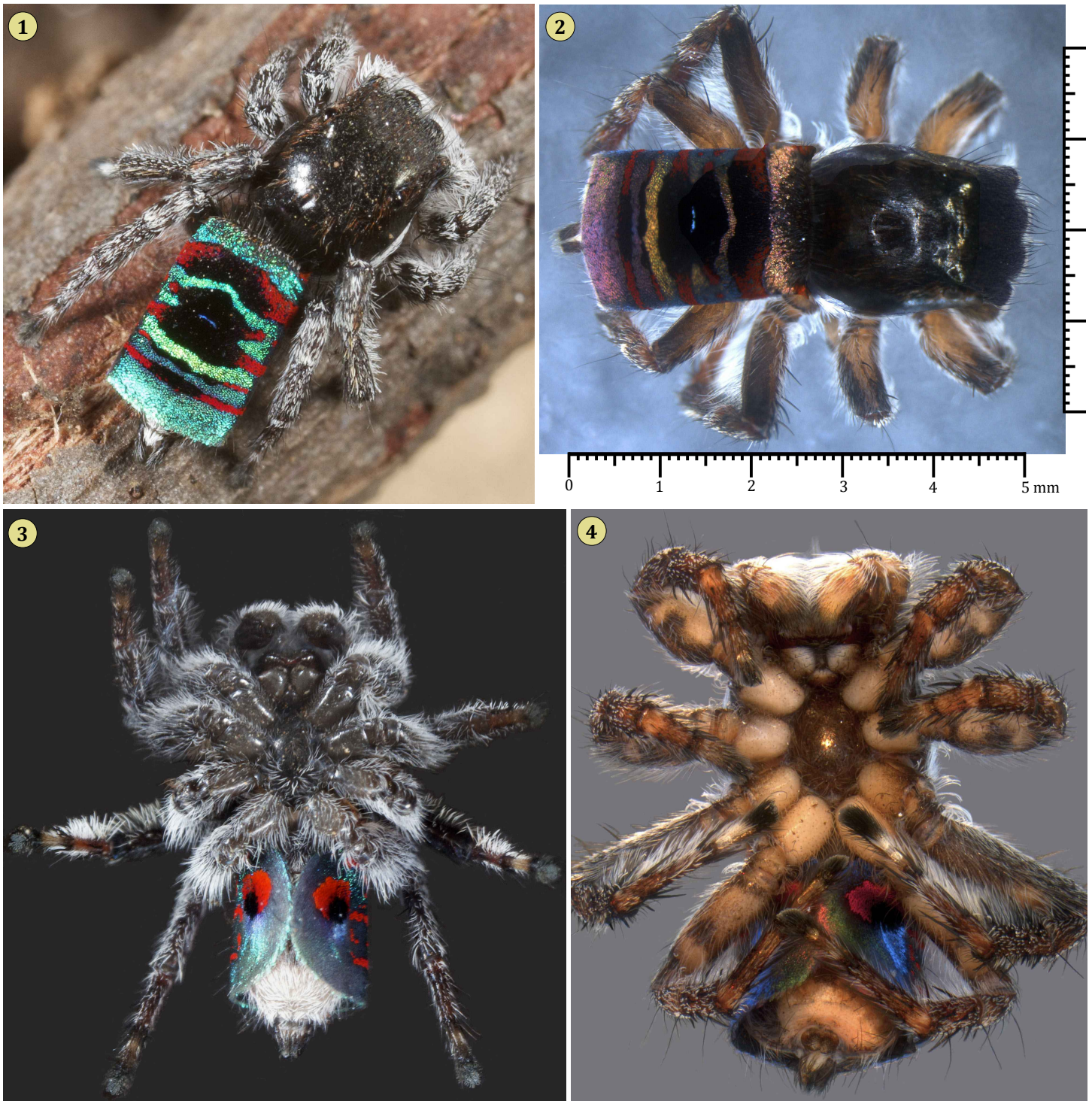
As shown in Figure 3, the male pedipalp resembles that of other *Maratus*, and is considered to be of limited use for identification. The appearance of the terminal portion of the coiled embolus in published drawings of *Maratus* and related euophryines varies greatly depending on the style of the artist, and the exact angle of the view that is drawn. The terminal part of this coil has a longer, outer projection, and a shorter, inner projection. This is similar to that described for the related *M. mungaich* (Figure 4 in Waldock 1995), but it is also very similar to the embolus of the more distantly related *Lycidas anomalus* Karsch 1878 from eastern Australia (Prószyński 1984, Żabka 1987).



**Figure 3.** Left pedipalp of male (#5) *Maratus* species A. 1-2, Lateral views. 3, Drawing of lateral view. 4, Drawing of ventral view. 5, Medial view. 6-8, Ventral views.

Dorsal and ventral views of this spider, both when living and after preservation, are shown in Figure 4. In these views, the lateral flaps of the dorsal opisthosomal plate (fan) are folded under the opisthosoma, meeting at the midline.

