

Two new peacock spiders from Western Australia (Araneae: Salticidae: Euophryini: *Maratus* Karsch 1878)

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Abstract: Two new species of the genus *Maratus* are described from Western Australia: *M. boranup* and *M. flavus*. The two species are thought to be closely related members of a new clade within *Maratus*, the *flavus* group. Courtship display of both species is also documented.

Key words: jumping spider, *flavus* group, *Maratus boranup*, *Maratus flavus*

Introduction

We recently added four new species from the Southwest Australia Ecoregion to the known peacock spider (*Maratus* Karsch 1878) fauna of Western Australia (Otto & Hill 2017a), bringing the total number of species of *Maratus* known from that region to 31, 25 of which are known only from that part of Australia. Here we add two more species (*M. boranup* and *M. flavus*) to that total, both known only from this ecoregion (Figure 1). This addition brings the number of known *Maratus* species to at least 67 (Otto & Hill 2017b). Based on similarities of their genitalia, their courtship, and in particular the pattern of larger pigmented scales radiating from black lines on the dorsal opisthosomal plate (fan) of each male (Figure 2), we place these two species into a new clade within the genus *Maratus*, designated as the *flavus* group.



Figure 1. Localities (Boranup, Tims Thicket) associated with two new species of *Maratus* from the Southwest Australia Ecoregion of Western Australia, a biodiversity hotspot.

Maratus boranup, new species

Type specimens. The holotype male (♂ #1) five paratype males (♂ #2-6), and six paratype females (♀ #1-6) were collected as immatures at Boranup, Western Australia (34.076983°S, 115.015567°E, 1-14 OCT 2017, coll. J. Otto and D. Knowles), and subsequently reared to maturity. All types will be deposited in the Western Australian Museum, Perth.

Etymology. The species group name (*boranup*, noun in apposition) refers to the Boranup area, just south of the town of Margaret River in southwest Western Australia, where this species was found. Boranup is an Aboriginal (Noongar) word that means *place of the male dingo*.

Diagnosis. Genitalia of this species closely resemble those of *M. flavus* (see below), but also a number of other *Maratus* species including members of the *mungaich* group of Western Australia that may also have a single serration on the ventral margin of the larger outer apex of the embolus of the male pedipalp. Like *M. flavus*, the pattern of scales covering the dorsal plate of the male opisthosoma (fan) includes a border of relatively large pigmented scales radiating from a series of black lines, something not found in other *Maratus* that have been described. Based on this unique character we place both species in a new clade within *Maratus*, the *flavus* group. The courtship display of the two species is also similar in its reliance on bilateral movement or waving of the outstretched legs III. The two species can be readily separated by the pattern of scales on the fan of the male (Figure 2). The females are very similar, but the female *M. flavus* has narrower red-brown stripes behind the AME, more like the stripes on the carapace of the male of that species.



Figure 2. Comparison of the fan of the male *Maratus boranup* (1-2) with that of *M. flavus* (3). In both species relatively large pigmented scales (orange in *M. boranup*, mustard-yellow in *M. flavus*) radiate from a series of black lines. *M. boranup* has a small orange anterior lateral flap and a tuft of long, white setae on either side of the fan, but the fan is only known to be elevated as shown here (1) when the spider mates. In contrast *M. flavus* will raise the fan as part of courtship display (3), but there are no flaps or long setae on the sides of this fan.

Description of male (Figures 3-6). The male types are 3.5-3.7 mm in length (n=6).



Figure 3 (continued on next page). Living male types for *Maratus boranup*. 7, Right side of opisthosoma of mating male showing small orange flap and tuft of long white setae surrounded by orange setae at the base.



Figure 3 (continued from previous page). 13, 24, Lateral views of the elevated opisthosoma of two mating males. The small anterior flaps of the opisthosoma were never extended.



Figure 4. Ventral view of living male types for *Maratus boranup*.

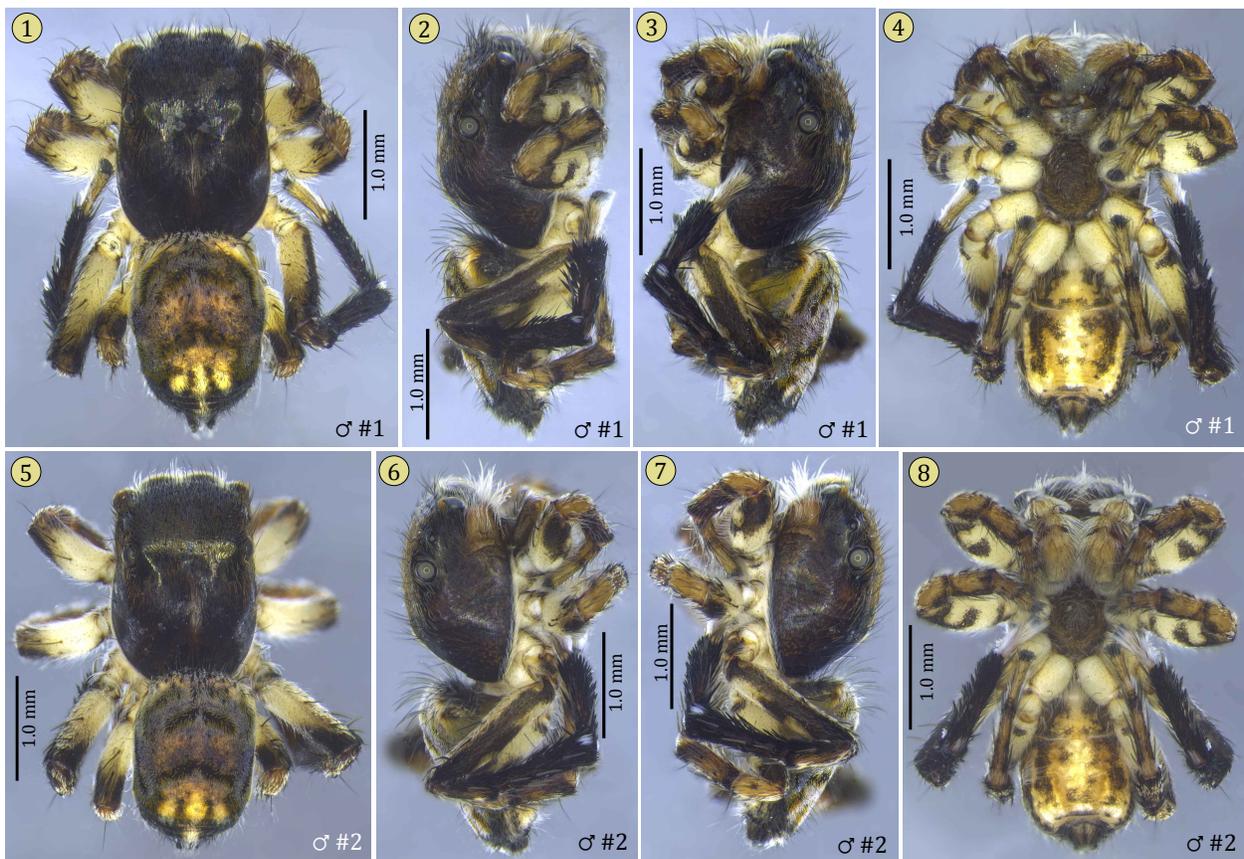


Figure 5 (continued on next page). Male type specimens for *Maratus boranup* in ethanol.

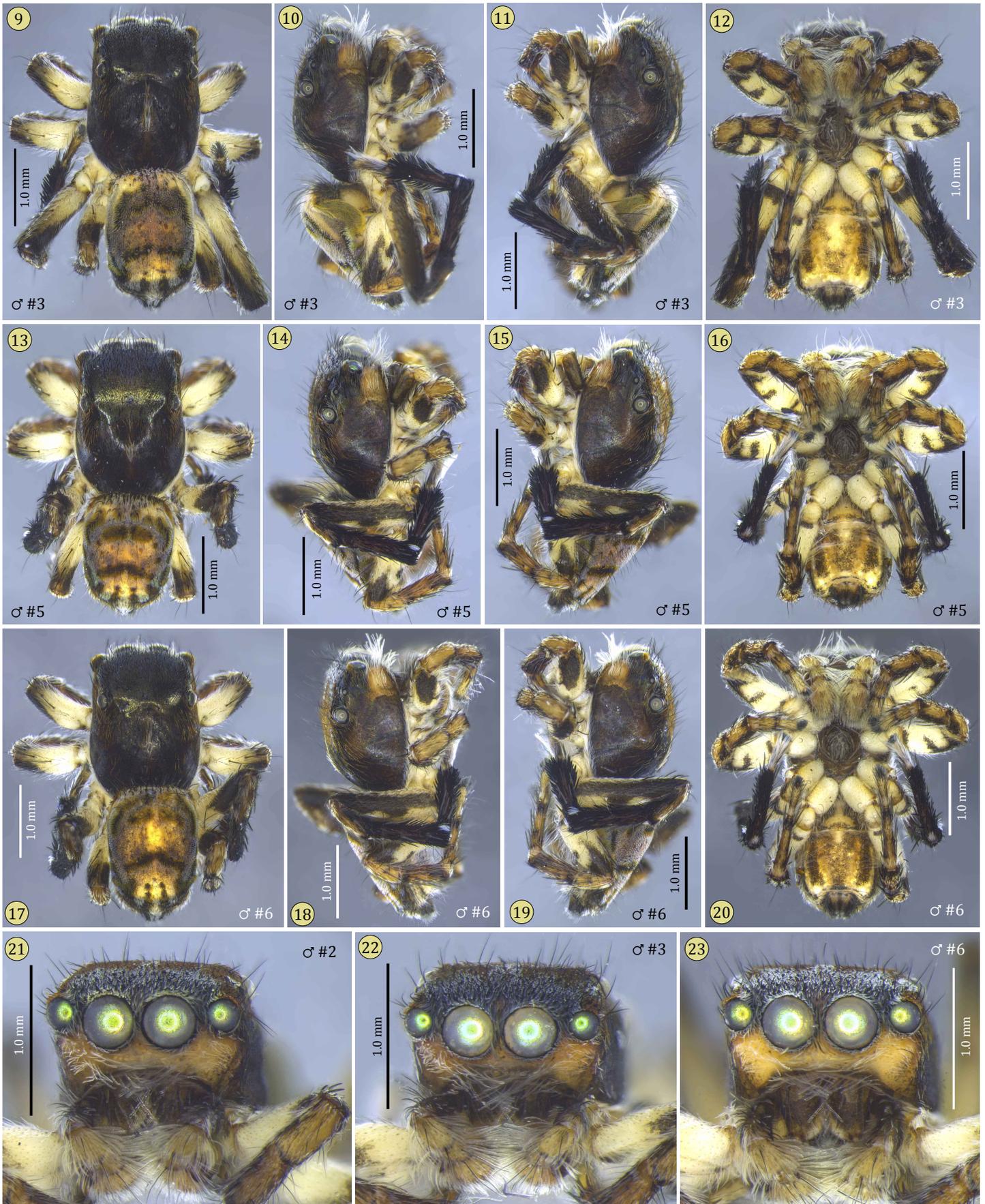


Figure 5 (continued from previous page). Male type specimens for *Maratus boranup* in ethanol.

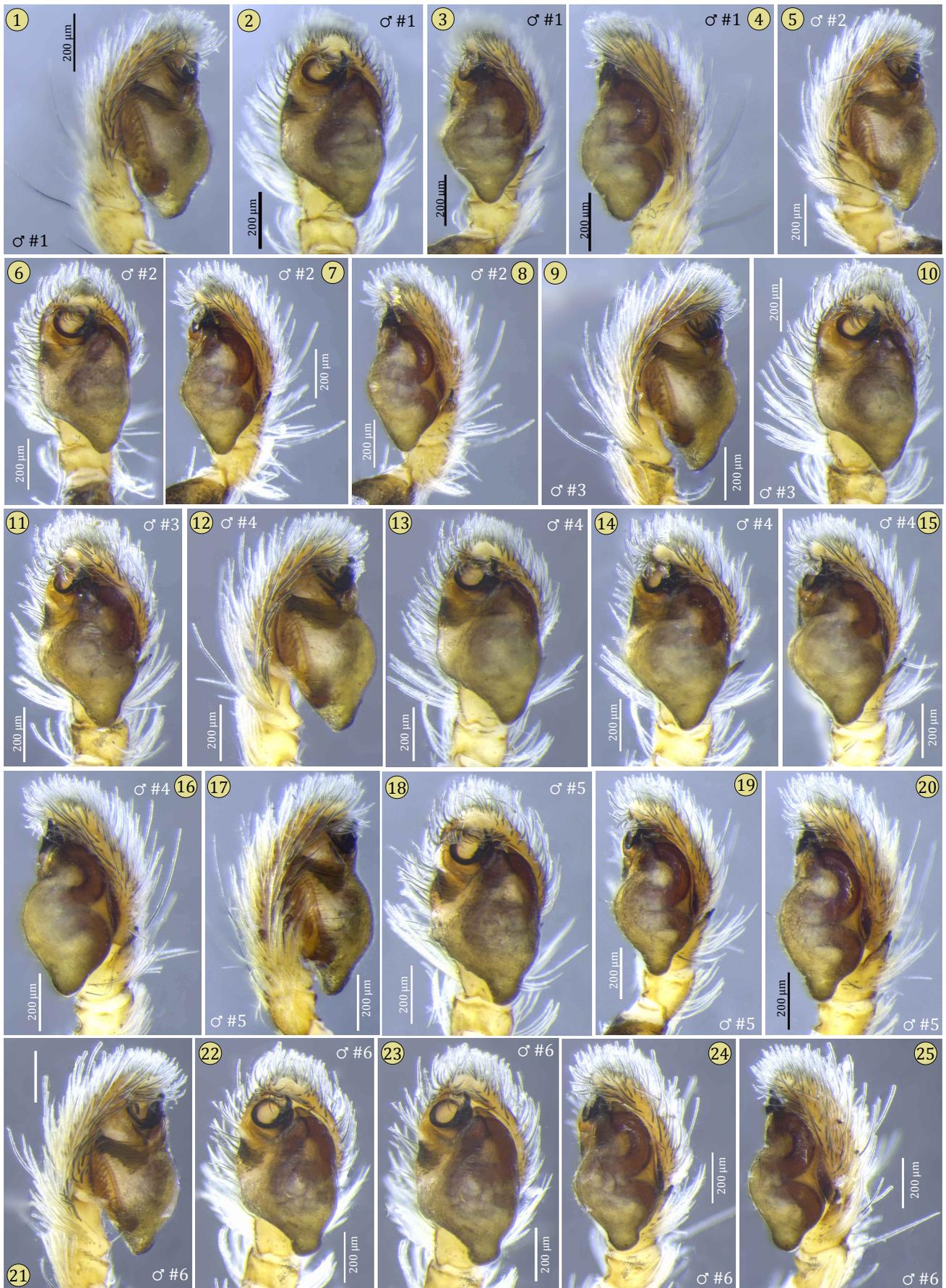


Figure 6. Median to lateral views of the left pedipalp of male *Maratus boranup* types.

