

Three new Australian peacock spiders (Araneae: Salticidae: *Maratus*)

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Abstract. Three new species are described in the genus *Maratus* Karsch 1878: *M. plumosus*, *M. tasmanicus*, and *M. watagansi*. *M. watagansi* is unusual in that males do not raise their opisthosoma as they display to females. The use of legs III to power the jumps of *M. watagansi* is also measured from high speed video frames (1000 fps).

Introduction

Maratus Karsch 1878 is a diverse genus of small euophryine jumping spiders that are endemic to Australia. Many new species have been described or otherwise placed in this genus recently (Otto & Hill 2011, 2012a, 2012b, 2012c, 2013). Here we name and describe two species that we have previously reported (Otto & Hill 2011), and one new species that has apparently lost the *peacock* display of its congeners.

Maratus plumosus, new species

Maratus-like spider, Hill 2009, p. 21-22, figs. 26-27.

Maratus species B, Otto & Hill 2011, p. 23, fig. 28.

Maratus species B, Otto & Hill 2012b, p. 20-23, figs. 28-31, 36 (5-6).

We have previously published many photographs of this unique spider, including a comparison with two other species (*M. calcitrans* Otto & Hill 2012 and *M. digitatus* Otto & Hill 2012) that we consider to be close relatives and also part of the *calcitrans* group of the genus *Maratus* (Hill 2009, Otto & Hill 2011, 2012b). We also published photographs of a distinct 'Melbourne form' of this species and a range map showing all localities where it has been found in southeastern Australia (Otto & Hill 2012b).

Type specimens. The holotype male (♂#4) and 24 paratypes (15 males and 9 females) were collected in the Wildflower Garden Reserve, St. Ives, New South Wales (33°42'15.29"S, 151°10'30.31"E, 2-8 SEP 2012, J. Otto coll.). All will be deposited in the Australian Museum, Sydney. Many other specimens have been observed and photographed.

Etymology. The species group name (*plumosus*, adj., Latin form, English translation *plumose*) refers to the presence of feather-like flaps or plumes at the rear of the opisthosoma of adult males.

Diagnosis. Males cannot be confused with any other described species of this genus. Although similar to both *M. calcitrans* and *M. digitatus* with respect to their unilateral leg extension and asymmetrical positioning of the elevated dorsal opisthosoma during display, many other differences between these species have been documented (Otto & Hill 2012b). These include the presence of normal (not inflated) spinnerets, the presence of iridescent blue scales covering the front of femur III, the extension and movement of the contralateral (relative to the direction that the fan is turned) leg III during display, the

pattern of the dorsal opisthosoma, the presence of divided (anterior and posterior) lateral flaps, and the presence of posterior plumes that resemble spinnerets in *M. plumosus*.

Description of male (Figures 1-5). Males ranged from 4.35 to 5.10 mm in body length (n=16). Chelicerae short, narrow, dark brown, and glabrous. Long white setae project ventromedially across the clypeus beneath each AME. AME bordered with scales on all sides. Ocular area (*ocular quadrangle*) with 13 longitudinal scale fields or stripes, a median dull red-orange stripe and six stripes of alternating colour on either side: thin grey-white, broad dull red-orange (behind each AME), thin grey-white, thin red-orange, shorter thin grey-white and very short dull red-orange (the latter two stripes behind or to the side of each ALE). These stripes do not extend to the rear behind the ocular area. The carapace is otherwise dark brown (preserved specimens) or black (living) with five longitudinal tracts of bright white scales: one posterior median, one on each side behind the PLE, and one at each posterolateral margin. The PME are slightly closer to the PLE than to the ALE.

The dorsal opisthosoma is covered with a distinctive *herringbone* pattern comprised of bright to dull red-orange pigmented scales on a background of light blue iridescent scales. On either side are two separate flaps, an anterior flap that is more irregular with prominent tufts of large black and white setae, and an oval posterior flap covered with dull green iridescent scales, with a darker 'eye' spot with red-orange scales surrounded by black anteroventrally. Each oval flap bears three prominent tufts of setae that extend well beyond the lateral and posterior margins (numbered 1-3 in Figure 3: 9). The two posterior tufts (2-3) have black setae above and white setae below, and give the appearance of a pair of long spinnerets on either side. The anterior tuft (1) is short and comprised only of white setae. The anterior spinnerets are light at the base, black distally, and above these is a distinctive triangular patch of bright white, posteromedially oriented setae, above the anal tubercle. This feature, found in many *Maratus*, is less evident in preserved specimens. Ventrally, the opisthosoma is grey just in front of the spinnerets, then light brown with darker patches. The sternum, labium, endites, and ventral aspect of the pedipalps are brown to dark brown.

Legs I and II are about the same length, shorter than legs III and IV. Leg III is by far the longest. From ventral coxae to femur, all legs are generally light in colour, almost translucent. The coxae of legs III and IV are light dorsally, those of legs I and II are however dark brown or black dorsally. From patella to tarsus, all legs are dark, bearing many long white scales and setae. These are relatively uniform in distribution on legs I and II, but the white scales are clustered into bands or rings on the distal segments of legs III and IV. All femora appear to have light or translucent surfaces anteriorly and posteriorly, but the front of femora III are densely covered with iridescent light blue setae (Figure 3: 7). These setae figure prominently when a leg III is waved in front of a female, but their colour and brightness is highly directional and also cannot be seen in specimens under alcohol (Figure 3: 6). Legs III also have a dense ventral fringe of long white setae, most prominent on the femur but also present distal to that segment. Legs III are strongly banded with white scales, and the distal tarsi are dark.

The pedipalps are dark brown to black and glabrous ventrally and proximally, but the enlarged distal segments are covered dorsally with long, dense setae. At the rear of each pedipalp these setae comprise a bright white stripe, and at the front they are light brown or tan. The pedipalps are often held or extended forward directly in front of the chelicerae (Figure 2), so that the white stripe is positioned laterally with respect to the larger medial area of long light brown setae. The detailed structure of the pedipalps (Figure 4) compares with that of *M. calcitrans* and *M. digitatus* in all respects, but the irregular edge of the outermost ring of the embolus is distinctly angular in *M. plumosus* (Figure 4: 2-3). The distal embolus is heavy and comprised of inner and outer apices, a feature generally seen in *Maratus* but not always noted. In preserved specimens the lateral margin of the tegulum appears to be heavily sclerotized where it meets the cymbium, and the blunted RTA is darker distally. An area of heavily sclerotized cuticle can be observed on that part of the tegulum that is proximomedial to the ring of the embolus.



Figure 1. Photographs of living holotype male *Maratus plumosus* (σ #4). **1**, Anterior view, with pedipalps held in front of the chelicerae. Note pattern of stripes in the ocular area, and the presence of light brown or tan setae surrounded laterally by bright white setae on the anterior surface of the pedipalps. **2**, Oblique view, showing light blue iridescent area of the anterior femur III. **3-4**, Posterolateral views showing retracted opisthosomal flaps. **5**, Detail of posterodorsal opisthosoma, showing triangular patch of white setae above the anal tubercle, found in most *Maratus*. On either side tufts of large black and underlying white setae project from the rounded lateral flaps. **6**, Ventral view of spider walking under glass. **7**, Dorsolateral view. **8**, Dorsolateral view of this spider as it prepared to jump by extension of flexed legs III. Note the marginal band of white scales that occupies each posterolateral corner of the carapace.



Figure 2. Four other male *Maratus plumosus*. 7, This male (♂#20) apparently regenerated legs LIII and LIV, which as a result have relatively little setation.

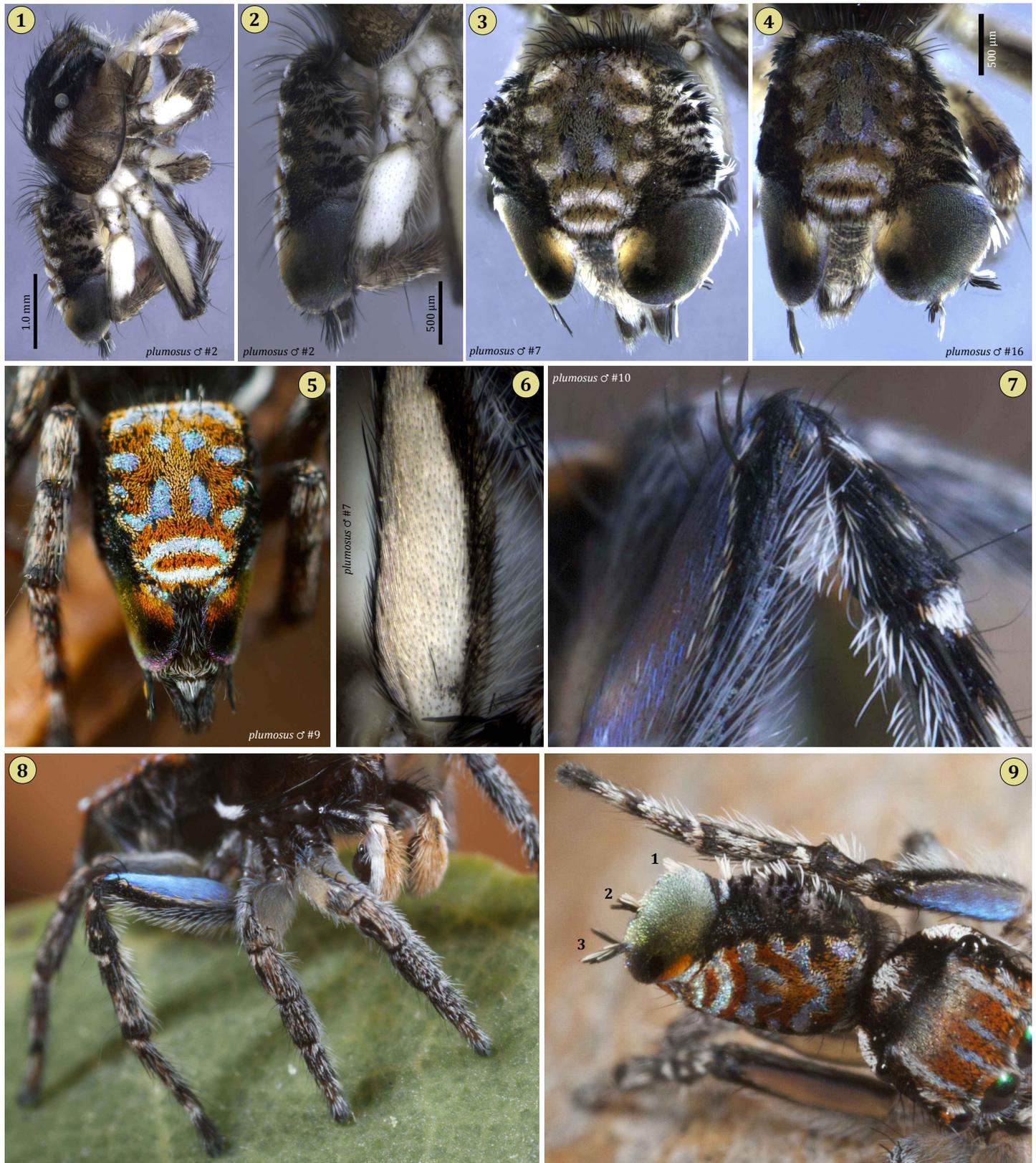


Figure 3. Details of male *Maratus plumosus* structure. **1-2**, Lateral views of specimen with retracted opisthosomal flaps. Little of the colour of living animals can be seen in specimens under alcohol. **3-4**, Dorsal opisthosoma of two specimens with extended lateral flaps, showing complex structure. On either side of the opisthosoma is an irregular anterior flap dominated by tufts of large black and white setae, and a rounded posterior flap with an eye-like pattern of scales and three separate tufts of large black and white setae (9: numbered 1-3). **5**, Dorsal view of opisthosoma of living male, showing distinctive pattern comprised of red-orange and light blue iridescent scales anteriorly, and retracted oval flaps toward the rear. **6**, Anterior femur LIII of male specimen showing fringe of dense, long white setae ventrally (to the right). **7-9**, The bright light-blue colour of the iridescent setae that cover the anterior surface of femur III can be seen in these living males. This colour is highly directional.

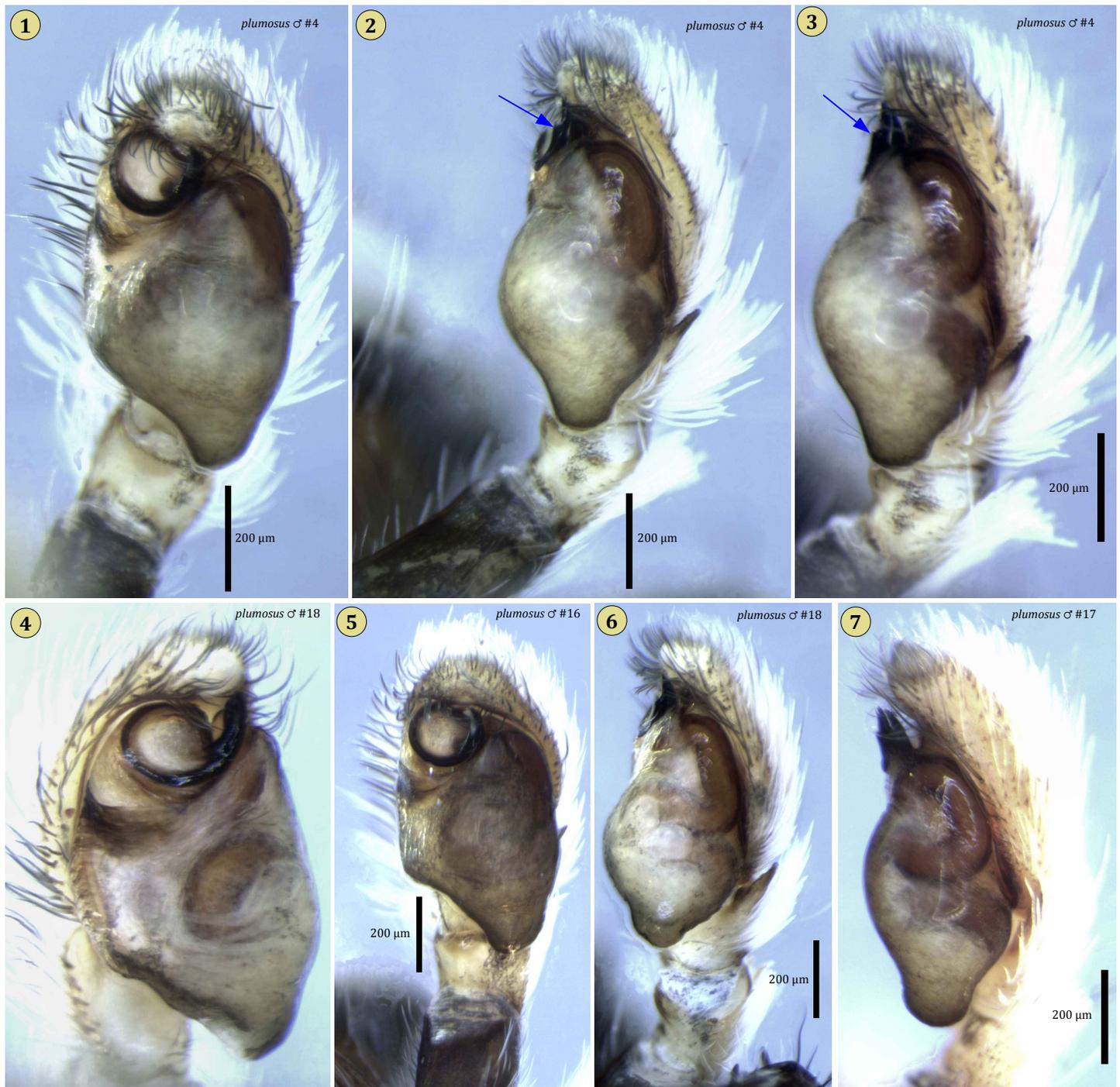


Figure 4. Left pedipalp of male *Maratus plumosus* specimens under alcohol. **1-3**, Left pedipalp of male holotype (♂#4). **4-7**, Pedipalps of three additional specimens. In all respects these are similar to pedipalps of other *Maratus*, except for an irregular distoventral edge of the thickened outer ring of the embolus (2-3: arrows), which is more angular or pointed than a similar feature observed in male *M. calcitrans* and *M. digitatus*. Other features, including the shape of the RTA (2-3, 6) and the presence of a dark, heavily sclerotized area proximomedially to the embolus, are also seen in those two species.



Figure 5. Holotype male *Maratus plumosus* (♂#4) with subdued colours due to immersion in ethanol.

Visual displays of the male. We recently (Otto & Hill 2012b) described the general features of the courtship display of *M. plumosus*. Additional photographs of this display are shown in Figure 6-7. Facing a female, a male extended its pedipalps in parallel toward the front and down, rotated the elevated opisthosoma (fan) to either the right or to the left, and extended contralateral (to the direction of opisthosomal rotation) leg III and contralateral opisthosomal flaps. In this position the extended leg III was flexed at the tibiometatarsal joint (Figure 6: 9), and repeatedly waved back and forth in a plane parallel to the body axis (Figure 7). A male might also step sideways or otherwise move relative to the position of the female, displaying alternatively to either side. Other displays, including what appear to be more general semaphore or 'alert' signals with one or both legs III, are shown in Figures 8-9.

