

Two new peacock spiders in the *Maratus linnaei* group of southwestern Australia (Araneae: Salticidae: Euophryini: Australphryni)

Jürgen C. Otto¹ and David E. Hill²

¹ 19 Grevillea Avenue, St. Ives, New South Wales 2075, Australia, *email* jurgenotto8@gmail.com

² 213 Wild Horse Creek Drive, Simpsonville SC 29680, USA, *email* platycryptus@yahoo.com

Abstract. Two new species in the *linnaei* group of the genus *Maratus*, from the biodiversity hotspot of southwestern Australia, are described: *M. kwenda* and *M. nannup*. Both are close relatives of *M. candens*. Courtship display by males of both species is also documented.

Keywords. courtship behaviour, courtship display, jumping spider, *Maratus candens*, *Maratus kwenda*, *Maratus nannup*, narrow endemic, sexual selection

Recently (Otto & Hill 2024) we described two new jumping spiders in the *Maratus linnaei* group, endemic to the southwestern corner of Australia. This brought the number of known species in that group up to eight. We also identified the presence of several undescribed *linnaei* group species, to include one close relative of *Maratus candens* Otto & Hill 2022 (*M. cf. candens*). Here we describe that species, as well as a third member of the *candens* group, a subgroup of the *linnaei* group (Figure 1).



Figure 1. Courtship display by ♂ jumping spiders in the *Maratus candens* group. **1**, *M. candens*. **2**, *M. kwenda*, new species. **3**, *M. nannup*, new species.

The *candens* subgroup is endemic to a small area of predominantly Jarrah forest that is known for a high degree of plant endemism (Cook et al. 2015; Halstead 2019; Brundrett 2021; Nge & Skeels 2025) near the southwestern corner of Australia, parapatric to all other known members of the larger *linnaei* group (Figures 2-3). Within this area, and separated by less than 40 km, the three species in the *candens* subgroup are also parapatric with respect to their known distribution. We previously discussed the *microendemism* or *narrow endemism* of peacock spiders in southwestern Australia (Otto & Hill 2024). The detailed locality map (Figure 3) highlights the fact that there are many intermediate (but not distant) sites where we would expect to find members of the *candens* subgroup, either new species or varieties of known species. Presently we can hypothesize a very small range associated with a very low dispersal rate (as measured by km traversed per generation) for each of these species, but we cannot be certain of this.

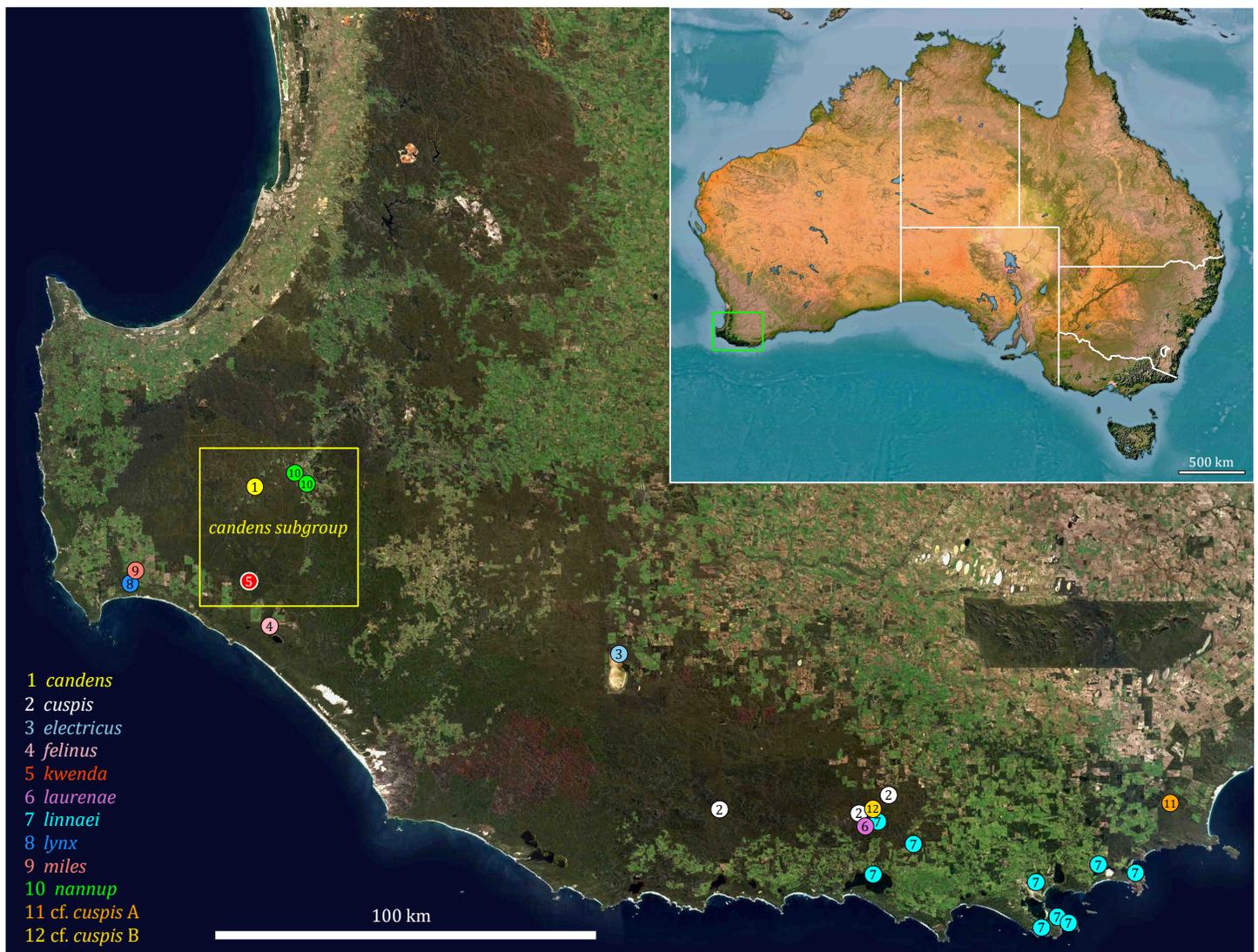


Figure 2. Known localities for peacock spiders in the *Maratus linnaei* group (updated, from Otto & Hill 2024). The area occupied by members of the *candens* subgroup (yellow rectangle) is shown in detail in Figure 3. Nearby are the three members of the *felinus* subgroup (*M. felinus*, *M. lynx* and *M. miles*).

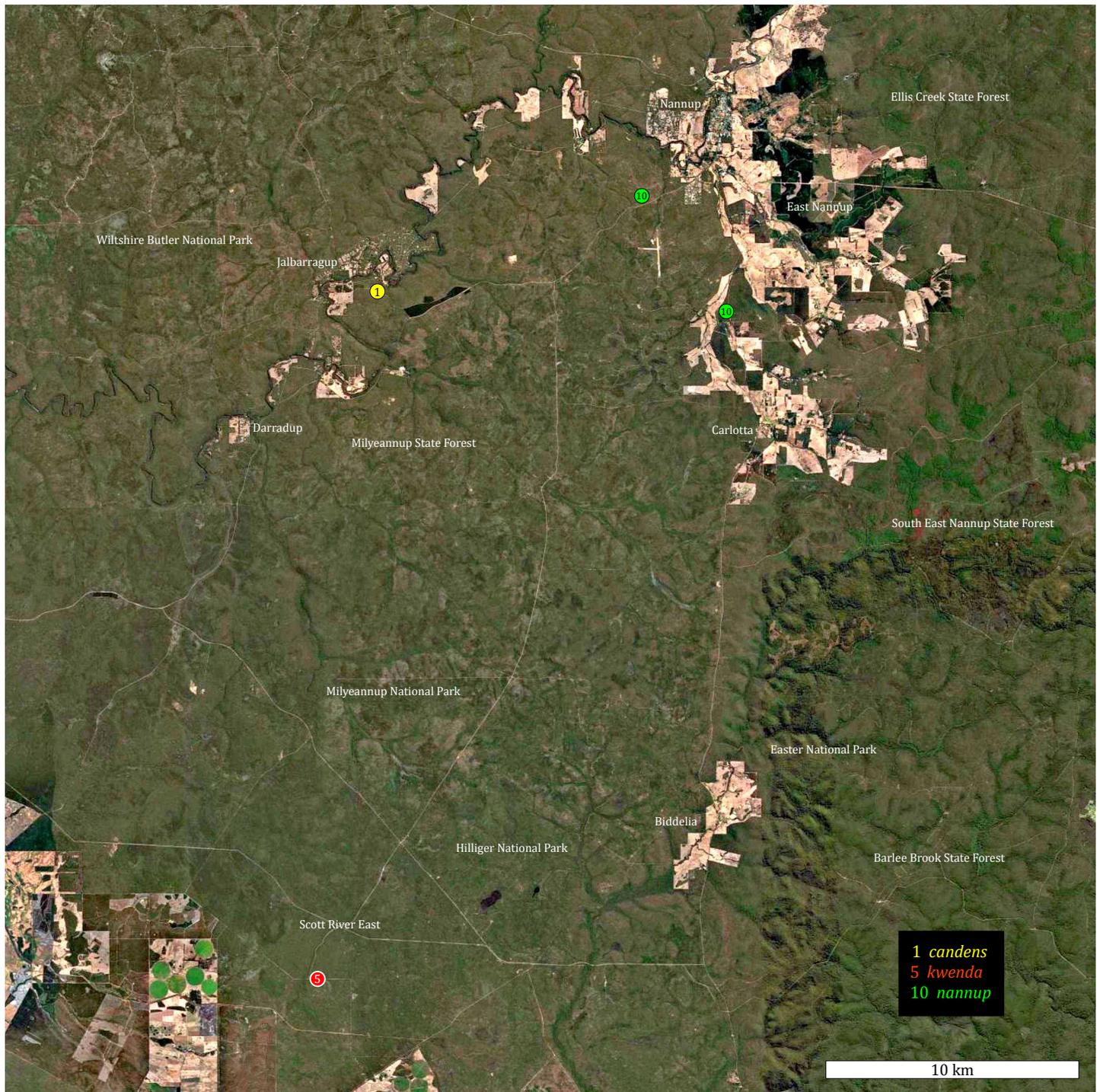


Figure 3. Closer view of the yellow inset rectangle in Figure 2, showing known localities for peacock spiders in the *Maratus candens* subgroup of the *M. linnaei* group. Collection at the two localities for *M. nannup* (#10) was separated by about one year (late 2023 at the northern site, late 2024 at the southern site for *M. nannup* and the *M. kwenda* site). *M. candens* was collected in late 2021 near Jalbarragup, in open Jarrah forest (Otto & Hill 2022). Background map ©OpenStreetMap.

The phenomenon of microendemism is not uncommon in arthropods (e.g., Gebremeskel et al. 2023; Hlebec et al. 2023; Platania & Gómez-Zurita 2023). The long-term habitat stability of *refugia* appears to be a requirement for the low dispersal rates associated with microendemism (Vences et al. 2009; Harrison & Noss 2017), just as out-migration or dispersal is needed for species survival in an unstable environment. To effectively study this phenomenon, fine-scale studies (e.g., Ball et al. 2020) that cover the areas between localities identified in Figure 3 will be necessary.