In living males the chelicerae and carapace are black. The chelicerae are mostly glabrous. Long grey setae extend anteromedially from the clypeus. Grey setae surround the front eyes and extend to the rear to cover almost half of the eye region. Dark red-brown setae cover the posterior half of the eye region and surround the lateral eyes on each side. Behind this and on the sides the carapace is mostly black and glabrous, except for a short middorsal stripe of off-white setae, and a marginal band of bright white setae on either side. The PME are closer to the PLE than to the ALE.

The opisthosoma is rectangular/ovoid with a dorsal plate or scute covered with a distinctive pattern of scales. The iridescent background scale cover of this plate appears grey to light pink or lilac. On this background larger, pigmented orange scales radiate from a series of black lines or figures, and there are four bars of pigmented orange scales along the rear margin (Figures 2:2; 3:4). Each lateral margin of the fan bears a small orange flap toward the front, and a tuft of long, white setae surrounded by orange scales on either side toward the rear (Figures 2:1; 3:7,13). Although the opisthosoma is partly elevated by a mating male, we have not seen it displayed during courtship or agonistic encounters, and the small flaps are not extended. Off-white setae are present on either side of the opisthosoma below the dorsal plate, but these are sparse ventrally. Behind the dorsal plate the opisthosoma is black. Above the anal tubercle is a small triangular patch of white setae, and the spinnerets are black. The underside of the opisthosoma is brown with somewhat irregular darker areas. A more-or-less distinct black line may be present on either side of the venter. From below, the proximal part of each leg (coxa to proximal half of the femur) is brown and covered with scattered off-white setae. The sternum, labium, and endites are brown to dark brown and mostly glabrous.

Legs I and II are shorter, legs III and IV longer, and legs III the longest. Distal segments of legs I, II and IV are irregularly banded with alternating light brown to black based on the distribution and colouration of setae. Legs III, which play a major role in the display of these spiders, are mostly black from the femur to the metatarsus, and the tarsus is covered with bright white setae that extend over the grey footpads. The dorsal side of each femur III is covered with brown to off-white setae. There is a small patch of white setae to the front and rear of each distal tibia III (Figure 3:17,18,21), and these patches, although small, are clearly visible toward the front during courtship display. The pedipalps are similar to those of many other *Maratus*, with a heavy black outer apex in front of a shorter black inner apex of the embolus (Figure 6). In some specimens a single serration or irregular projection can be observed along the ventral edge, proximal to the tip, of the outer apex when viewed from the side. Above, the pedipalps are covered with off-white or light brown setae. Below, they are dark brown.

Description of female (Figures 7-10). The female types are 4.6-5.0 mm in length (n=6). The chelicerae are brown, translucent, and glabrous. The carapace is light brown except for the dark brown dorsum. Longer off-white setae extend anteromedially from the clypeus, and off-white setae surround the lower part of the anterior eyes. The eye region is covered with red-brown setae except for a median stripe of light brown or off-white setae that extends behind the PLE to the rear, ending just beyond the point where the carapace slopes steeply to the rear. The sides of the carapace are mostly glabrous except for a lateral stripe comprised of off-white scales that extends to the rear from just in front of each PLE to the rear of each PLE, and scattered dorso-ventrally aligned scales below this. There is no well-defined marginal band. The PME are closer to the PLE than to the AME.



Figure 7 (continued on next page). Living female types for *Maratus boranup*.

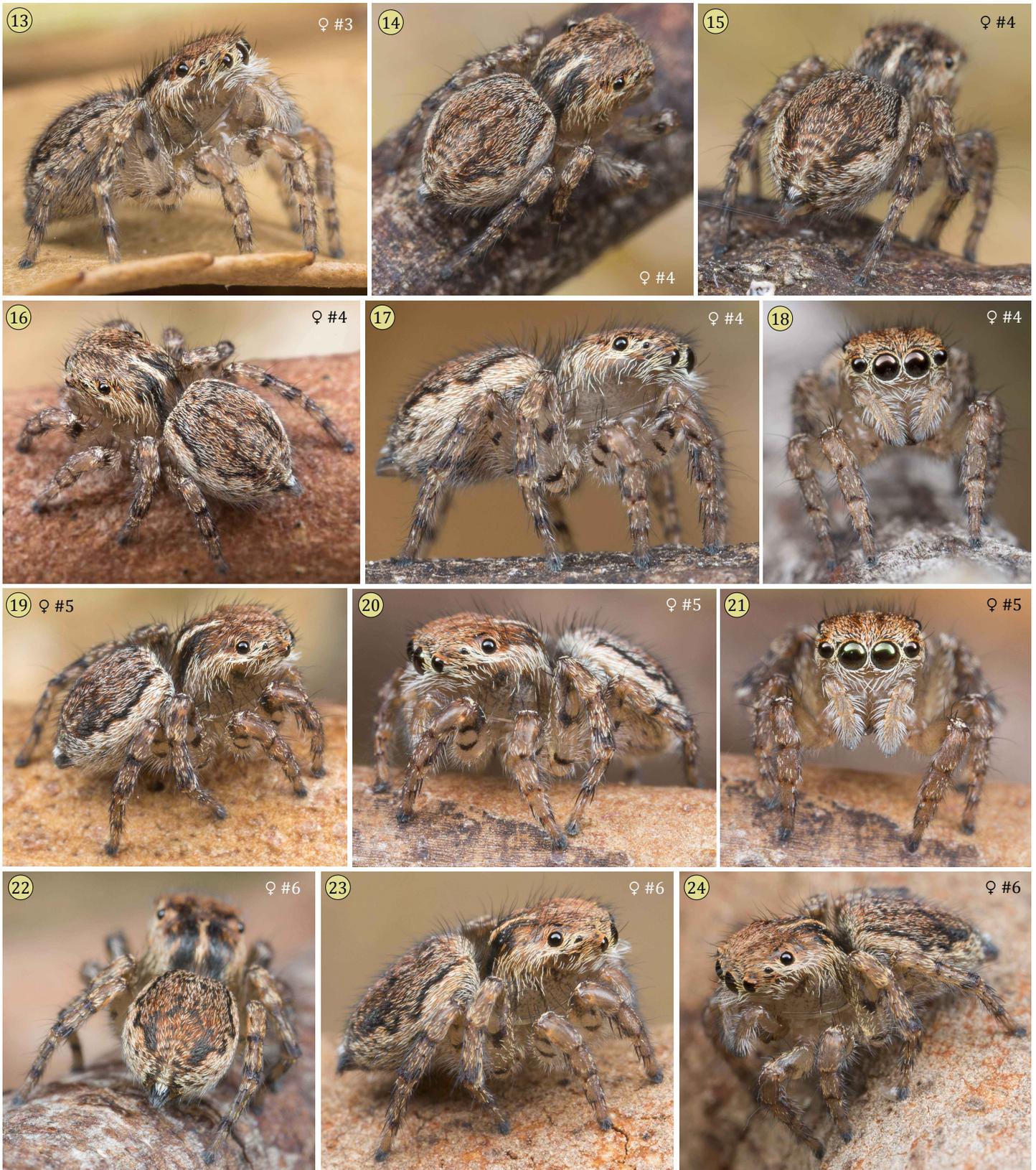


Figure 7 (continued from previous page). Living female types for *Maratus boranup*.

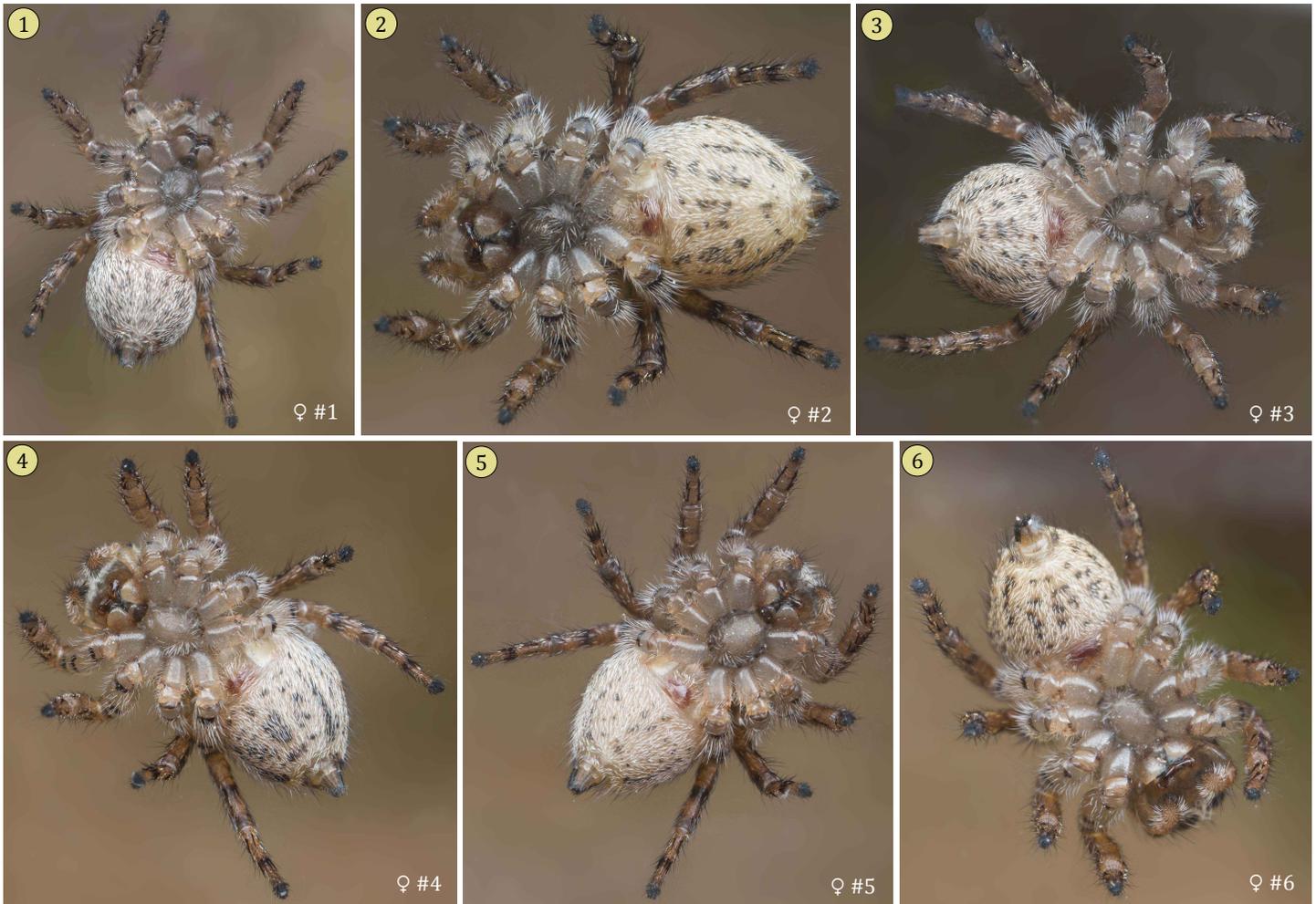


Figure 8. Ventral view of living female types for *Maratus boranup*.

The dorsum of the opisthosoma is dark brown to red-brown with scattered off-white setae, bordered laterally by irregular black straight to wavy, or broken, lines. There are four more-or-less distinct chevrons situated posteriorly along the midline. The sides and venter of the opisthosoma are covered with off-white setae, more scattered with mottling or darker black spots, and an indistinct pair of dark lateral lines, on the venter. A small white triangle of colular setae is present above the black spinnerets.

From below the coxae, trochanters, proximal femora, sternum, and endites are mostly light brown, translucent, and glabrous, except for scattered off-white setae to the rear of the sternum. Legs I and II are shorter and of similar length, and legs III and IV are longer, also of similar length. The legs are generally brown with indistinct bands of either dark pigment or lighter off-white setae. The pedipalps are light brown and translucent with a cover of off-white setae.

As in many other *Maratus* species, the epigynum has a pair of relatively large ovate to circular fossae, separated by a septum of variable width. Behind each fossa is a larger, ovate to circular posterior spermatheca. Sclerotized ducts are present anterior to each spermatheca, visible through the fossa.

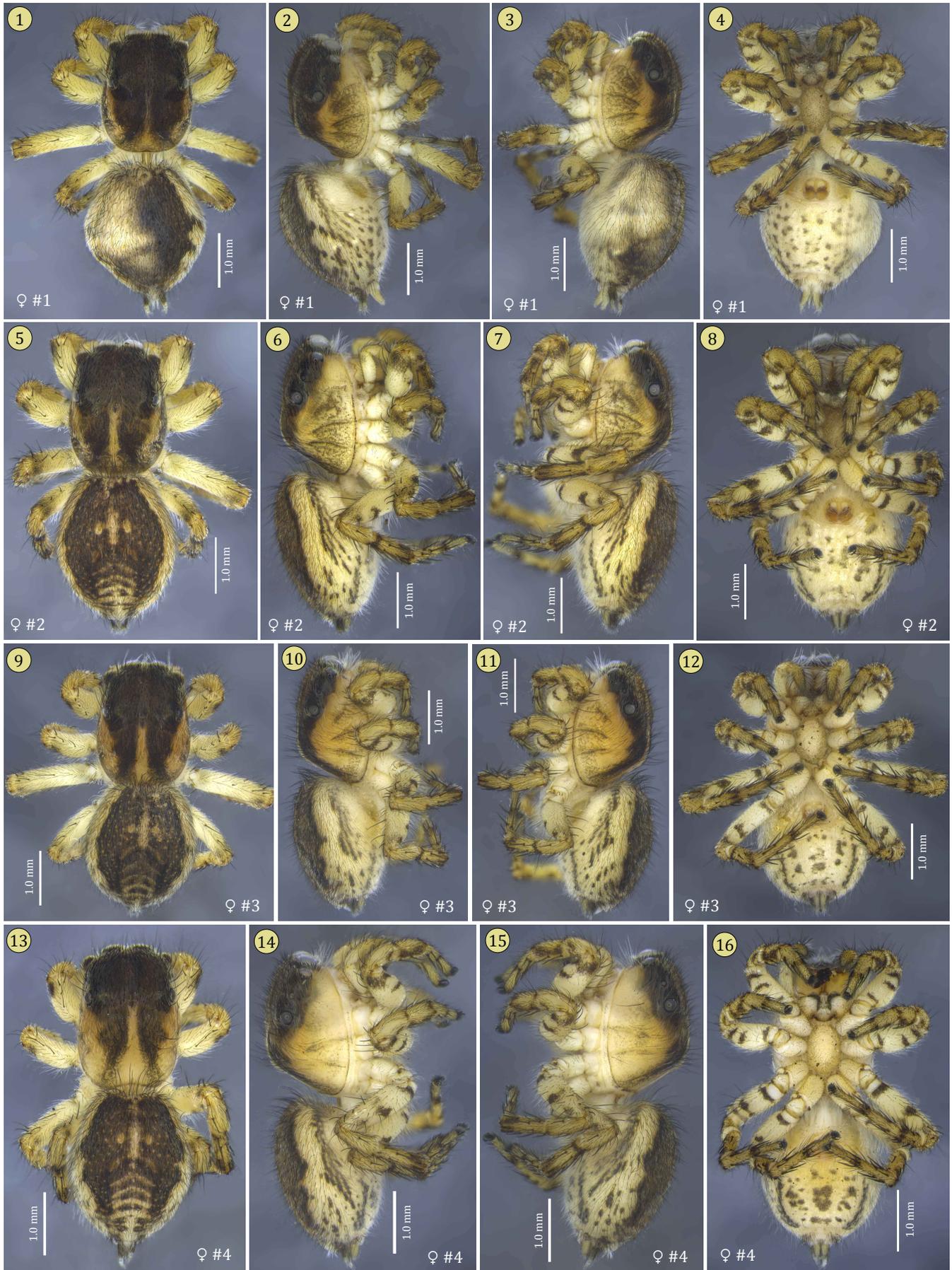


Figure 9 (continued on next page). Female type specimens for *Maratus boranup* in ethanol.