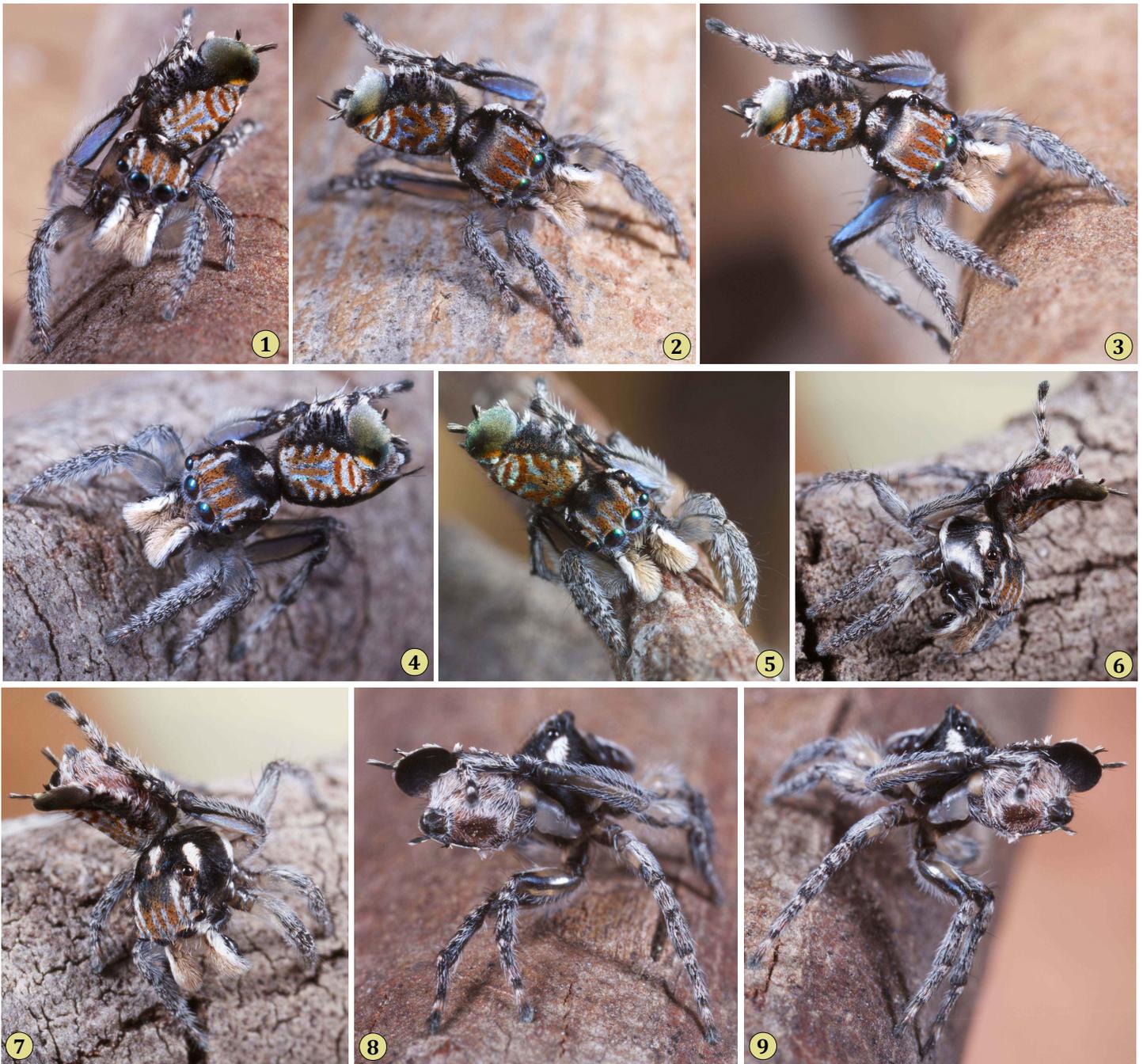


Figure 6. Display by male *Maratus plumosus* to females. **1-3**, From the front, the bright, light blue iridescent setae that cover the anterior femora III are visible. In (3) the anterior surfaces of both femora III were oriented toward the front. Note the flexion of the tibiometatarsal joint in each instance. The contralateral (on the opposite side with respect to the direction of rotation of the opisthosoma) leg III was repeatedly and rapidly (~ 7 cycles/s) flexed at the femuropatellar joint when extended in this manner. The pedipalps were held together in a medial position, extended forward and downward in front of the chelicerae, and could also be moved up and down during this display. Because the bright dorsal (anterior in this position) setae of the pedipalps cover not just the cymbium but also more proximal segments of the pedipalps, these appear very long from the front, bracketed by two nearly vertical stripes of bright white setae (1). **4-5**, The tibia and more distal segments of the leg III that is elevated were usually held behind the extended opisthosomal flaps as that leg III was flexed. **6-7**, More lateral view of display, showing position of the extended leg III behind the thin flaps. **8-9**, Posterior view of male displaying alternately to either side, showing flexion of the contralateral leg III in contact with the opisthosoma, below the flaps. The extended posterior, oval flap of the contralateral side was held directly behind the carapace of the spider as the ipsilateral flaps were retracted during this display. Note the extreme inflation of the opisthosoma in this position, a characteristic feature of *Maratus*.

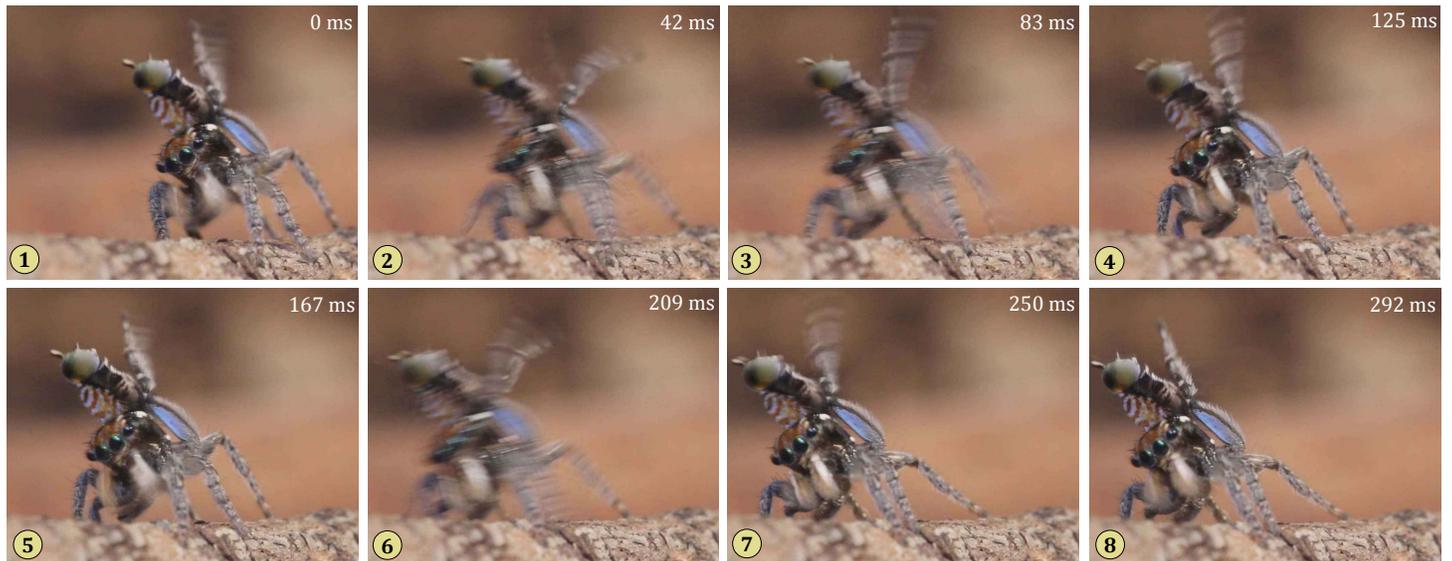


Figure 7. Sequential video frames (1-8, 23.976 FPS) of a male *Maratus plumosus* displaying to a female. Cumulative elapsed time is shown at the upper right in each frame. From (1) to (8), two cycles of leg III waving were completed as this male stepped laterally (~ 150 ms/cycle, or ~ 7 cycles/s). Note the lack of movement of contralateral femur LIII relative to the body as it was held erect to display its bright iridescent blue anterior surface.

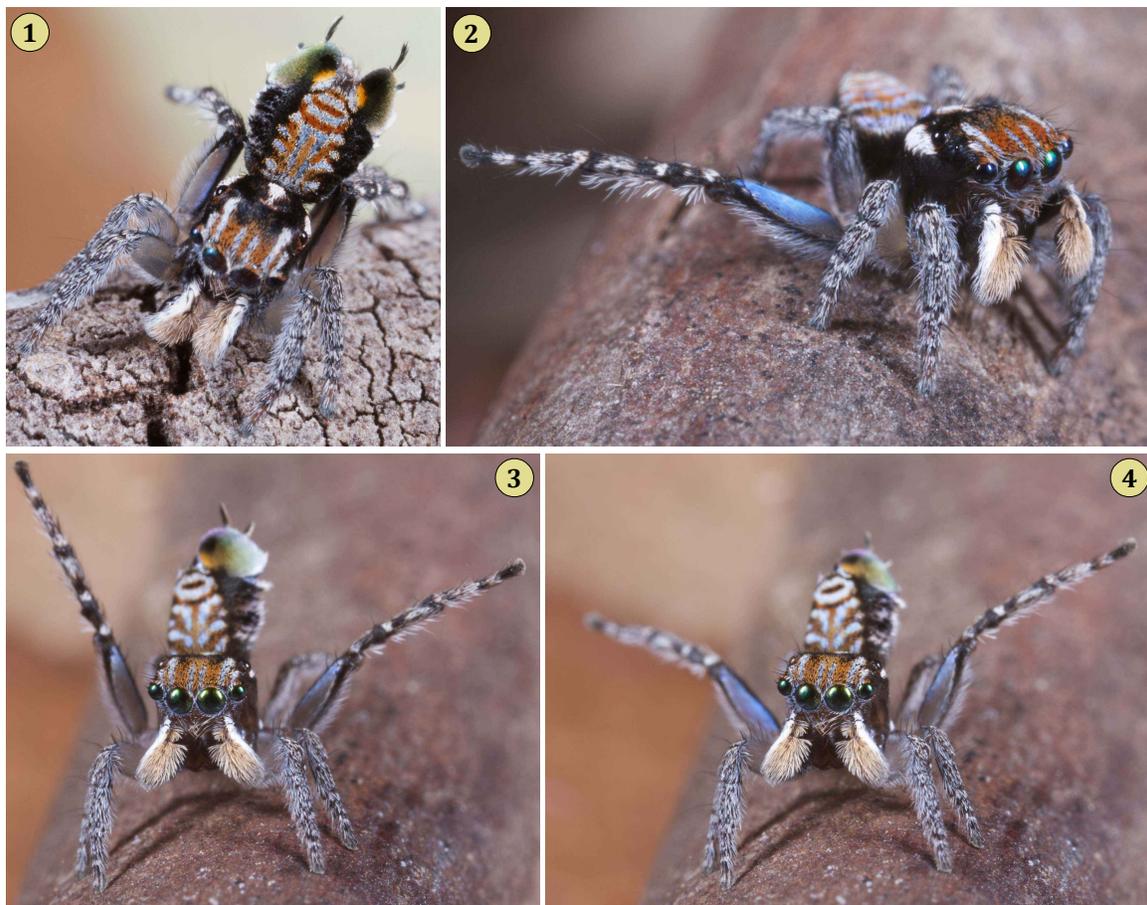


Figure 8. Other displays by male *Maratus plumosus*. **1**, Bilateral extension of flaps on both sides of the opisthosoma during display to a female. Although not usually observed, this at least demonstrates that these spiders are capable of extending flaps on both side simultaneously. **2**, Single leg semaphore with pedipalps held apart. As in other *Maratus*, this may constitute an alert or warning signal to another spider sighted at a distance. **3-4**, Bilateral semaphore signalling with body elevated, pedipalps held apart to expose the shiny anterior surfaces of the chelicerae, and extended legs III raised and lowered on both sides.

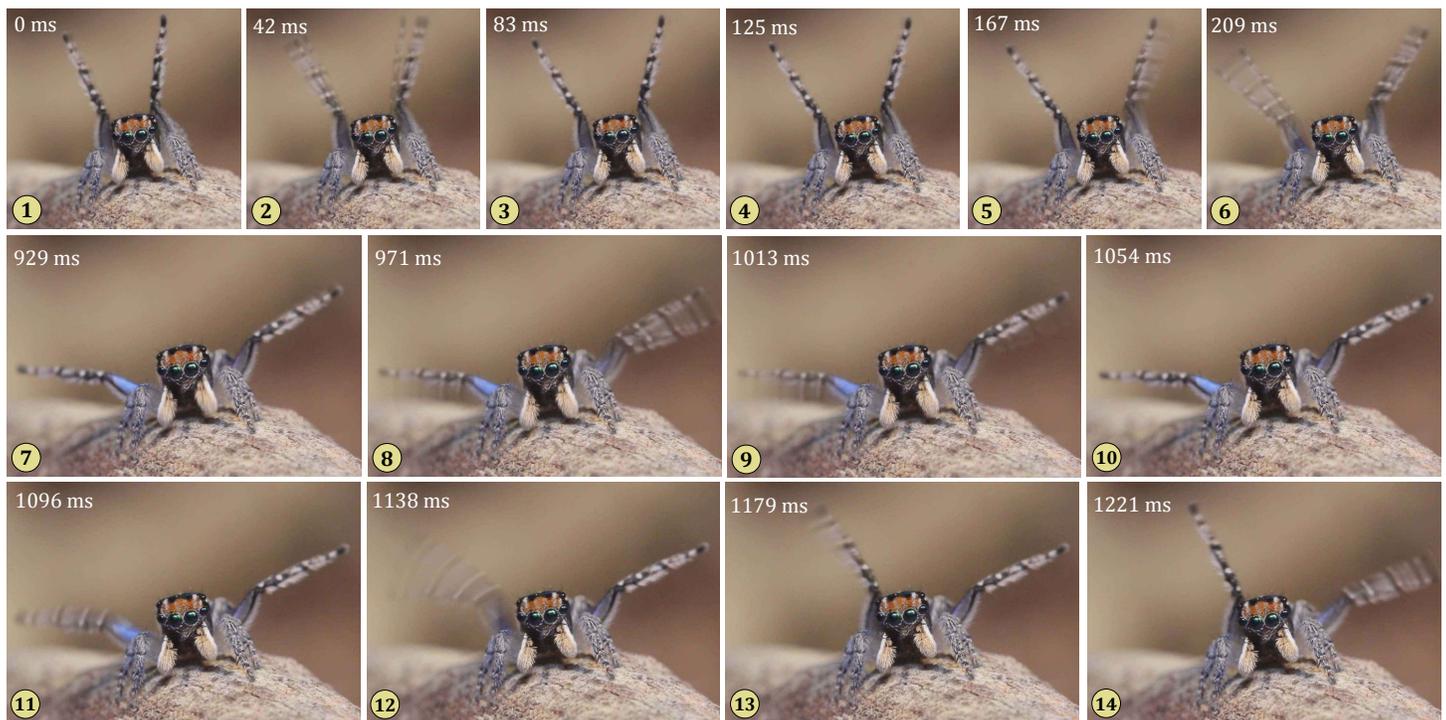


Figure 9. Two sets of sequential frames (1-6, 7-14) showing a male *Maratus plumosus* engaged in a semaphore display (23.976 fps, cumulative elapsed time shown at upper left in each frame). At this frame rate it was not possible to measure the actual rate of vibration of the extended legs III. During this display, which is thought to alert other spiders in the vicinity if present but not to represent courtship of a female, the elevated legs III were lowered in discrete steps. As can be seen in individual frames, intermittent vibration of legs III was either bilateral (6), or unilateral (11-12, 14). Pedipalps were not moved.

Description of female (Figures 10-12). Females ranged from 5.20 to 6.05 mm in body length (n=9). Externally they are virtually indistinguishable from females of *M. calcitrans* and *M. digitatus* (Otto & Hill 2012b). Chelicerae are light brown and glabrous. Long off-white setae extend ventromedially across the clypeus. The carapace is glabrous on the sides, with scattered off-white setae across an otherwise dark brown dorsum, with a more distinct band of off-white scales extending along each dorsolateral margin, below the lateral eyes. The PME are equidistant from the ALE and PLE.

The dorsal opisthosoma is dark brown with scattered off-white scales, bounded anterodorsally on either side by a thin black stripe, which in turn is bounded laterally by a broad band of off-white scales and other setae. Each off-white lateral band is also bordered below by a thin, dark stripe that extends from the pedicel to the spinnerets. Below, the opisthosoma is light brown or tan with longer white setae, appearing mostly white under alcohol, with short dark stripes laterally, and mottled medially.

Legs I and II are about the same length, shorter than legs III and IV which are of similar length. All legs are light brown and translucent in living animals, but white in preserved specimens under alcohol. They are covered with scattered off-white setae, with more or less distinct dark brown (or black under alcohol) rings on each segment. Spinnerets light brown to grey. As in the male, a small triangular tuft of white setae lies above the anal tubercle. The translucent light brown (white in preserved specimens) pedipalps are covered in front with long off-white setae, and have dark rings on each segment like those on the legs.



Figure 10. Five living female *Maratus plumosus*, all from the type locality. Those identified with letters instead of numbers are not paratype specimens. **10-12,** As do other *Maratus*, females can elevate their opisthosoma to display to males. By doing so, they appear to be warning them to stay away.