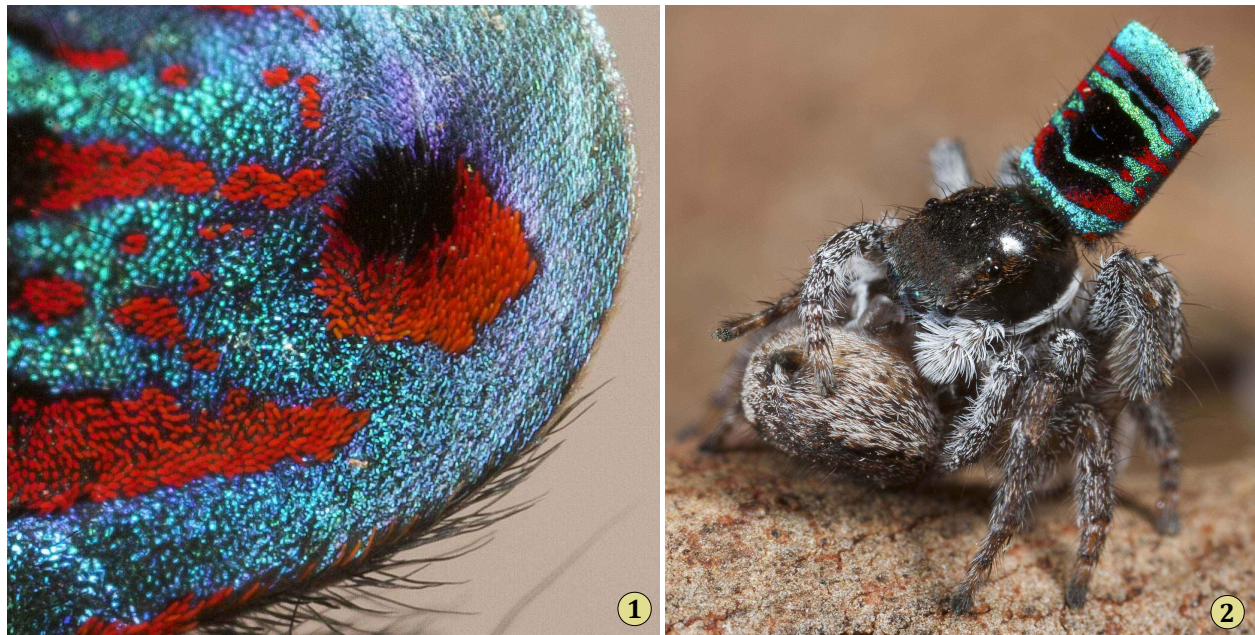




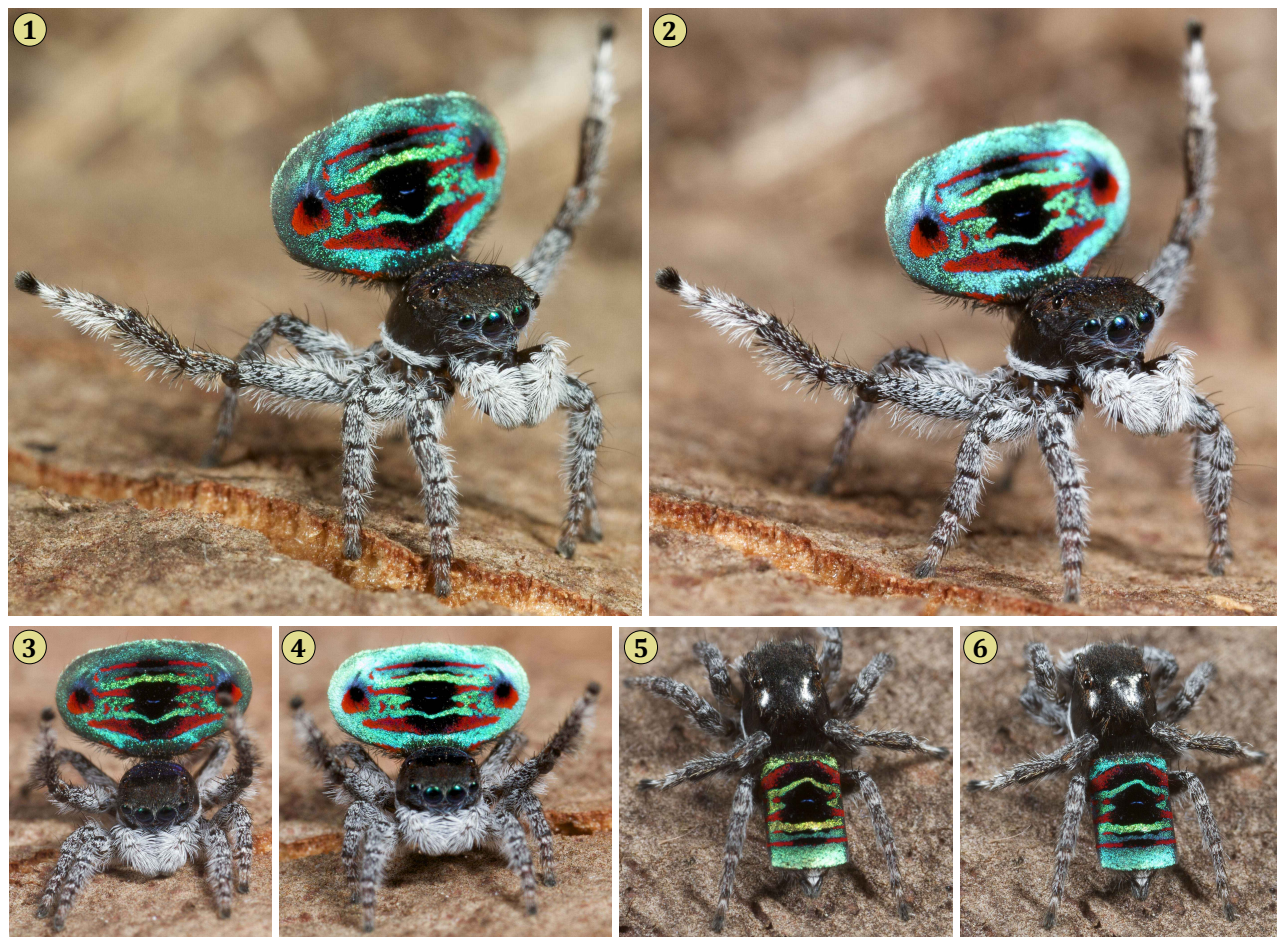
**Figure 4.** Dorsal and ventral views of male (#5) *Maratus* species A. **1**, Dorsal view of living spider. **2**, Dorsal view of specimen, in preservative. **3**, Ventral view of living spider. **4**, Ventral view of specimen in preservative. Note the change of colouration of the normally blue-green iridescent fan scales when submerged in an aqueous solution. The many long white setae that cover the legs of this spider are also much less apparent when preserved. The carapace, with a marginal white band, is mostly dark and glabrous, with some dark brown to red brown scales. The generally grey colour of the cuticle of the living spider also differs from the yellowish colouration of the preserved specimen.

The fan is carpeted with figures comprised of black or red-orange pigmented scales, in a field of iridescent blue-green scales (Figure 5-1). Unless the spider is displaying, the lateral flaps of this fan are tightly folded around the opisthosoma (Figure 5-2). The colouration of the iridescent scales of the fan depends greatly on the relative directions of incident and reflected light, as well as humidity (Figure 6).





**Figure 5.** Fan of a male (#5) *Maratus* species A. **1**, Black or bright red-orange scales form figures on a background of blue-green iridescent scales. **2**, Mating pair. The flaps of the male opisthosomal fan are folded unless the spider is displaying to a female.



**Figure 6.** Changes in appearance of the opisthosomal fan of a male (#5) *Maratus* species A. **1-2**, As the male displayed to a female, the orientation of the fan relative to incident and reflected light changed its brightness considerably. **3-4**, Another example of a change in brightness related to the orientation of the fan. **5-6**, Spider showing colour change related to humidity, ~40 s after removal from a vial containing moist cotton (~100% humidity, 5), and three minutes later after drying (6).



The detailed pattern of the fan of *Maratus* species A is compared to that of *M. mungaich* in Figure 7 and Table 1. This pattern provides the most useful field marks for identification of the two species. Among the many differences between the two species, the anterior lateral field of iridescent scales that are extensive and usually appear dull green in *M. mungaich* are perhaps the most obvious (Figure 7, feature 10). When a larger series of individuals are compared, these differences are quite consistent (Figure 8).



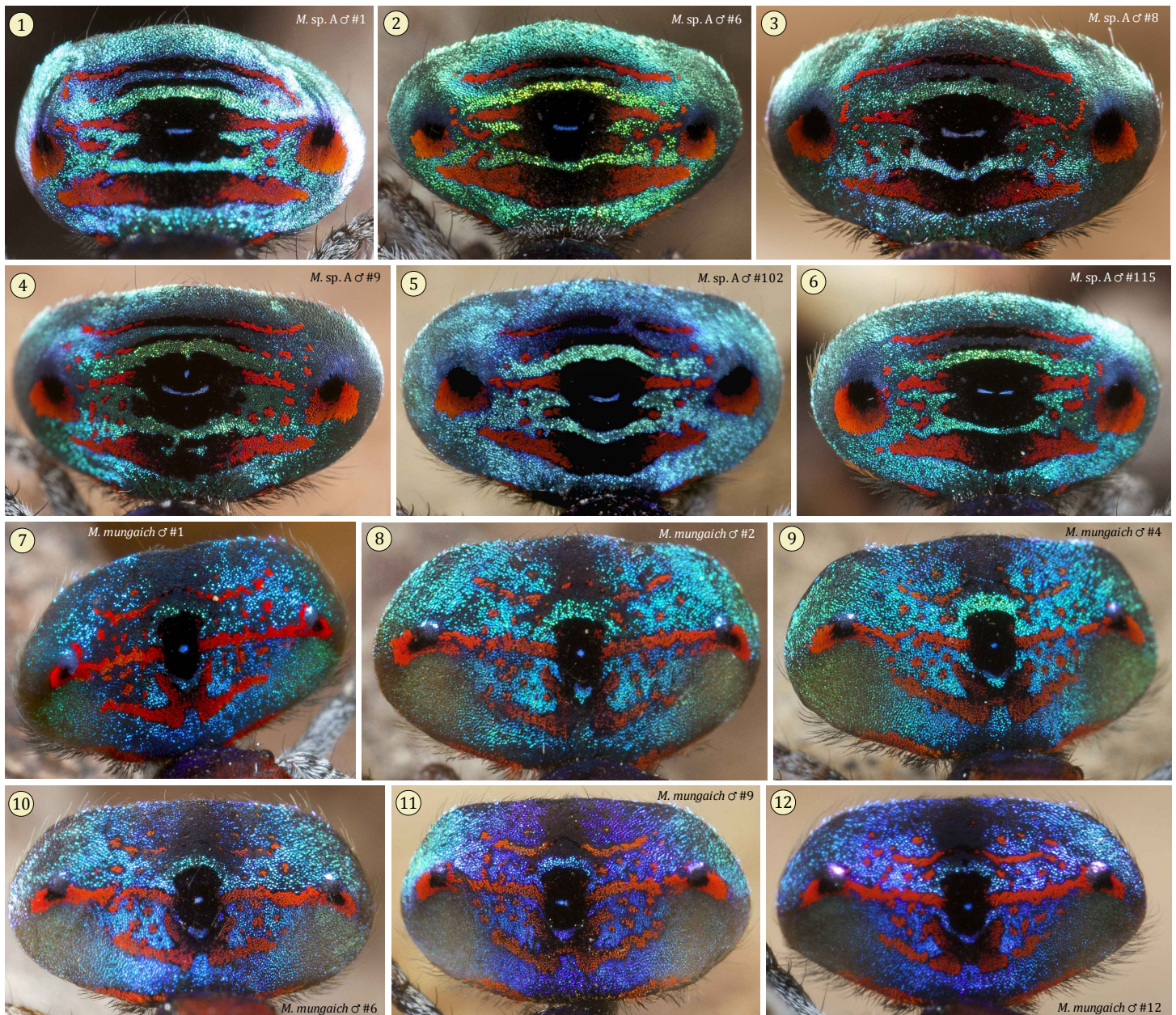
**Figure 7.** Comparison of the fan of a male (#5) *Maratus* species A with that of *M. mungaich*. **1-2**, Expanded (1) and retracted or folded (2) fan of male *M. sp. A*. **3**, Expanded fan of a male *M. mungaich* from Mt. Dale. **4**, Retracted or folded fan of a male *M. mungaich* from the Talbot Road Nature Reserve (photograph © Jean and Fred Hort, used with permission). Specimens recently observed by both Bokhari (2012) and Hort & Hort (2012) from this area showed the same pattern with two small blue spots at the center of the black central shield, with a more extensive group of red-orange scales bordering that shield toward the rear. Numbered features [1-12] are described and compared in Table 1. Both species have remarkably wide lateral flaps.