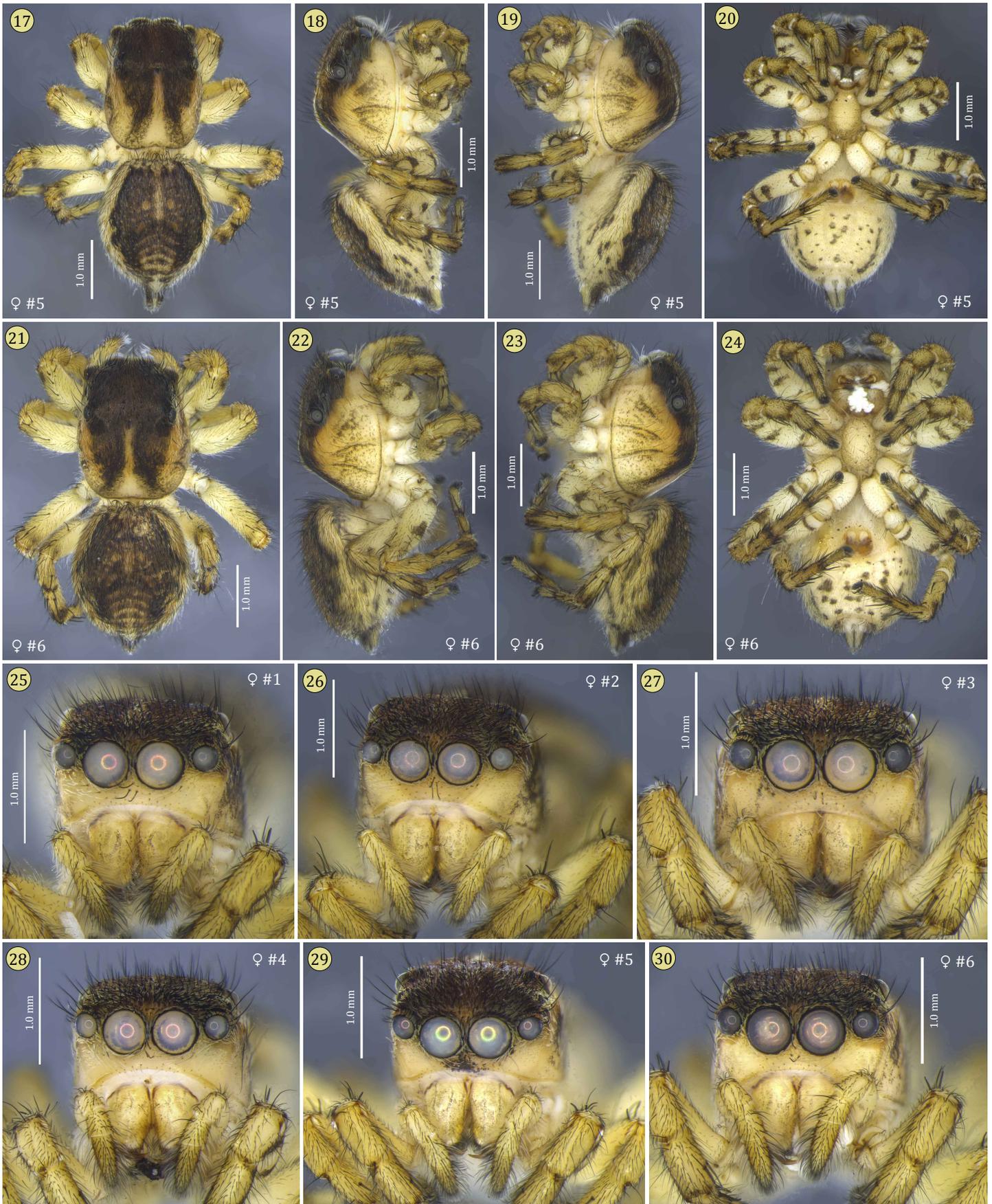


Figure 9 (continued from previous page). Female type specimens for *Maratus boranup* in ethanol.

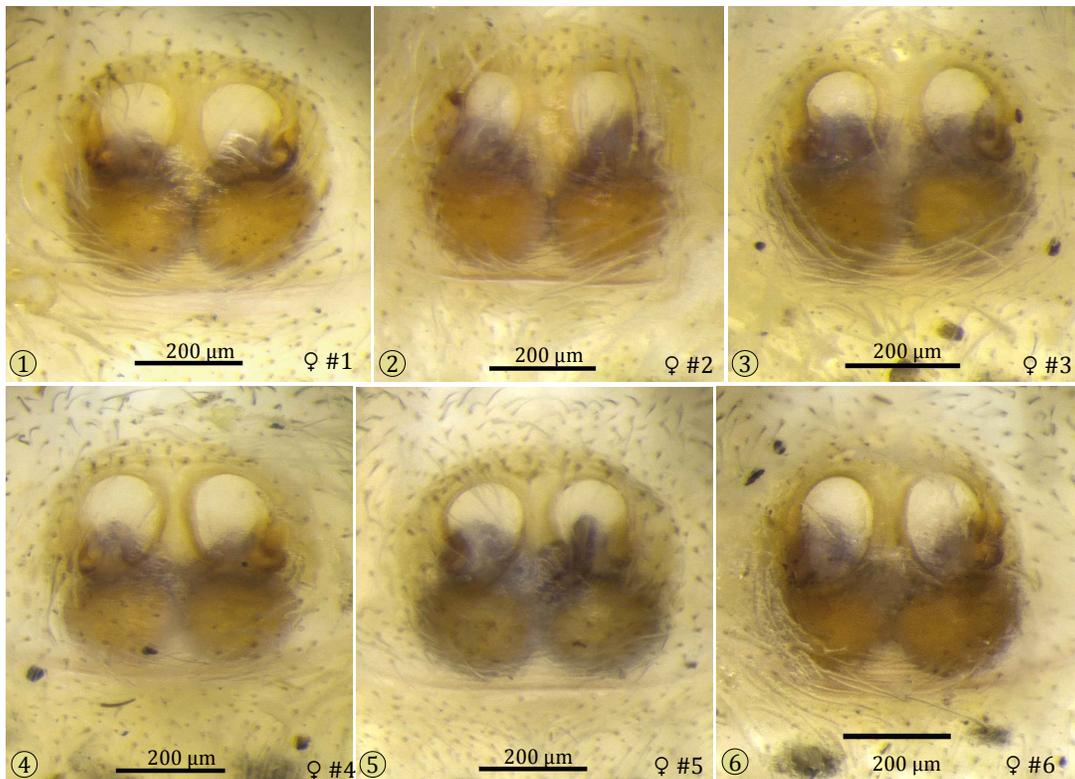


Figure 10. Ventral view of the epigynum of the six female type specimens for *Maratus boranup* in ethanol.

Immatures (Figures 11-12). Immatures of both sexes resemble the adult female in colouration. By the time that they reach the penultimate stage females look very much like adults, but males have bolder or more contrasting light and dark brown patterns on the opisthosoma.

Courtship display (Figures 13-16). Males do not raise their opisthosoma during courtship display, but they rapidly (~8-13.5 cycles/s) bob it up and down in a nearly horizontal position. In one display (Figure 14) they hold their extended legs III in a variably elevated, bilaterally symmetric V-shaped position, and wave this pair of legs up and down (bilaterally symmetric movement; both legs up then both legs down) at a similar rate (~11 cycles/s). In a second display (Figure 16) they tend to hold both legs III in position as they bob the opisthosoma, but intermittently rotate both extended legs III in the same direction. This movement may be accompanied by slight movement of the body in the same direction. We have also observed a tendency of these spiders to slowly slide the trailing legs I and II along the underlying surface in the direction that legs III are slowly rotated, while continuing to bob the opisthosoma at a rate of ~10 cycles/s (Figure 16:8). Males generally hold their pedipalps in front of their chelicerae as they court. The elaborate decoration of the lateral margins of the opisthosoma of these males is somewhat of a mystery as these males were not observed to display the fan either during courtship or during male-male (agonistic) encounters, and they only partly elevated the opisthosoma as they mated (Figure 17). These are not the only *Maratus* that have elaborate decorations not used in display. For example, male *M. harrisi* Otto & Hill 2011 from southeastern Australia extend and display with their legs III during courtship, but a close relative from the west, *M. lobatus* Otto & Hill 2016, does not (Otto & Hill 2011, 2016, 2017b). Many members of the *Maratus pavonis* group, as well as *M. tessellatus* Otto & Hill 2016, also retain some decorative scales on the fan but do not use this fan in courtship (Otto & Hill 2016, 2017b). These examples suggest that either the trade-off between male survival and sexual selection, or even the genetic drift associated with sexual selection, can drive the loss of even highly evolved components of the courtship display of these spiders.



Figure 11. Immature male *Maratus boranup*. 7-12, Penultimate stage of three different male types.



Figure 12. Immature female *Maratus boranup*. 7-14, Penultimate stage of the six female types.

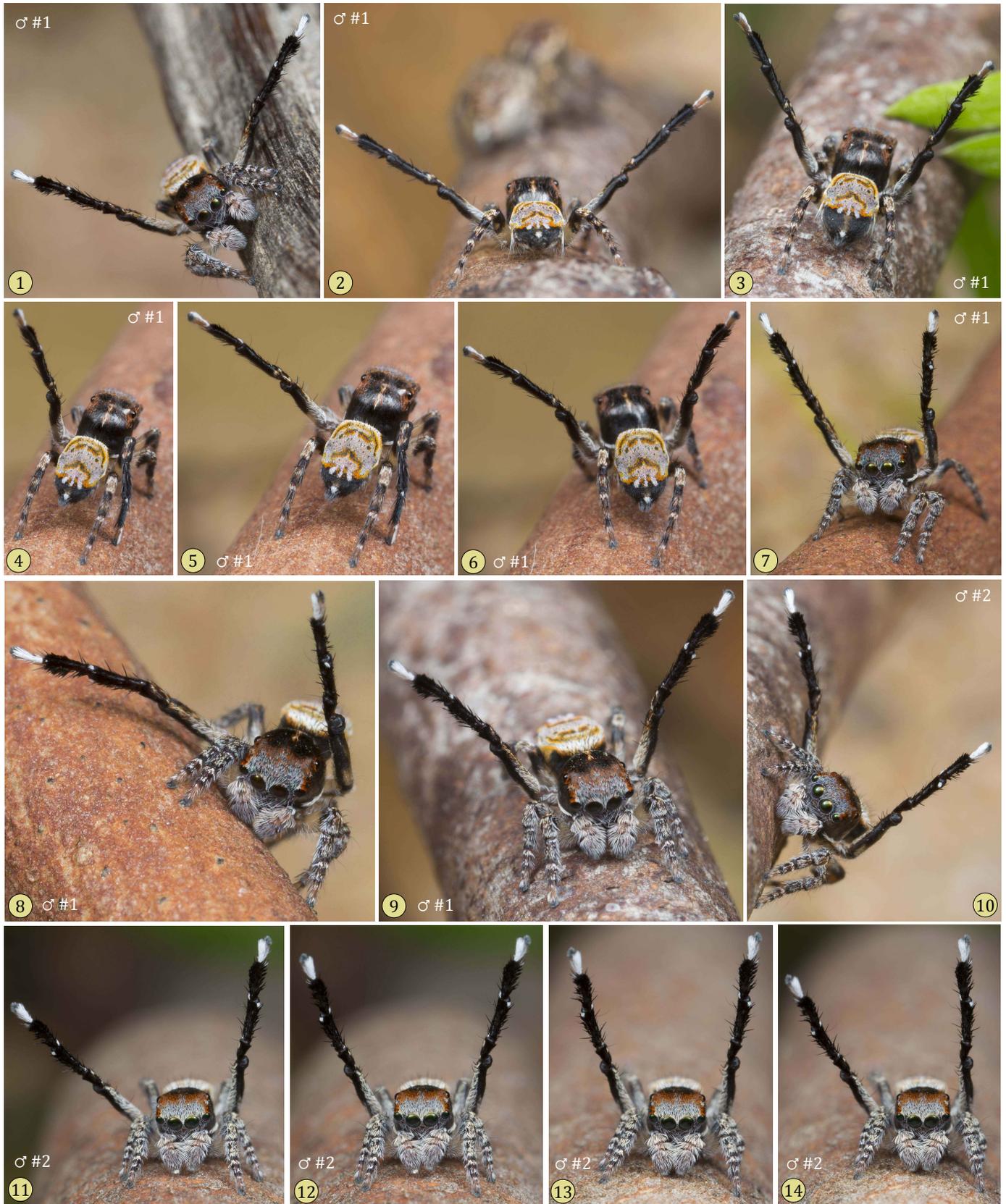


Figure 13 (continued on next page). Courtship display by male *Maratus boranup*. **2**, Display in front of female with wide separation of legs III. **4-5**, Sequential positions by male waving the left leg III unilaterally. **11-14**, Note the pair of small, bright white spots at the distal end of each tibia III. The opisthosoma may be bobbed up and down but is not elevated during this display.