Figure 11. Three female *Maratus plumosus* (paratype specimens). In alcohol, these lose their light brown pigmentation and appear to be solid white instead of translucent.

The epigynum (Figure 12) is very similar to that of other *Maratus* females, particularly *M. digitatus*, with a pair of large fossae and larger posterior spermathecae. Sclerotization or darkness of internal ducts anterior to the spermathecae varies.

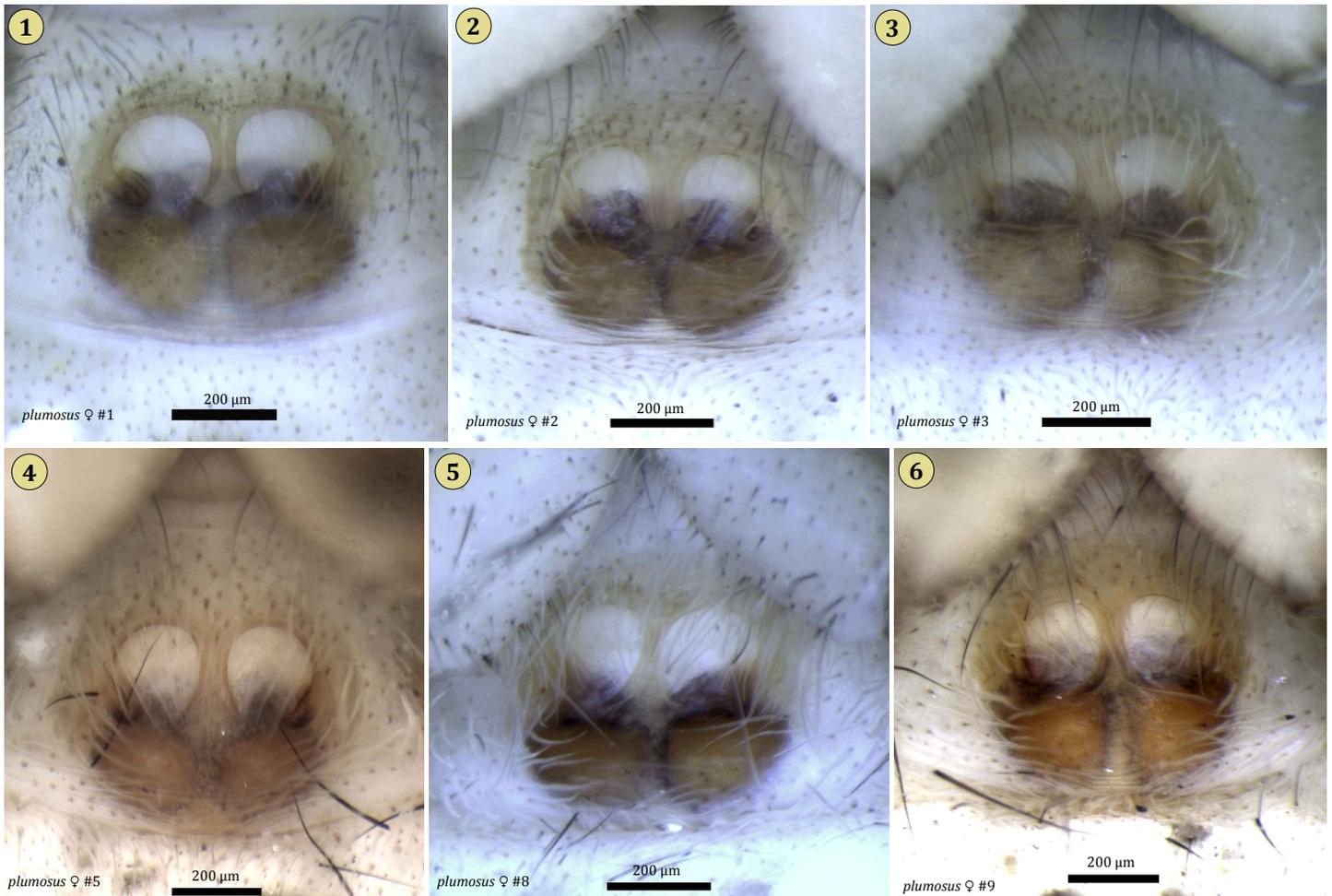


Figure 12. Exterior, ventral view of epigynum of six female *Maratus plumosus* (paratypes).

Immatures. Three penultimate males are shown in Figure 13. Like females, colouration is cryptic and scales or setae are primarily white to light brown, but the cuticle of the carapace and dorsal opisthosoma is black. They are strongly patterned in a manner suggestive of, but not close to, the colouration of the adult male, with three white stripes of the posterodorsal carapace, and black spots that appear much like a pair of eyes facing to the rear.

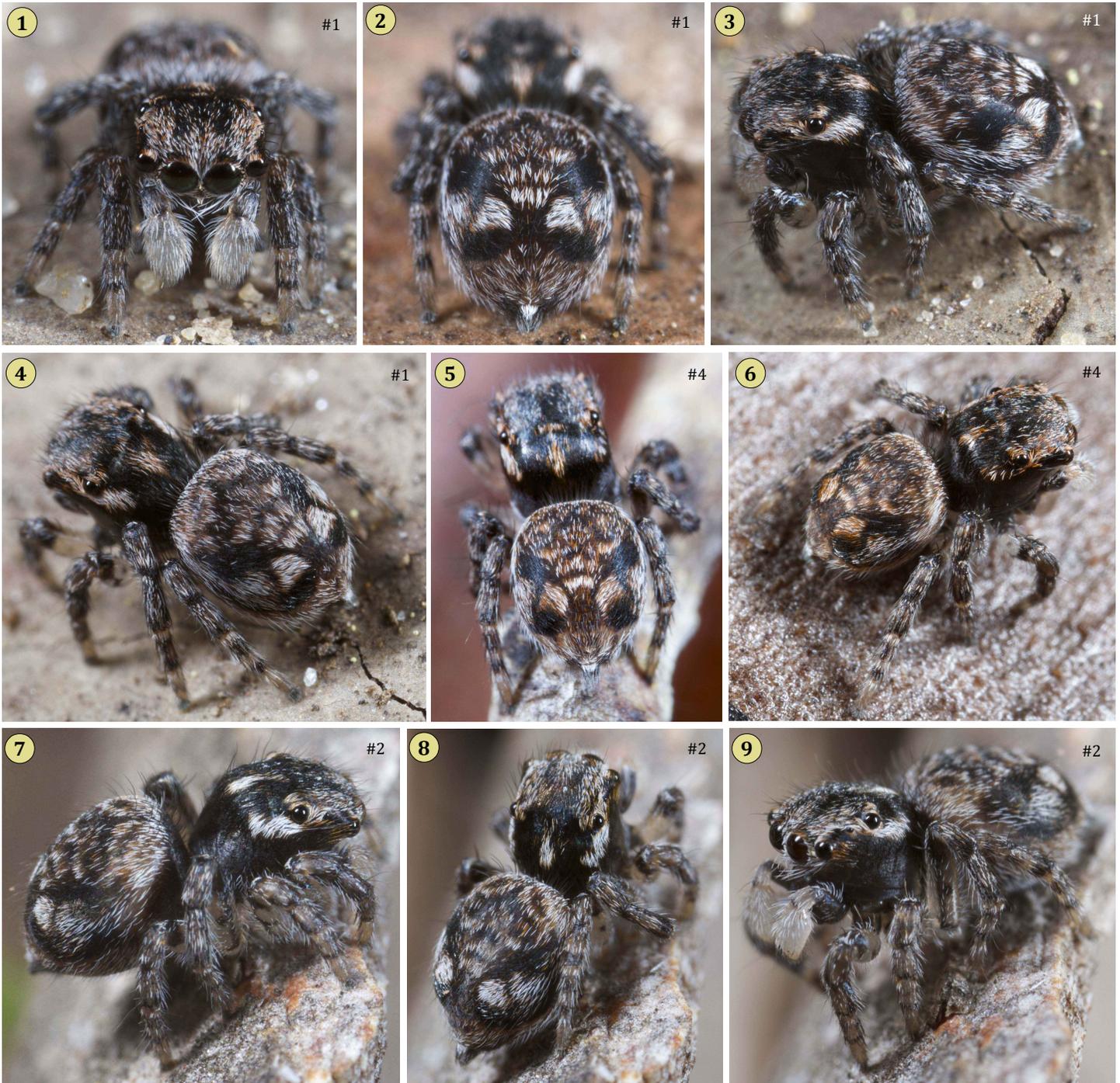


Figure 13. Three different (1-4, 5-6, 7-9) penultimate male *Maratus plumosus*, all from the type locality. Note the three white stripes of the black posterior carapace, and the high contrast pattern of the dorsal opisthosoma that bears some resemblance to that of the adult male.

Maratus tasmanicus*, new speciesMaratus* species C, Otto & Hill 2011, p. 24-25, figs. 29-30.

Type specimens. The holotype male (♂#1) and 7 paratypes (3 males, 3 females, and 1 immature female) were collected in Stanley, Tasmania (40°46'30.71"S, 145°16'58.65"E, 26 DEC 2010, J. Otto coll.). Two of the four males were collected as immatures and developed into adults early MAR 2011. All will be deposited in the Tasmanian Museum & Art Gallery (TMAG), Hobart. One additional paratype specimen that we have identified as *M. tasmanicus* was previously collected at Anson's Bay in northeastern Tasmania (Australian Museum KS.30911, 41°3'S, 148°17'E, 1 JAN 1929, V. V. Hickman coll.), and Framenau (2009) also posted a photograph of a *Maratus* from Eucla (southeastern corner of Western Australia) that almost certainly represents a male of this species (Figure 14).

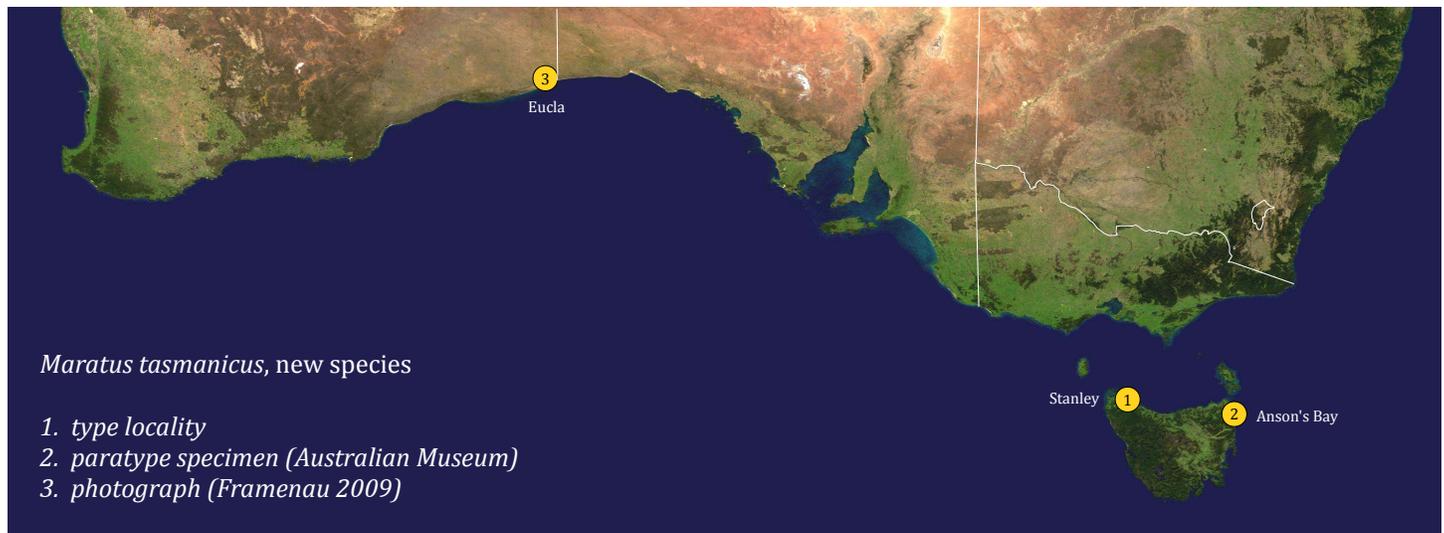


Figure 14. Distribution of *Maratus tasmanicus* in southern Australia. Satellite Image courtesy of NASA Visible Earth Project.

Etymology. The species group name (*tasmanicus*, adj., Latin form, English translation *Tasmanian*) refers to the fact that this spider was found in Tasmania.

Diagnosis. The pattern of scales on the dorsal prosoma and opisthosoma of the male is characteristic, and unlike that of any other species of *Maratus*. The striped pattern of the ocular area of *M. tasmanicus* resembles that of *M. volans* (O. Pickard-Cambridge 1874), but also bears an additional red-orange median stripe. The large black spots on the lateral opisthosomal flaps of male *M. tasmanicus* are seen in other *Maratus*, including *M. amabilis* Karsch 1878, but these are not present in *M. volans*. These flaps are similar in shape to those of *M. harrisi* Otto & Hill 2011 and *M. vespertilio* (Simon 1901). The latter species, although cryptic in colouration (Otto & Hill 2011), also bears a similar pattern of stripes in the ocular area. The presence of colourful orange rings on bright white legs I and II also distinguishes male *M. tasmanicus*.

Description of male (Figures 15-18). The type males (n=4) range from 4.39 to 5.10 mm in body length. Chelicerae short, narrow, dark brown, and glabrous. Long white setae project ventromedially across the clypeus beneath each AME. AME bordered with scales. Ocular area with nine longitudinal stripes, one median red-orange stripe and four stripes of alternating colour on either side: broad grey, narrower red-orange (behind AME), broad grey, and narrower red-orange along each lateral eye row. Behind ocular area the carapace is dark brown with scattered orange-brown scales, with a median white stripe and a lateral white stripe, both comprised of bright white scales, extending along the top of the carapace behind each PLE. Except for a narrow marginal band of bright white scales on either side, the rear and sides of the carapace are dark brown and glabrous. PME slightly closer to the PLE than to the ALE.

The dorsal opisthosoma bears long white setae extending to the front of the anterior margin, and a distinctive pattern of three broad stripes comprised of orange to red-orange pigmented scales on a field of iridescent blue-green scales. On either side these stripes are joined at the front to a lateral band of brighter red-orange scales, and encircled at the rear by a transverse, curved band of equally bright red-orange scales. Each lateral flap bears a large central black spot surrounded by a field of iridescent blue-green scales, the latter continuous with those of the dorsum. The spinnerets are black to dark brown with a triangular patch of bright white, posteromedially oriented setae, above the anal tubercle. Ventrally, the opisthosoma is brown (or white in preserved specimens) with many white setae, and three more or less distinct brown stripes on either side where the setae are sparse. The sternum is darker.

Legs I and II are about the same length, shorter than legs III and IV. Leg III is by far the longest. Legs I and II are strongly ringed, with alternating white and orange rings. Legs IV are similarly, but less distinctly, ringed. Legs III are more uniformly dark brown to black, particularly on the tibiae and metatarsi that are fringed with white setae below, with a narrow, dark ring separating bright white setae that otherwise cover the distal metatarsi and tarsi. White setae are also present on the anterior surface of each femur III, and the dorsal surface of each patella III.

Basal segments of the pedipalps are dark brown, distal segments light brown and covered anteriorly and laterally with long white setae. The detailed structure of the pedipalps (Figure 18) is similar in all respects to that of other *Maratus*. The distal embolus is heavy and appears to have two apices when viewed laterally. An area of heavily sclerotized cuticle can be observed on that part of the tegulum that is proximomedial to the ring of the embolus.



Figure 15. Two rear views of a paratype male *Maratus tasmanicus* (σ #2). The colouration of the dorsal opisthosoma is associated with orange to red-orange pigmented scales arranged in stripes or bands on a field of blue-green iridescent scales (1), but the observed colour of the iridescent scales is highly directional and can also appear as dull green to purple as shown here (2).