**Table 1.** Comparison of the dorsal opisthosoma of a series of male *Maratus* species A from Bluff Knoll with those of a series of male *M. mungaich* from Mt. Dale, based on features identified and enumerated in Figure 7.

feature	description	♂ <i>M. sp. A</i>	♂ <i>M. mungaich</i>
1	anterior marginal band	lateral orange to red tracts separated medially by white or black scales	
2	transverse band	two broad orange to red tracts extending more than 3/4 of distance from median to lateral margin on each side, separated medially by a large chevron-shaped black area pointed forward	narrower orange to red tracts extending about 1/2 of distance from median to lateral margin on each side, either joined or separated at median by the background field of iridescent scales
3	transverse band	orange to red tracts extending laterally on each side from anterior part of central dark figure (9), broken up into smaller patches laterally	shorter diagonal orange to red tracts each attached to ipsilateral tract of transverse band 2 antero-medially, and separated from the central dark figure (9) by iridescent background scales
4	transverse band	orange to red tracts extending laterally on each side from posterior part of central dark figure (9), more solid than band (3), may be interrupted	orange to red tracts extending laterally on each side from central part of central dark figure (9) toward the lateral dark spot, may be interrupted
5	transverse band	uniform narrow band with red to orange scales laterally, joined across median by tract of black scales with width equal to that of the central dark figure (9)	broken into variable series of small tracts curving to the rear on either side, or indistinct
6	transverse band	uniform narrow band (wider than 5) with red to orange scales laterally, joined across the median by a wider group of black scales	absent or indistinct, may be represented by a line of small red to orange spots
7	lateral red tract	with (8) in a posterior position, comprise a larger, oval patch or red to orange scales on each side, appearing as an extension of both bands (3) and (4)	with (8) in a posterior position, comprise a smaller band or red to orange scales on either side, appearing as an extension of band (4) only
8	lateral dark spot	relatively large, bounded by tract (7) anteriorly for a distance equal to its diameter	relatively small, bounded by only a narrow span of tract (7) scales anteriorly
9	central dark figure	wide field of dark scales separated into anterior and posterior areas by a thin medial, transverse tract of blue scales, the anterior area joining the lateral tracts of band (3), and the posterior area joining the lateral tracts of band (4)	much narrower, shield-shaped area of black scales with one or two small, ovoid blue spots aligned on the midline, joining the lateral tracts of band (4) only, at the center
10	antero-lateral iridescent tract (10)	behind anterior margin (1), anterior band of iridescent (background) scales fairly uniform with no wide antero-lateral area	distinctive wide area (patch) of background iridescent scales at antero-lateral margin of fan, usually appears green to drab or olive-green from the front, extending from anterior margin (1) to the curved anterior limit of tract (7), approaching close to the lateral dark spot (8)
11	setation of spinnerets	grey to black setae	
12	setation of anal tubercle	group or patch of uniform bright white setae, converging distally	

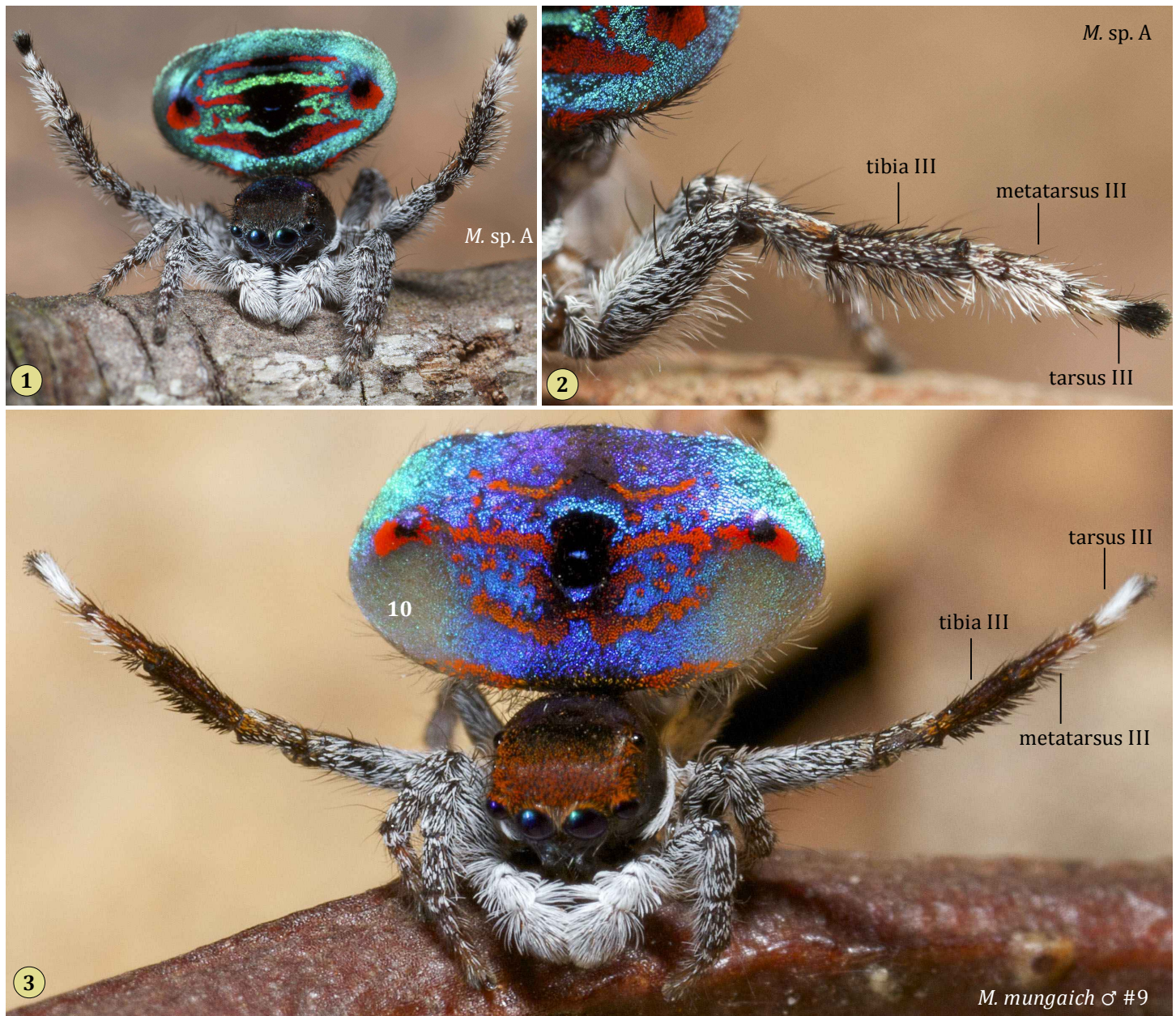




**Figure 8.** Comparison of the expanded fan of six male *Maratus* species A (1-6) from Bluff Knoll with six male *M. mungaich* (7-12) from Mt. Dale. Much of the difference in colour of the iridescent background scales was due to either the relative direction of incident and reflected light, or to differences in moisture and humidity. Differences identified in Figure 7 and Table 1 are quite consistent.