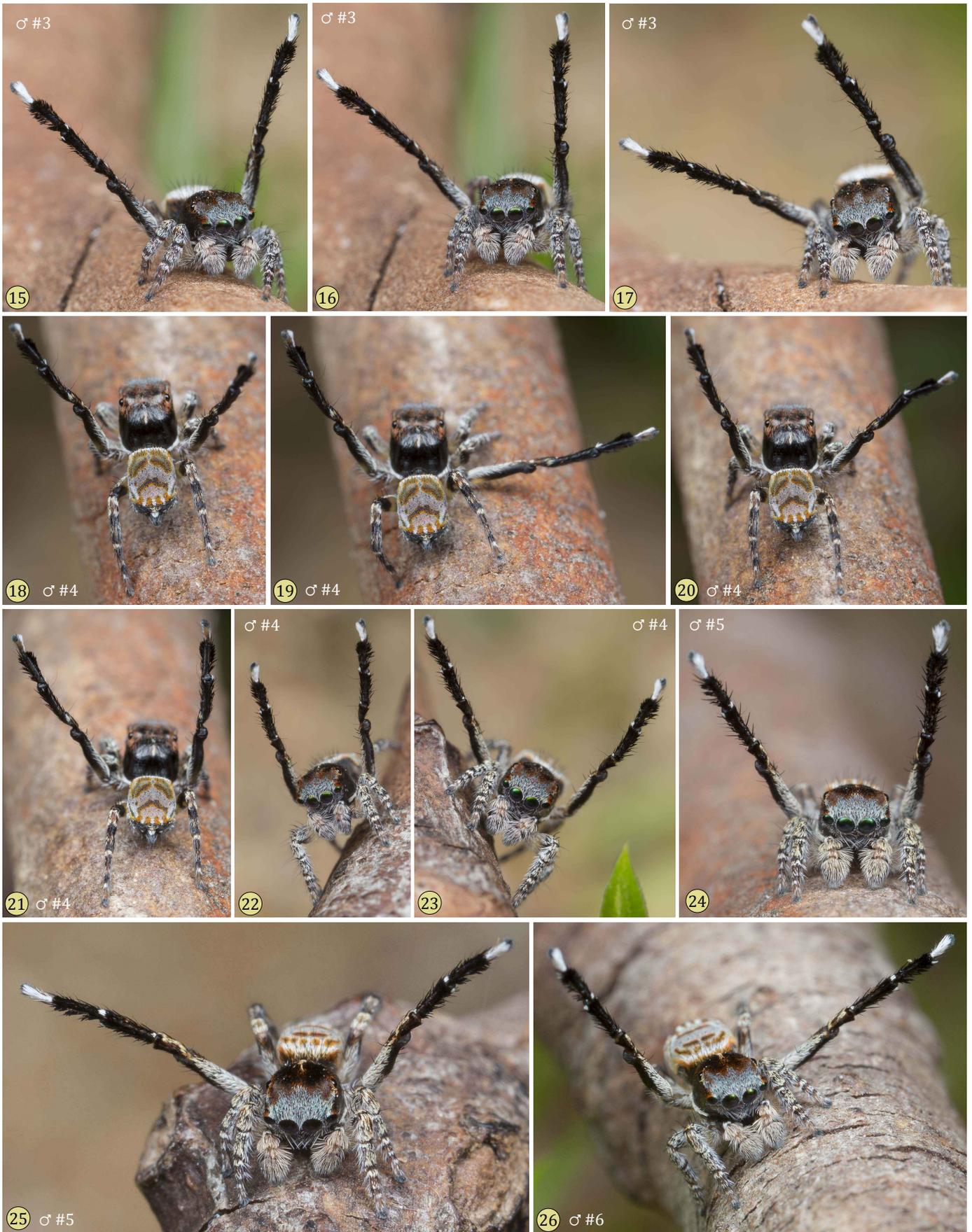


Figure 13 (continued from previous page). Courtship display by male *Maratus boranup*.

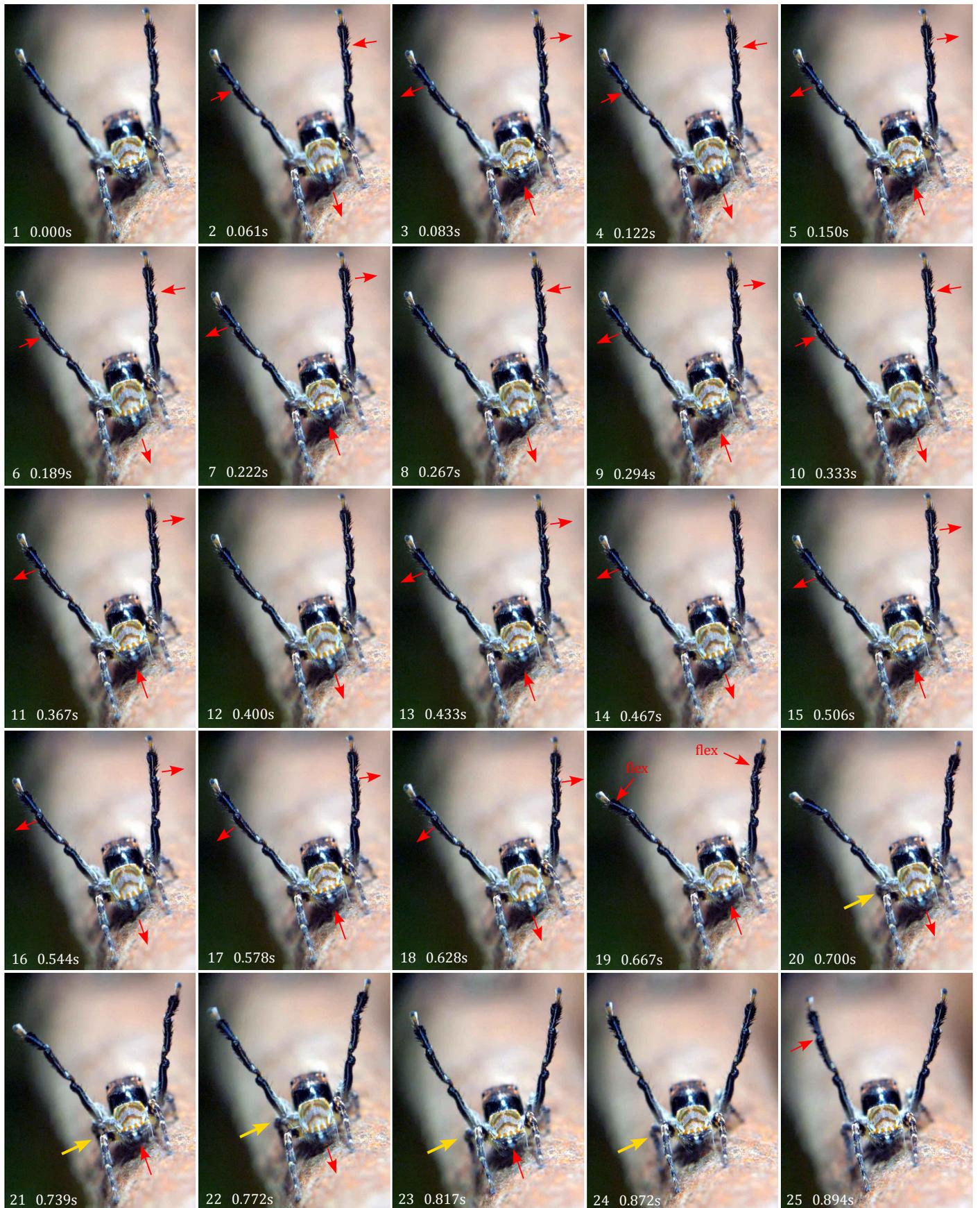


Figure 14. Sequential but not consecutive high speed video frames (180 fps) showing bilateral waving of legs III (~11 cycles/s) and rapid bobbing of the opisthosoma (~13.5 cycles/s) during courtship display of a male *Maratus boranup*. Arrows indicate movement of legs III or the opisthosoma relative to the previous frame.

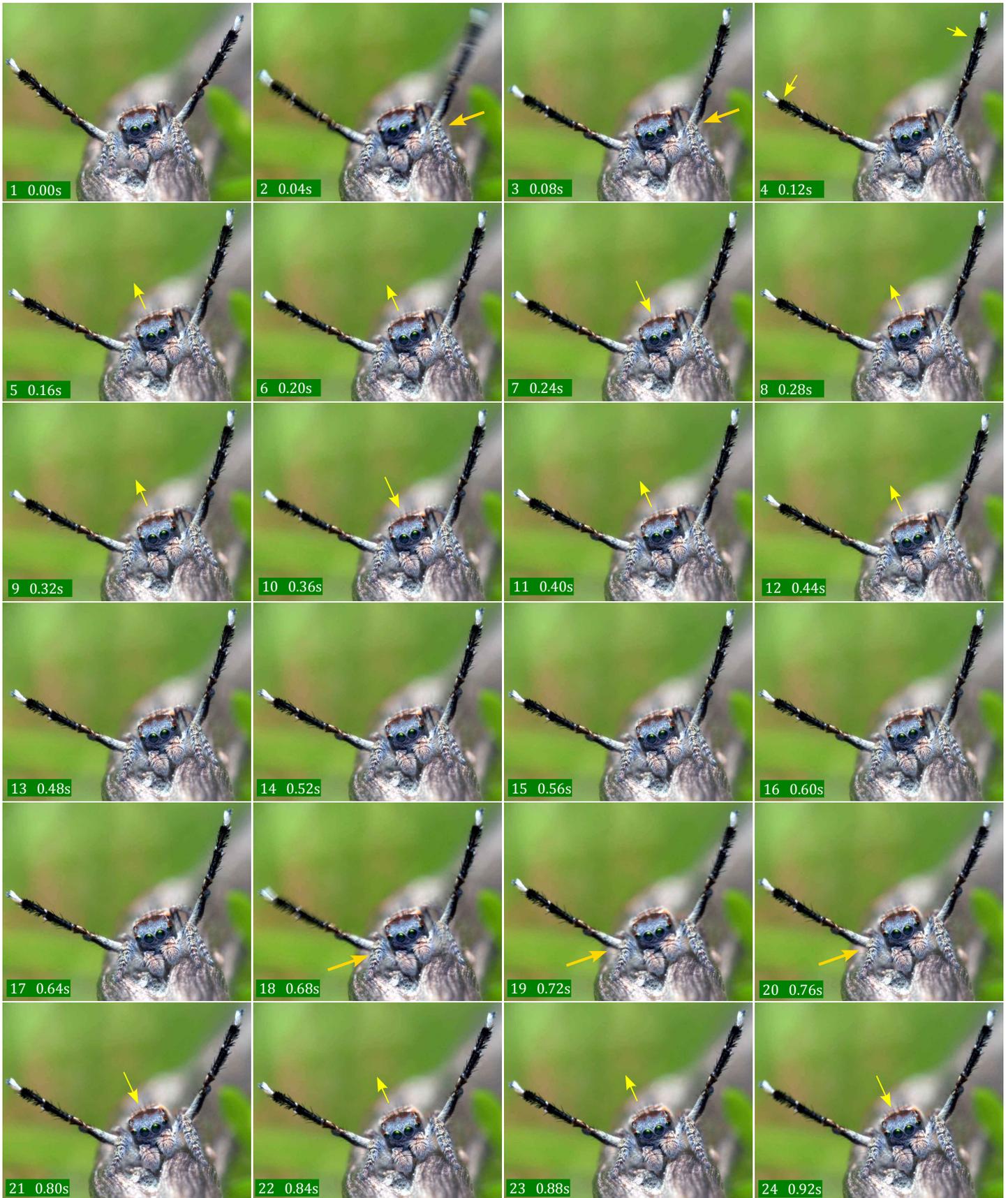


Figure 15. Consecutive frames from a video (25 fps) showing intermittent bobbing of the opisthosoma (~ 8 cycles/s when active) as legs III were held in a wide position during the courtship display of a male *Maratus boranup*. Movements of the opisthosoma (arrows) are barely visible from the front.

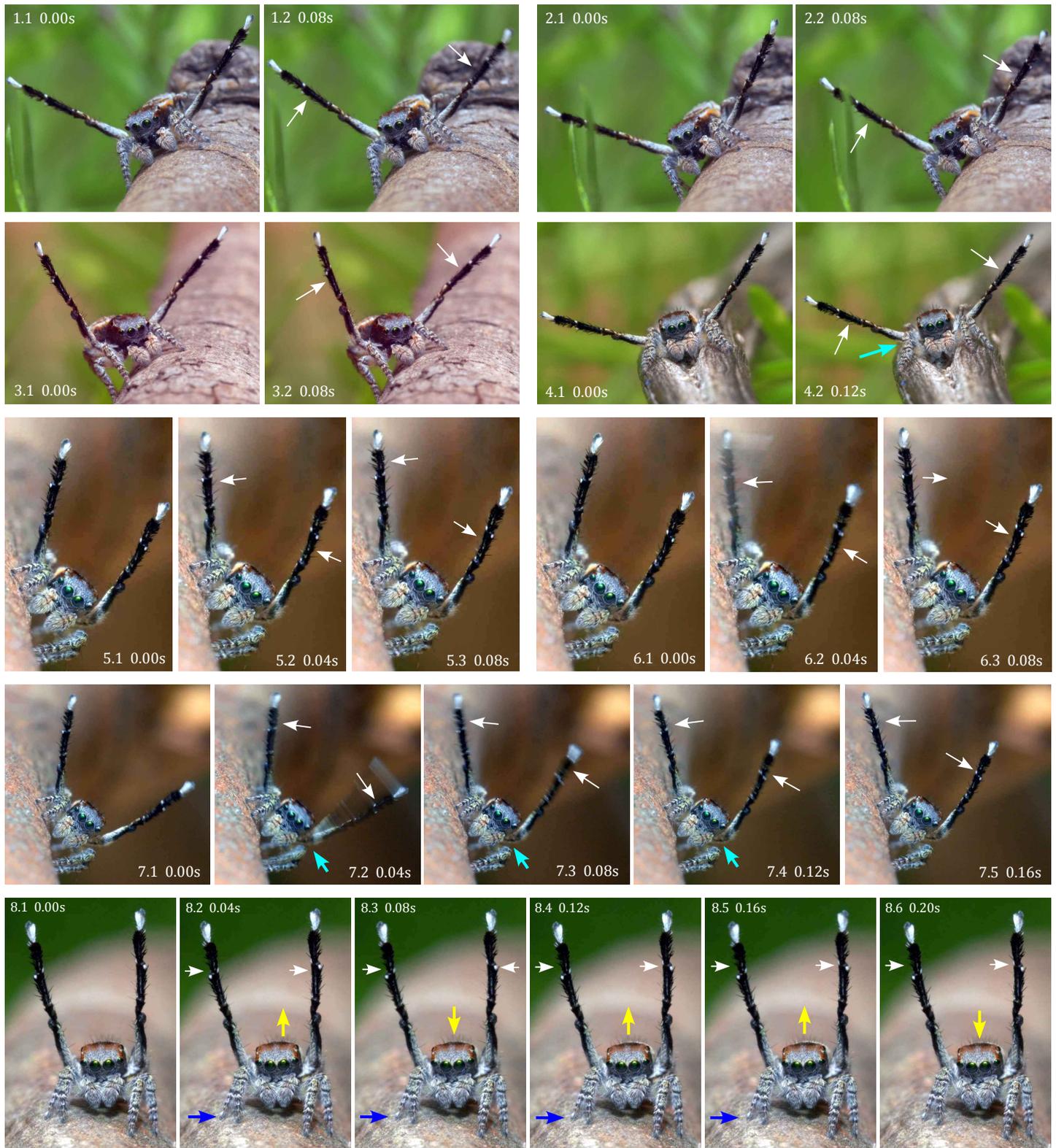


Figure 16. Eight video sequences (1-8, 25fps) showing movement of legs III by a courting male *Maratus boranup*. Arrows indicate movement relative to the previous frame in each sequence. **1-3**, Three sequences showing sudden rotation of both extended legs III toward the left of the spider. **4**, Rotation of both legs toward the left of the spider with slight movement of the body in the same direction. **5-6**, Two sequences showing sudden rotation to the right of the spider of both legs III (5.2, 6.2), followed by very slight adjustments of the leg III position (5.3, 6.3). **7**, Sequence showing slight adjustments of relative leg III position (7.2, 7.5) as both legs III were rotated to the right (7.3, 7.4), with slight movement of the body in the same direction (cyan arrows). **8**, In this sequence the spider moved both legs III slightly to the left while bobbing the opisthosoma up and down at a rate of ~ 10 cycles/s. The right legs I and II also slid slowly over the surface during this movement (blue arrows).