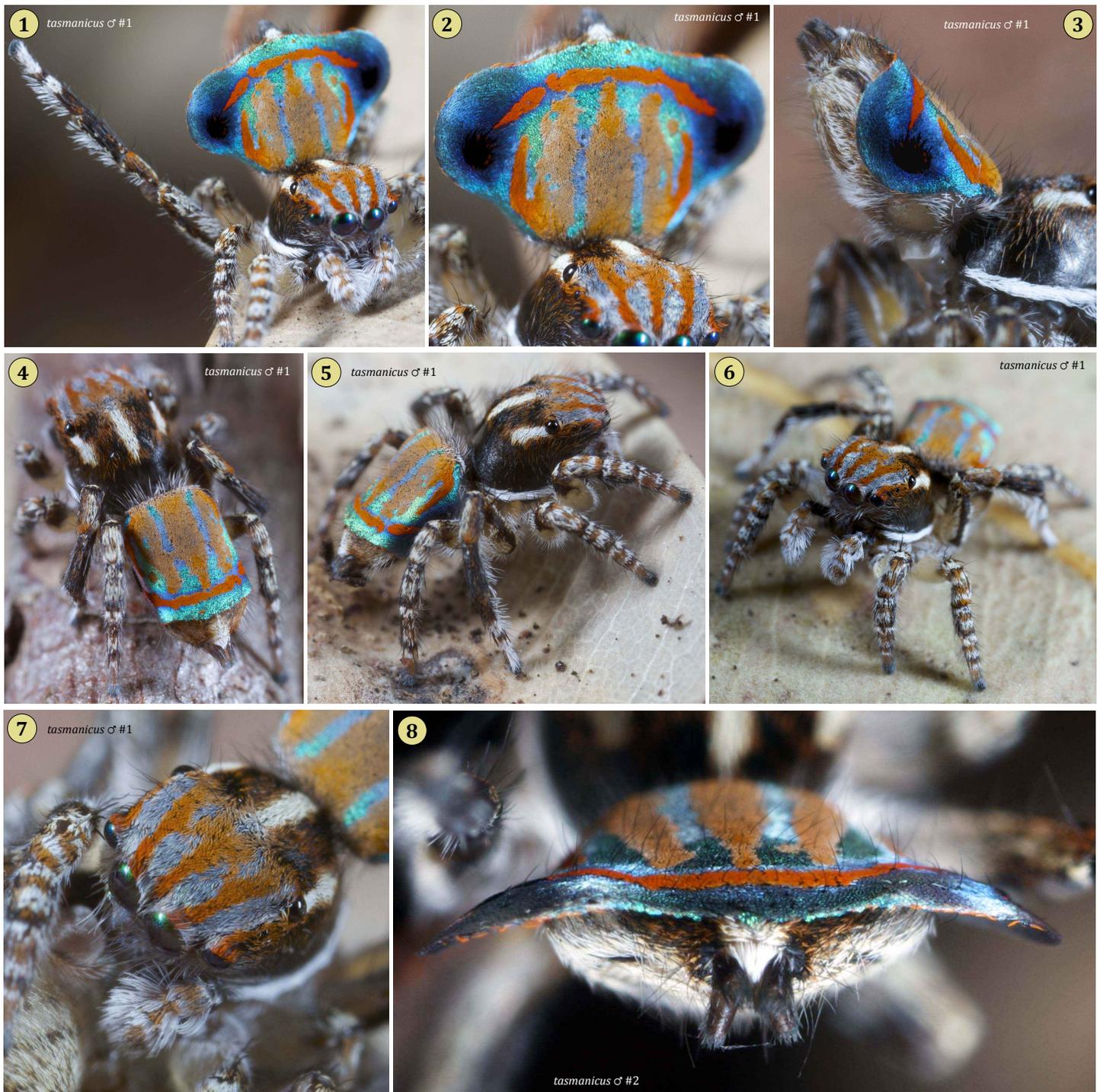


Figure 16. Holotype (1-7, ♂#1) and paratype (8, ♂#2) male *Maratus tasmanicus*. **1-2**, Opisthosoma elevated with extended lateral flaps, and legs III extended during display to a female. The pattern of five longitudinal orange to red-orange stripes on the ocular area of the carapace appears to continue the similar pattern of five opisthosomal stripes when viewed from the front like this. **3**, Detail of right lateral flap when folded or retracted. **4-6**, More views of the holotype male. **7**, Detail of dorsal carapace, showing alternating red-orange and grey stripes in the ocular area, and fewer alternating white and brown stripes behind this. **8**, Elevated opisthosoma with extended flaps of a paratype male, viewed from above.

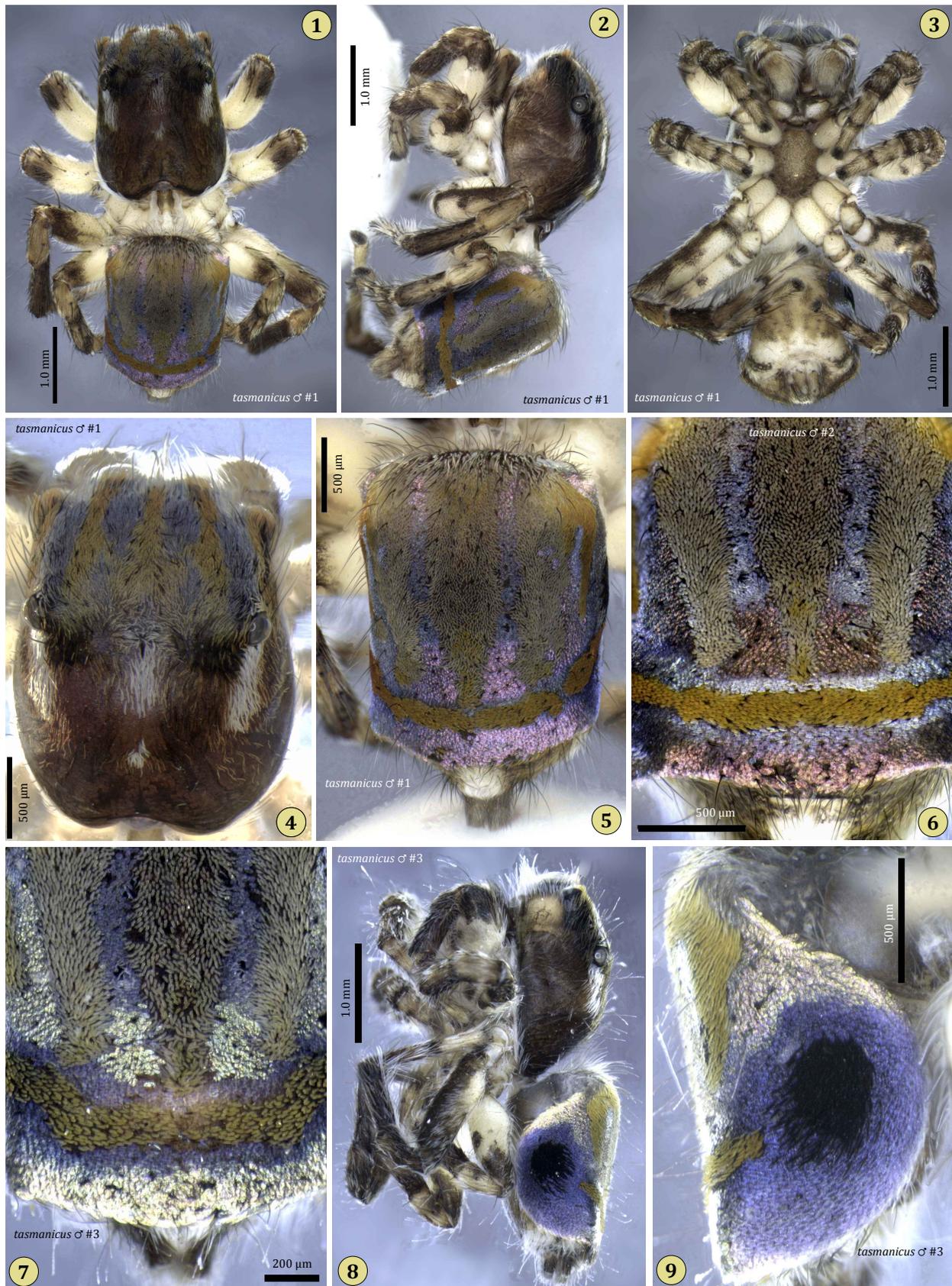


Figure 17. Holotype (1-5) and paratype (6-9) male specimens of *Maratus tasmanicus*, under alcohol. Colours differ significantly from those of living spiders (see Figures 12-13) as pigmented scales fade and submersion alters the physical properties of iridescent scales. **1-3**, Dorsal, lateral and ventral views of holotype. **4**, Dorsal view of carapace. **5-7**, Detail of scales covering the dorsal opisthosoma of 3 different males. **8**, Lateral view of a paratype male showing the retracted left lateral flap of the opisthosoma. **9**, Detailed lateral view (with dorsal direction to the left) of the retracted right lateral flap of the paratype specimen shown in (8).

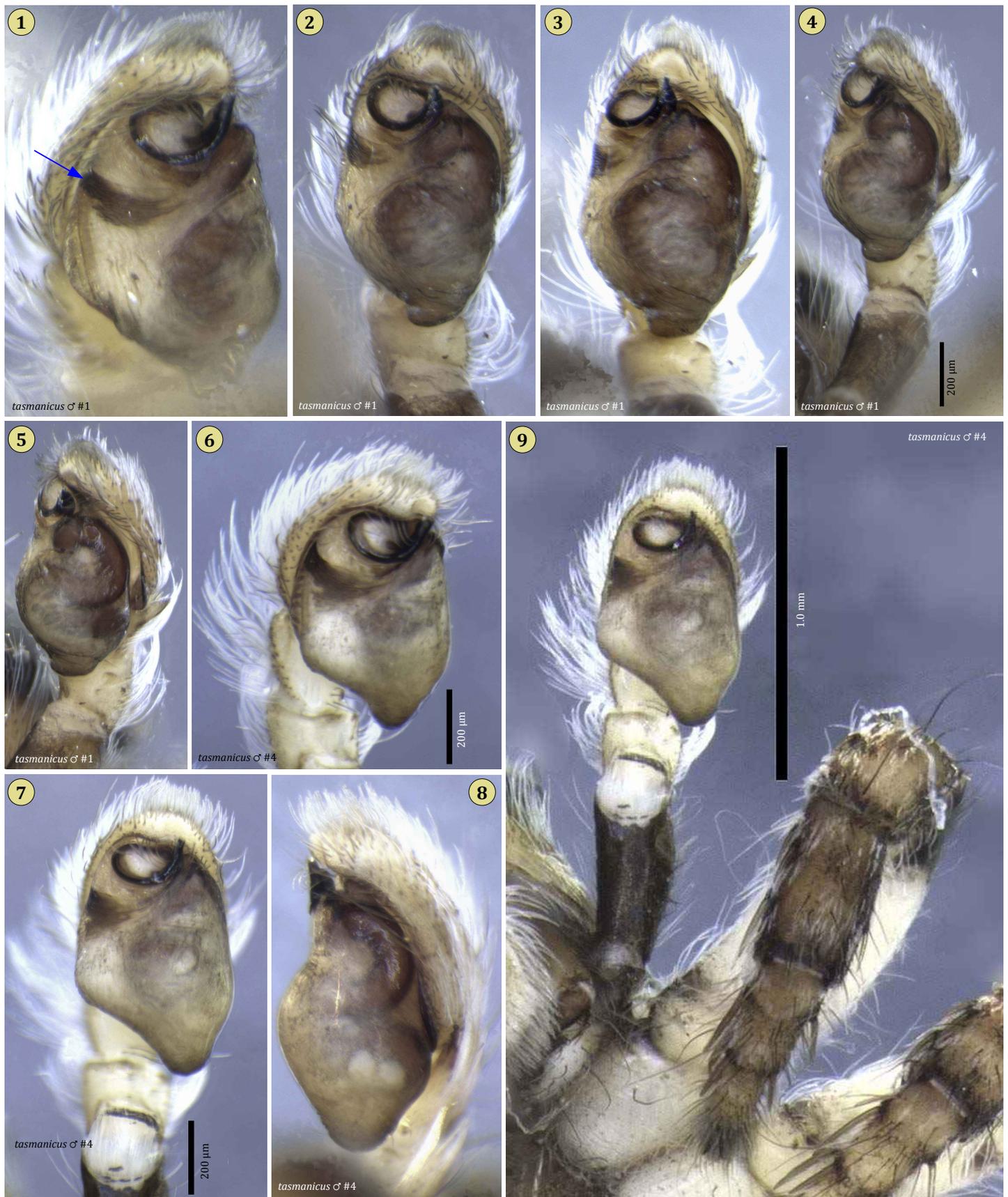


Figure 18. Left pedipalp of holotype (1-5, ♂#1) and paratype (6-9, ♂#4) male specimens of *Maratus tasmanicus*. In all respects, including sclerotization of the tegulum proximomedially to the ring of the embolus (1, arrow), this is similar to the pedipalp of other *Maratus* species.

Visual displays of the male. Photographs of courtship and mating by *M. tasmanicus* are shown in Figures 19-21. A video that depicts this behaviour is also available (Otto 2011b). During display, the male faces a female, extends and raises legs III bilaterally, and elevates the opisthosoma with flaps extended (the *fan*). Active movement during this display includes bilateral up-and-down vibration of the pedipalps, bilateral vibration or rapid waving of fully extended legs III (held overhead or in a V- or wide-V-shaped configuration) in a transverse plane, and slight rotation or vibration of the raised and expanded opisthosoma in a transverse plane. The speed of these combined vibrations varies, about 2-5/s, and the male may also step quickly from side to side as it vibrates in this manner. During this movement legs III may be flexed and then extended slightly at the tibiometatarsal joint. Males may also retract the opisthosomal flaps and rapidly vibrate the lowered opisthosoma up-and-down (*bobbing*) as the extended legs III are vibrated. This *bobbing* behaviour (seen in many salticid species) has also been observed when a male approaches a female that has stopped moving, as it holds extended legs III out to the sides and reaches forward to touch the carapace of the female with legs I (Figure 21). This is much like the approach behaviour that we have observed in other *Maratus* (Otto & Hill 2012b). The pattern of rapid movement of legs III and side to side movement of the fan during the fan dance is similar to that of *M. volans* (Hill 2009, Otto 2011a, Girard *et al.* 2011).

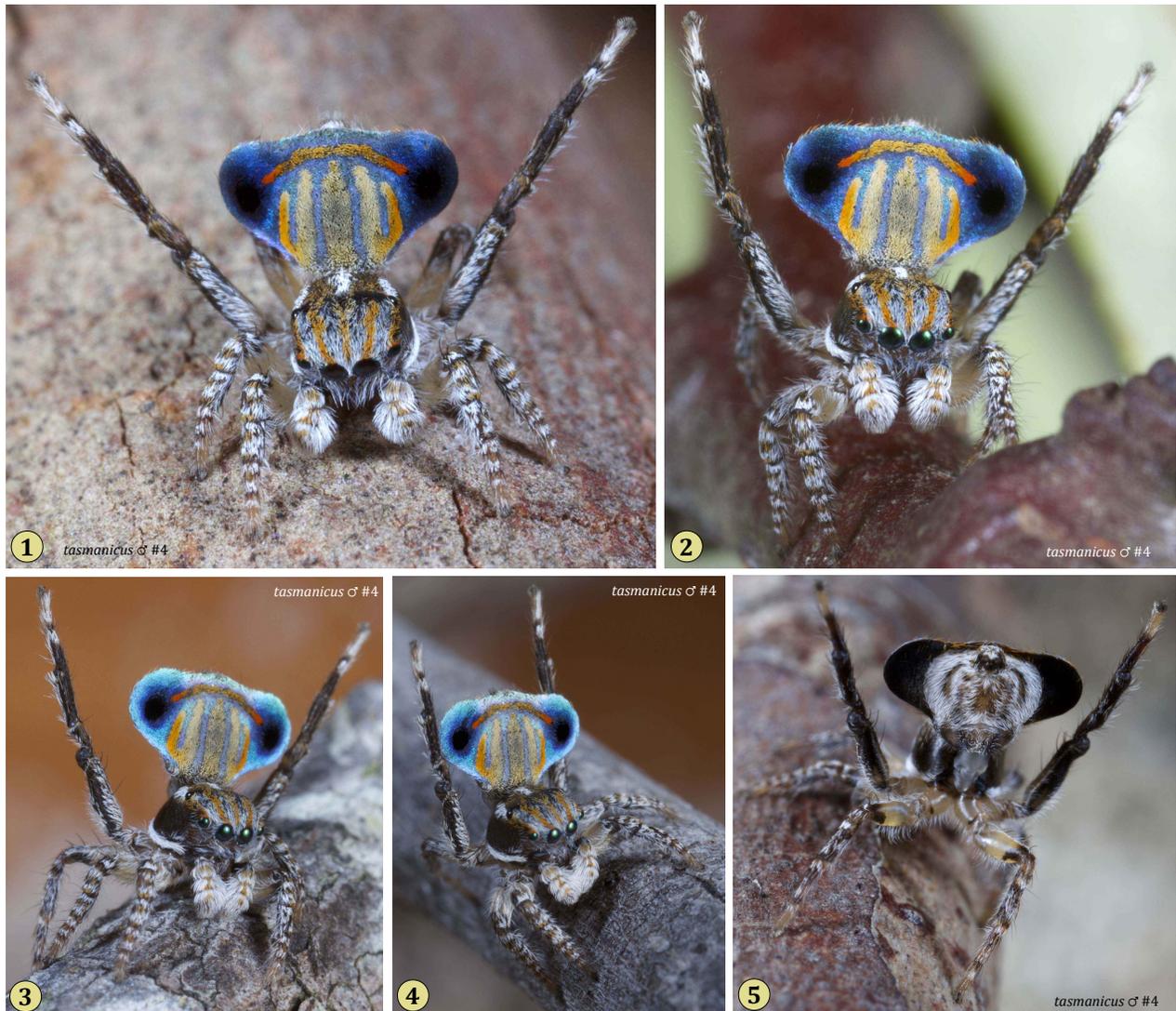


Figure 19. Visual courtship display by a paratype male *Maratus tasmanicus*. 1-4, Front views of courtship display. The angle formed by the extended legs III, as determined by the degree of flexion at the trochantofemoral joint, varied. 5, Rear view of display, showing hyperextension of the pedicel that is typical of *Maratus* species. Note also the separation of white bands of setae on the underside of the opisthosoma by dark brown stripes, and the dark brown to black posterior surface of legs III.