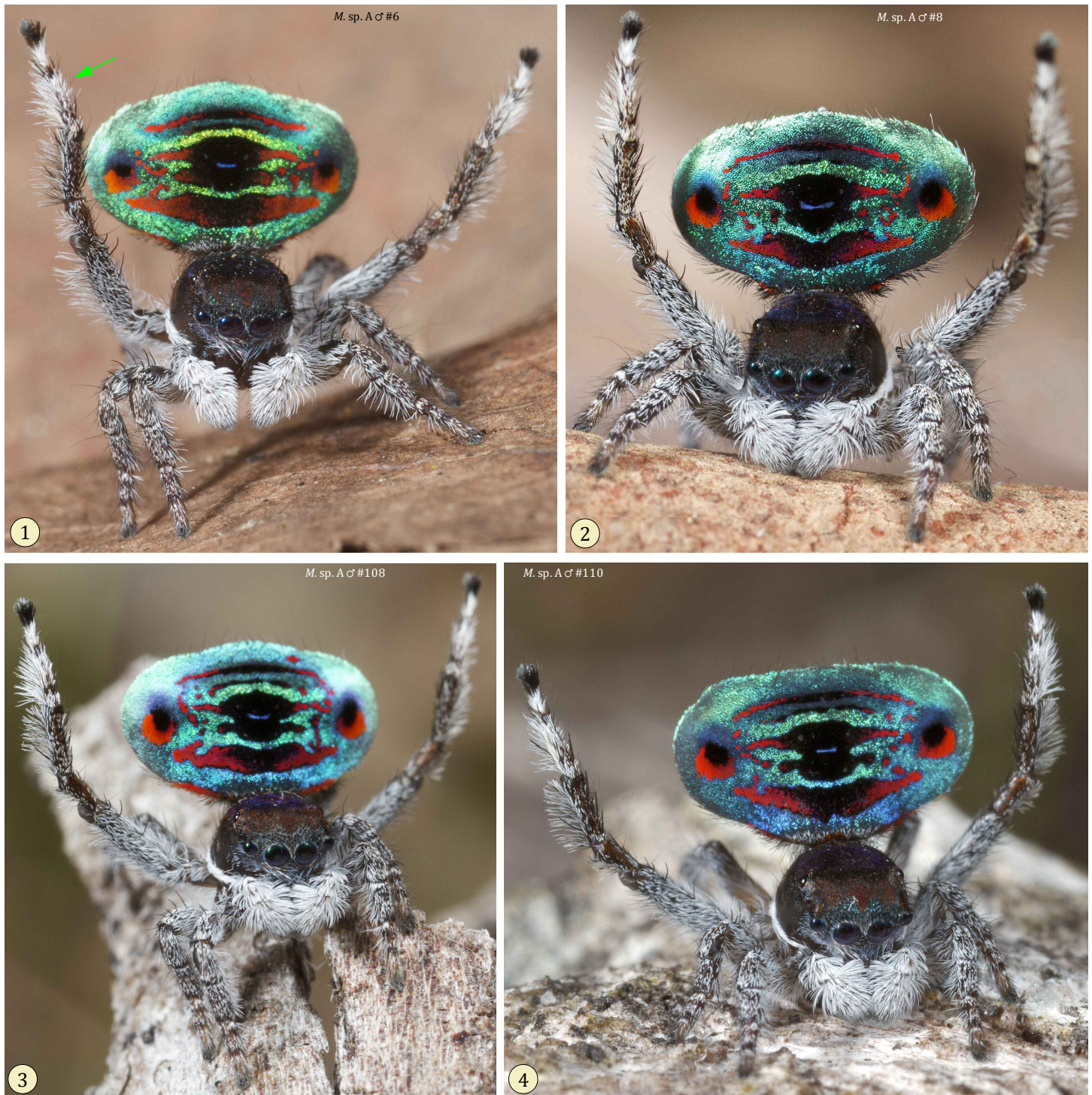
The carapace and legs III of the two species are also markedly different (Figure 9), with more of a grey to black colouration in *Maratus* species A, and a red-brown to white colouration in *M. mungaich*. The setal fringes on legs III of *M. sp. A* are much longer than are those of *M. mungaich*. When a series of individuals were compared (Figures 10-11) these differences were consistent.





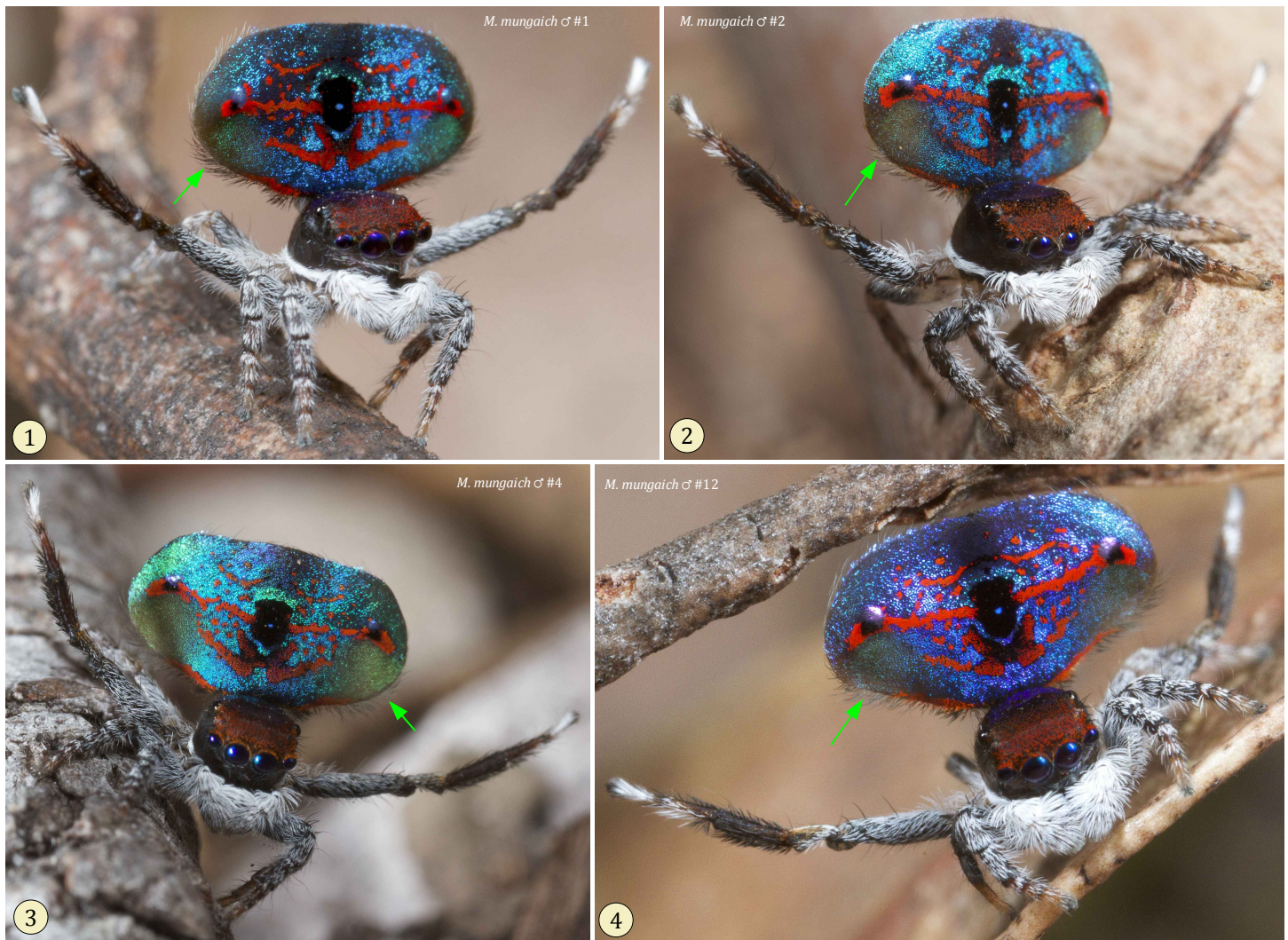
**Figure 9.** Comparison of carapace and legs III of a male (#5) *Maratus* species A (1-2) with a male *M. mungaich* (3). In both species, the carapace has a white marginal band. The optic quadrangle of *M. sp. A* is dark, with three poorly defined longitudinal tracts of dark red-brown scales. In *M. mungaich*, the optic quadrangle bears a uniform cover of much brighter, dark red to red brown scales. The femur III of *M. sp. A* bears a fringe of long white ventral setae, much more pronounced than seen in *M. mungaich*. The tibia III of *M. sp. A* has both white and black setae, with a fringe of long setae beneath, whereas the tibia III of *M. mungaich* is dark red-brown, fringed with shorter, uniform black setae. The metatarsus and proximal tarsus III of *M. sp. A* is covered with many white scales, including a prominent fringe of white setae beneath. The distal tarsus of *M. sp. A* also bears a prominent cover of long black setae. In contrast, the metatarsus of *M. mungaich* is dark red-brown to black, and the entire tarsus III is covered with long white, and no black, setae. In both species the foot pads of tenent setae (tenae) are grey. Note the dull green appearance of the iridescent scales at the anterior lateral margin of the fan of *M. mungaich* (3, feature [10]).