Mating (Figure 17). Male *Maratus boranup* elevate their opisthosoma at an angle of $\sim 40^\circ$ as they mate.



Figure 17. Mating by *Maratus boranup*. 1-3, Aerial mating while suspended from the dragline of the female. This pair continued to mate after falling from the branch on which they began to mate. 4, Decorative setae were exposed as the male raised his opisthosoma by $\sim 40^\circ$ while mating.

Habitat. *Maratus boranup* was found along a roadside in the vicinity of Conto's Campsite at Boranup in Western Australia (Figure 18). Vegetation along this track was dominated by peppermint (*Agonis flexuosa*), jarrah (*Eucalyptus marginata*), marri (*Corymbia calophylla*) and grass trees (*Xanthorrhoea* sp.).



Figure 18. Roadside habitat of *Maratus boranup* at Boranup.

Maratus flavus, new species

Type specimens. The holotype male (♂ #1) five paratype males (♂ #2-6), and four paratype females (♀ #1-4) were collected in *Banksia* woodland at Tims Thicket near Dawesville, Western Australia (32.639883°S, 115.6274°E, 20 OCT 2017, coll. J. Otto). Five paratype males (♂ #7-11) and three paratype females (♀ #5-7) were also collected in the same habitat (32.639423°S, 115.627531°E, 7-8 OCT 2017, coll. C. Anderson). All types will be deposited in the Western Australian Museum, Perth.

Etymology. The species group name (*flavus*, Latin, m., adj.), translated as *yellow* in English, refers to the mustard-yellow colouration of scales that cover the dorsal opisthosomal plate of the male.

Diagnosis. Most closely related to *Maratus boranup* as noted in the description of that species, but males can be readily separated by the pattern of scales on their fan (Figure 2). We place this species in the *flavus* group with *M. boranup*. Unlike that species, the male *M. flavus* does raise his opisthosoma during courtship display, but both species rely greatly on a bilaterally symmetric display of their extended legs III. Females of the two species are very similar and difficult to distinguish.

Description of male (Figures 19-22). The male types are 3.7-4.2 mm in length (n=11). The chelicerae are black and glabrous. The carapace is black, and the clypeus is mostly glabrous except for several off-white setae at the midline. Except at the top the anterior eyes are surrounded by grey scales. The eye region is covered with grey scales that extend below the lateral eyes on either side, interrupted by four prominent red-orange or red-brown stripes, one running to the rear behind each of the anterior eyes. To the rear and sides the carapace is mostly black and glabrous. A variable cover of scattered off-white setae is present on the sides of the carapace and a bright white median band extends to the rear behind the eye region. A band of bright white scales is also present along each lateral margin of the carapace. The PME are closer to the PLE than to the ALE.



Figure 19 (continued on next page). Living male types for *Maratus flavus*. 2, 6, 12, Detail of fan.



Figure 19 (continued from previous page). Living male types for *Maratus flavus*. 17-18, Display position.

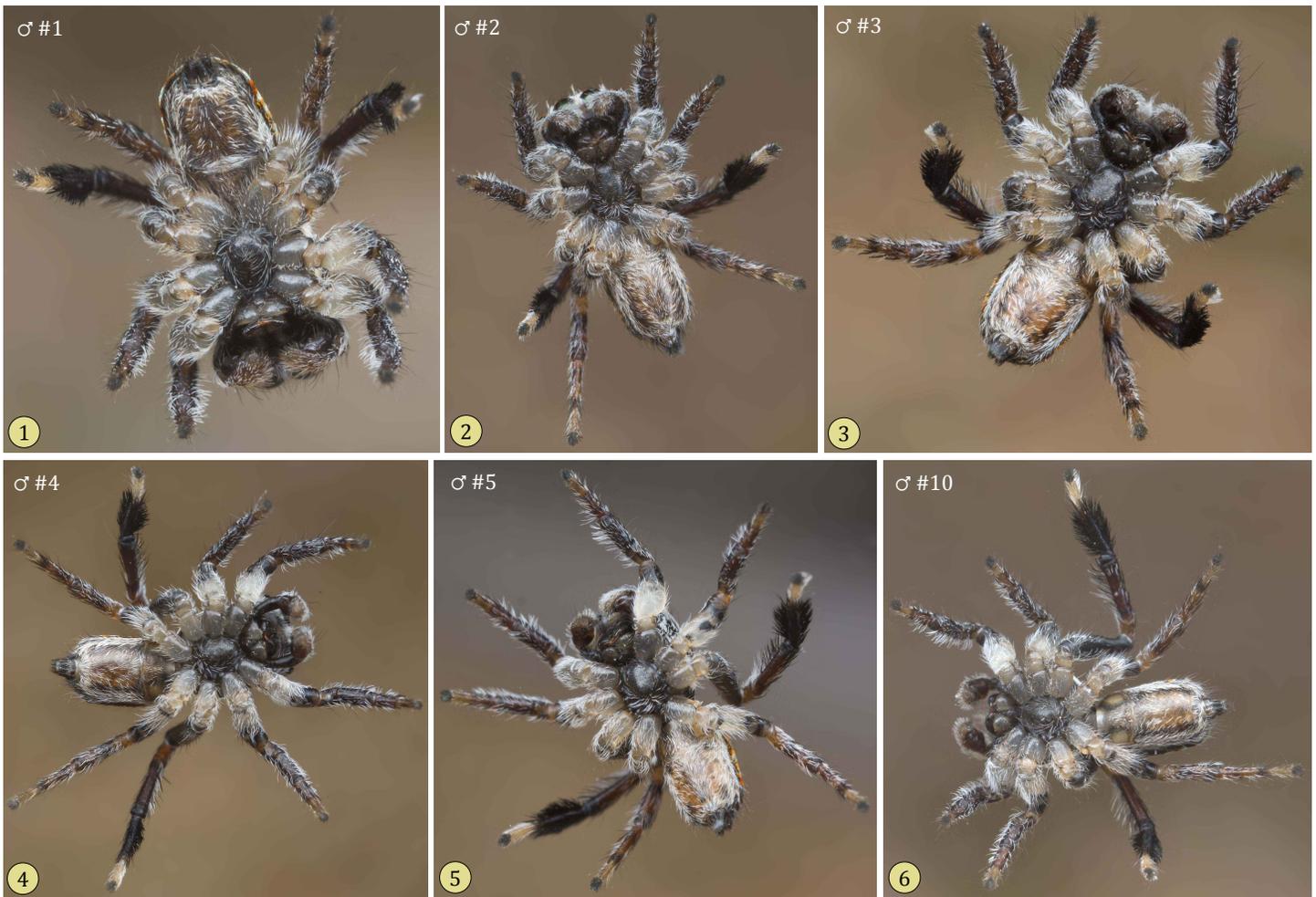


Figure 20. Ventral view of living male types for *Maratus flavus*.

The dorsal plate of the opisthosoma is subovate, more rectangular at the front and rounded at the rear margin. There are no lateral flaps or fringes except for some longer setae projecting forward at the front. The pattern of scale cover is distinctive, with orange or mustard-yellow scales radiating from a series of black lines or figures, on a background of iridescent scales that are green to yellow, orange, or grey depending on direction. A narrow black transverse line demarcates the rounded rear section of the fan, and on either side this line is surrounded by a small group of dull to bright red-orange scales. Behind the dorsal plate the opisthosoma is black except for a group of off-white setae in front of a small triangular patch of white colular scales. Below this patch the spinnerets are brown to black. The sides of the opisthosoma are black, covered with off-white setae below, and the venter is brown and mostly glabrous with a variable cover of scattered setae and with a darker line extending along its length on either side from the book lungs to the posterior margin. From below, the coxae and proximal femora are light brown to grey with a sparse cover of off-white setae. The sternum, labium, and endites are dark grey and mostly glabrous.

Legs I and II are shorter, legs III and IV longer, and legs III by far the longest. From the distal femur to the tarsus legs I, II and IV are brown with scattered white to off-white setae with generally indistinct banding. The anteroventral margin of the femur of each leg III is black. A red-brown dorsal stripe extends from the femur to the tibia of each leg III. The patella III and tibia III bear a fringe of longer white setae. The metatarsus III is fringed on all sides with long black setae, and the tarsus III is covered with bright white setae.

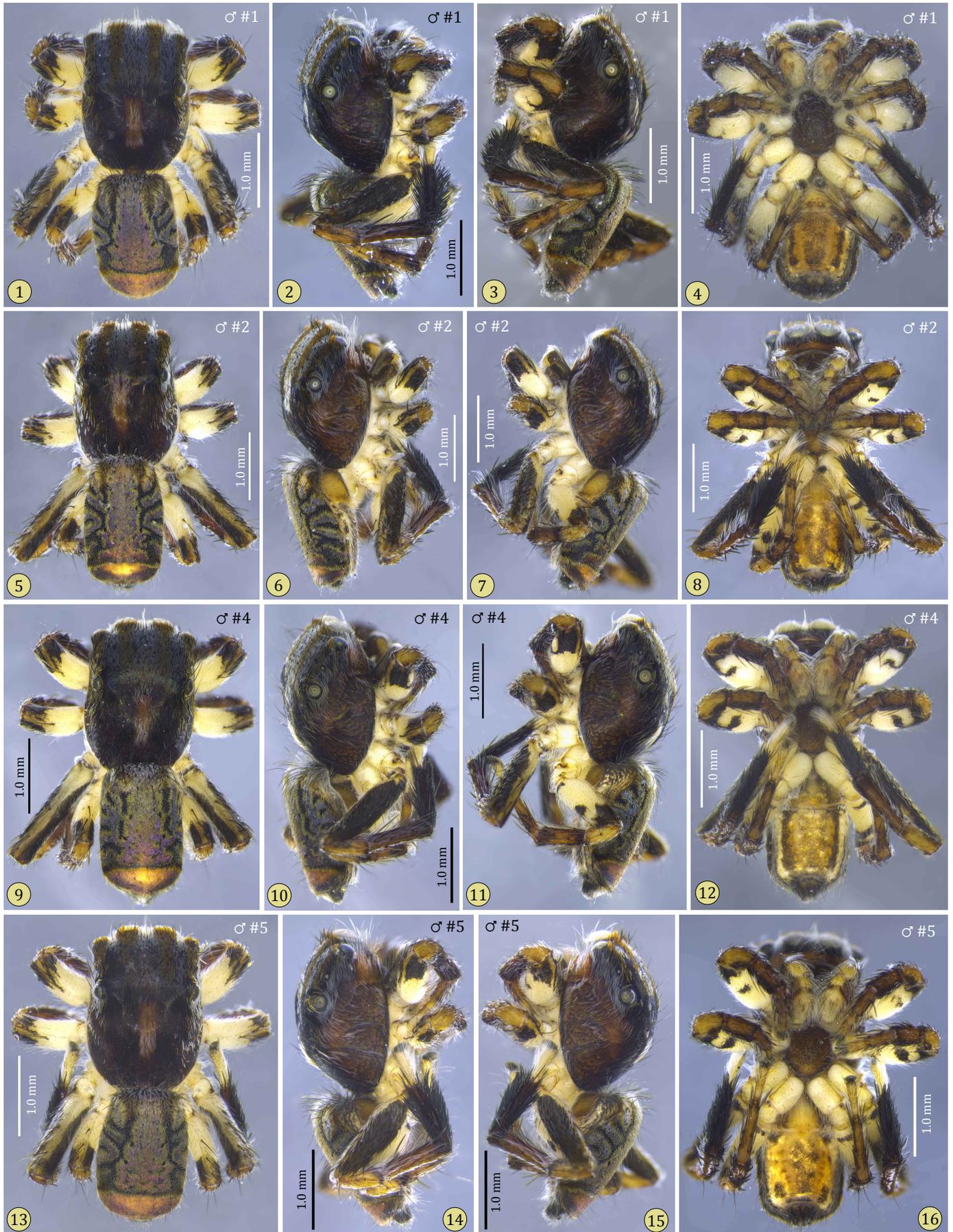


Figure 21 (continued on next page). Male type specimens for *Maratus flavus* in ethanol.

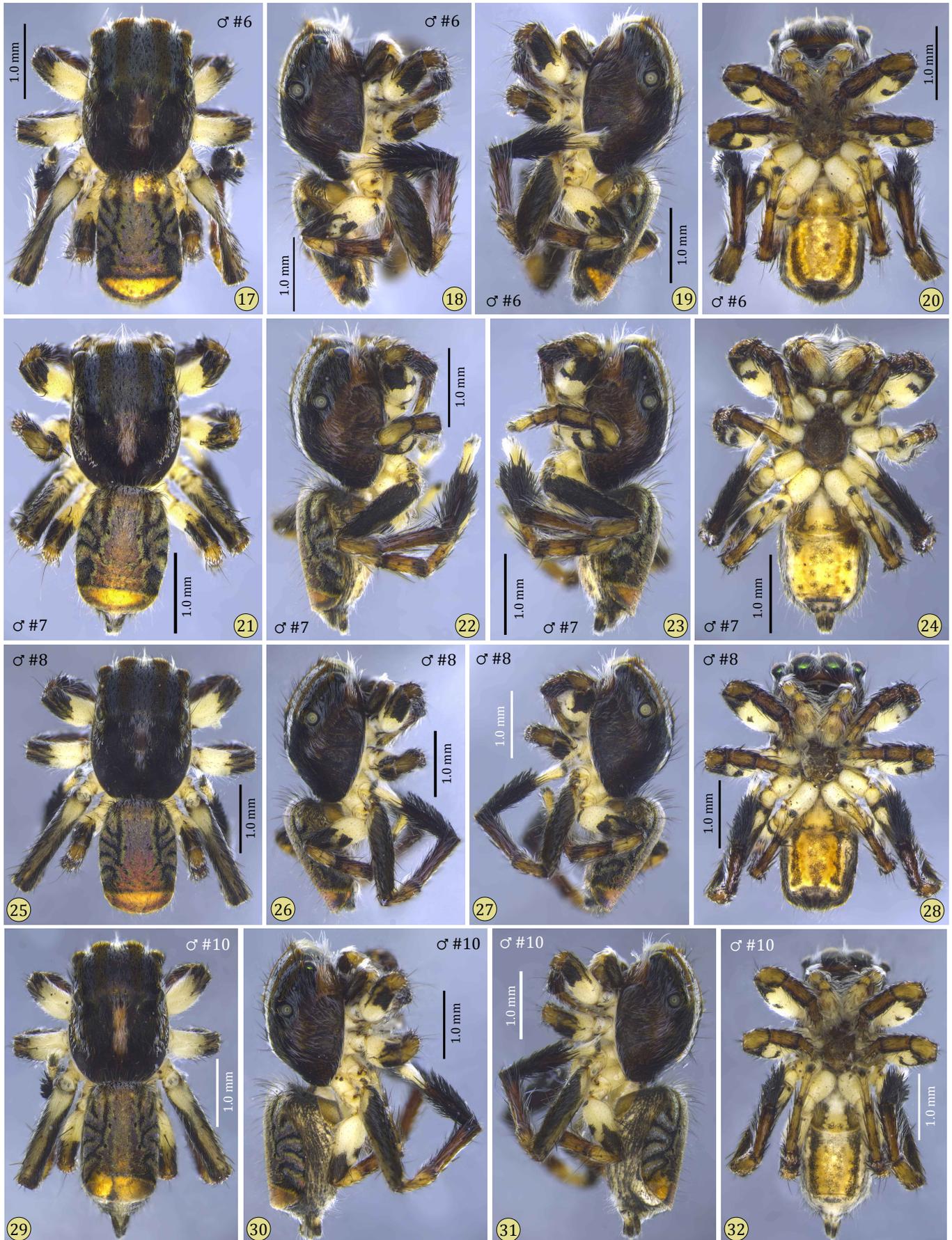


Figure 21 (continued on next page). Male type specimens for *Maratus flavus* in ethanol.