Genus *Maratus* Karsch 1878Type species *Maratus amabilis* Karsch 1878***Maratus kwenda*, new species**

Type specimens. The holotype male (♂#9), 7 paratype males (♂#1-3, 6, 8, 10-11), and 13 paratype females (♀#1-13) were collected 40 km east of Augusta, Western Australia, along a road called *Jacktrack* near the southwestern boundary of Hilliger National Park (34.287193S, 115.592868E, 5 Oct 2024, coll. Jürgen Otto and James McMulkin). All types will be deposited in the Western Australian Museum, Perth.

Etymology. The species group name, *kwenda*, noun in apposition, is taken from the Noongar name for bandicoot; some people may see the outline of this marsupial in the fan of the male.

Diagnosis. This species can be easily separated from the two related species in the *candens* group by the scale patterns on the fan of the adult male (Figure 1). The ventral opisthosoma of males of both *M. candens* and *M. nannup* is black and glabrous, that of male *M. kwenda* is light brown with a dense cover of off-white setae (Figure 6). The shape of the fan is not a reliable character, as this varies according to the degree to which the male expands it during display. Microscopic details of genitalic structure (male pedipalp and female epigynum) are not useful for identification, as these are very similar to those of many other *Maratus* species in southwestern Australia.

Description of male (Figures 1.2, 4-9). Males (n=8) ranged from 4.4-4.6 mm in length. The chelicerae are black and glabrous, with long white setae extending from the anterior surface of each paturon. A prominent tuft of bright white setae also extends anteroventrally from the clypeus. The pedipalps are covered with bright white setae dorsally. The eye quadrangle is covered with white scales, interrupted by five stripes of dark red scales, a narrower stripe at the midline, and a wider stripe extending to the rear behind each anterior eye. The sides and rear of the carapace are mostly black and glabrous, except for a median thoracic stripe of white scales just behind the eye quadrangle, and a bright white marginal band on either side. The PME are slightly closer to the PME than to the ALE. The fan (Figure 4) has a distinctive pattern of pigmented red to light brown and iridescent blue-green scales; the predominant colour is tan or light brown. The edge of the dark grey or black dorsal opisthosoma plate is visible at each side of the fan, particularly when it is expanded laterally during courtship display. However, distinct lateral flaps or fringes are not present. At the front of the fan is a large triangular field of bright white setae, bordered by red, pointed toward the rear. Behind this is a smaller chevron of light brown scales, with a thin medial stripe connecting this to the rear. The venter of the opisthosoma (Figure 6) is light brown, covered with off-white setae. Viewed from below, the coxae, sternum, labium, endites, chelicerae and distal pedipalpal segments are mostly glabrous and dark brown, with scattered off-white setae, most to the rear of the sternum and coxae.

Legs I and II are shorter and about the same length, legs III and IV longer, and legs III by far the longest. Legs I and II have a fairly uniform cover of bright white setae. Legs III are mostly dark brown, with a line of dark red scales near the top, but have prominent fringes of white setae below, with longer setae extending ventrally near the patella-tibia and tibia-metatarsus joints. These fringes also include some shorter, dark brown setae. There is a small tuft of bright white setae extending from the distal tarsus of each leg III. Unlike the other legs, legs IV are distinctly banded, with alternating bands of off-white setae and exposed, dark brown cuticle. The pedipalp (Figure 9) is similar to that of other *Maratus* from southwestern Australia, with a distinct "bump" (Figure 9.7) near the apex of the embolus.



Figure 4 (continued on next page). Dorsal opisthosomal plate, or fan, of ♂ *Maratus kwenda*. 1-2, Note the difference in appearance of the retracted (1) and extended (2) fan of this male. The fan does not have lateral flaps, but compression of the opisthosoma can widen it considerably during courtship display. In some cases the wider fan (e.g., 8) has a curved outline, but as shown here (2) this can also be polygonal.

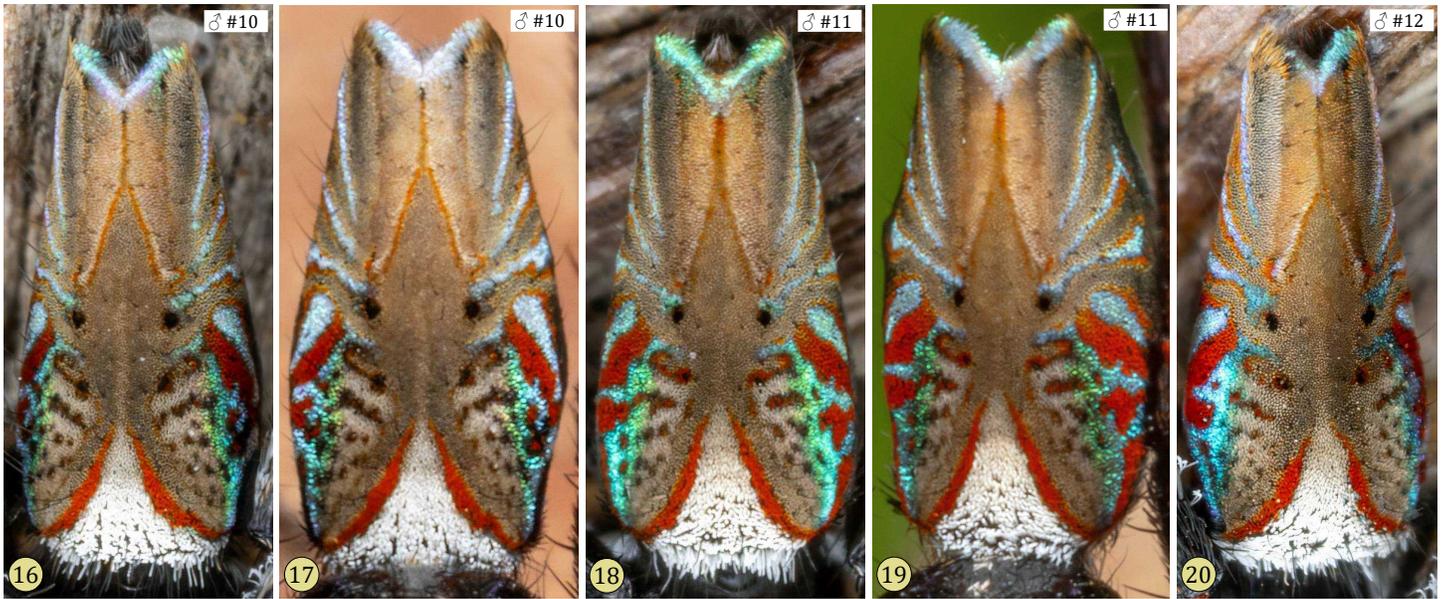


Figure 4 (continued from previous page). Dorsal opisthosomal plate, or fan, of ♂ *Maratus kwenda*.



Figure 5 (continued on next page). Living ♂ *Maratus kwenda*.



Figure 5 (continued from previous page, continued on next page). Living ♂ *Maratus kwenda*.



Figure 5 (continued from previous page). Living ♂ *Maratus kwenda*.



Figure 6 (continued on next page). Ventral views of living ♂ *Maratus kwenda*.



Figure 6 (continued from previous page). Ventral views of living ♂ *Maratus kwenda*.

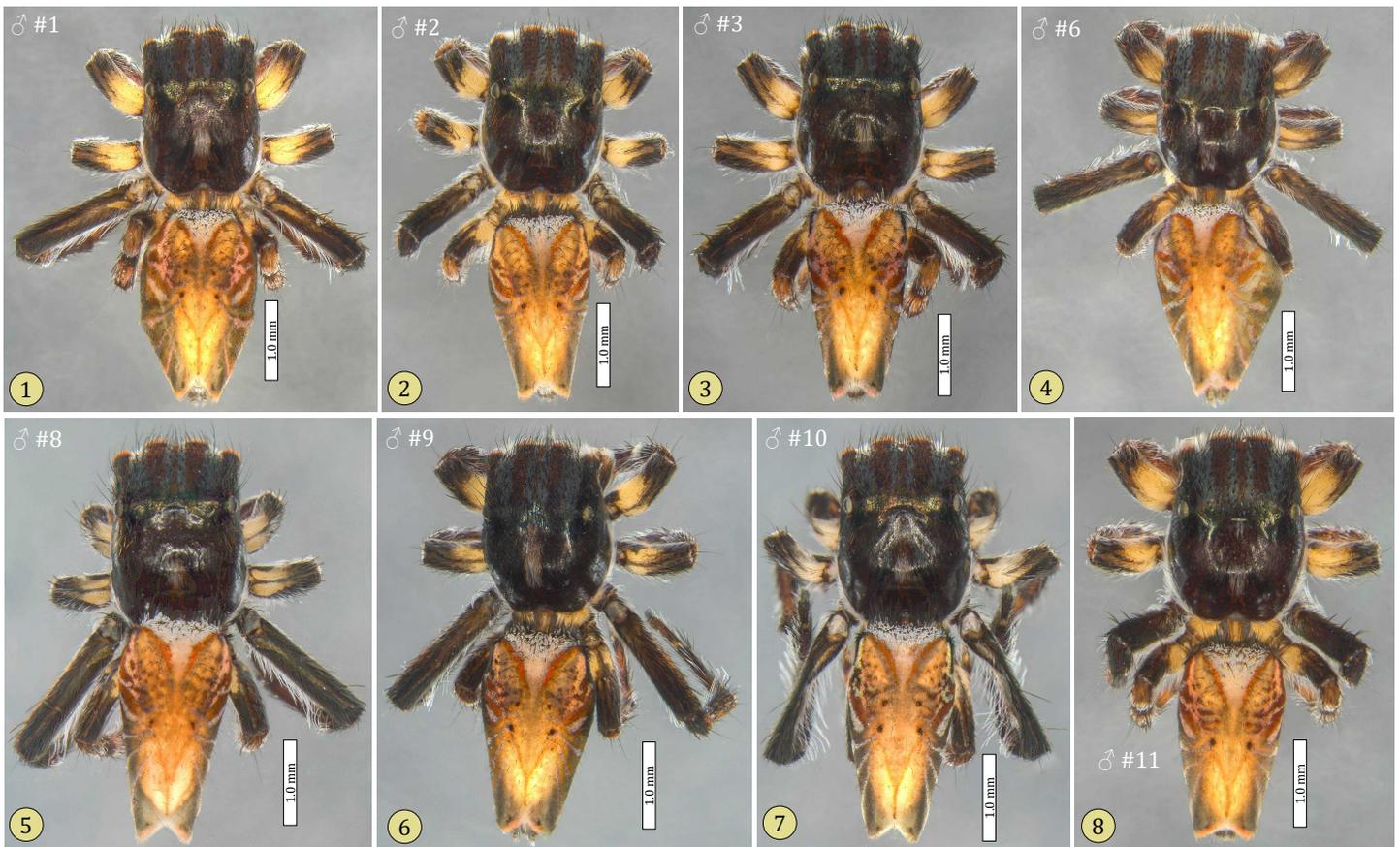


Figure 7. Dorsal view of types for ♂ *Maratus kwenda*, in alcohol solution.