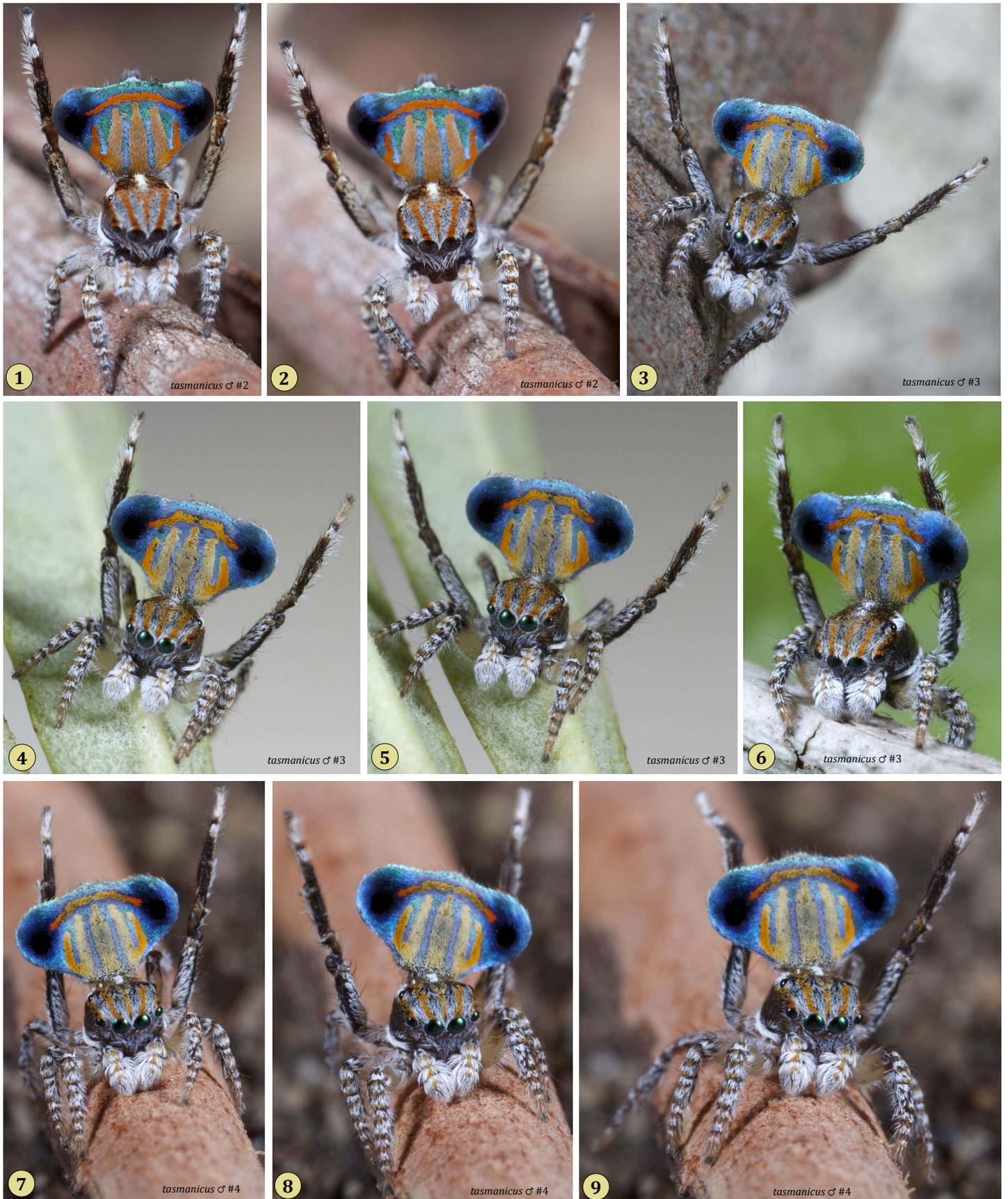


Figure 20. Visual courtship display (*fan dance*) positions of three different paratype male *Maratus tasmanicus* (1-2, 4-6, 7-9). During each display, extended legs III were waved (lowered and raised slightly) in a transverse plane as the elevated opisthosoma (*fan*) was rotated from side to side.



Figure 21. Approach and mating by *Maratus tasmanicus*. **1**, Male extending its legs I to contact the female before mounting, with legs III extended laterally. **2**, Mating position.

Description of female (Figures 22-24). The paratype females (n=3) range from 5.24 to 5.62 mm in body length. The chelicerae are translucent brown and glabrous. Long white setae cover the clypeus and project forward over the chelicerae. Scales, mostly light brown, surround the AME. The ocular area is covered with light brown setae, with three indistinct longitudinal bands of brown setae. The PME are almost equidistant between the ALE and PLE. Behind the ocular area the top of the carapace is also covered with light brown scales at the center, and darker brown markings laterally. Behind, the carapace is dark and glabrous. On the sides, except at the front behind the chelicerae (where it is light brown, translucent, and glabrous) the carapace bears a thin covering of long white setae.

The opisthosoma is also covered with light brown setae, and marked by distinctive tracts of dark brown or bright white setae. Lighter setae dominate the lateral margins of the opisthosoma. These patterns vary somewhat by individual (Figures 22-23). The spinnerets are black with dark setae, and above these is a small median, triangular tuft of bright white setae above the anal tubercle.

Legs I and II are much shorter than legs III and IV and similar in length. All legs are similar in appearance, translucent light brown bearing light brown to white setae, with a dark brown ring at the end of each segment. The underside of the legs, sternum, and endites is light brown, but this colour fades to white in preserved specimens.

Pedipalps are also light brown with many long, white setae. Like the legs, these appear white in preserved specimens.

The epigynum (Figure 23) is similar to epigyna previously described for other *Maratus* species. A pair of nearly circular, anterior fossae are well separated, in front of a pair of larger posterior spermathecae that are highly sclerotized and almost contiguous at the midline. The extent of sclerotization of ducts behind the fossae, and the resultant visibility of these ducts from the exterior, varies.

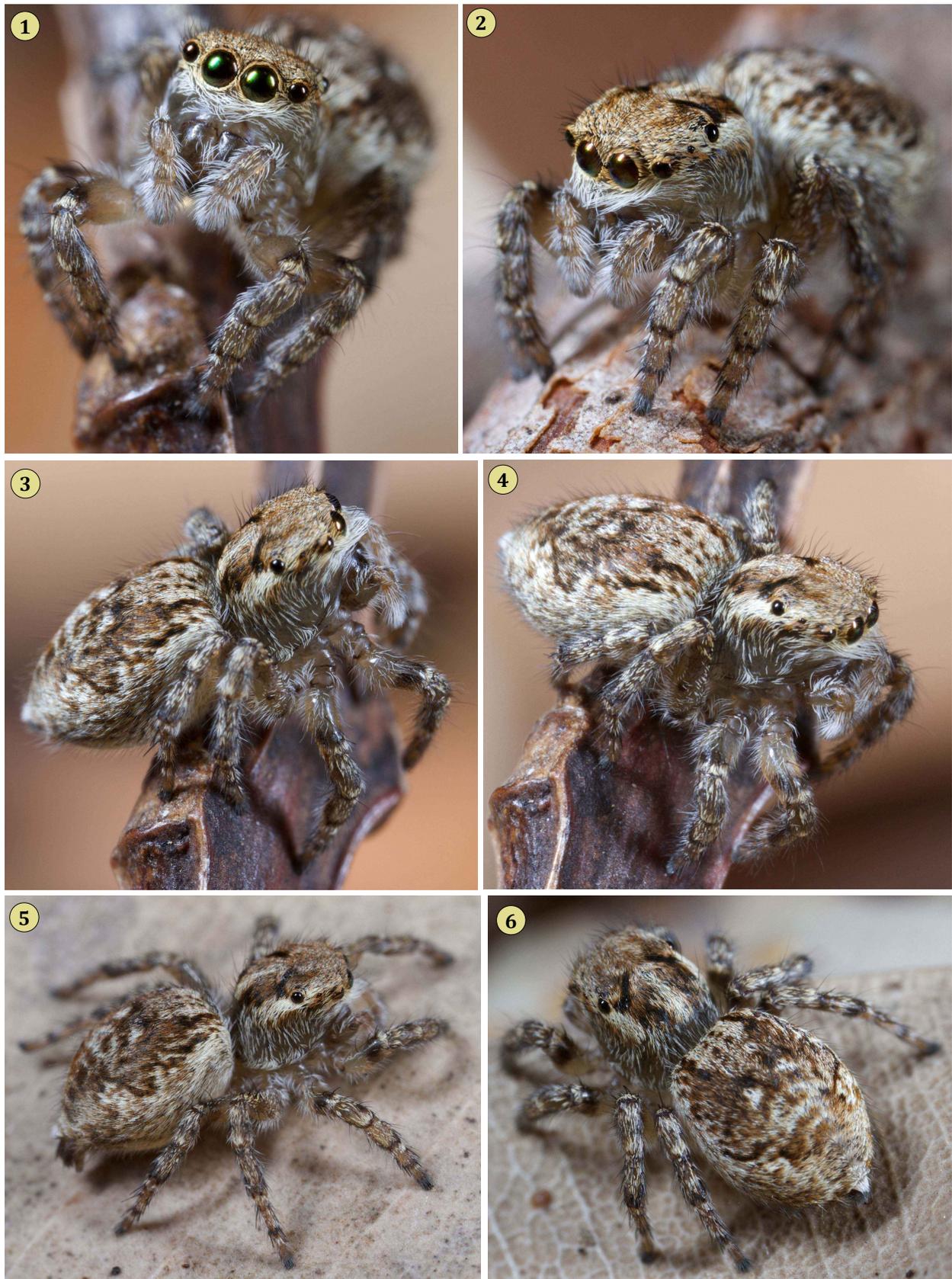


Figure 22. Living paratype female *Maratus tasmanicus* (♀#1). Although lacking the many coloured scales of the male, females exhibit a relatively bold pattern comprised of light to dark brown and black or white scales or setae.



Figure 23. Living paratype female *Maratus tasmanicus* (♀#2). 1, Feeding on a winged insect. 2, Lateral view, with opisthosoma slightly raised. 3-4, Rearing the opisthosoma in a display that is thought to warn off males in the vicinity. 5, Posterodorsal view, showing triangular patch of white setae above the dark posterior spinnerets, and the dark glabrous posterior slope of the carapace.

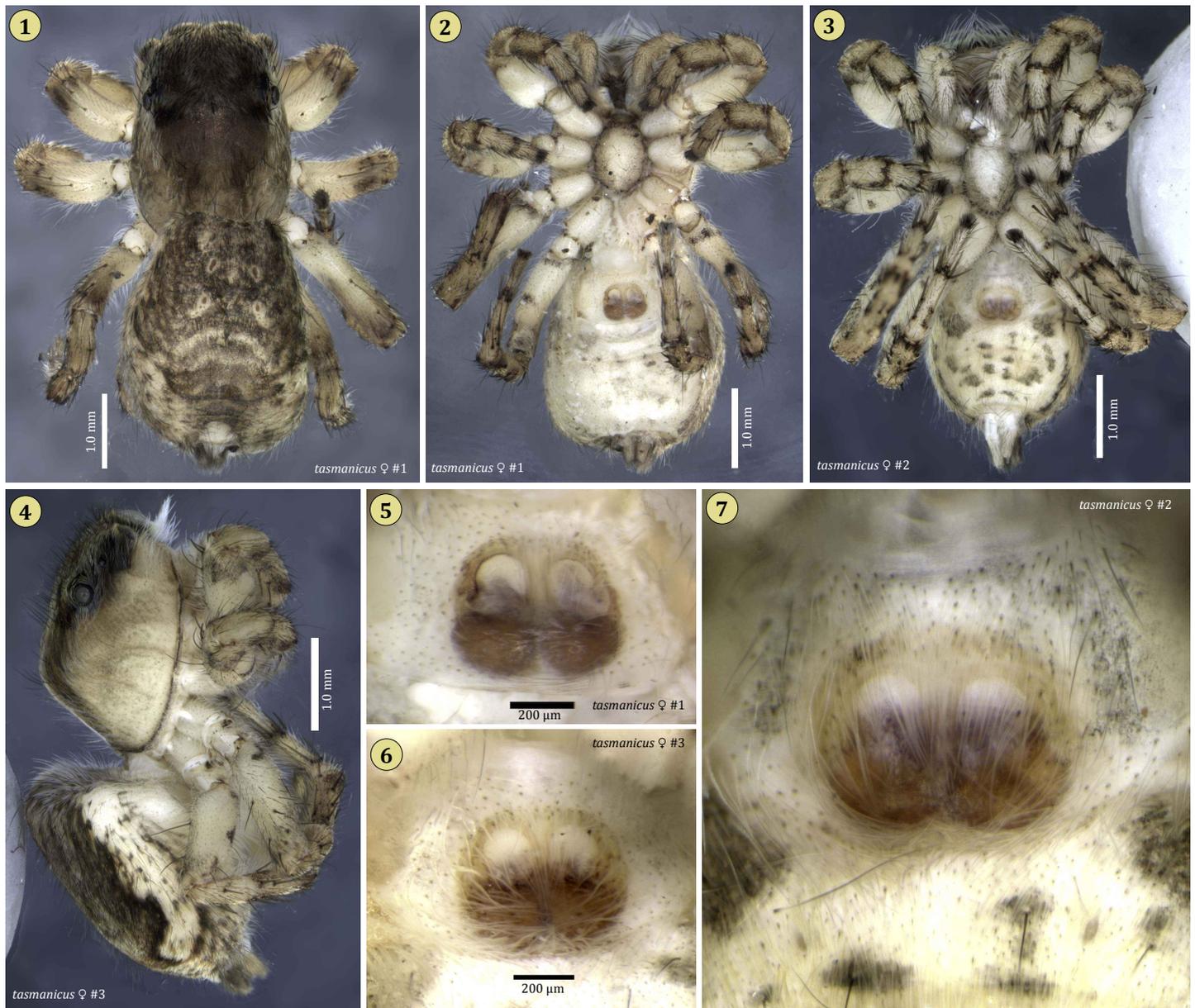


Figure 24. Paratype female specimens of *Maratus tasmanicus*, under alcohol. Most of the brown pigment has faded in these specimens, and the light brown translucent quality of most of the cuticle cannot be seen. 5-7, Detailed view of the epigyna of the three paratype females. These are similar to the epigyna of other *Maratus* in general shape and appearance (round anterior fossae smaller and more separate than the large posterior spermathecae), but the extent of sclerotization (and external visibility) of ducts is greater than the norm for this genus, sometimes occupying the posterior half of the fossae.

Immatures. Immature males (Figure 25) exhibit bold white to dark brown markings that resemble those of the adult male. These include dark segmental leg rings as well as mostly longitudinal stripes of both the dorsal carapace and the dorsal opisthosoma.

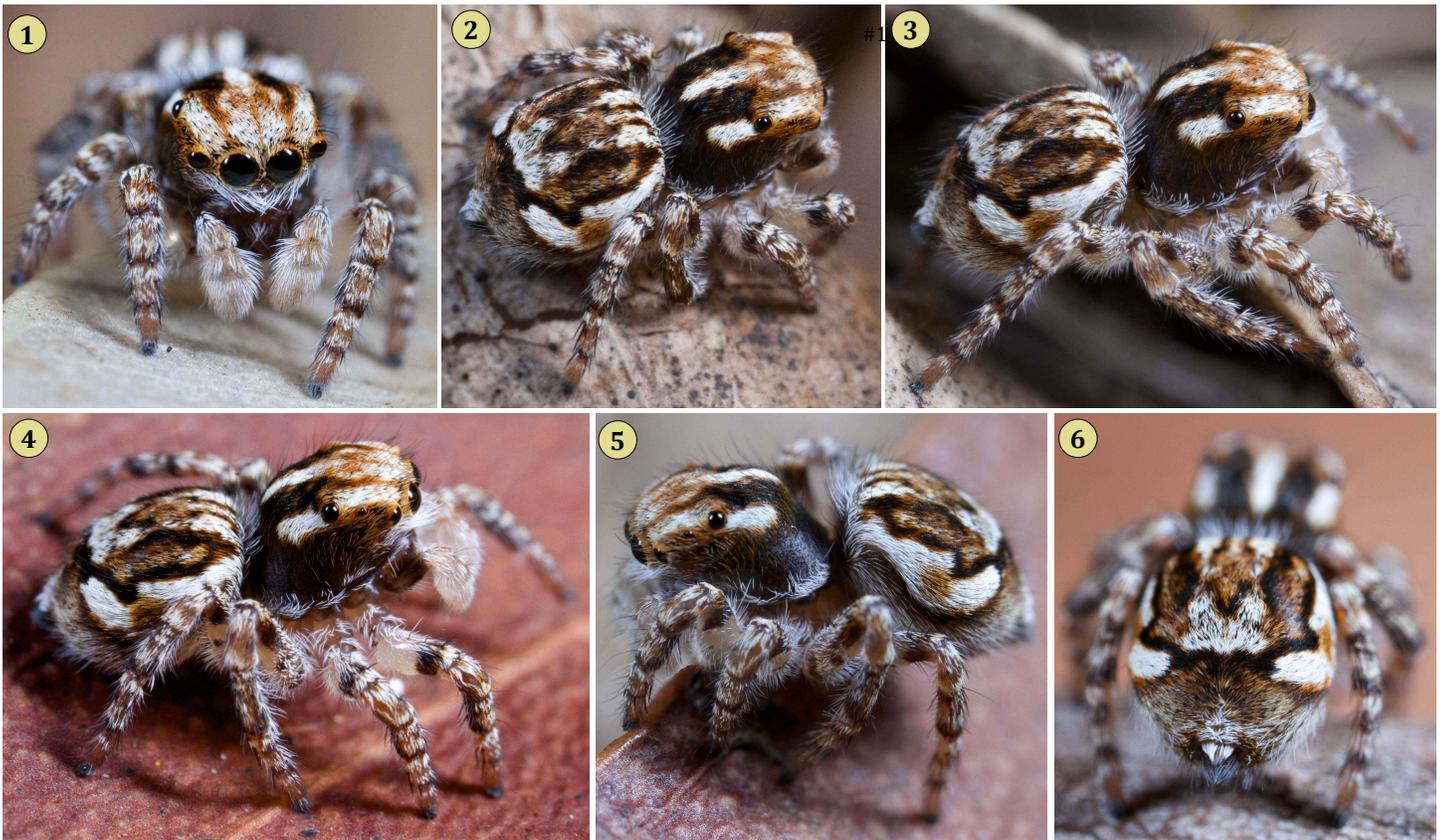


Figure 25. Penultimate male *Maratus tasmanicus*, from the type locality. The bold markings comprised of white to dark brown scales are much more prominent than those of an adult female. Except for their lack of colour and opisthosomal flaps, these markings resemble those of the adult male.