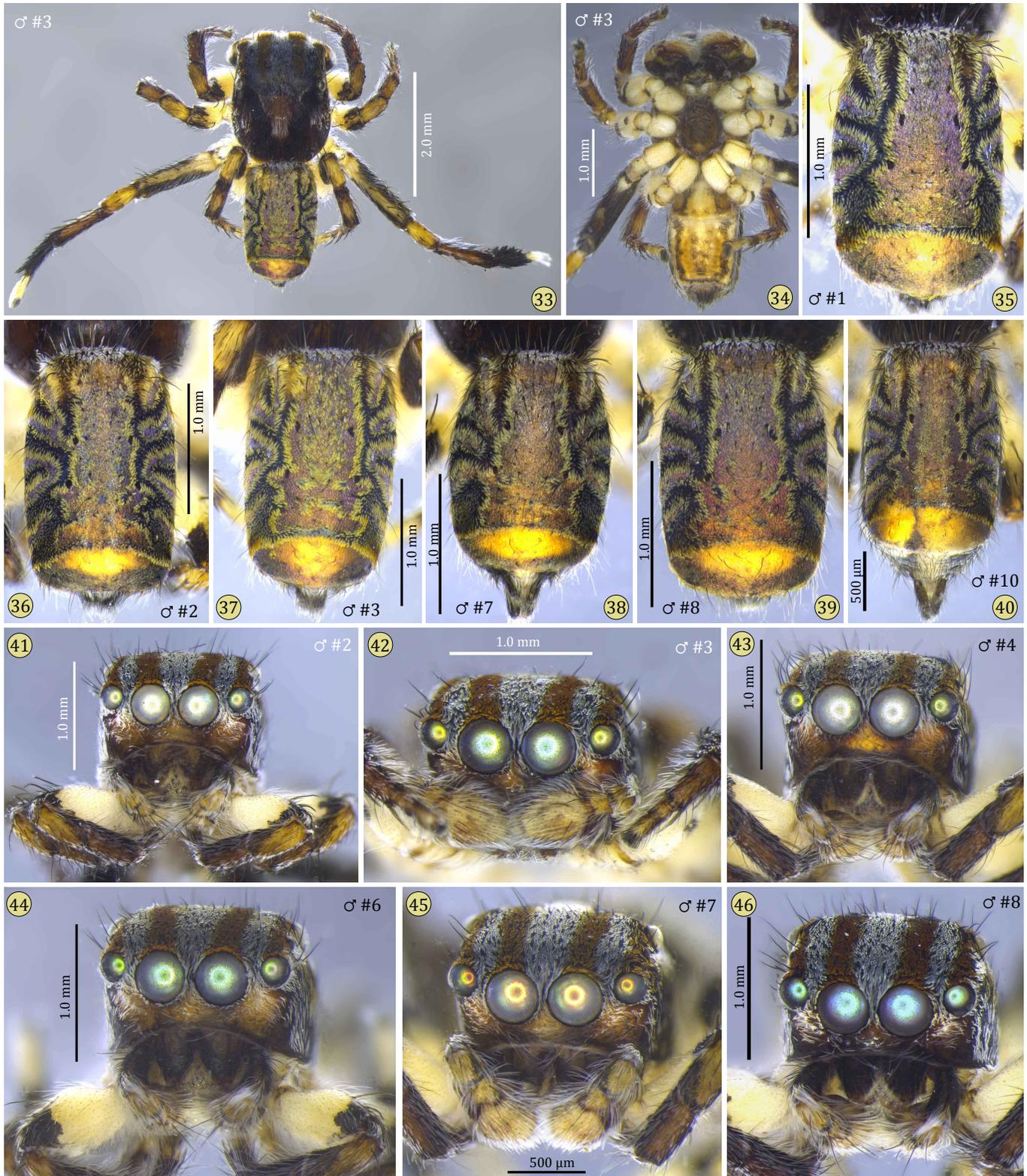


Figure 21 (continued from previous page). Male type specimens for *Maratus flavus* in ethanol. 35-40, Detail of dorsal plate of the opisthosoma. Note the bright yellow colour of the illuminated posterior opisthosoma in ethanol.

Dorsally the pedipalps have a cover of white setae and ventrally they are dark brown. Detailed structures of the pedipalp (Figure 22) are similar to those of other *Maratus*. A single serration or projection is present on the ventral edge of the outer apex of the embolus (Figure 22:19).

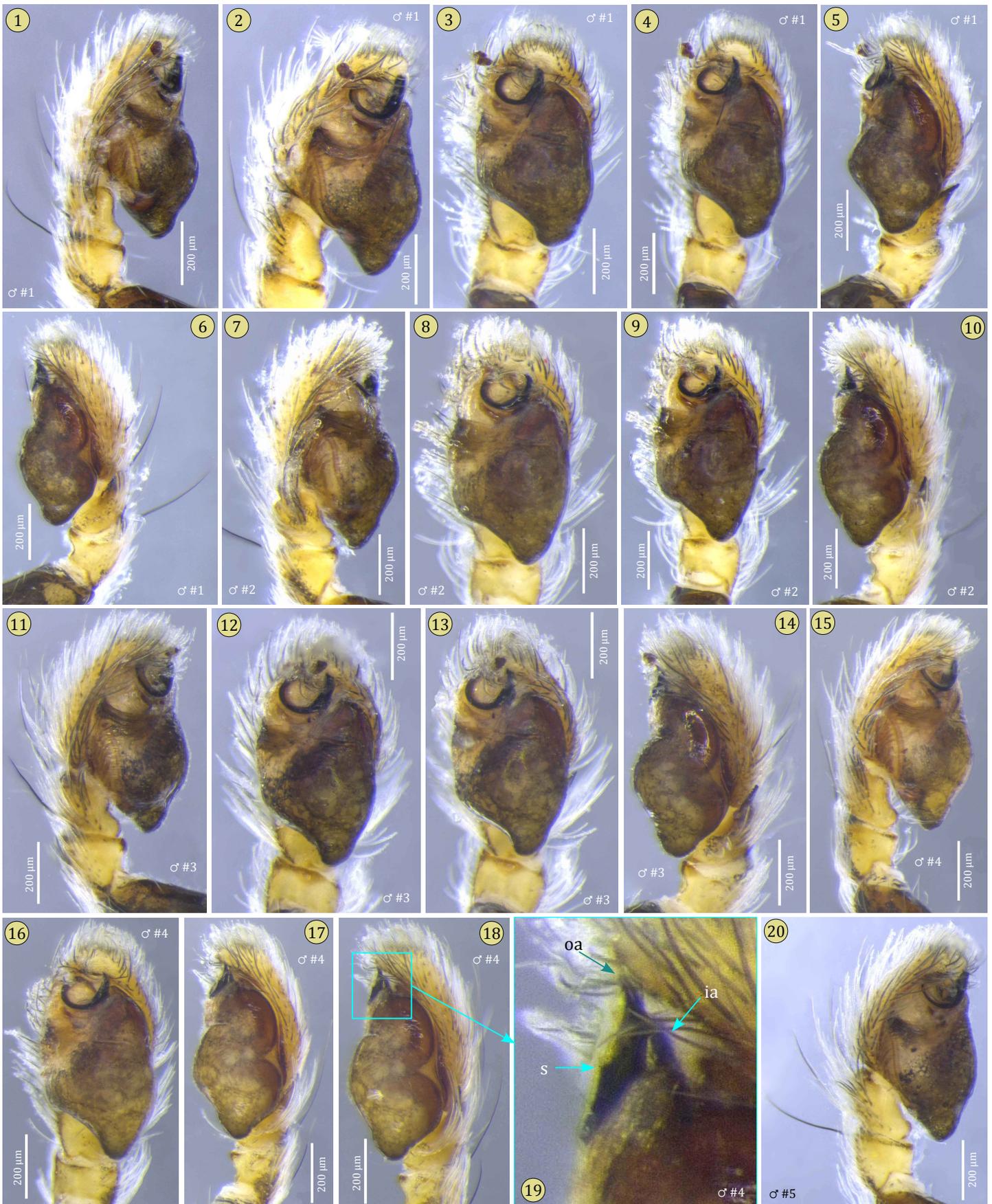


Figure 22 (continued on next page). Median to lateral views of the left pedipalp of male *Maratus flavus* types. **19**, Detail of inset in (18), showing outer (oa) and inner (ia) apices of the embolus, and the serration or projection (s) of the outer apex.

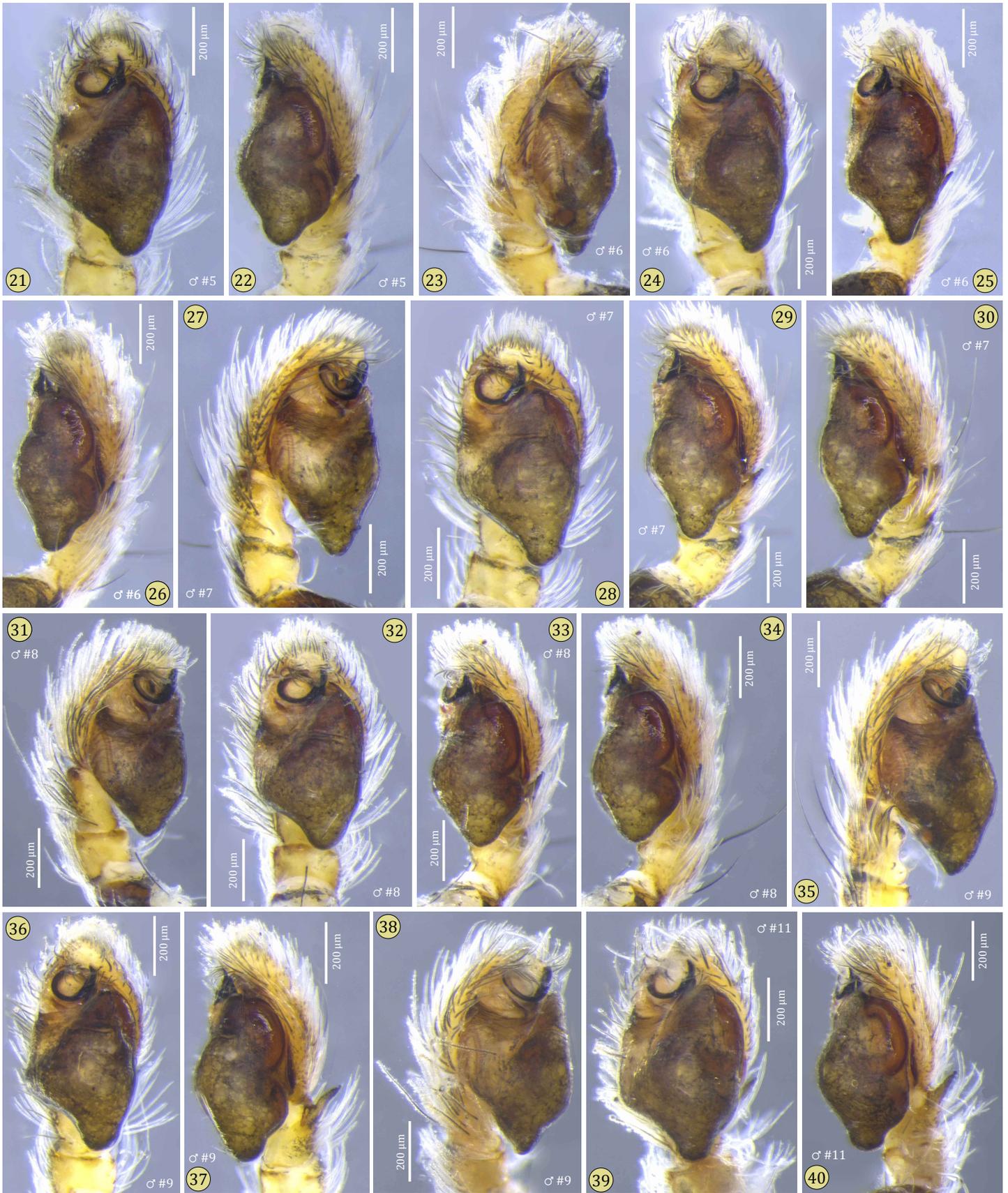


Figure 22 (continued from previous page). Median to lateral views of the left pedipalp of male *Maratus flavus* types.

Description of female (Figures 23-26). The female types are 4.7-5.3 mm in length (n=7).



Figure 23 (continued on next page). Living female types for *Maratus flavus*.



Figure 23 (continued from previous page). Living female types for *Maratus flavus*.