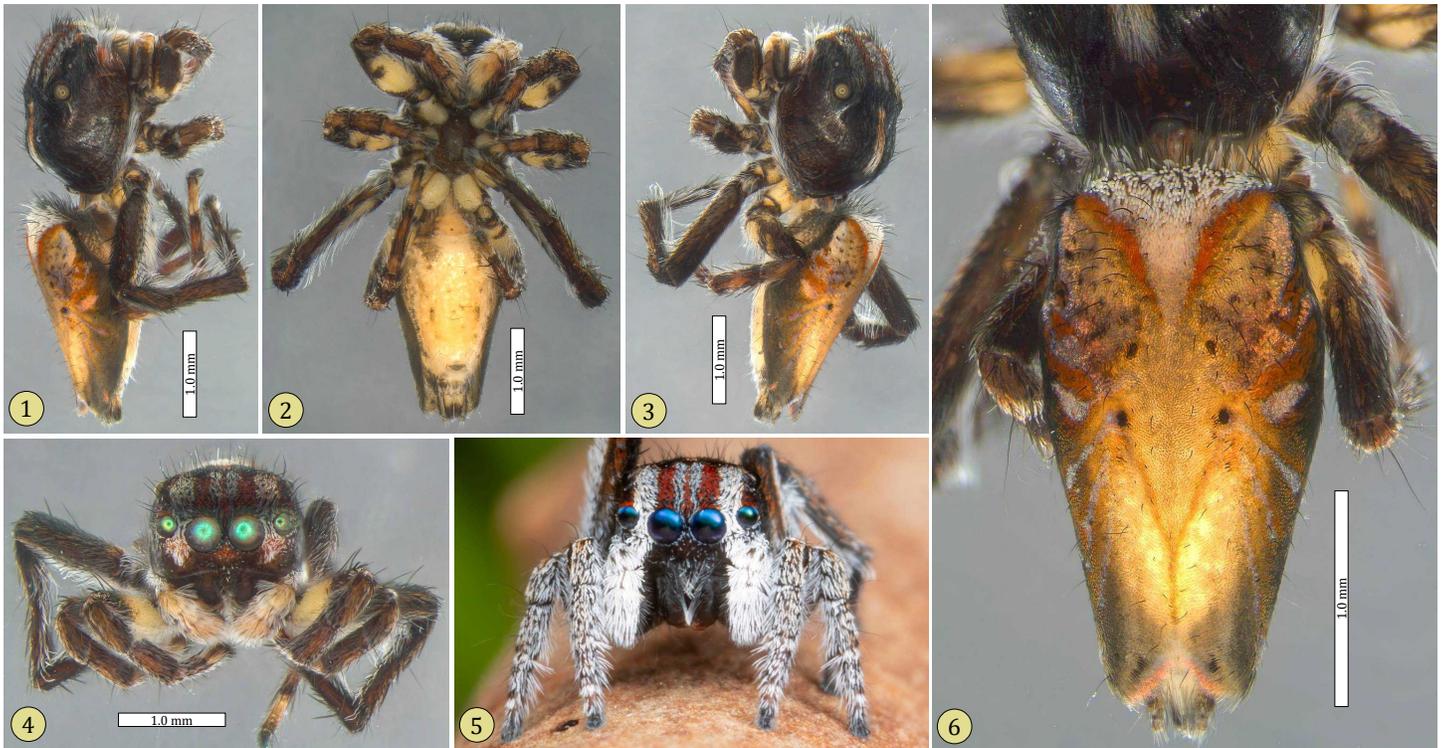


Figure 8. Holotype *Maratus kwenda* (♂ #9). 1-4, 6, Specimen in alcohol solution. 5, Frontal view of living spider.

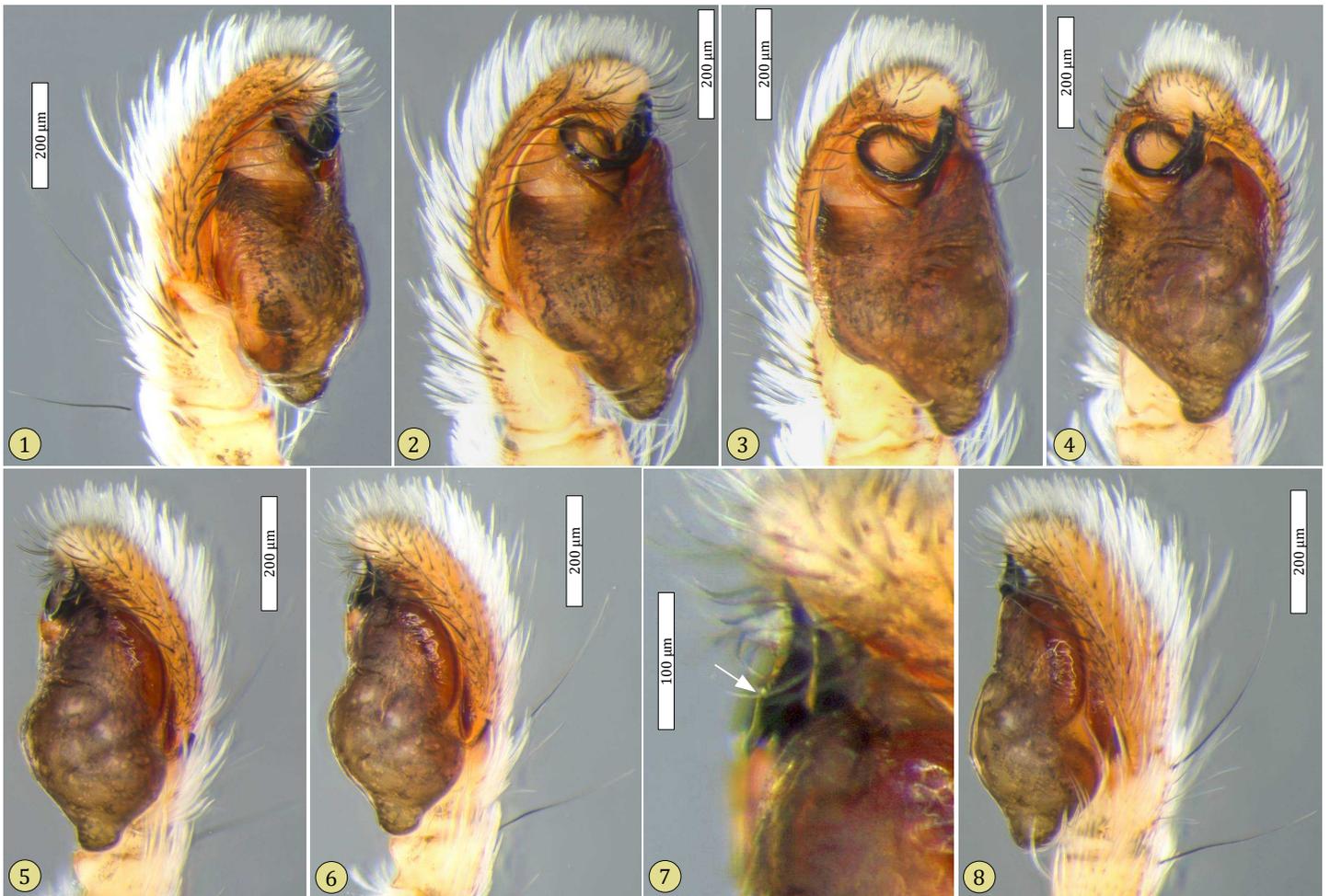


Figure 9. Medial to retrolateral views of left pedipalp for the *Maratus kwenda* holotype (♂ #9). 7, Bump on embolus (arrow).

Description of female (Figures 10-13). Females (n=12) ranged from 4.8-5.8 mm in length. The clypeus is covered with long, white, ventromedially directed setae. Below these, a smaller set of similar setae originate on the medial surface of each paturon. The pedipalps are light brown and translucent, with a dense cover of white to off-white setae. The carapace is black dorsally, more translucent brown on the sides. Mixed off-white and red-brown scales cover the eye quadrangle, but this cover may be interrupted by a black stripe of more exposed cuticle behind each AME. The PME are about the same distance from the ALE and PLE. Behind the eye quadrangle, a partial midthoracic stripe of off-white scales may be present. The sides of the carapace are mostly glabrous, and no marginal band is present. Dorsally the opisthosoma may have a partial stripe of off-white setae along the midline, but this may be absent; otherwise it is dark brown to black with a variable cover of mixed off-white and red-brown scales, usually flanked on either side by a broad band of mostly off-white scales. At the rear a small triangular tuft of white setae is present, above the grey spinnerets.

Ventrally (Figure 11) the opisthosoma is light in colour and mottled, with a uniform cover of off-white setae. Viewed from below, the coxae, sternum, endites and chelicerae are mostly glabrous, translucent, and light to dark brown. Scattered off-white setae are present at the rear of the sternum. Legs I and II are shorter and about the same length; legs III and IV are longer and about the same length. All legs are banded, with alternating bands of dark cuticle and off-white setae, but legs I and II are indistinctly banded, III and IV distinctly banded. The epigynum (Figure 13) is similar to that of many other *Maratus* species, with a pair of anterior windows that are usually smaller than a pair of large, posterior spermathecae, and twisted copulatory ducts visible between each window and each spermatheca.



Figure 10 (continued on next page). Living ♀ *Maratus kwenda*.



Figure 10 (continued from previous page, continued on next page). Living ♀ *Maratus kwenda*. **11-16**, This ♀ (#4) lacked the distinct band of off-white setae on the lateral margins of the opisthosoma, usually separated by an irregular, dark band from the field of mixed off-white and red-brown scales of the dorsum.



Figure 10 (continued from previous page, continued on next page). Living ♀ *Maratus kwenda*.



Figure 10 (continued from previous page). Living ♀ *Maratus kwenda*.