Maratus watagansi, new species

Type specimens. The holotype male (σ #2) and 13 paratypes (7 males and 6 females) were collected near the Boarding House Dam, Watagans National Park, New South Wales (32°59'53.20"S, 151°24'17.52"E, 23 DEC 2012, J. Otto coll.). All will be deposited in the Australian Museum, Sydney.

Etymology. The species group name (*watagansi*, gen. s., Latin form, English translation of *the Watagans*) refers to the *Watagans* of New South Wales where this spider was found.

Diagnosis. Superficially, male *M. watagansi* look much like male *Saitis barbipes* (Simon 1868), the type species for *Saitis* Simon 1901. Unlike other *Maratus* (*peacock spiders*) that have been described, male *M. watagansi* do not raise their opisthosoma as they display to females. However, the pedipalps, epigyna and many other features of *M. watagansi* are similar to those of both *M. pavonis* Dunn 1947 and *M. splendens* Rainbow 1896. Male *M. watagansi* also have a dorsal opisthosomal plate that, although it is not raised, may bear several iridescent scales near the center. Although *M. watagansi* can be readily distinguished from those two species (Hill & Otto 2011, Otto & Hill 2011) by its colouration, we consider many aspects of its display to be very similar. We thus consider it to represent a member of what we have called the *pavonis* group (of *Maratus*) that has lost its fan dance in the course of its evolution.

Description of male (Figures 26-29, *M. pavonis* and *M. splendens* pedipalps are shown for comparison in Figure 30). The type males (n=8) range from 3.62 to 4.26 mm in body length. The chelicerae are short, dark brown, and glabrous. A few long white setae cross the clypeus. The AME are ringed with scales, white below and red-orange above. The ocular area is covered with more or less uniform light brown to brown scales, with orange scales above the anterior eyes. The PME are distinctly closer to the PLE than to

the ALE. Behind this is a broad median band of light brown setae, surrounded by the dark brown, glabrous surface of the carapace that bears only a few scattered setae. On either side is a narrow marginal band of white setae.

The dorsal opisthosoma bears a long covering plate of the same shape as that found in *M. pavonis* individuals that also do not have lateral flaps (Hill & Otto 2011). At the center this is covered with uniform tan or light brown pigmented scales, often with a small central patch of iridescent blue-green scales, encircled laterally, and to a lesser extent at the rear, by broad bands of dark red-brown or orange-brown pigmented scales. Below this plate, the lateral margins of the opisthosoma may bear dark stripes anteriorly, and the underside of the opisthosoma is mottled with irregular dark spots. Spinnerets are dark with white tips, and above these is a small triangular patch of white scales.

Legs I and II are shorter than legs III and IV and of the same length. Legs I-II and IV are translucent light brown with dark segmental rings. These rings are narrow on legs I and II and much wider on legs IV. Above, the femora of legs I and II bear long white setae above, and are black below. Legs III, by far the longest, have prominent fringes of long black setae below along most of their length, longer and expanded on all sides of the metatarsus. These legs are otherwise dark red, except for the tarsi which are covered with short white hairs.

The pedipalps are light brown and translucent, with anterior (medial) fringes of long white setae that are often held together to form a continuous white band beneath the anterior eyes. An outer ring of the embolus is enlarged distally (laterally) to form a distinct third component of the apex of that structure (Figure 29: 3). The medial shoulder of the tegulum is heavily sclerotized (g in Figure 29: 3), and there is also a heavily sclerotized lateral margin or cusp of the cymbium near the RTA. The RTA is blunt and dark at the end.

Comparison with related species. We previously published (Hill & Otto 2011) detailed descriptions of *M. pavonis* and *M. splendens* that facilitate this comparison. Dunn (1947) published a drawing of the pedipalp of *M. pavonis* when he described that species, but his simple sketch revealed little detail. Here (Figure 30) we present illustrations of the pedipalps of both species, to show their similarity to the pedipalp of the male *M. watagansi*. This resemblance includes both colour and setation of the exposed dorsal (anterior) surfaces of these pedipalps as they are held together in front of the chelicerae, beneath the anterior eye row. There are many other similarities between these three species, including the lack of distinct lines in the ocular area, the position of the PME, a median band on the posterior carapace, narrow white marginal bands of the carapace, the general pattern of a reddish parens or circle surrounding a field of tan or iridescent blue green scales on the opisthosomal plate, and even the detailed setation and appearance of the legs (particularly leg III).

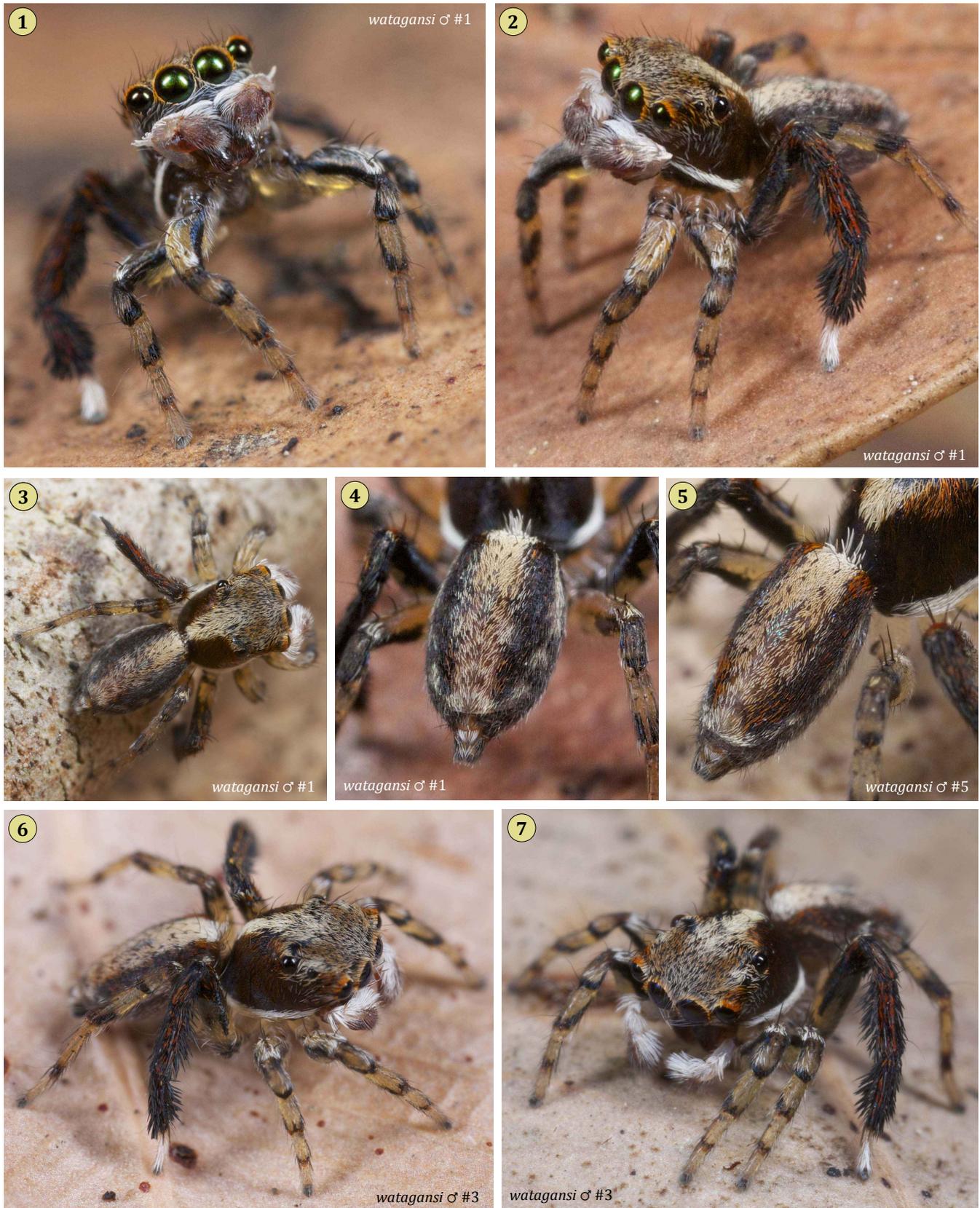


Figure 26. Three different paratype male *Maratus watagansi* (1-4, 5, 6-7). The pedipalps are frequently held as shown in (1), with their long white anterior (medial) setae forming a continuous fringe beneath the anterior eyes. 4-5, As in other *Maratus*, there is a distinct edge to the dorsal opisthosomal plate, but the colouration of this plate (light brown bracketed laterally by dark brown to dark red-brown or red-orange) is muted and it is not raised during courtship display. These two individuals each exhibit a small patch of iridescent blue-green scales near the center of this plate, however. The large legs III are dark red and are fringed with many long black setae, except for the tarsi that are covered with short white setae.

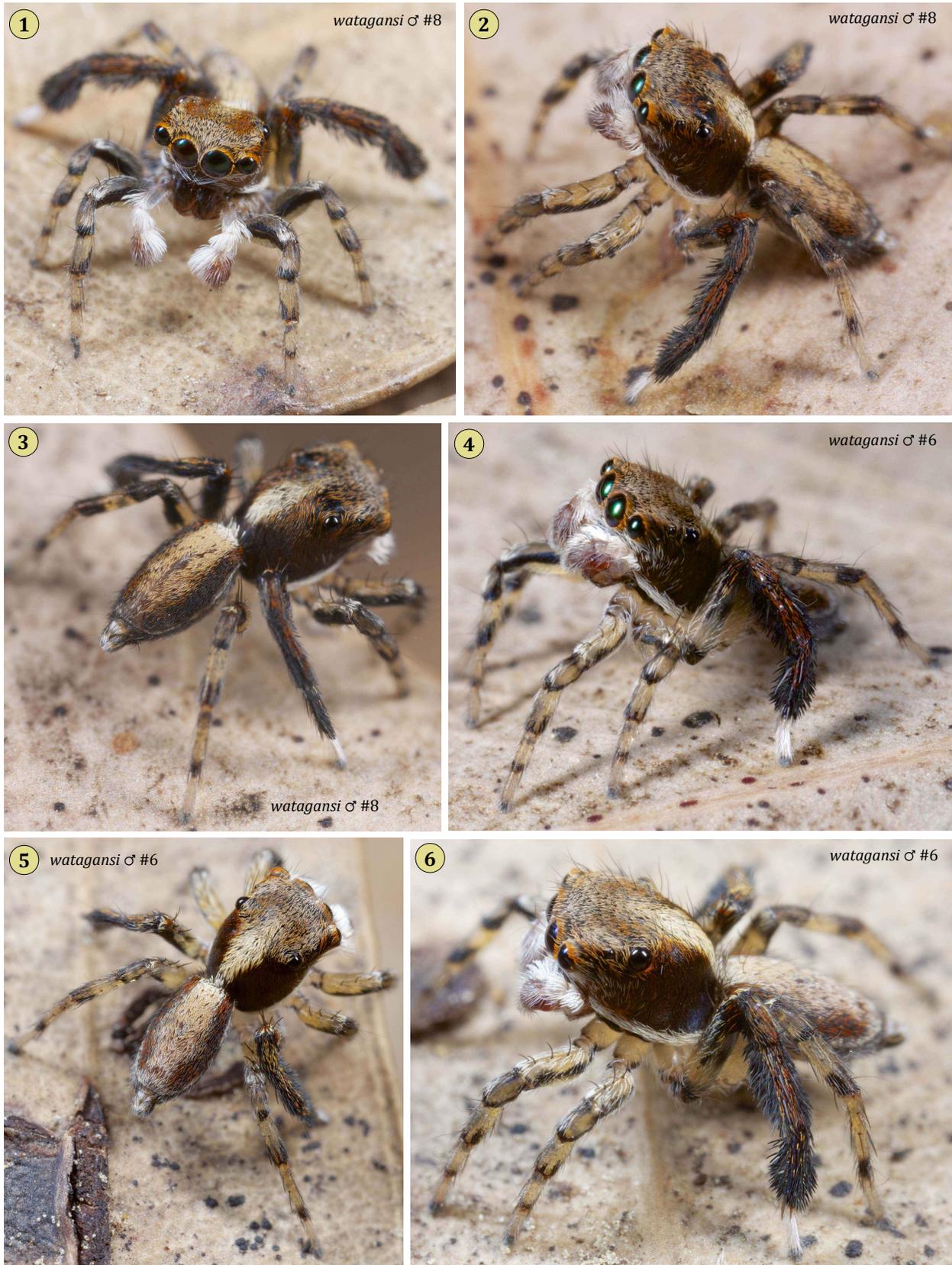


Figure 27. Two different paratype male *Maratus watagansi* (1-3, 4-6).

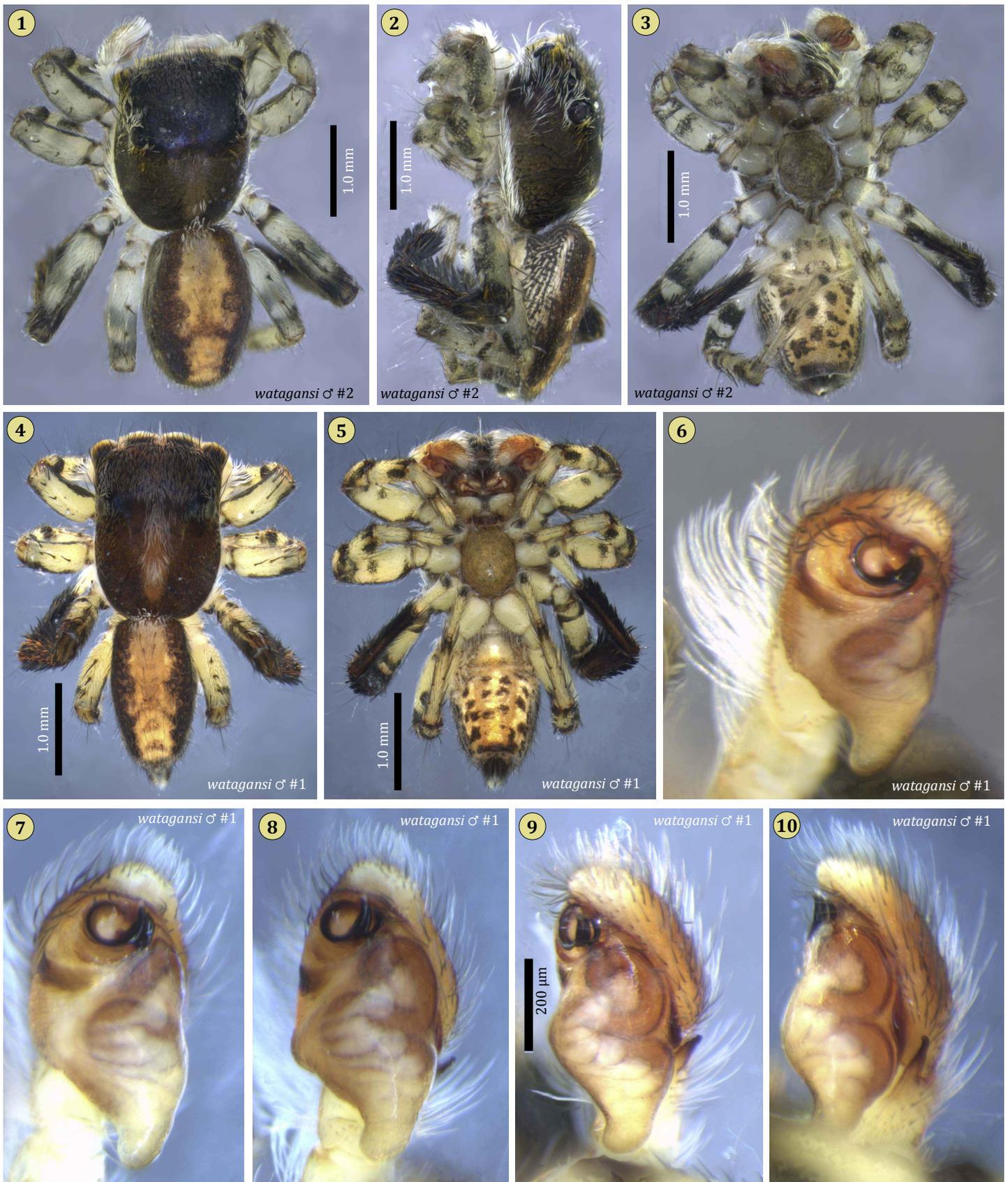


Figure 28. Holotype (1-3) and paratype (4-5) male specimens of *Maratus watagansi*, with (6-10) multiple views of the left pedipalp of this paratype male (*watagansi* ♂ #1) specimen.