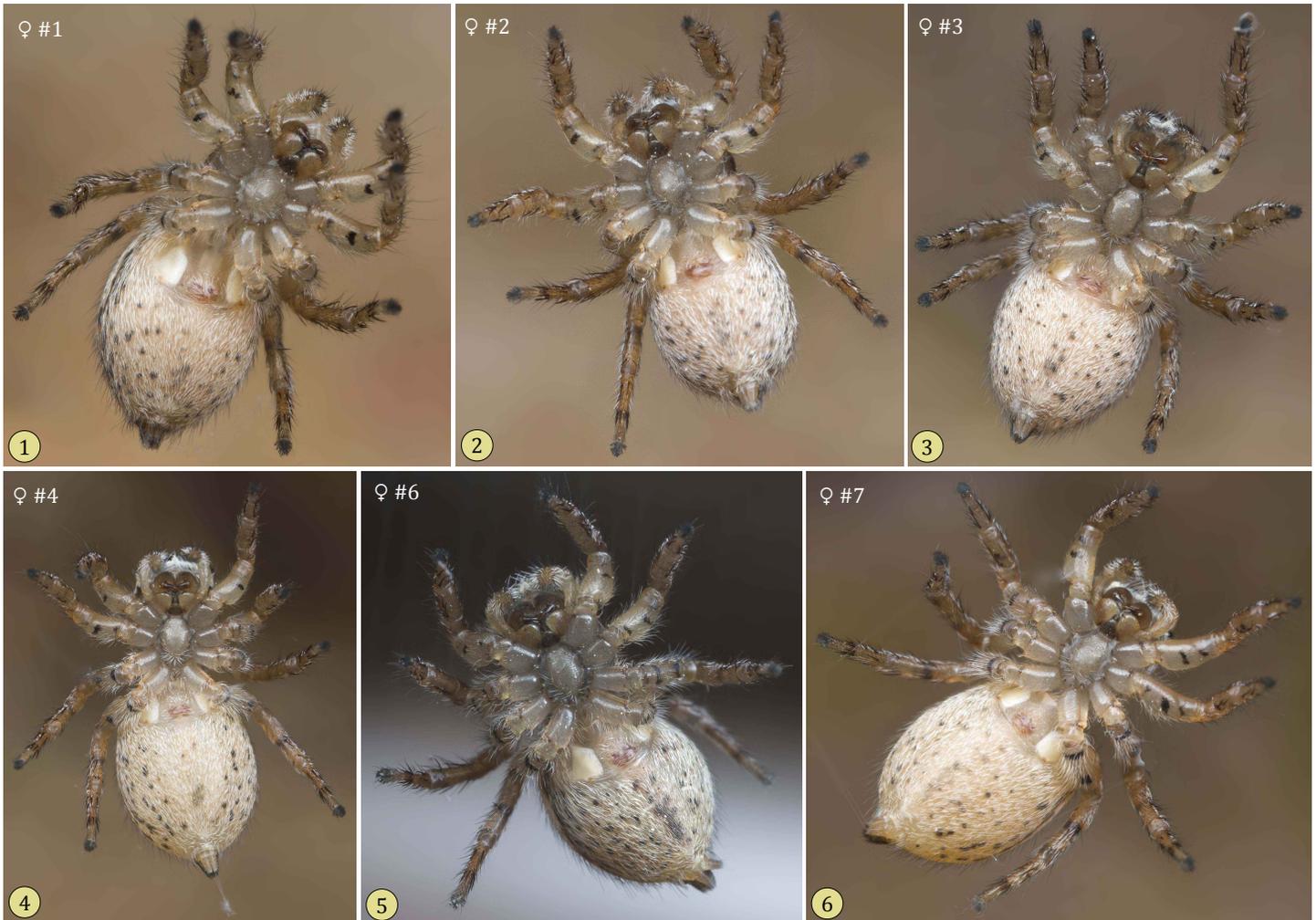


Figure 24. Ventral view of living female types for *Maratus flavus*.

The chelicerae are light brown, glabrous, and translucent. The carapace is light brown and translucent, except for the eye region and a stripe of dark pigment extending to the rear behind the eye region on either side (Figure 25:1,4,8). Long white to off-white setae extend over the clypeus, anteromedially below the anterior eyes. The eye region is mostly covered with light brown setae, except for a distinct, darker red-brown stripe running behind each AME. Behind the eye region, a median stripe of off-white setae extends to the rear, surrounded on either side by a wide, dark brown band that is mostly glabrous. On either side below the lateral eyes and on either side of these dark brown bands is a band of off-white setae. Otherwise the sides of the carapace are almost entirely glabrous and translucent, with no lateral marginal bands. The PME are closer to the PLE than to the ALE.

The dorsum of the opisthosoma is brown to dark brown, at the front with a cover of scattered off-white setae arranged in three irregular longitudinal bands. The lateral margins of this brown area are marked by a wavy line that separates it from a broad marginal band of off-white setae on either side. Below each marginal band is a dark brown stripe, separating this from the venter which is mottled with small brown spots and covered with shorter off-white setae. A small tuft of white to off-white colular setae is present.

From below the coxae, trochanters, proximal femora, sternum, and endites are mostly light brown to brown, translucent, and glabrous. Legs I and II are shorter and of similar length, and legs III and IV are longer, also of similar length. The legs are generally brown and irregularly spotted with dark pigment. The pedipalps are light brown and translucent with a cover of off-white setae.

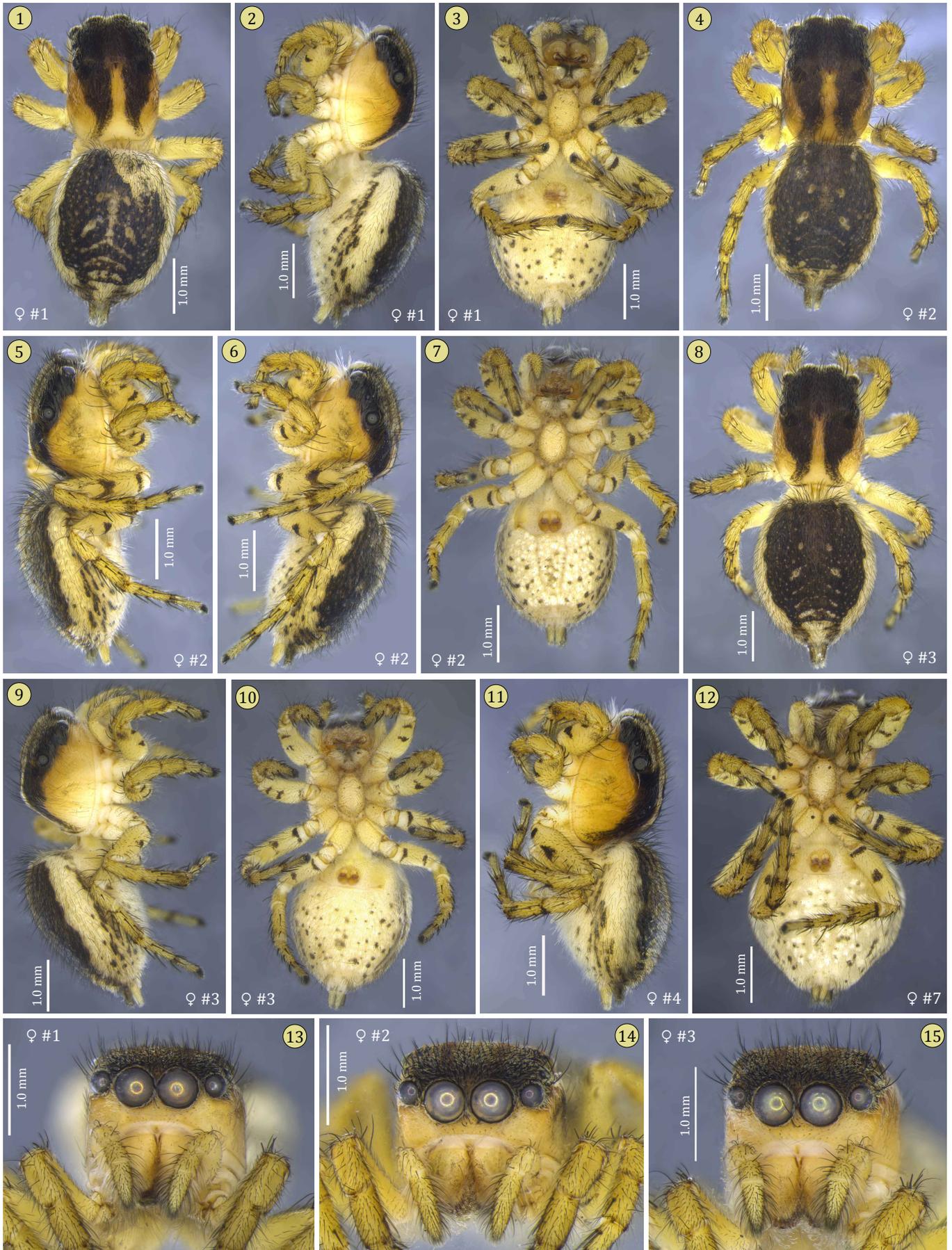


Figure 25. Female type specimens for *Maratus flavus* in ethanol.

The epigynum (Figure 26) has a pair of relatively large ovate to circular fossae, separated by a septum of variable width. Behind each fossa is a larger, ovate to circular posterior spermatheca. Sclerotized ducts are present anterior to each spermatheca, visible through the ipsilateral fossa.

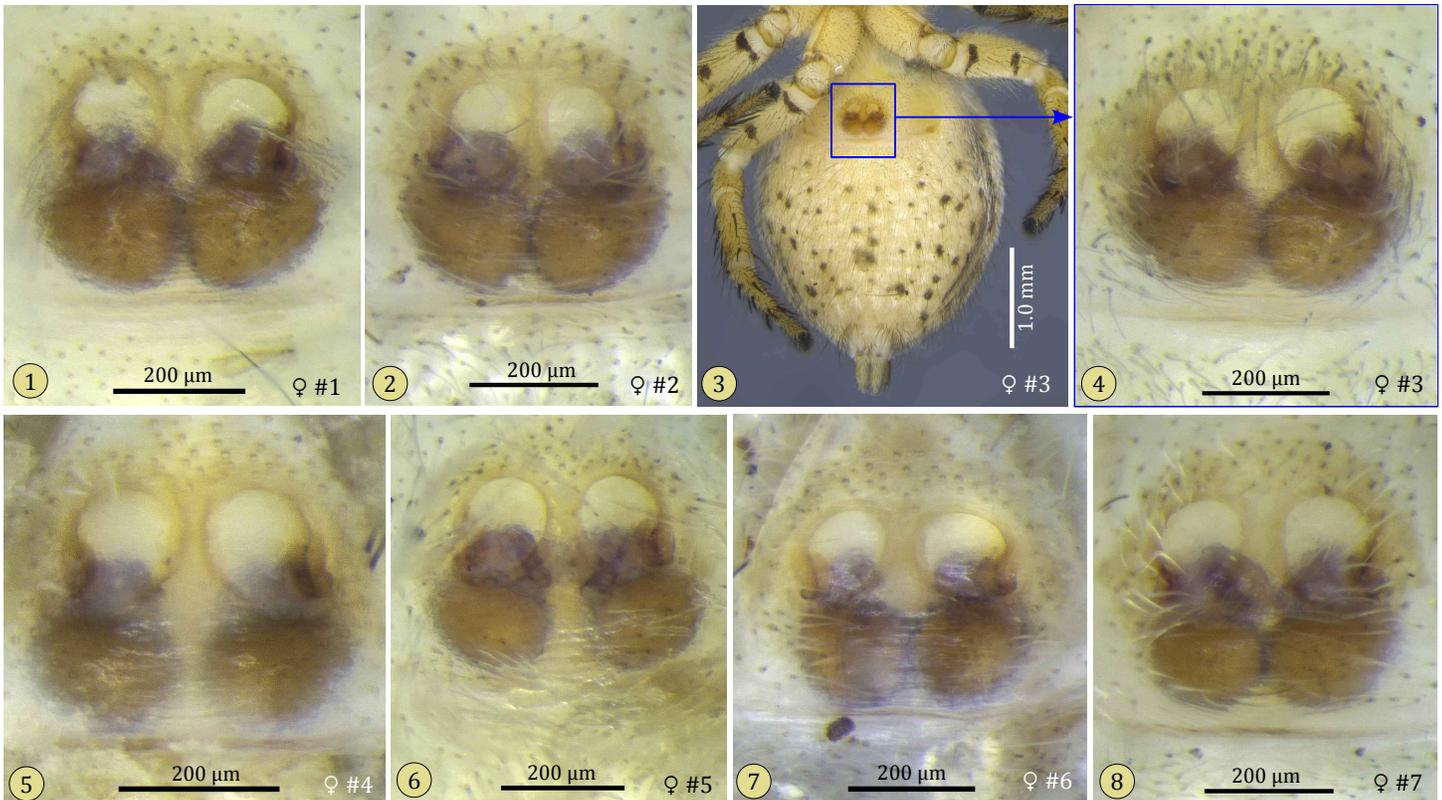


Figure 26. Ventral view of the epigynum of the seven female type specimens for *Maratus flavus* in ethanol. **4**, Detail of inset rectangle in (3).

Courtship display (Figures 27-29). The male *M. flavus* waves his extended and elevated legs III in a mostly bilaterally symmetric manner. High speed video recording (180 fps) has allowed us to time the very fast movement or vibration of these legs, alternately raised and lowered to the side at a rate of ~29-36 cycles/s (Figures 28-29). Legs III are held in a relatively vertical position as they are waved. Like *M. boranup*, *M. flavus* males also bob or wave their elevated opisthosoma as they wave legs III, but at a much lower and more irregular rate of ~5-10/s. As with *M. boranup* pedipalp movement is not part of this display, but in *M. flavus* each pedipalp is held to the side, exposing the black, glabrous chelicerae to the front in the direction of the courted female.

Display by females. As has been reported for other *Maratus* species (Otto & Hill 2016), female *M. flavus* display to males by rising on their legs and waving their elevated opisthosoma (Figure 30). They may also extend their legs III during this display. We consider this to represent a display of rejection targeted at a courting male.