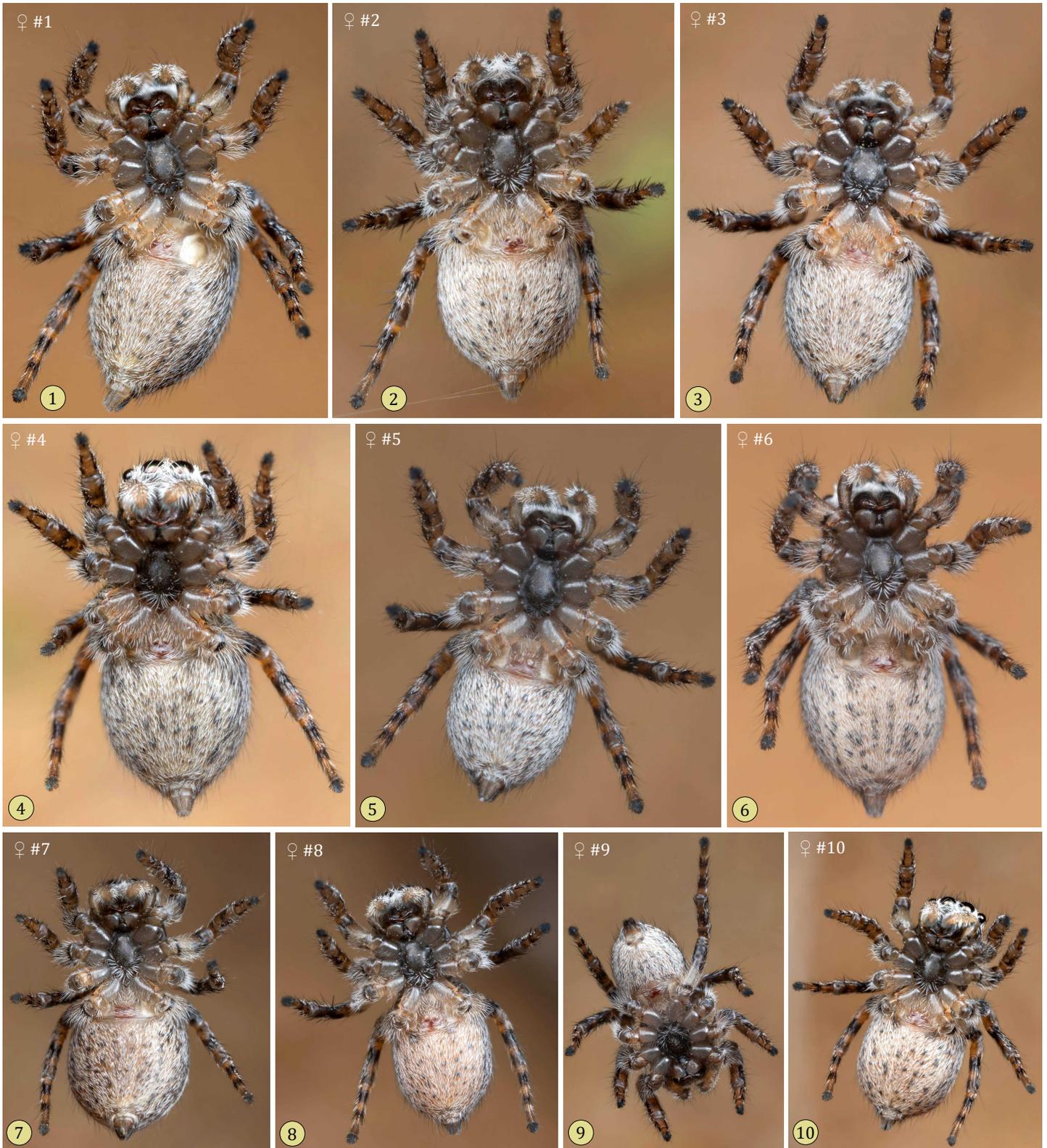


Figure 11 (Continued on next page). Ventral views of living ♀ *Maratus kwenda*.



Figure 11 (Continued from previous page). Ventral views of living ♀ *Maratus kwenda*.

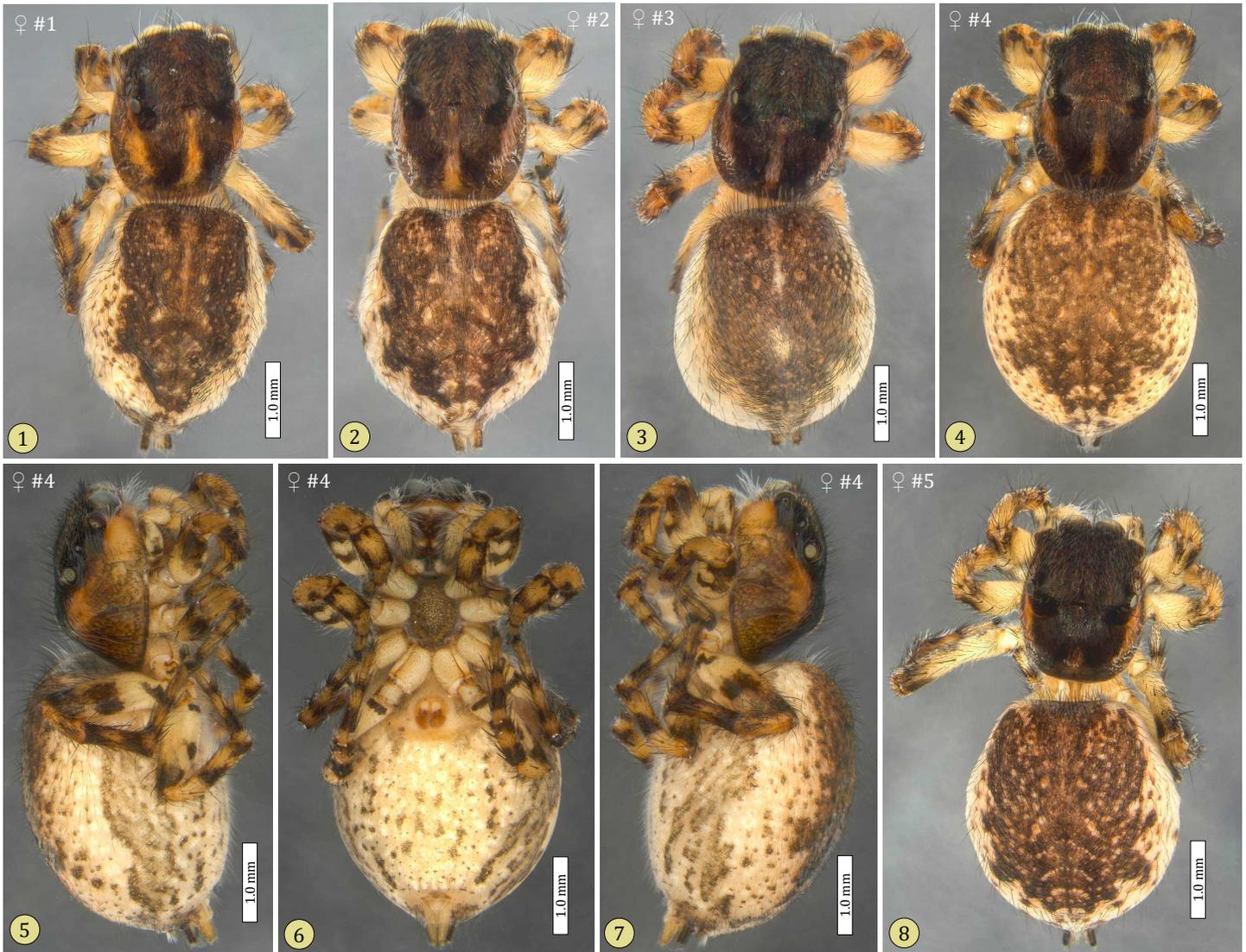


Figure 12 (continued on next page). ♀ types for *Maratus kwenda*, in alcohol solution.

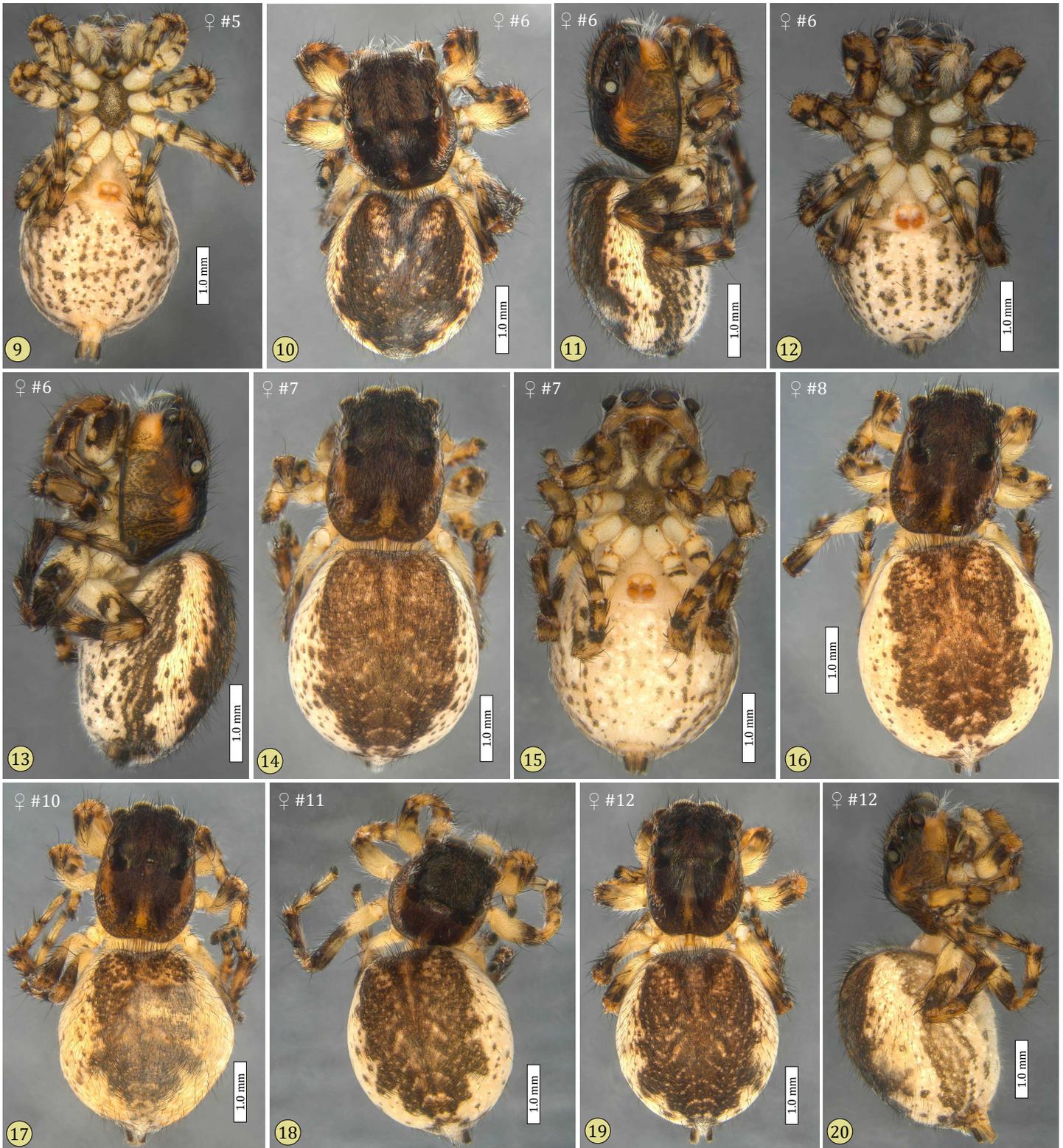


Figure 12 (continued from previous page, continued on next page). ♀ types for *Maratus kwenda*, in alcohol solution.