**Figure 10.** Front view of four different *Maratus* species A males as they displayed ('fan dance') to females. Each spider had three irregular longitudinal bands of dark red scales on the optic quadrangle; the carapace was otherwise quite dark. Note the black setae covering the distal tarsus III of each spider, and the prominent fringe of long setae on the underside of tibia III (white and black setae) and metatarsus III (white setae only). Flexion of legs III at the tibio-metatarsal joint (1, arrow) was observed frequently in this species. As with *M. mungaich*, a series of intermittent and sudden lateral rotations of the extended and elevated fan, to either side, was an important part of this display.



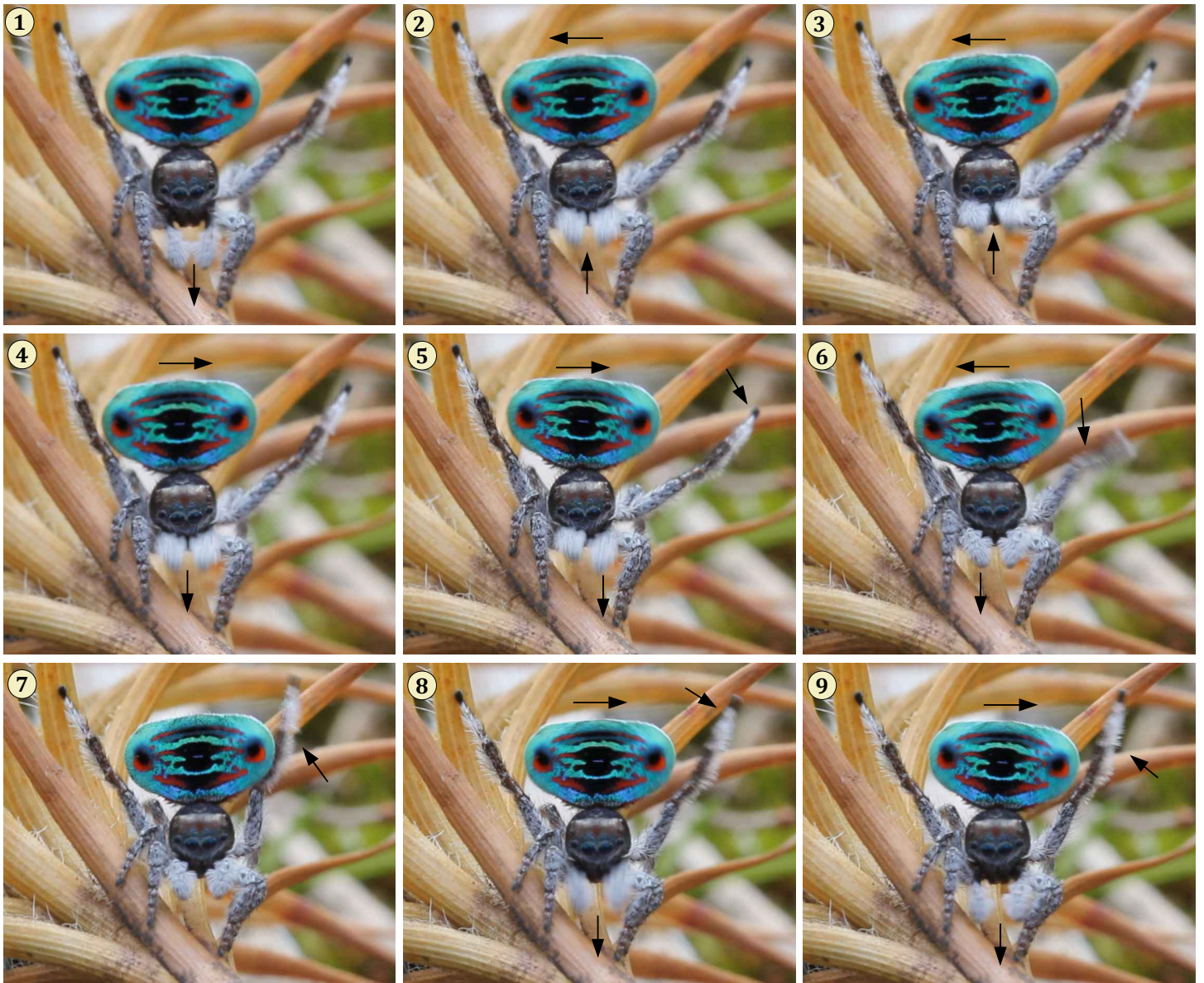


**Figure 11.** Front view of four different *Maratus mungaich* males as they displayed ('fan dance') to females. In each spider, the tibia was black, fringed with only black setae that were much shorter than those of *M. sp. A*. The entire tarsus was covered with white setae. Note also the uniform cover of red-brown scales on the optic quadrangle (dorsal carapace) of these spiders. The extensive field of iridescent scales at the anterior lateral margin of each fan appeared dull green, as shown here, from the front. During this display male *M. mungaich* tend to hold their legs III in the extended position shown here, as they rotate the fan from side to side.

Differences in leg III colouration are accompanied by observed differences in the use of these legs during the 'fan dance' display by males in front of a female (Figures 12-13). In general, *M. sp. A* appears to move its legs III, and flex these legs at the tibio-metatarsal joint, frequently during display, whereas *M. mungaich* appears to rely more on side-stepping with legs III extended and held in a relatively static position. Male *M. sp. A* may also side-step in front of a female, but appear to do this much less than do male *M. mungaich*. A video depicting the display of *M. sp. A* was recently posted (Otto 2012), and this provides a good introduction to the temporal sequence of these movements.