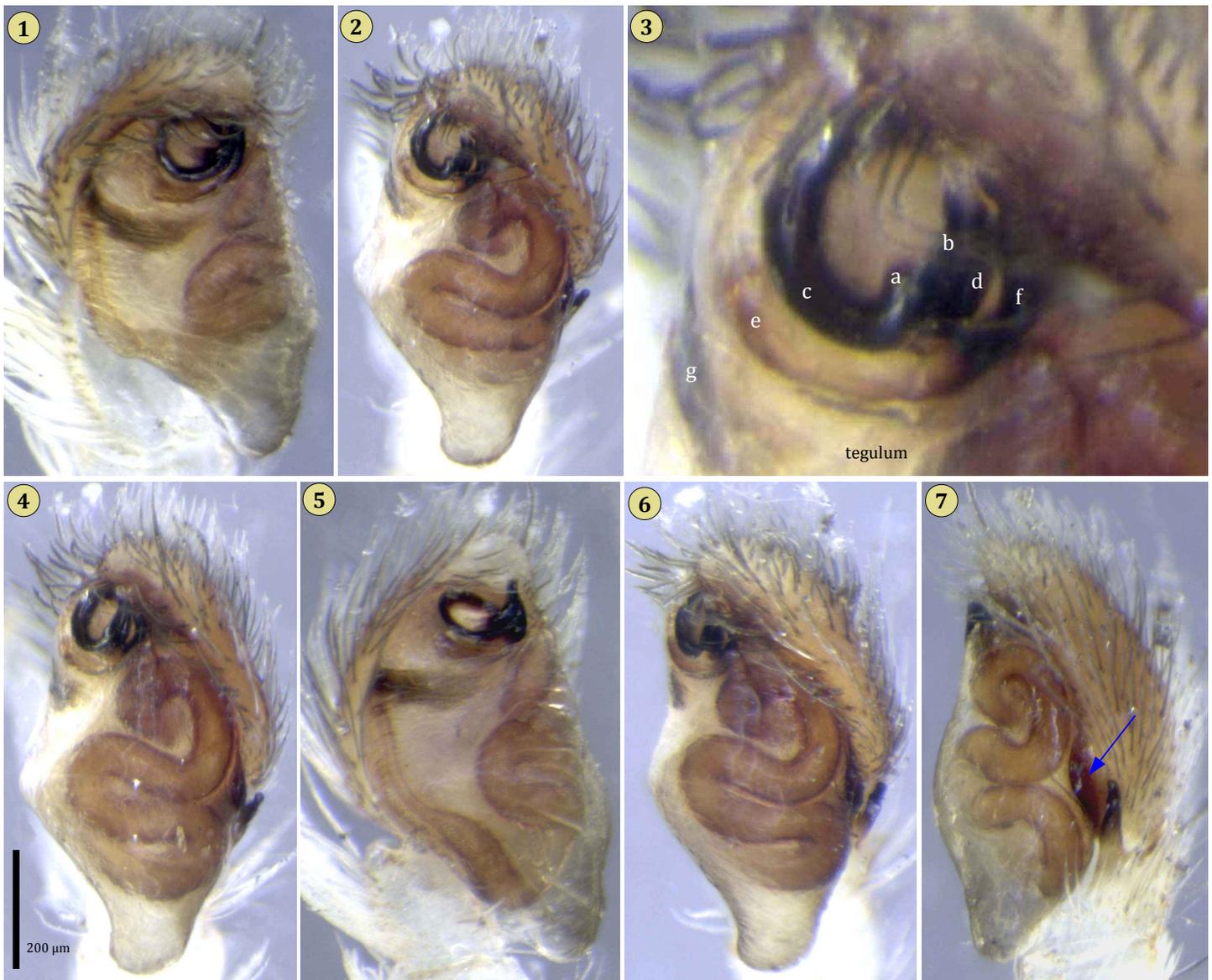


Figure 29. Left pedipalp of male holotype (*watagansi* ♂#2) specimen of *Maratus watagansi*. **3**, Visible features associated with the embolus are identified with letters for reference. A thin outer ring (e) encircling the heavy ring of the embolus (c) thickens distally to form a heavy, third component of the terminal apophysis (f), in addition to the two apices (b and d) often observed in *Maratus*. Sclerotization of the medial shoulder of the tegulum (g), and a short inner strut associated with the terminal apophysis (a) are also seen in the pedipalps of other *Maratus* species. The RTA is blunt and dark at the end. A heavily sclerotized lateral border of the cymbium (7, arrow) can also be seen near the RTA.

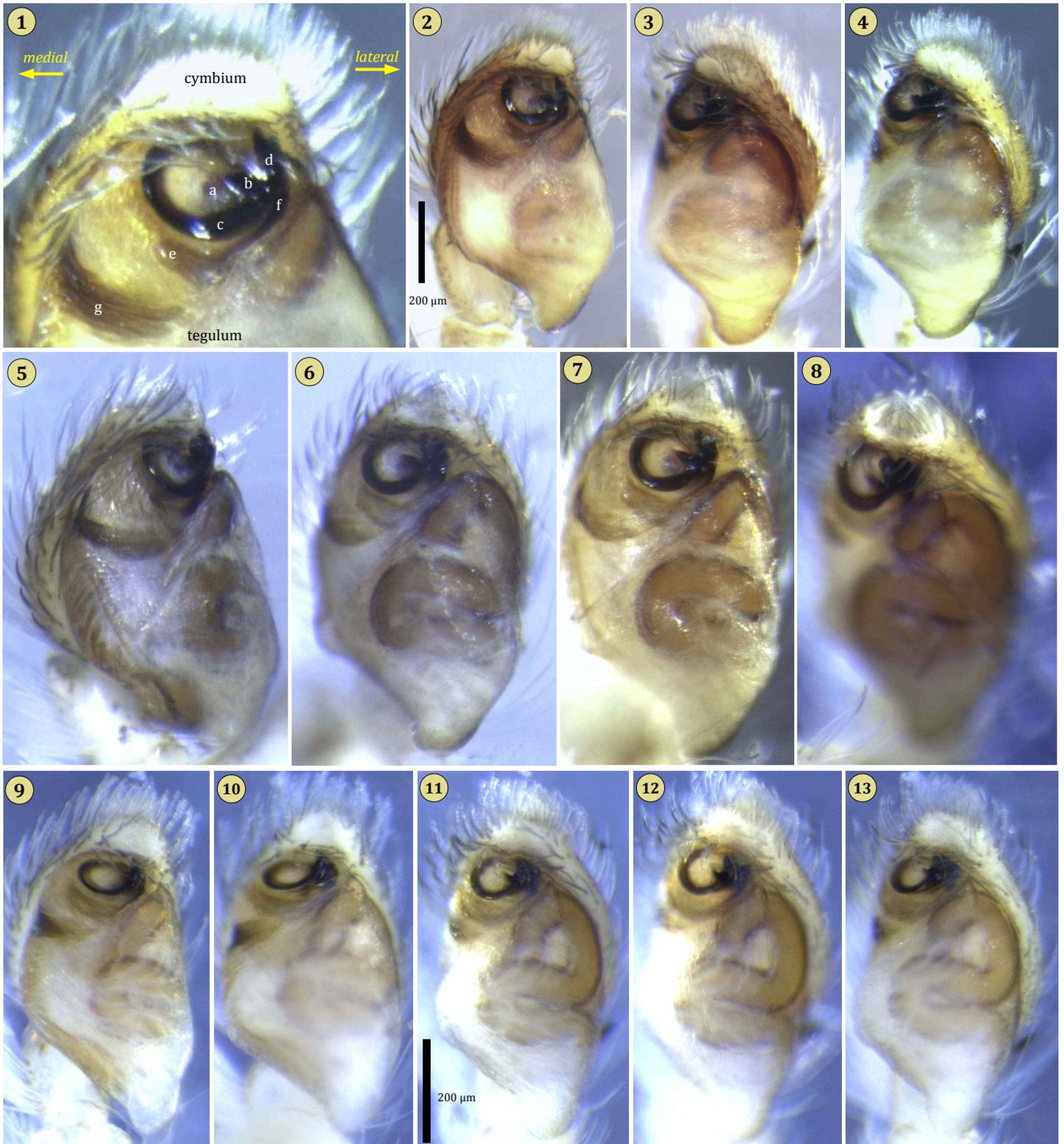


Figure 30. Left pedipalp of the males of two other *Maratus* species, for comparison with *M. watagensis*. 1-4, *M. pavonis* from Colleambally in south-central New South Wales. Features identified in (1) correspond to those shown in Figure 29 (3). 5-8, *M. pavonis* from Stanley, Tasmania. 9-13, *M. splendens* from Lane Cove National Park, Sydney, New South Wales.

Courtship display of male. The pattern of signalling or display with legs III of *M. watagensis* includes a characteristic behaviour (*rocking*, Figures 31-32), in which the male alternately pivots the body forward while raising and advancing the laterally extended legs III, then pivots to the rear and lowers these legs, still extended, to a lower position toward the rear. The opisthosoma appears to be in contact with the surface beneath the spider in the rear position, and it may be scraped against that surface as the spider

rocks forward. This rapid (Figure 31: 36ms/cycle, or 28 cycles/s, in intermittent bouts of ~5 cycles) back-and-forth movement may be accompanied by sideways steps, or movement toward a female that a male is facing. Other display behaviours that have been observed include *single leg waving*, or movement of one extended leg III up and down. This may represent a more general response to the sighting of a conspecific at a distance. *Bilateral semaphores*, in which both extended and lateral legs III are raised to a near vertical position then lowered to the sides, were also observed. Both of these displays may be accompanied by rapid *bobbing* of the opisthosoma, up and down. This may be associated with the production of audible vibrations, as in *M. volans* (Girard *et al.* 2011). We have previously described similar displays by *M. pavonis* (Hill & Otto 2011), including a *tapping* display corresponding to the *rocking* display of *M. watagansi*, but our video analysis at that time was limited by a 25 fps frame rate. Here (Figure 31) we can demonstrate that, based on high-speed (1000 fps) video analysis, the rapid rate of rocking (tapping) by an *M. pavonis* male is similar to that of *M. watagansi*.

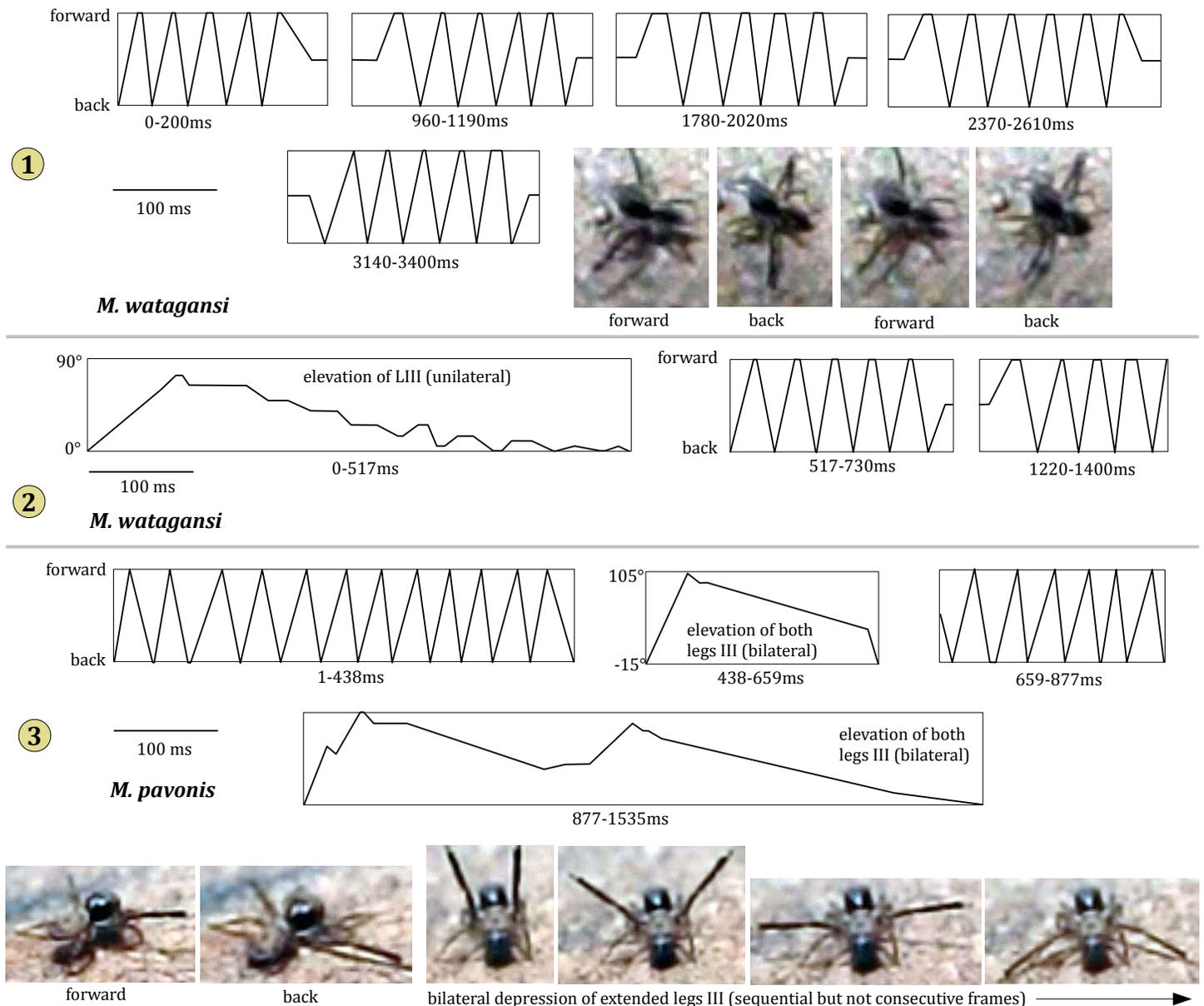


Figure 31. High-speed (1000 fps) analysis of the rocking behaviour of male *Maratus watagansi* (1-2) and male *M. pavonis* (3) as they displayed to females. **1**, Over the course of 3.4s (3400ms) this male completed 5 bouts of forward/backward rocking display, each containing about 5 cycles of rocking at a rate of ~28 cycles/s. Only intervals where the spider was rocking are shown. **2**, Prior to two bouts of rocking, this male raised and then lowered LIII as shown in the chart at left. **3**, This male *M. pavonis* alternated longer bouts of rocking with intervals of bilateral *semaphore* display.

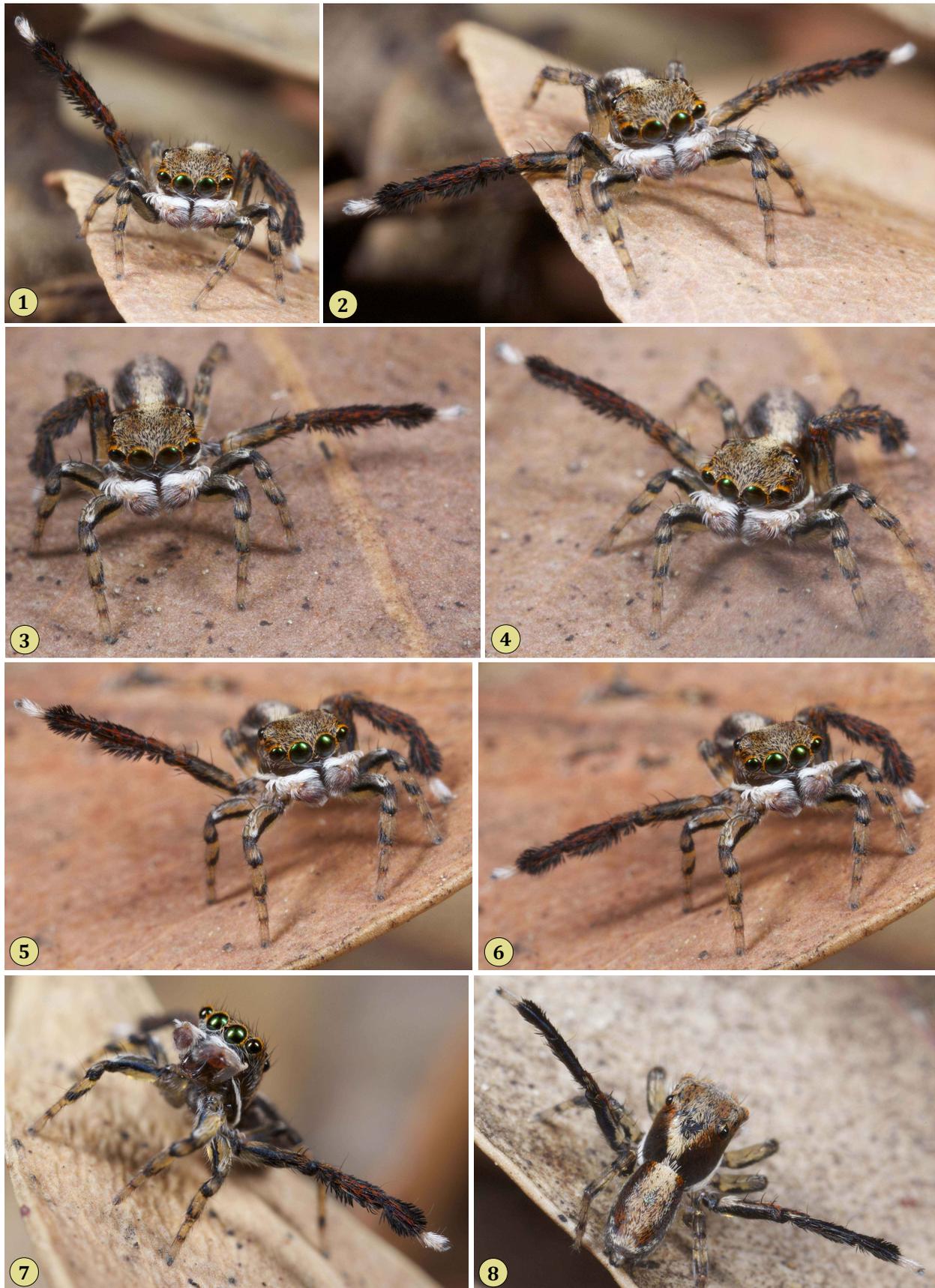


Figure 32. Photos from five different sequences of display by male *Maratus watagansi* (σ #1: 1-2, 3-4, 5-6, 7; σ #5: 8). These displays include unilateral or bilateral extension raising and lowering of legs III. As shown in (2) and (8), the most distinctive courtship display is associated with rapid back and forth *rocking* of the male, as extended legs III are alternately moved forward and raised, then moved to the rear and lowered.