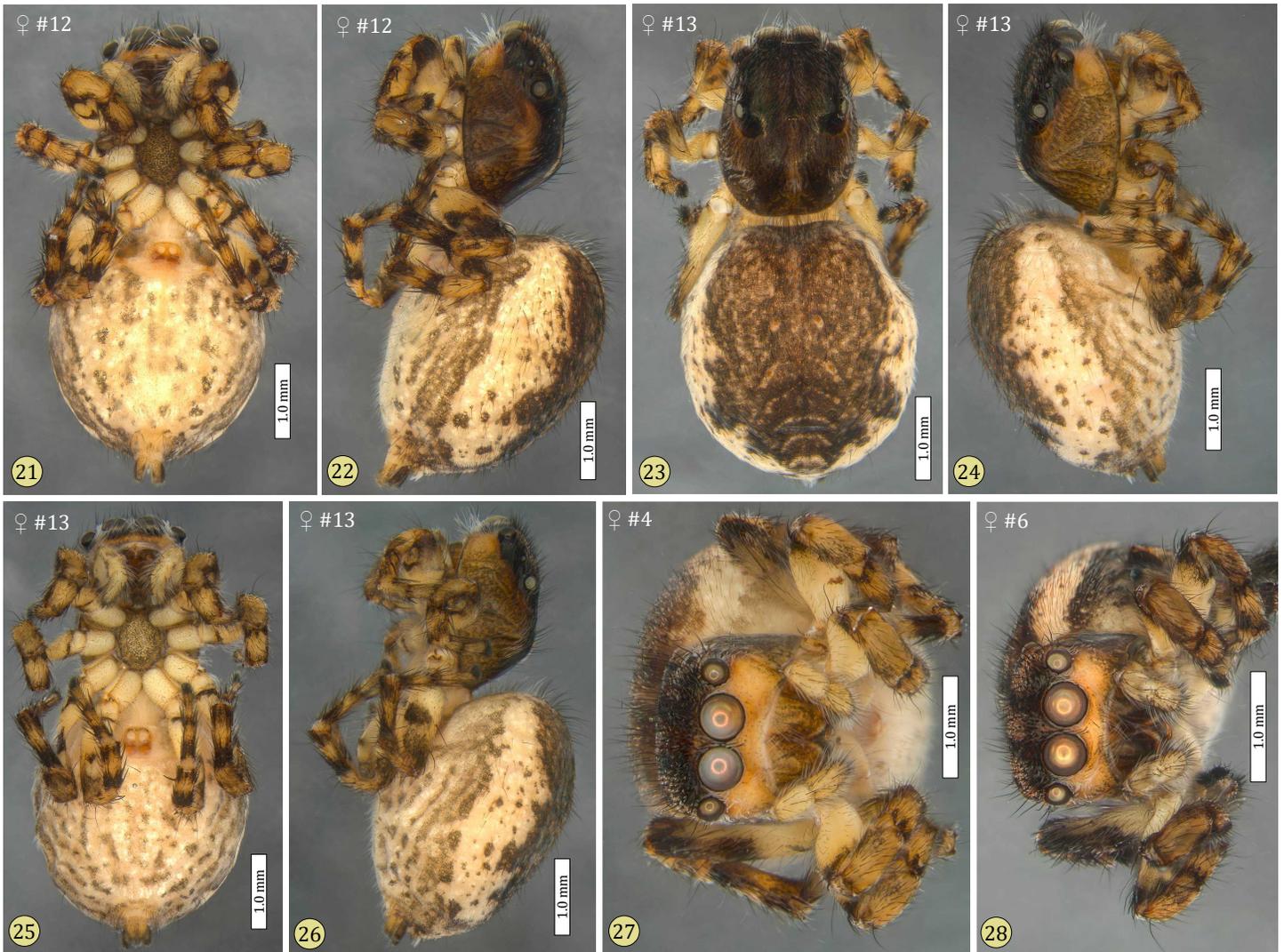


Figure 12 (continued from previous page). ♀ types for *Maratus kwenda*, in alcohol solution.

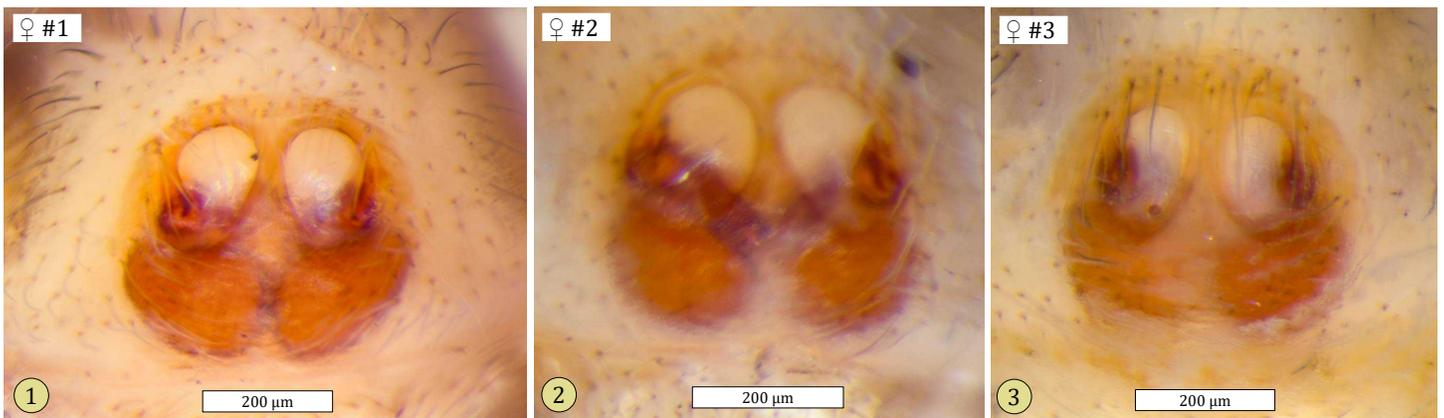


Figure 13 (continued on next page). Ventral view of epigynum for ♀ types, *Maratus kwenda*, in alcohol solution.

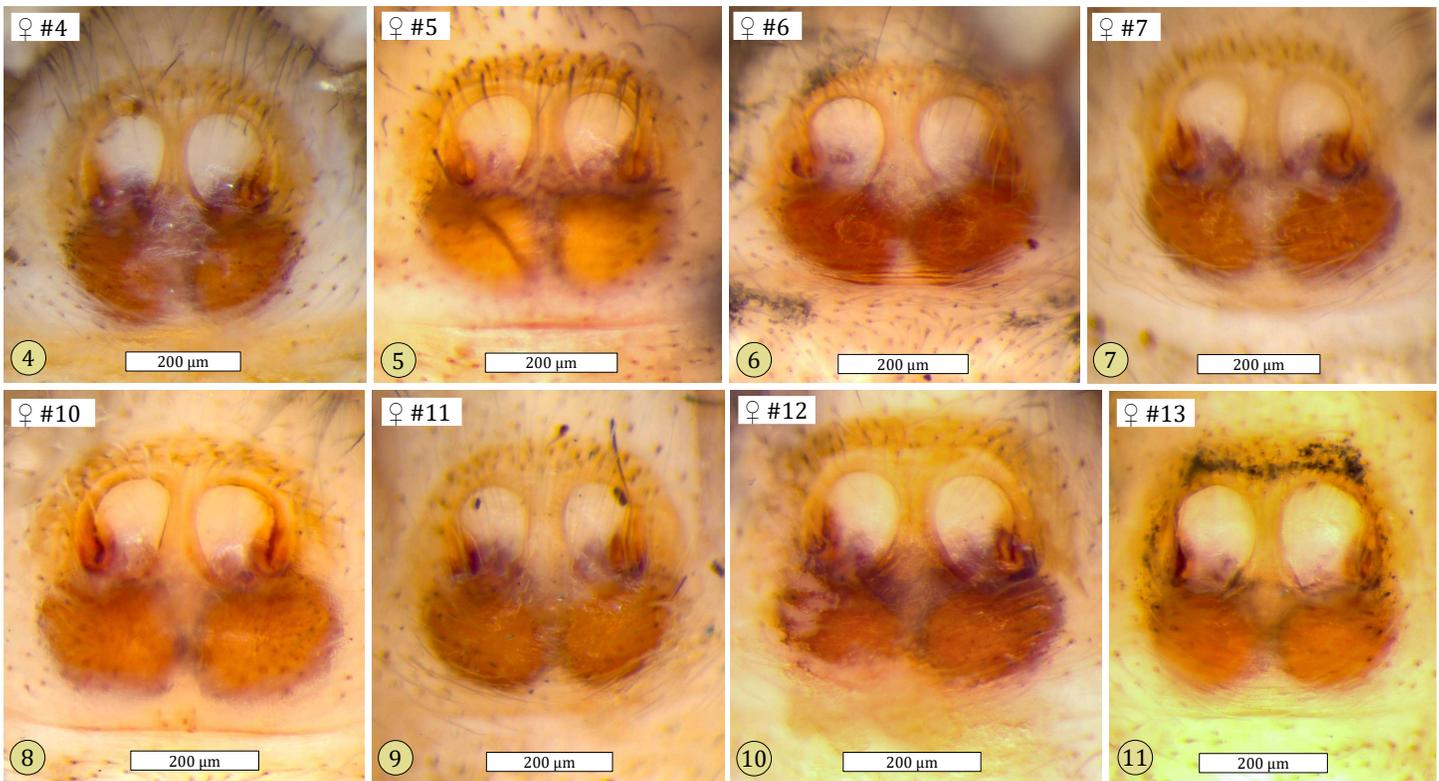


Figure 13 (continued from previous page). Ventral view of epigynum for ♀ types, *Maratus kwenda*, in alcohol solution.

Courtship display (Figures 14-27). Displays of the male *Maratus kwenda*, as documented under naturalistic conditions in the laboratory, were very similar to those previously observed for *M. candens* (Table 1; Otto & Hill 2022), with distinctive alternating movement of each paturon in front of the female highlighted by a tuft of bright white setae extending forward from the anterior surface of each paturon during the *high fan* (Table 1: 5) and *fan dance* (6) displays. In addition rapid (~40-50 Hz) tapping of each leg I was observed during the fan dance of *M. kwenda*, something not seen in *M. candens* but a characteristic of three related species found nearby (*felinus* subgroup: *M. felinus*, *M. lynx*, *M. miles*; Otto & Hill 2024; see Figure 2 for localities).

Table 1. Displays of the male *Maratus kwenda*.

display	position of female	description	Figures
1. single leg III wave	may be in sight but not facing the male	in place, extended and elevated leg III waved at low amplitude (~2-5°) and low frequency (~1 Hz), fan depressed or elevated	14-15
2. high two leg III wave	probably sighted to the front of the male	in place, elevation of both legs III to a vertical position, fan depressed or elevated; each leg III is waved through a moderate amplitude (~5-8°) at a low frequency (~1 Hz), mostly synchronously	16-17, 18.1-18.3
3. wide two leg III wave	within sight	with partly to fully elevated fan; each leg III is waved through an amplitude of ~10° at a low frequency (~1 Hz), only loosely synchronous	18.4-18.5, 19
4. caliper dance	within sight and may be closer to the male	male alternately lowers extended legs III as fan is raised, then raises extended legs III to a vertical or caliper position and lowers the fan during a quick step to the side (1.0-1.9 Hz cycles)	18.6-18.8, 20-21
5. high fan	close to male, but female may not be facing to follow male movements	male maintains an elevated position with variable amplitude (1-2°, or 10-14°, ~4 Hz left-right cycles) lateral movement or waving of the elevated fan, with legs III held together in a vertical caliper position; during display each paturon is alternately moved (~2 Hz cycles) from side to side, less frequently than during the <i>fan dance</i> which may follow	22-24
6. fan dance	facing and approaching the male, turning to follow each movement made by the male	male alternately holds fan in elevated position between legs III, held in a vertical, caliper position, and alternately lowers then raises the fan (~2s/down-up cycle, intermittent cycles at ~0.2 Hz or ~1 each 5s), chelicerae moved from side to side as fan moves up and down (mostly alternately, at ~4 Hz for each paturon), fan may be waved at a regular rate (~4 Hz) at a low amplitude (~1.5°), as in the <i>high fan</i> display, or at a much faster but variable rate (10-25 Hz) with low amplitude (~1-3°) inversely proportional to that rate (effect is slow but constant side-to-side movement of fan at ~50-60°/s; see Figure 27); when fan is in a lower position legs I (loosely synchronous) may be tapped up and down on the surface just in front of the attending female (~40-50 Hz for each leg, low amplitude).	25-27



Figure 14. Single leg III wave by ♂ *Maratus kwenda*. Slight hyperextension of the metatarsus (1) correlated with extension of long white ventral (here, lateral) setae near the tibia-metatarsus joint of each leg III.