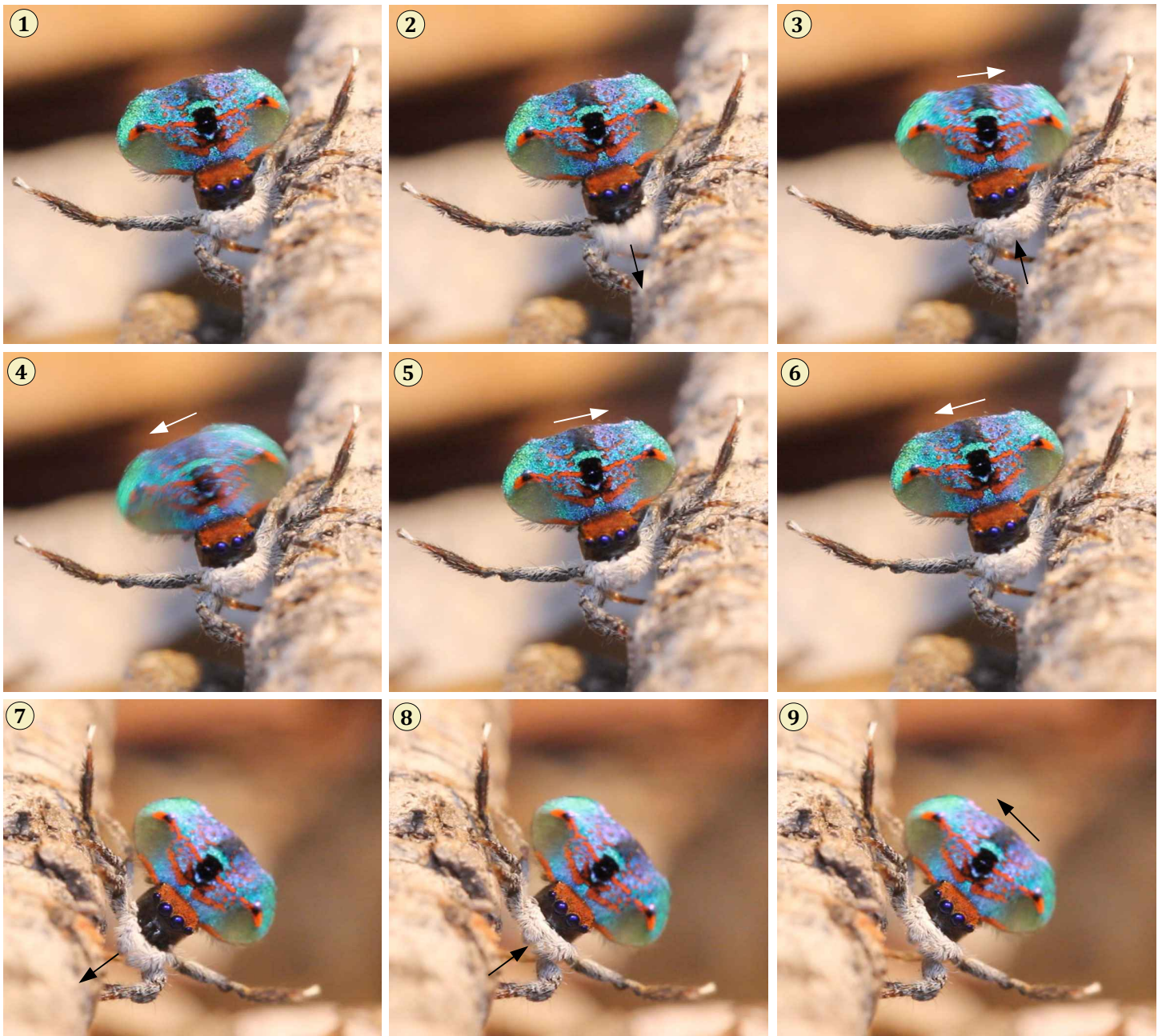
Only the 'fan dance' of the two species is compared here. Both species also have many other signals in their courtship repertoire, including single leg waving at a distance, and semaphore movements of legs III with the fan lowered as the female is approached.





**Figure 12.** Sequential (1-9), but not consecutive, frames from a video recording of a male (#110) *Maratus* species A as it displayed to a female ('fan dance'). In each frame, arrows indicate prior movement that led to each observed position. **1**, Pedipalps lowered. **2-3**, Pedipalps raised and fan rotated to the (spider's) right. **4**, Pedipalps lowered and fan rotated to the left. **5**, Left pedipalp lowered, fan rotated to the left, and left leg III rotated to the left. **6**, Right pedipalp lowered, fan rotated to the right, and left leg III flexed. **7**, Left leg III extended. **8**, Pedipalps lowered, fan rotated to the left, and left leg III rotated to the left. **9**, Pedipalps lowered, fan rotated to the left, and left leg III rotated to the right. This species typically combined rapid pedipalp, fan, and leg movements while displaying in place as shown here.