Description of female (Figures 33-36). The paratype females (n=6) range from 4.45 to 5.45 mm in body length. The chelicerae are small, rounded in front, light brown to brown or red-brown, and glabrous. They are darker distally. The clypeus and sides of the carapace are also light brown and glabrous, almost barren of setae. The cuticle of the ocular area is dark, and may bear scattered tan setae. Behind this, to the rear margin, the carapace is dark dorsally with a lanceolate (pointed toward the front) area of light, translucent cuticle at the median. At the center of this median cuticle may lie a narrow tract of white setae. As in the males, the PME are noticeably closer to the PLE than to the ALE, a character shared with both *M. pavonis* and *M. splendens*.

The opisthosoma is dark above, striped light and dark on the sides, and light below with extensive black mottling.

Legs I and II are of the same length, much shorter than legs III and IV. All legs are almost uniformly light brown or tan to brown or red-brown, translucent, and relatively glabrous. These appear completely white in preserved specimens. There is a black mark under each femur. The underside of the legs, including coxae, and sternum, labium, endites, and pedipalps are light brown and also appear white in preserved specimens.

The epigynum (Figure 36) is typical for this genus, with a pair of large, separate, nearly circular anterior fossae, and a much larger pair of posterior, contiguous spermathecae. Sclerotized ducts behind the fossae (as viewed from below) may occupy as much as half of the area of the fossae.



Figure 33. Two different paratype female *Maratus watagansi*. The cuticle of the carapace is dark in the ocular area, and in two bands extending to the posterior margin of the carapace, to the rear. The dorsal opisthosoma is also dark.



Figure 34. Two more paratype female *Maratus watagansi*.

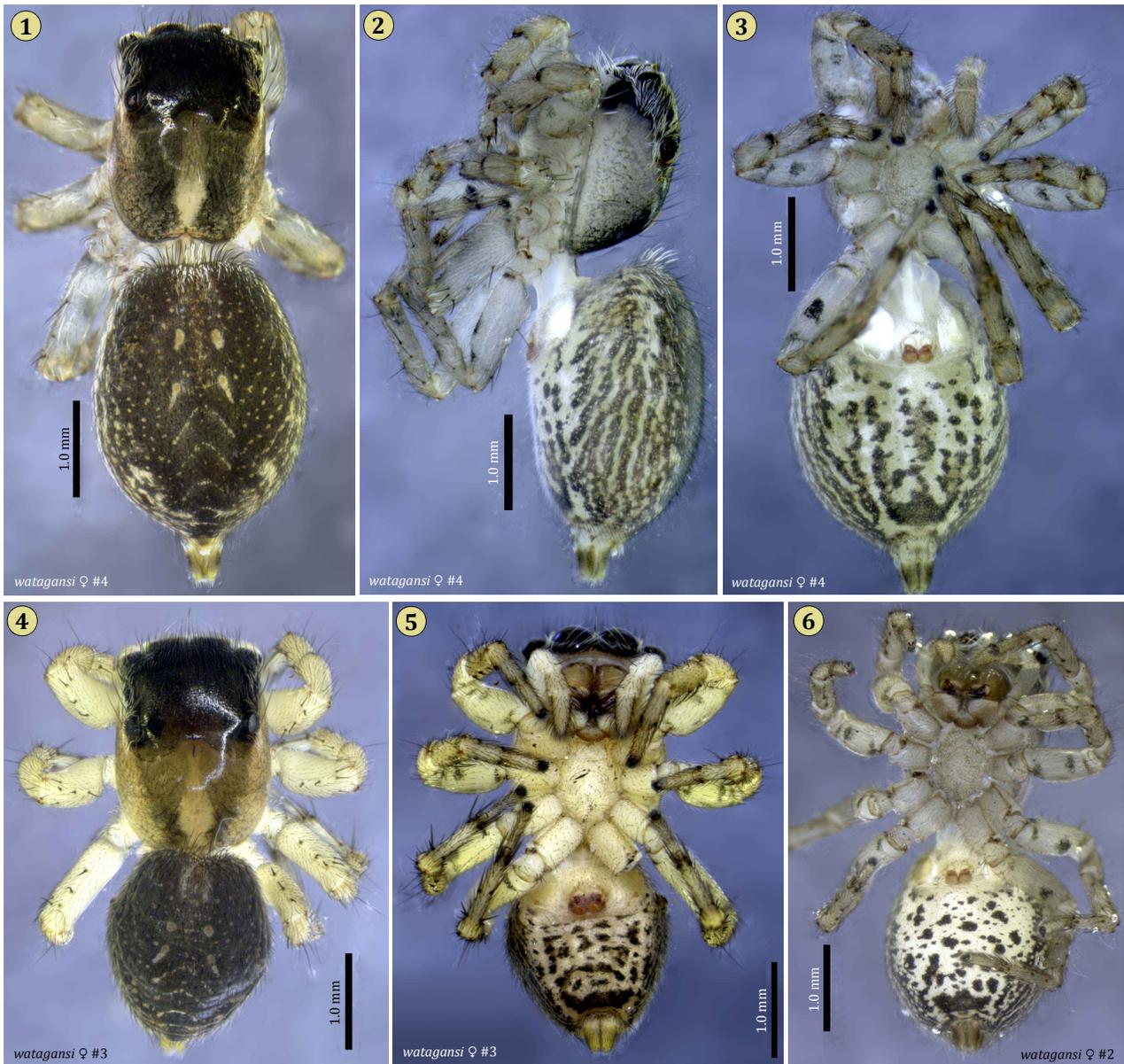


Figure 35. Three paratype female specimens of *Maratus watagansi* (1-3, 4-5, 6). The light brown colour of the legs and underside of living animals faded to white in these preserved specimens. The carapace and opisthosoma are mostly dark above, light below. The opisthosoma is striped laterally, mottled below.

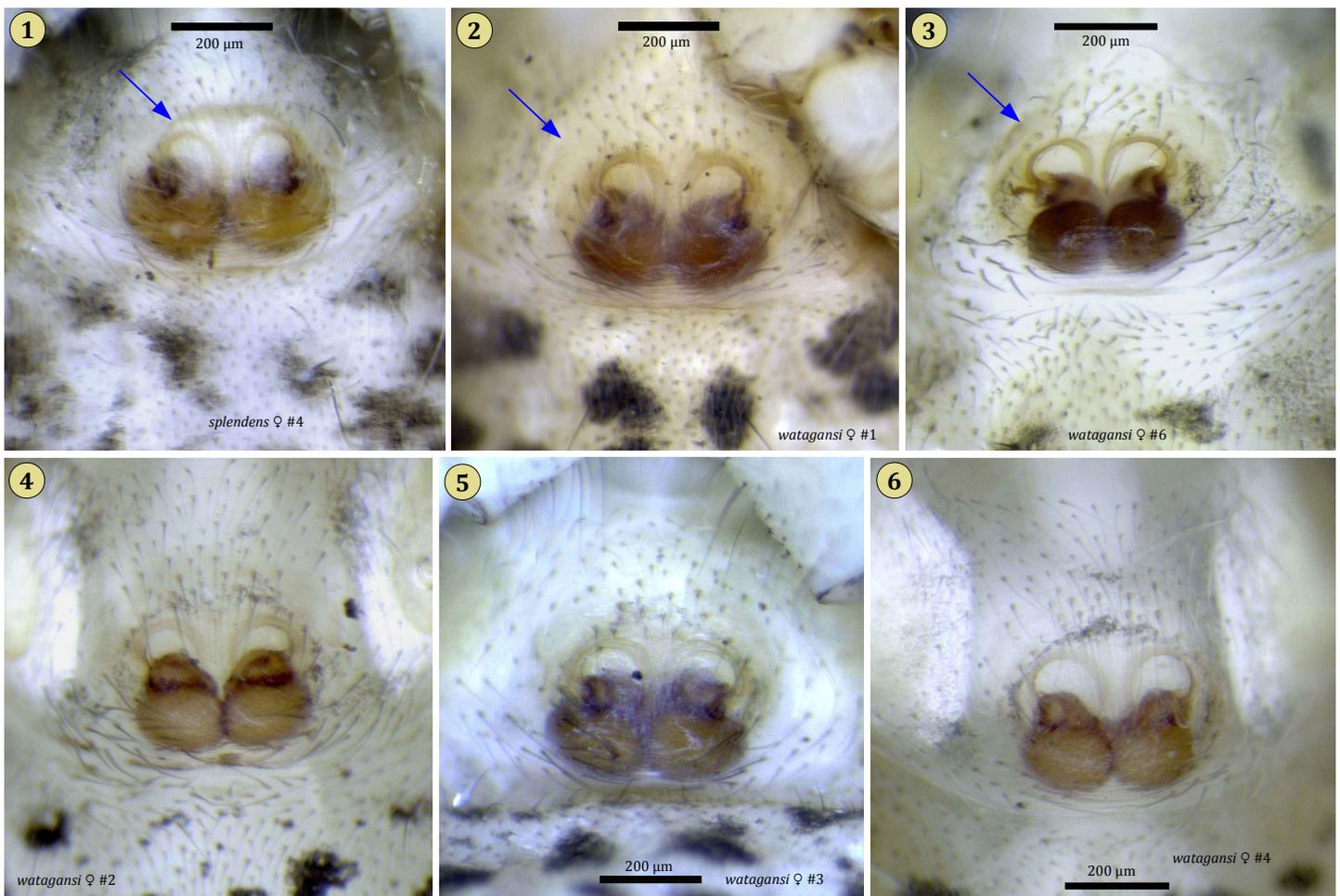


Figure 36. Epigyna of five different paratype female specimens of *Maratus watagansi* as viewed externally (2-6, anterior toward the top). An *M. splendens* epigynum is also shown (1) for comparison. With nearly circular fossae, a larger and contiguous pair of posterior spermathecae, and a nearly oval mass of sclerotized ducts visible in the posterior part of the fossae, these are quite similar, and also typical for *Maratus*. Where it can be seen easily (arrows), the sclerotized margin of the epigynum appears to be much closer to the fossae in *M. splendens*.

Behavioural ecology. The Watagan Mountains (or Watagans) lie southwest of Newcastle, about 100 km north of Sydney, in New South Wales. *Maratus watagansi* was found in the understory of a temperate rainforest near Boarding House Dam (Figure 37). It is possible that association with this forest habitat may have led these spiders to lose advantages associated with the display of an opisthosomal fan during courtship. The presence of a dorsal opisthosomal plate, as well as many other characters linking this species to the *pavonis* group, suggests that ancestors of this species engaged in the 'peacock' displays that we find in other *Maratus* species. Like other *Maratus*, these spiders power their jumps through the rapid extension of legs III, and they may feed on ants (Figure 38).



Figure 37. Wide angle composite view of the seasonally dry rainforest near the Boarding House Dam in the Watagans, where *Maratus watagansi* was found.



Figure 38. Living paratype male *Maratus watagansi* (*watagansi* ♂#6). **1**, Position right before a jump, with legs I and II raised, legs III flexed to power the jump as they subsequently extend, and legs IV in place to provide stability. **2**, Captive spider feeding on a alate ant.

Kinematic analysis of a jump powered by legs III. We previously described the remarkable convergence between Australian *Maratus* and the unrelated North American *Habronattus* jumping spiders, both of which use legs III to power their jumps. This is thought to relate to their need to jump vertically from positions on or near the ground (Otto & Hill 2012b). Here (Figure 39) we provide a kinematic analysis of a jump from a horizontal surface by a male *M. watagansi*, based on measurement from high-speed (1000 fps) video frames. In this example, acceleration took place primarily during an 8ms interval associated with extension of legs III. The estimated take-off velocity (~ 92 cm/s) for this jump was equal to the greatest velocity previously recorded for the much larger *Phidippus* (Hill 2010), and far greater than velocities reported for other salticids that normally power their jumps through the extension of legs IV (Parry & Brown 1959).

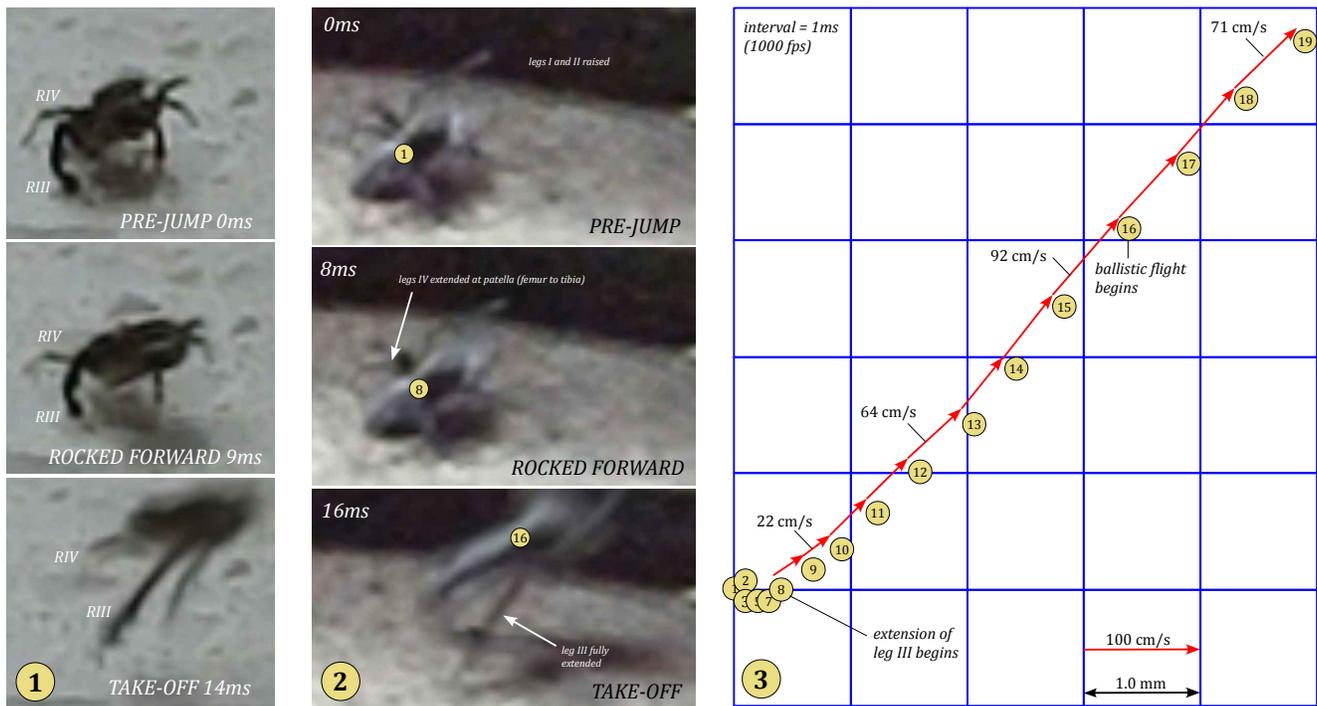


Figure 39. Kinematics of jumps from a horizontal surface by a male *Maratus watagansi*, based on analysis of high-speed video frames (1000 fps, or 1 frame/ms). **1**, Right anterolateral view of jump (top to bottom). Jumps began (0-9ms) as the spider rocked forward on legs III by extending legs IV at the femuropatellar joint (but not the tibiotarsal joint, which remained flexed). This was followed (9-14ms) by complete extension of legs III. **2**, Lateral view of a jump (top to bottom) corresponding to three plotted positions on the chart at right (**3**). In each frame, a small circle indicates the position of pedicel of the spider (used as an estimate center of gravity). **3**, Successive (1ms interval) positions of the spider shown in (**2**) recorded on a grid of 1.0mm squares. Displacement between successive positions of the spider (red vectors) corresponds to the instantaneous velocity of the spider for each interframe interval. Almost all acceleration took place during extension of legs III during the 8ms interval between frames 8 and 16, resulting in a take-off velocity of ~92cm.

Acknowledgments

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