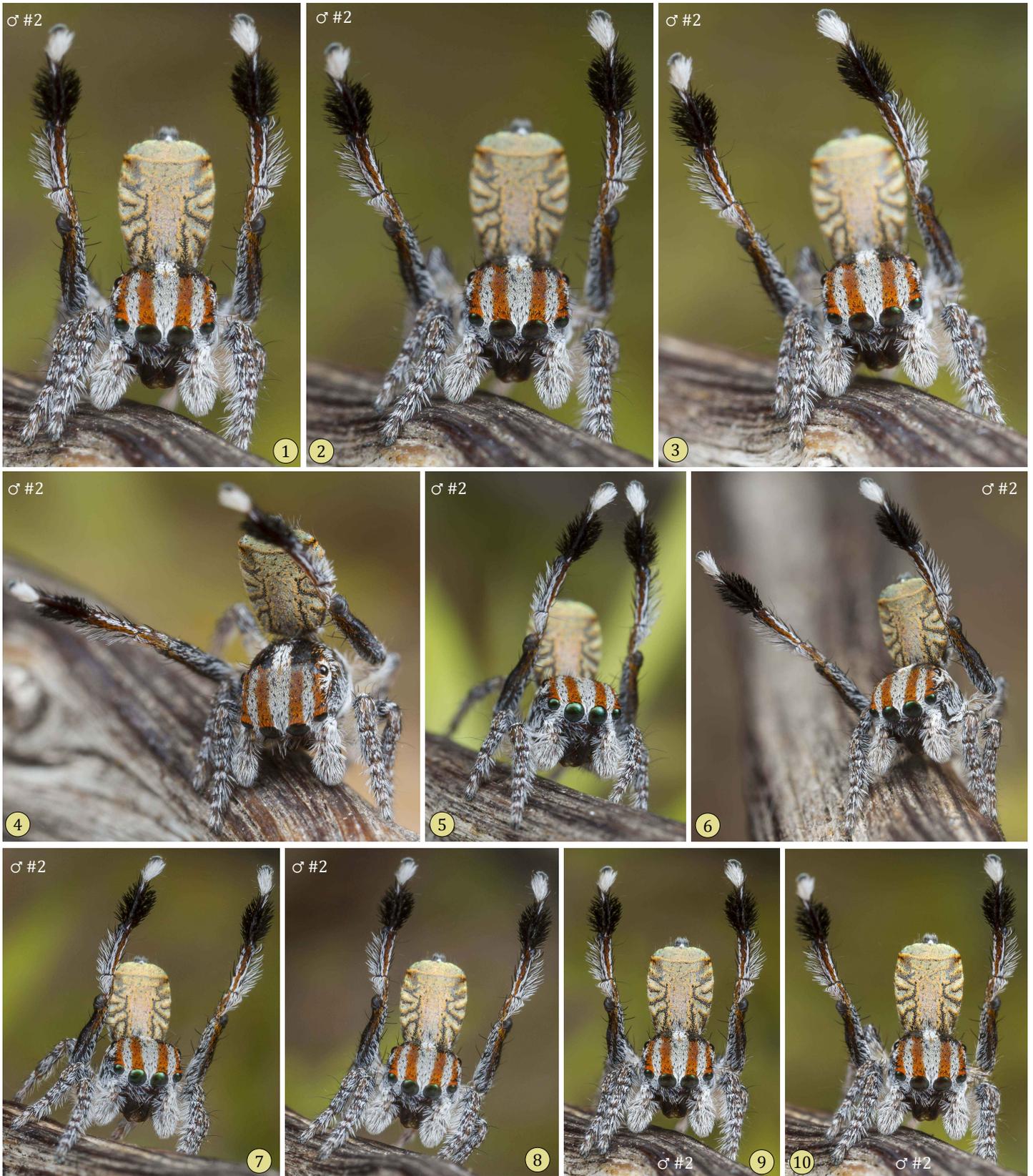


Figure 27 (continued on next page). Courtship display by male *M. flavus*. Note how the pedipalps were held to the side to expose the black chelicerae during this display.

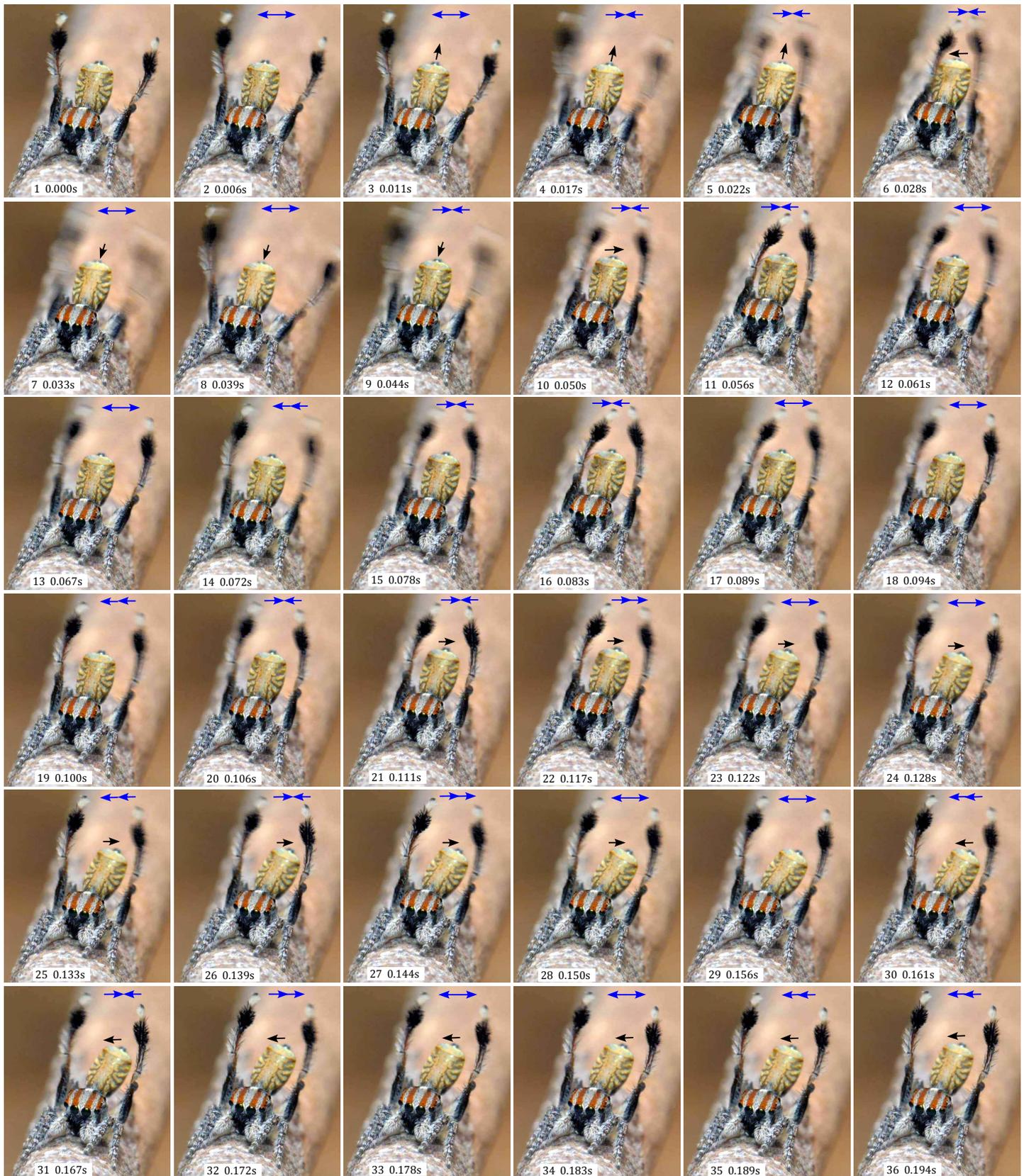


Figure 28. Consecutive frames from a high speed video (180 fps) of courtship display by a male *Maratus flavus*. Arrows indicate direction of movement of legs III or the fan relative to the previous frame. The extended and elevated legs III were waved in a nearly bilaterally symmetric manner very quickly (~ 36 cycles/s), while the fan was waved more slowly (~ 5 - 10 /s) through a relatively low amplitude of rotation.

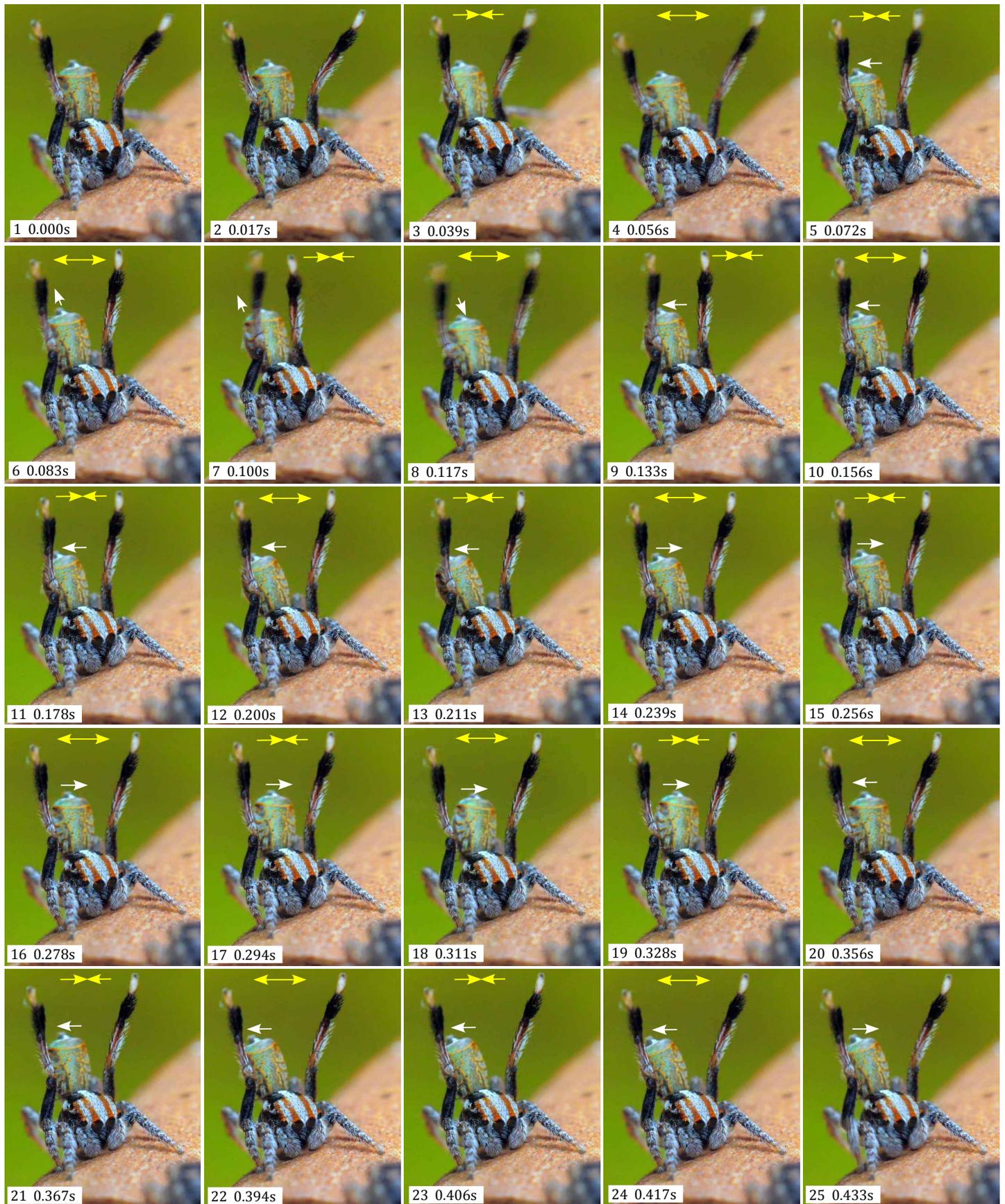


Figure 29. Sequential but not consecutive frames from a high speed video (180 fps) recording of courtship display by a male *Maratus flavus*. The extended and elevated legs III were waved in a bilaterally symmetric manner at a rate of ~ 29 cycles/s, as the fan was waved through a low amplitude of rotation at a slower rate of ~ 5 -6 cycles/s.

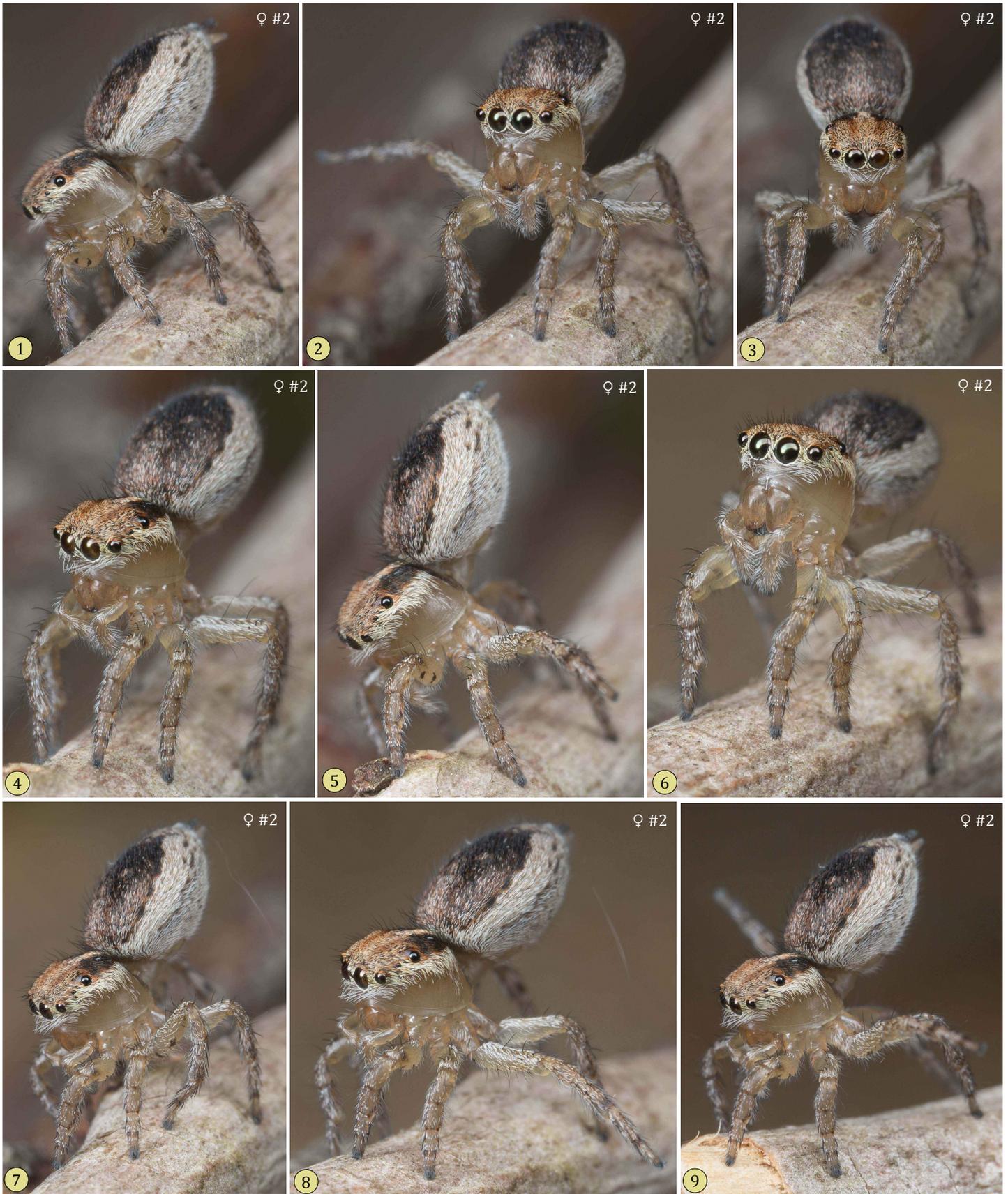


Figure 30. Sequence of positions assumed during the rejection display of a female *Maratus flavus*. 2, 9, Note extension of one (2) or both (9) legs III during this display.

Habitat. The habitat of *M. flavus* in the Swan Coastal Plain *Banksia* woodland of Tims Thicket near Dawesville, just south of Perth, Western Australia is shown in Figure 31. Most of the individuals collected by one of us (J. Otto) were found on small shrubs belonging to the genus *Hibbertia*, identifiable in Figure 31 by their yellow flowers.



Figure 31. *Maratus flavus* were found on or near the ground in this *Banksia* woodland near Dawesville, Western Australia.

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