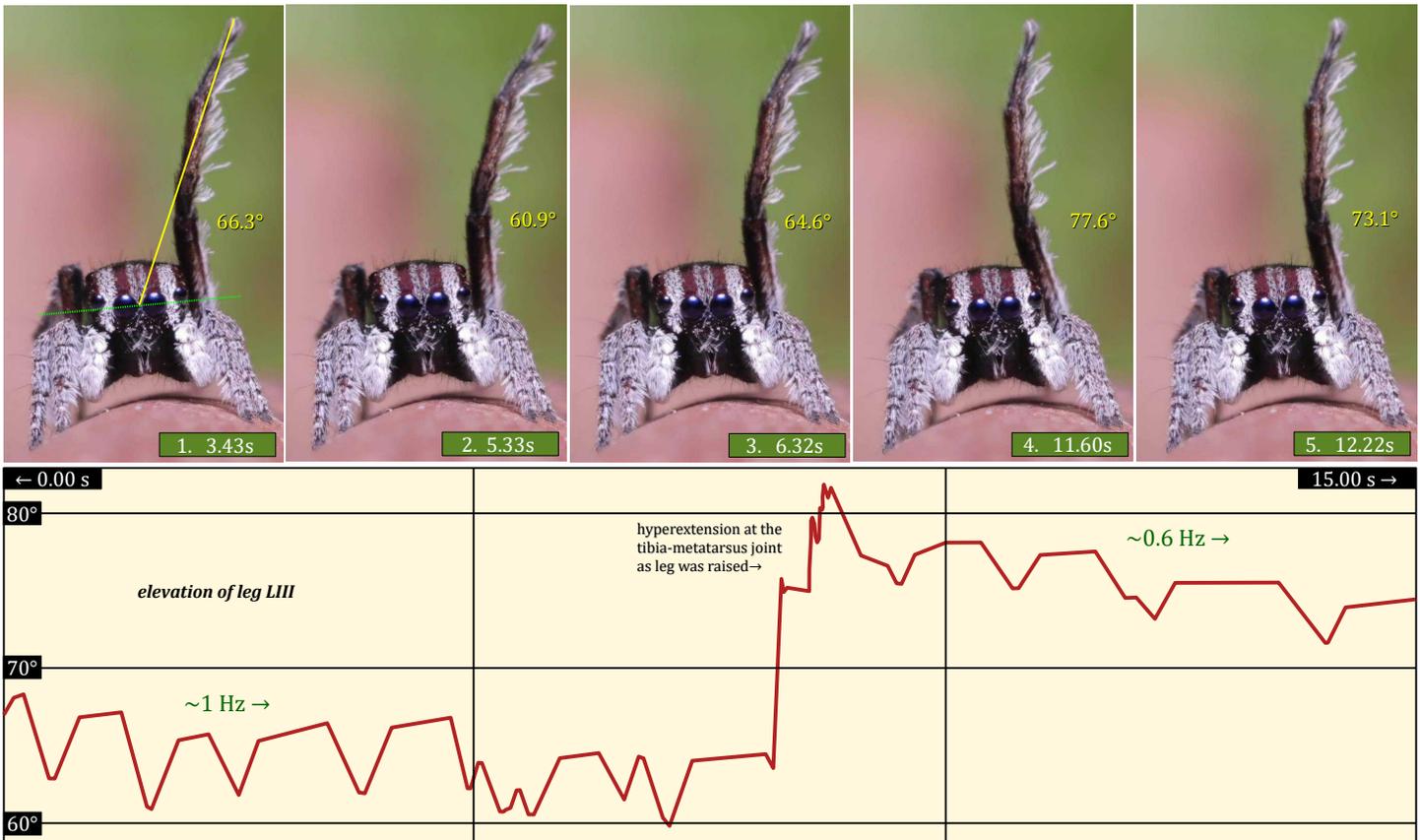


Figure 15. Single leg III wave by ♂ *Maratus kwenda*, based on measurement of the elevation of leg LIII (1) recorded from frames of a 100 fps video. Waving during this interval took place over a low amplitude ($\sim 2\text{-}5^\circ$) at a relatively low and variable frequency ($\sim 1\text{ Hz}$). Note that during this interval the metatarsus of leg LIII was slightly flexed (not fully extended) and the long white setae near the tibia-metatarsus joint of that leg were not fully extended.

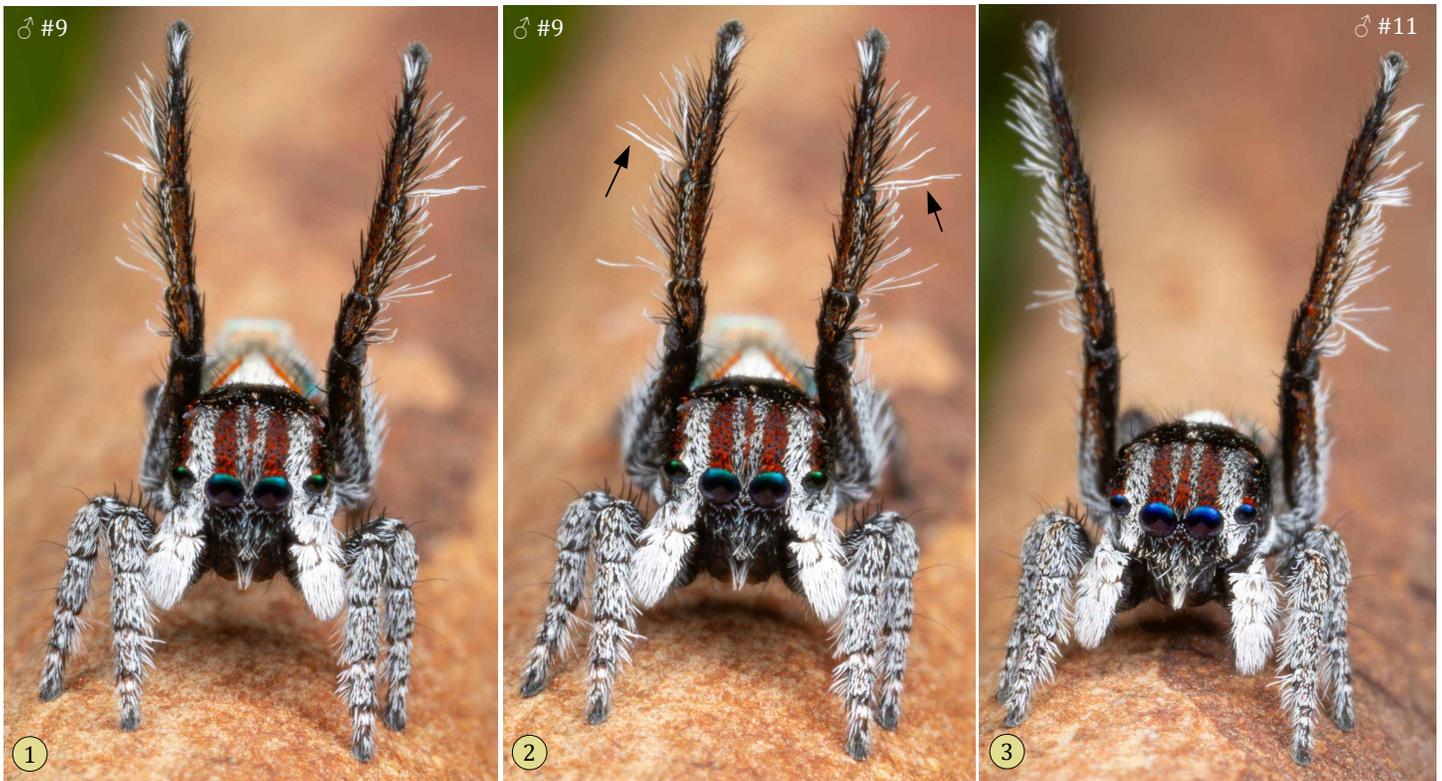


Figure 16. High two leg III wave by ♂ *Maratus kwenda*. **2,** As in the single leg III wave, slight hyperextension of the metatarsi of the third legs correlated with full extension of the long white setae that emerge near each tibia-metatarsus joint (arrows).

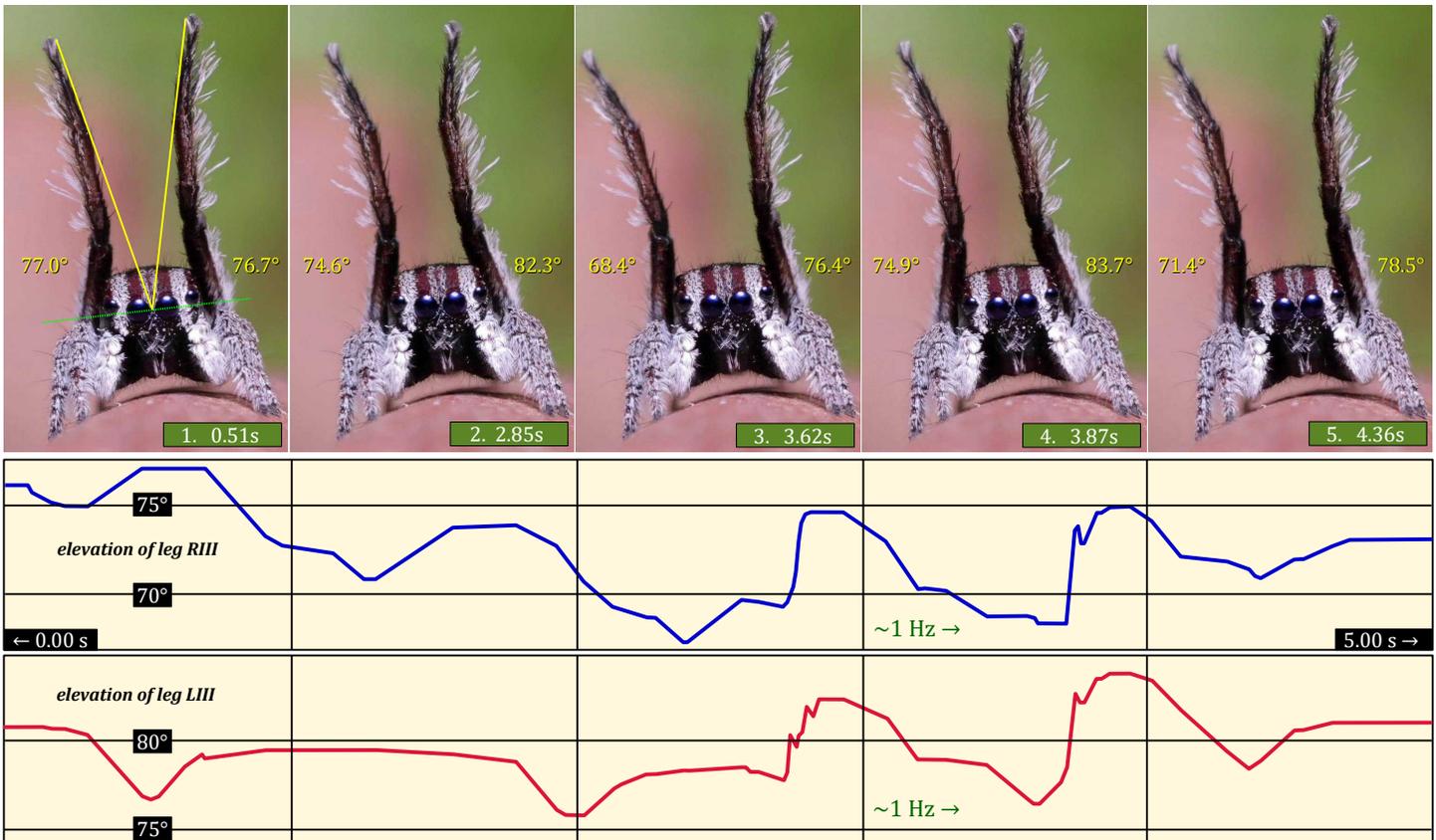


Figure 17. High two leg III wave by ♂ *Maratus kwenda*. Elevation of each leg III was recorded as shown in (1) for each frame from a 5s clip of a 100 fps video record. During the last 3s of his interval movement of the two legs III was synchronized (~1 Hz, amplitude of 5-8°).