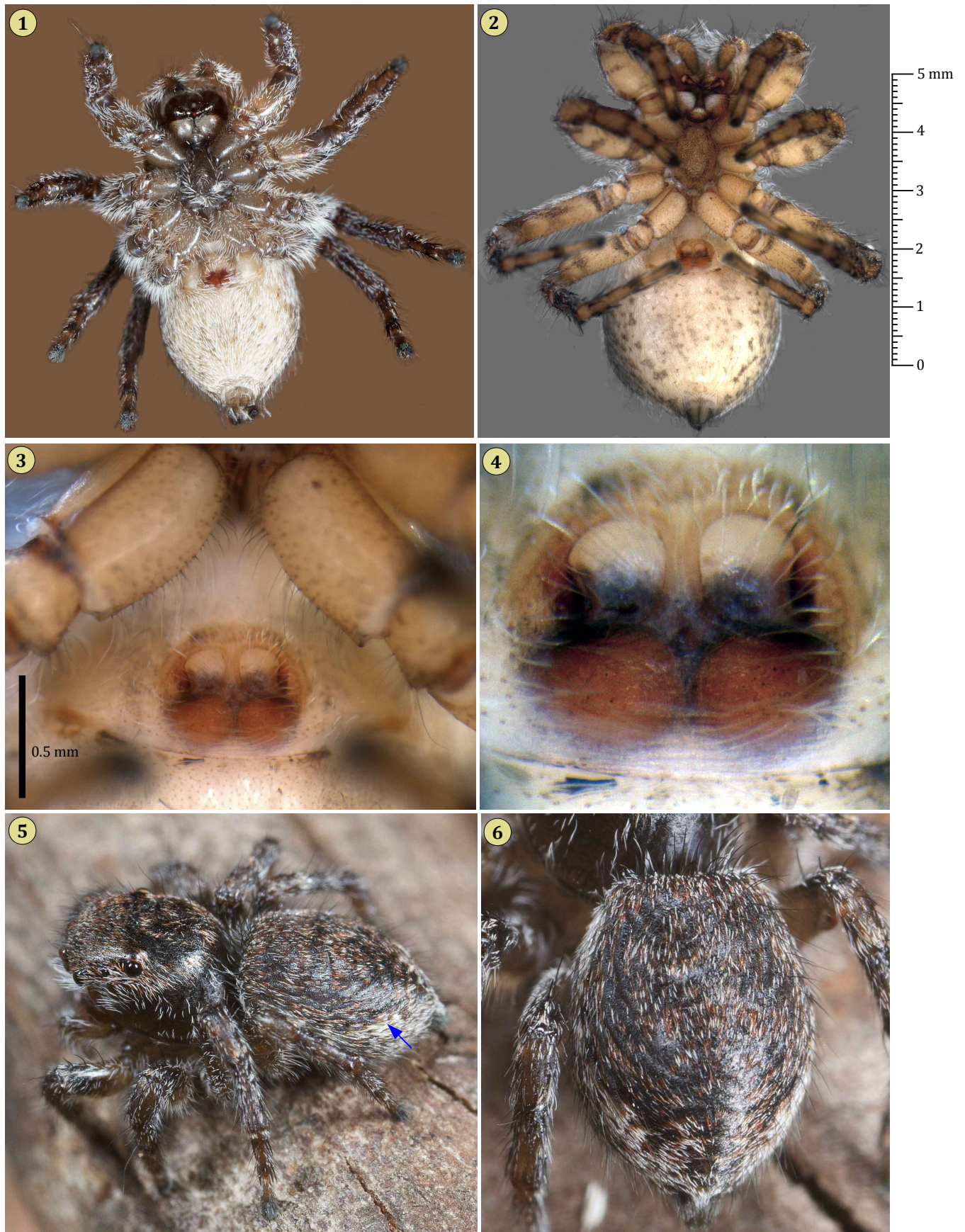


**Figure 13.** Sequential (1-9), but not consecutive, frames from a video recording of a male (#4) *Maratus mungaich* as it displayed to a female ('fan dance'). **1**, In position with legs III extended in an arc on one side of a branch. **2**, Pedipalps lowered. **3**, Pedipalps raised and fan rotated to the (spider's) left. **4**, Fan rotated to the right. **5**, Fan rotated to the left. **6**, Fan rotated to the right. **7**, In position after side-stepped to the opposite side of the branch, pedipalps lowered. **8**, Pedipalps raised. **9**, Fan rotated to the right. When compared to the fan dance of *M. sp. A*, the observed movement of *M. mungaich* was relatively simple and patterned. The male would side step in front of the female, assume this characteristic pose as it moved the pedipalps up and down in that new position, then remained in place as it rotated ('twiched') the fan from side to side several times. It would then side step to a position on the other side of the female, as shown here, and repeat this sequence. In contrast, *M. sp. A* tended to combine pedipalp, fan, and leg III movements included leg flexion (Figure 11), in a more variable performance.

### Description of the female

A representative female (#5) *Maratus* species A is shown in Figure 14. Other females of this species are also compared with *M. mungaich* females in Figures 15-16. The females of these two species are very similar.





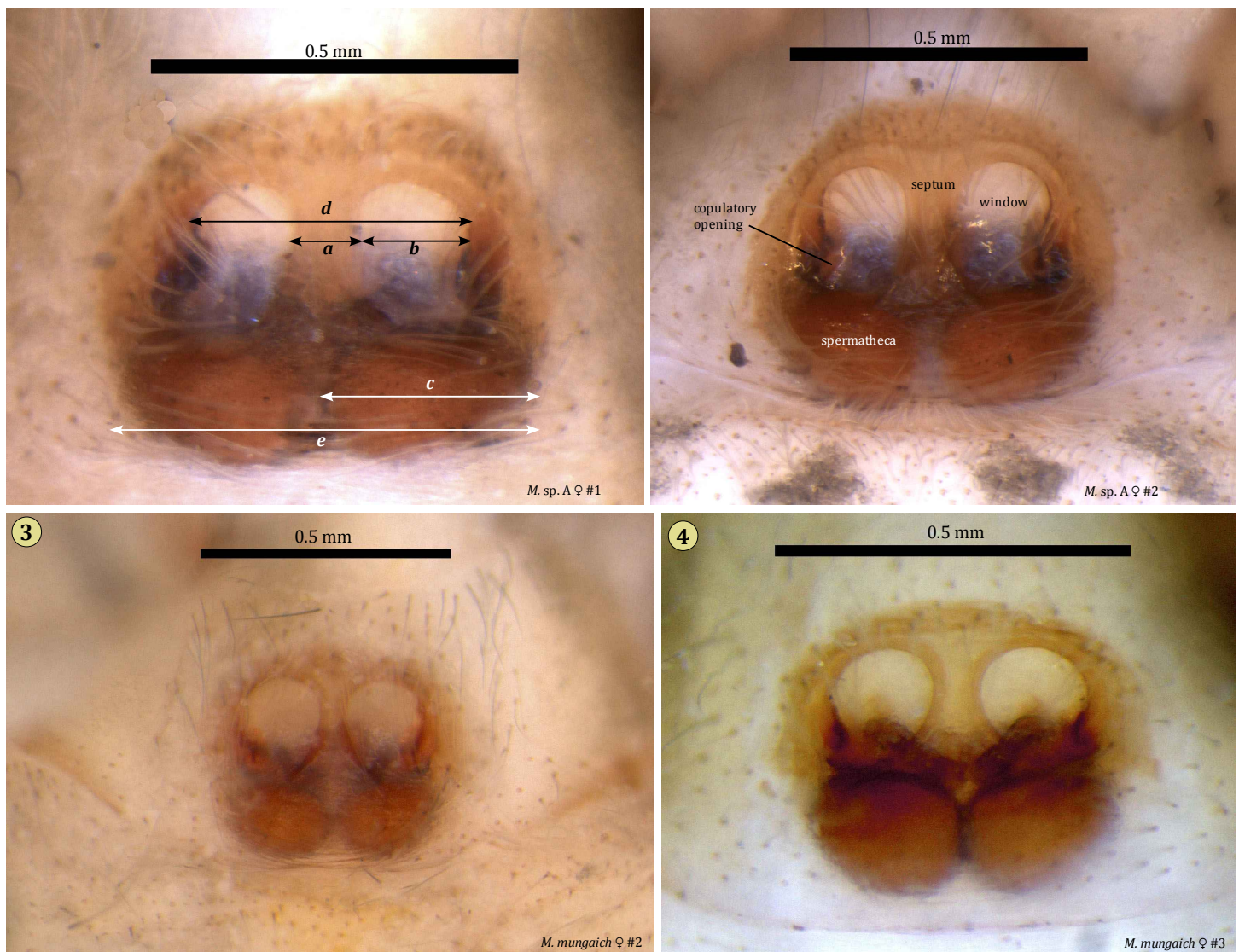
**Figure 14.** Representative female (#5) *Maratus* species A. **1**, Underside of living spider. **2**, Underside of preserved specimen. **3**, Ventral view of anterior opisthosoma, showing epigynum. **4**, Detail of epigynum, at higher contrast and magnification. **5-6**, Two views of living spider, showing mixture of white and darker red-brown scales on both carapace and dorsal opisthosoma. This contrasts (**5**, arrow) with a lateral opisthosomal band of white scales, a feature that is more prominent in the spiders shown in Figure 14 (1-6).





**Figure 15.** Other individual female *Maratus* species A (1-6) compared with female *M. mungaich* (7-12). As is the case with female *Maratus* in general, these are fairly nondescript, and it is advisable to use only males as designated holotypes. Some of the *M. sp. A* females have median figures on the dorsal opisthosoma (2, arrow), and most have a dark band (5, arrow) separating the dorsal area of the opisthosoma from a lateral marginal band comprised of lighter-coloured scales. Female *M. mungaich* may have a pair of anterior-dorsal opisthosomal spots (11, arrows). The legs of *M. mungaich* females also appear to be somewhat lighter in colour.





**Figure 16.** Comparison of external (ventral) view of the epigynum of two *Maratus* species A females (1-2) with two Female *M. mungaich* (3-4). Spiders of the genus *Maratus* exhibit little variation in epigynal structure. Relative to the spermatheca, the windows of *M. sp. A* are relatively smaller than are those of *M. mungaich*. This is expressed in the ratio  $b/c$ , which is about 0.5 in *M. sp. A*, and 0.8-0.9 in *M. mungaich*. The ratio  $d/e$  is about 0.6-0.7 in *M. sp. A*, and 0.8-0.9 in *M. mungaich*. The relative width of the septum ( $a/b$ ) varies greatly, from about 0.4-0.7 in *M. sp. A*, to about 0.3-0.4 in *M. mungaich*. These differences in proportion may relate to differences in overall body size of the two species.

### Size compared to *M. mungaich*

Relative size is only useful within limits, as this may vary from year to year, or from place to place, solely as the result of environmental conditions including relative abundance of prey. Overall measurements of body length may not be reliable, due to changes in the relative position of prosoma and opisthosoma, as well as shrinkage, of preserved specimens. For spiders like *Maratus*, with a large and flexible pedicel related to the great extent to which these spiders can rotate the opisthosoma, 'body length' is thus an even less precise measurement. Nonetheless, the *Maratus* species A adults that have been measured are the largest known *Maratus* (Otto & Hill 2011), considerably larger than the related *M. mungaich* (Table 2, Figure 17).