Figure 18. Courtship display by ♂ *Maratus kwenda*. **1-2**, High two leg III wave positions with elevated fan. Here the male has raised its body high above the surface. Note lateral expansion of the fan in (2). **3**, Rear view of a similar display, showing the inflated pedicel. **4-5**, Sequential images showing full elevation of fan during a wide two leg III wave display. Elevation of the fan during this display can vary. **6-8**, Typical positions assumed during a caliper dance, in which the fan is elevated as legs III separate, until a sudden step to the side in which the fan is lowered and the extended legs III are brought together (Figures 20-21).

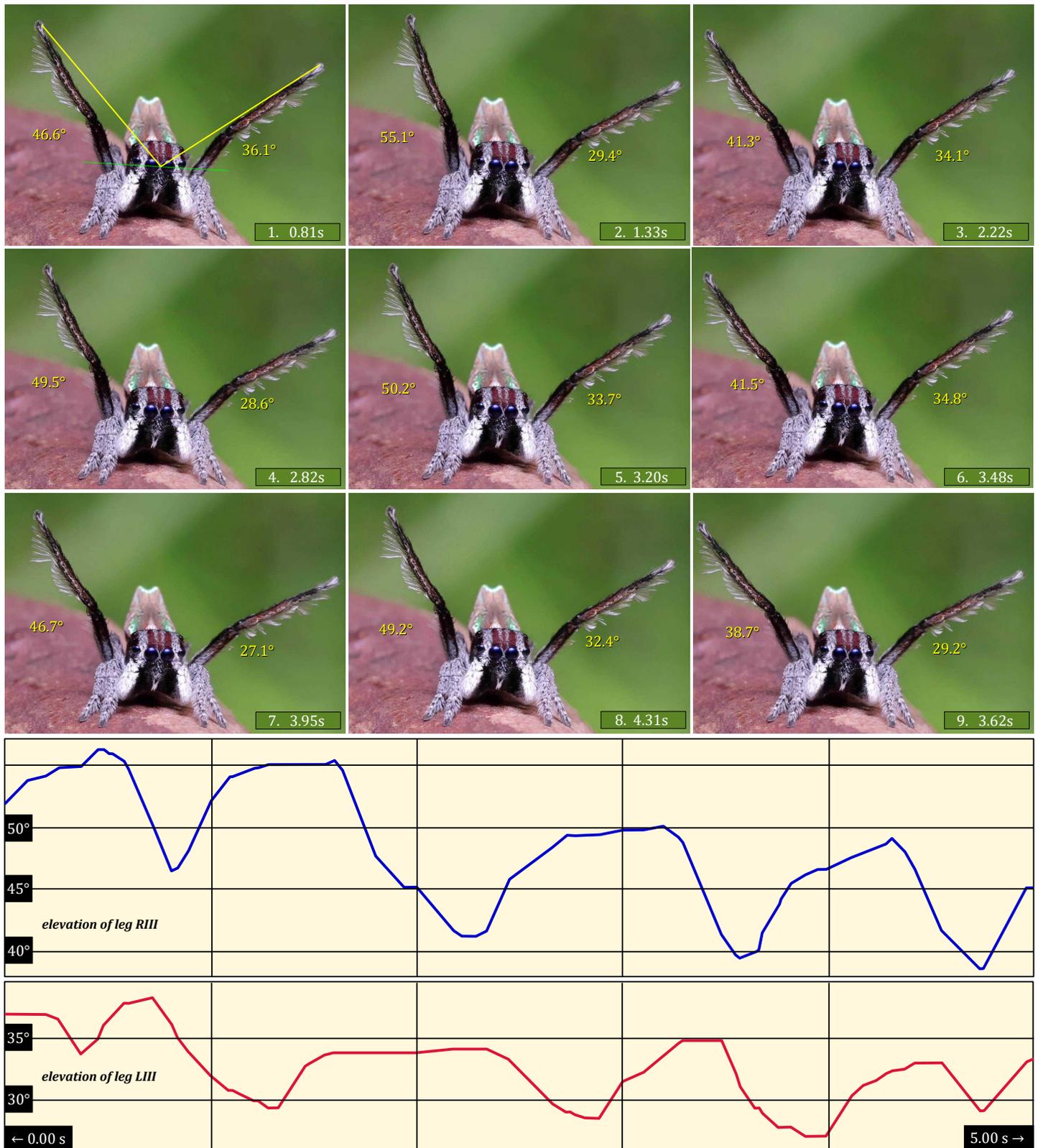


Figure 19. Wide two leg III display by a ♂ *Maratus kwenda*. Elevation of each leg III was measured as shown in (1) from each frame of a 5s sequence recorded at 100 fps. The fan was not moved but held in a partly elevated position as shown here for the entire sequence, animated solely by movement of the extended legs III (~10° amplitude, ~1 Hz per cycle for each leg. Although timing of movement of each leg was similar, at best it can be said that this was *loosely synchronous*.

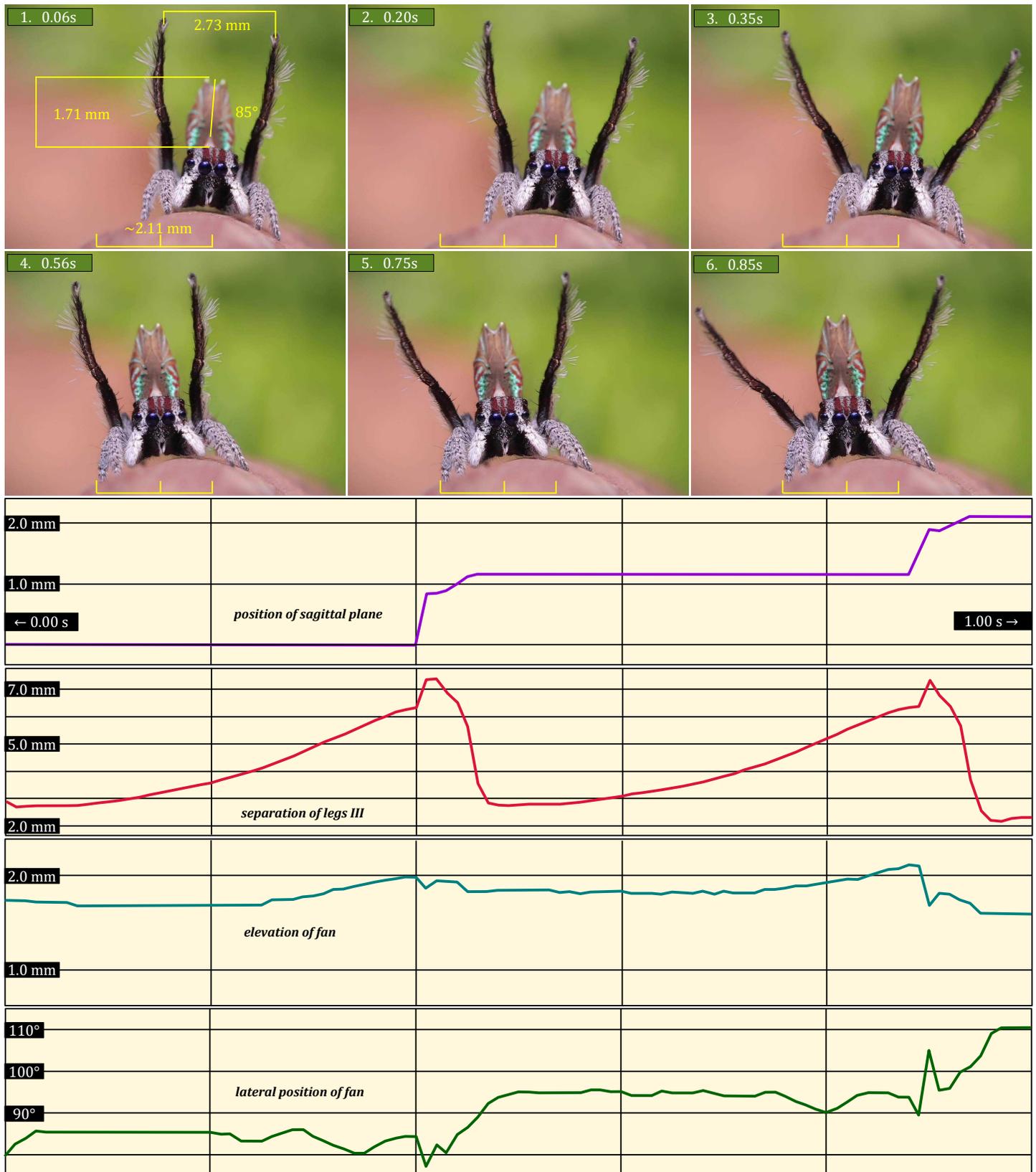


Figure 20. Detailed analysis of movement during the caliper dance of a ♂ *Maratus kwenda* (1s, 100 fps). Positions were measured from each frame as shown in (1). This spider moved in two incremental steps (~1 mm/step, ~2 Hz cycles) toward its right side (shown as change in position of sagittal plane in top chart). Prior to each step the two elevated legs III slowly separated as the fan was raised. Each step led to rapid caliper movement of legs III as they were brought together, and depression of the fan (not great in this example). As indicated by the lateral position of the fan (lower chart), fan waving was not regular or significant during this display, except during brief intervals of stepping.