**Table 2.** Comparative size of adult *Maratus* species A and *M. mungaich*. Measurements (in mm) are given as averages, with the range in parentheses. The width of the carapace was measured at its widest point, behind the optic quadrangle. Waldock (1995) only supplied measurements for a single male (holotype), and a single female (paratype).

species	N	body length	carapace length	carapace width	opisthosoma length	source
♂ <i>Maratus</i> species A	9	5.6 (5.2-6.2)	2.8 (2.6-3.2)	2.1 (2.0-2.4)	2.9 (2.6-3.5)	new specimens from Bluff Knoll
♂ <i>Maratus mungaich</i>	11	4.6 (4.0-4.9)	2.2 (1.9-2.4)	1.6 (1.5-1.8)	2.4 (2.3-2.5)	new specimens from Mt. Dale
♂ <i>Maratus mungaich</i>	1	4.8	2.4	—	2.4	Waldock 1995
♀ <i>Maratus</i> species A	5	5.8 (5.3-6.2)	2.8 (2.6-3.1)	2.1 (2.1-2.2)	3.1 (2.7-3.5)	new specimens from Bluff Knoll
♀ <i>Maratus mungaich</i>	3	4.8 (4.4-5.5)	2.1 (2.0-2.3)	1.8 (1.7-1.8)	2.4 (2.2-2.8)	new specimens from Mt. Dale
♀ <i>Maratus mungaich</i>	1	5.2	2.4	—	2.8	Waldock 1995

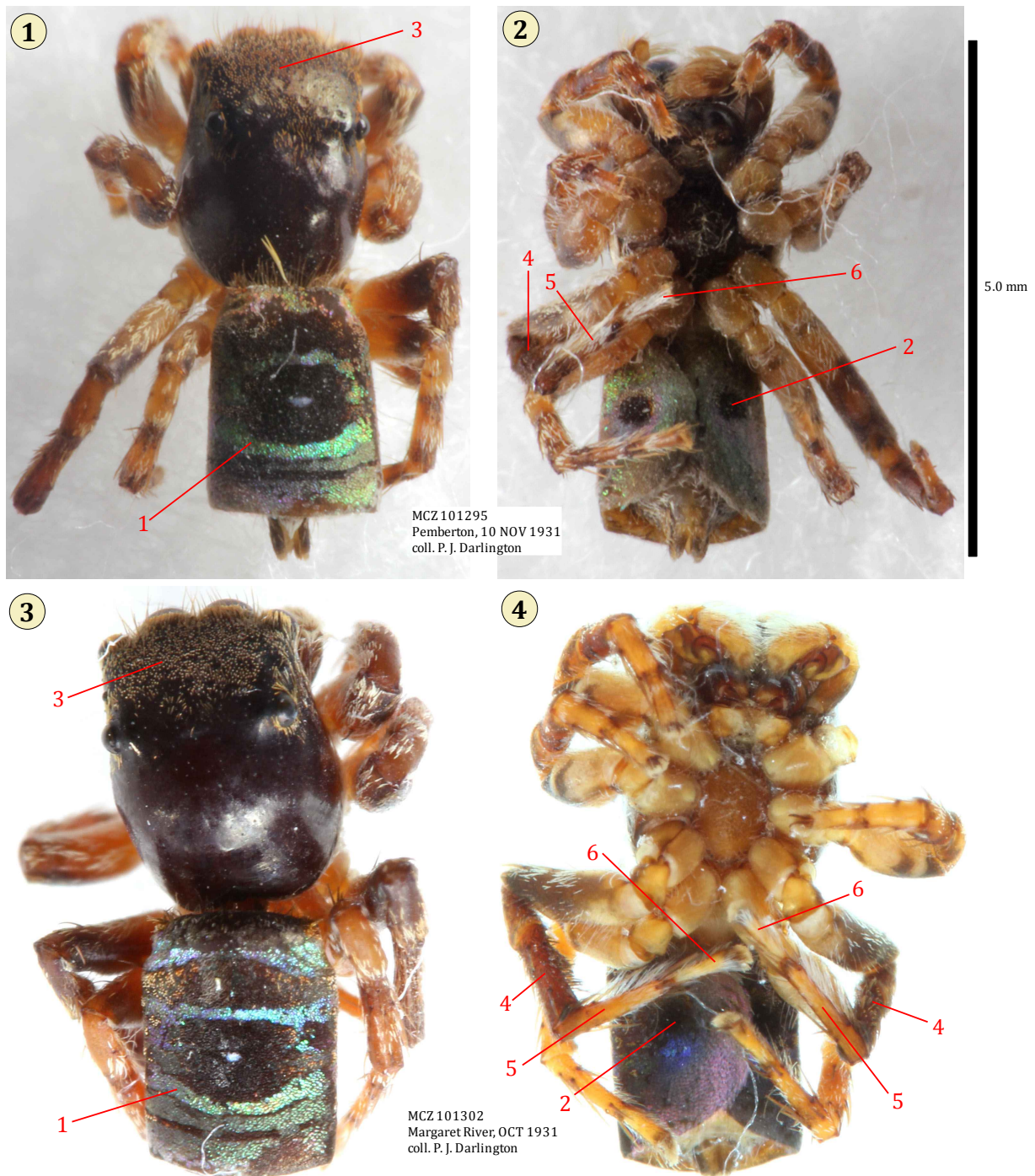


**Figure 17.** Comparison of an adult male *Maratus* species A from Bluff Knoll with an adult male *M. mungaich* from Mt. Dale. The larger *M. sp. A* (1- at right, 2- at left) is much heavier bodied, with prominent fringes of long white setae under legs III.



### *Maratus* species A specimens collected by P. J. Darlington

The two males collected by P. J. Darlington in 1931, near Pemberton and Margaret River respectively (Figure 1), are shown in Figure 18. Selected characters used to separate *Maratus* species A (Bluff Knoll) from *M. mungaich* (Mt. Dale) are enumerated in Figure 18, and discussed in Table 3.



**Figure 18.** Two male *Maratus* species A (1-2, 3-4) collected by P. J. Darlington in 1931. Enumerated characters are listed in Table 3. To reveal the colours of their setae, both specimens were air-dried for a brief period of time, then quickly returned to an ethanol solution for preservation. Pigments such as those associated with red scales do not survive a long period of immersion in alcohol. Photos by D. E. Hill, released under a [Creative Commons Attribution 3.0 Unported](https://creativecommons.org/licenses/by/3.0/) license.



**Table 3.** Comparison of characters associated with the adult male specimens of *Maratus* species A collected by P. J. Darlington, shown in Figure 18, with *Maratus* species A from Bluff Knoll and *M. mungaich* from Mt. Dale. Some of their pigments of black setae, like those of red scales or setae, may have been dissolved into the alcohol used to preserve these specimens.

character	description	comparison
1	pattern of bands on the dorsal opisthosoma (fan)	like <i>Maratus</i> species A (Bluff Knoll)
2	large dark spots on the lateral flaps of the opisthosoma	like <i>Maratus</i> species A (Bluff Knoll)
3	uniform cover of dark red to brown setae in optic quadrangle	like <i>Maratus mungaich</i> (Mt. Dale)
4	only dark setae under tibiae III	like <i>Maratus mungaich</i> (Mt. Dale)
5	long white setae of metatarsus III	like <i>Maratus</i> species A (Bluff Knoll)
6	cover of long white setae, no distal dark setae, of tarsus III	like <i>Maratus mungaich</i> (Mt. Dale)
—	body length (~5.0 mm)	intermediate

Darlington's specimens generally agree with our description of *Maratus* sp. A from Bluff Knoll, in particular in the colouration and detailed pattern of the dorsal opisthosoma. However, in some characters Darlington's specimens also resemble *M. mungaich*. Despite these differences, which could in part result from the age of these specimens and associated loss of colouration and setation, we believe that the two spiders collected by Darlington near Pemberton and Margaret River are conspecific with the spiders from Bluff Knoll that we have illustrated in this paper. It is hoped that future studies will reveal more about the relationship and consistency of these differences with respect to the geographical distribution of populations of both species.

### Future Study

We have been informed that Julianne Waldock of the Western Australian Museum is presently engaged in a study of these species, and we have thus chosen not to publish a formal scientific name for *Maratus* species A ('Darlington's Peacock Spider') at this time.

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