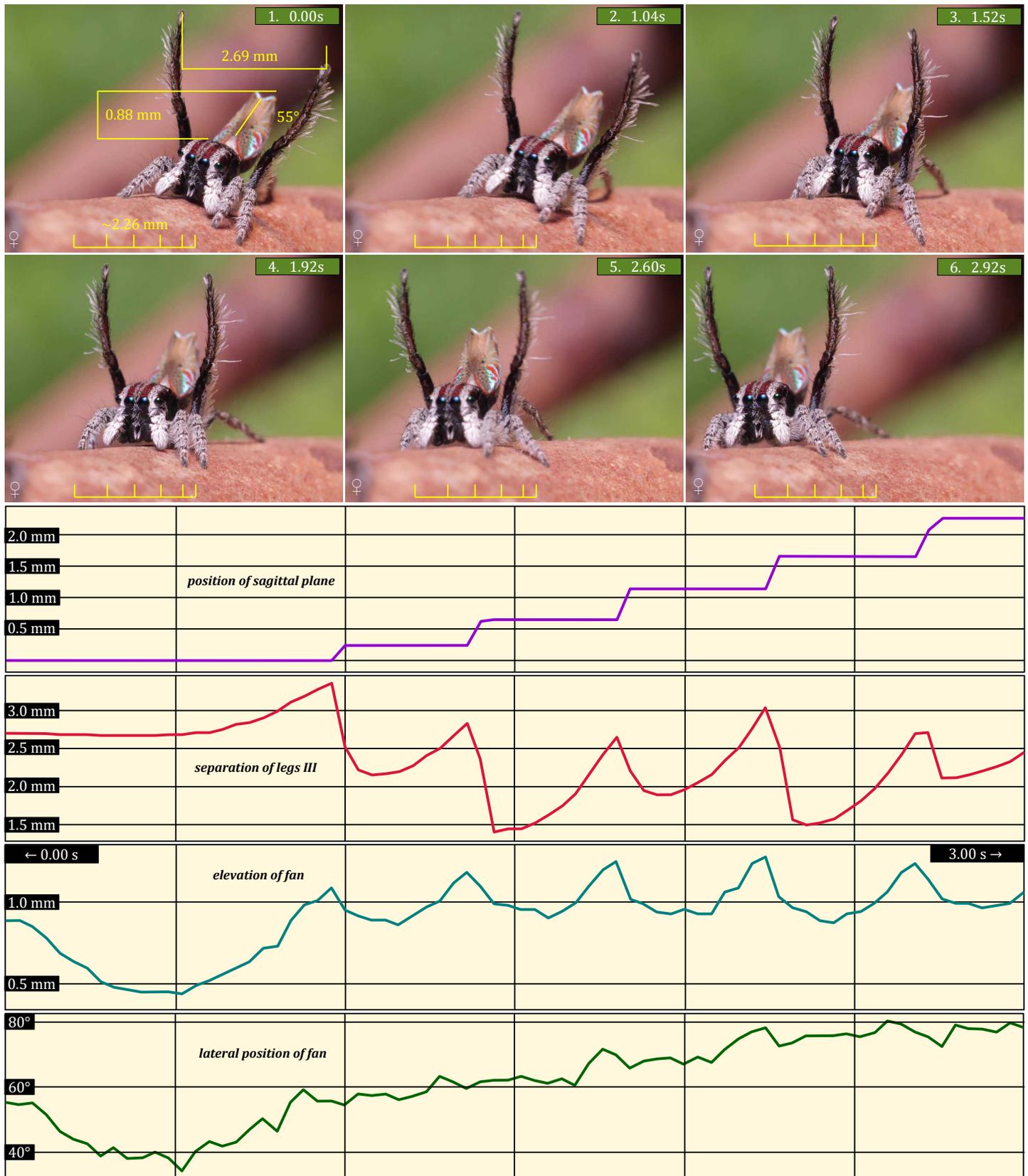


Figure 21. Analysis of movement during the caliper dance of a ♂ *Maratus kwenda* (3s, 25 fps, measurements as in Figure 20). In this sequence the male completed five successive steps to its right side, and synchronous movement of legs III and the fan (elevation) at a rate of ~2 Hz is evident. Recording of the lateral position of the fan (lower chart) was not so accurate in this case, particularly because of the oblique angle of measurement, but did not reveal any particular pattern.

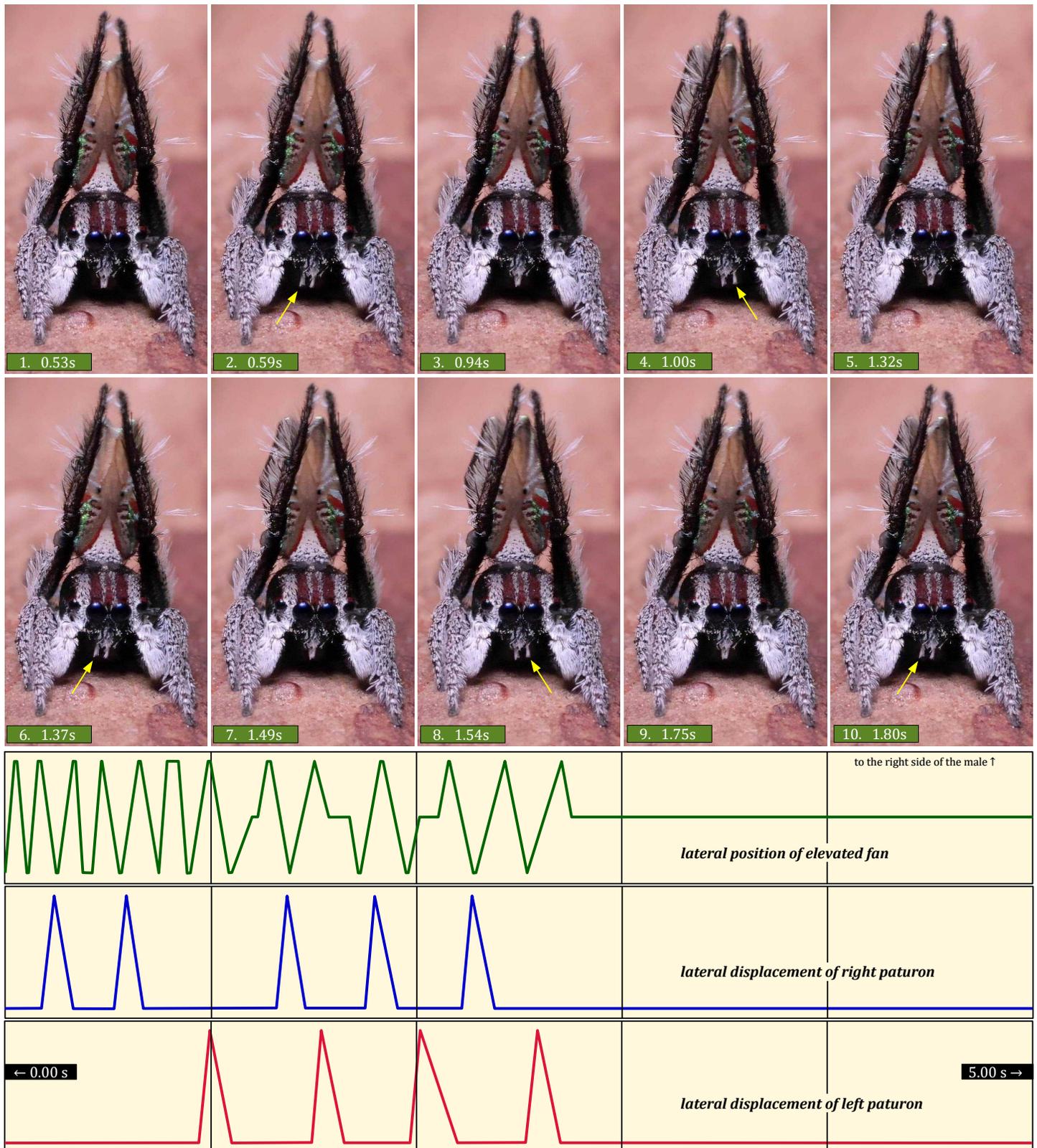


Figure 22. High fan display by a ♂ *Maratus kwenda* (5s, 100 fps). Here the charts do not indicate the magnitude of each movement, but only the timing of this movement. All animation during this display was associated with lateral movement of the fully expanded fan (variable rate, ~3.5-7 Hz, low amplitude), and alternating lateral movement of each paturon (~2 Hz for each) during part of the sequence. **1-10**, Representative frames from this sequence, showing alternating lateral movement of each paturon as indicated by the position of the tuft of bright white setae (arrows) along its medial margin.

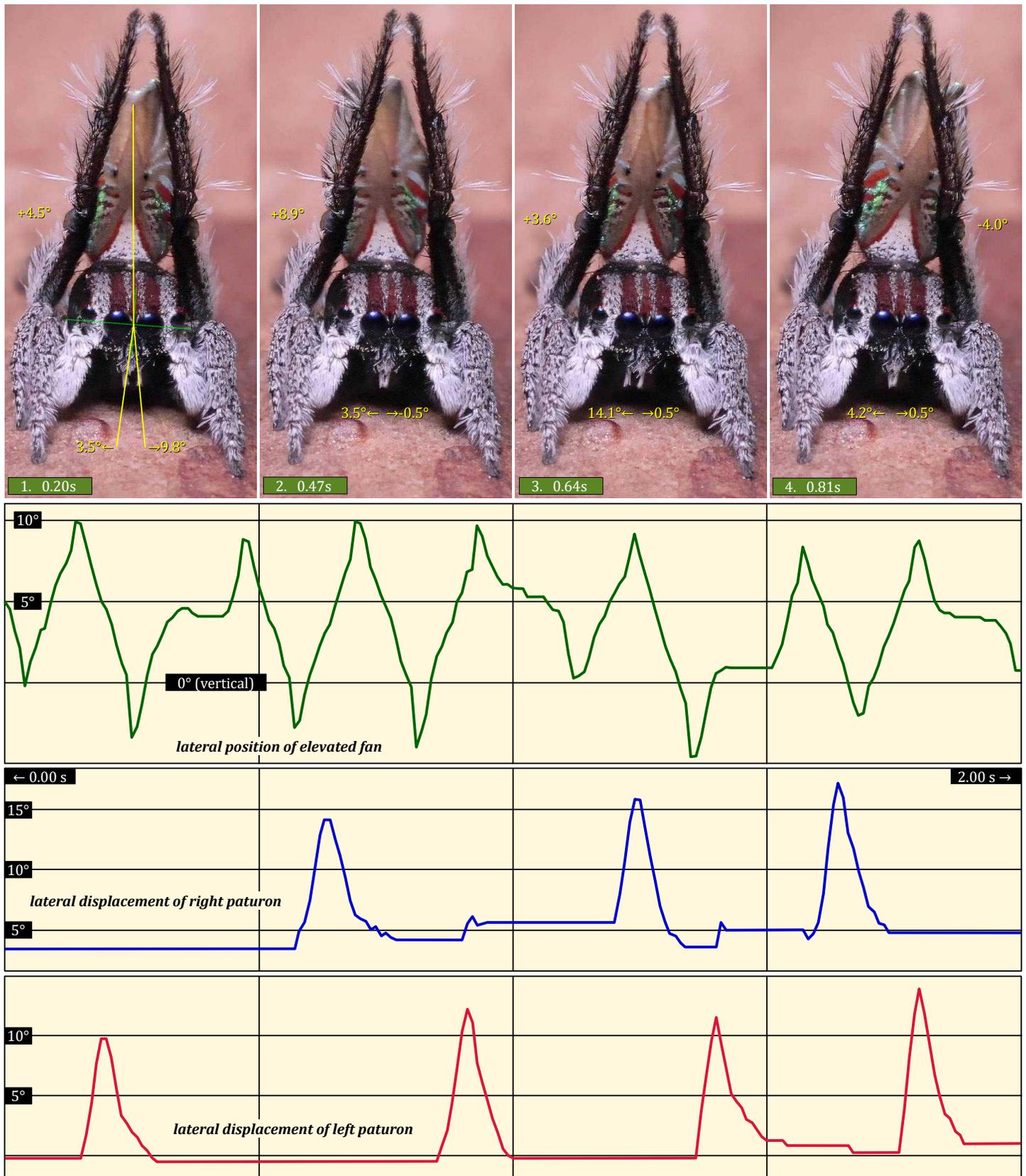


Figure 23. High fan display by a ♂ *Maratus kwenda* (2s, 100 fps). Here movement of each paturon (~2 Hz for each, in alternation) and waving of the fan (~4 Hz, 10-14° amplitude) are charted in more detail, based on measurements shown in (1).

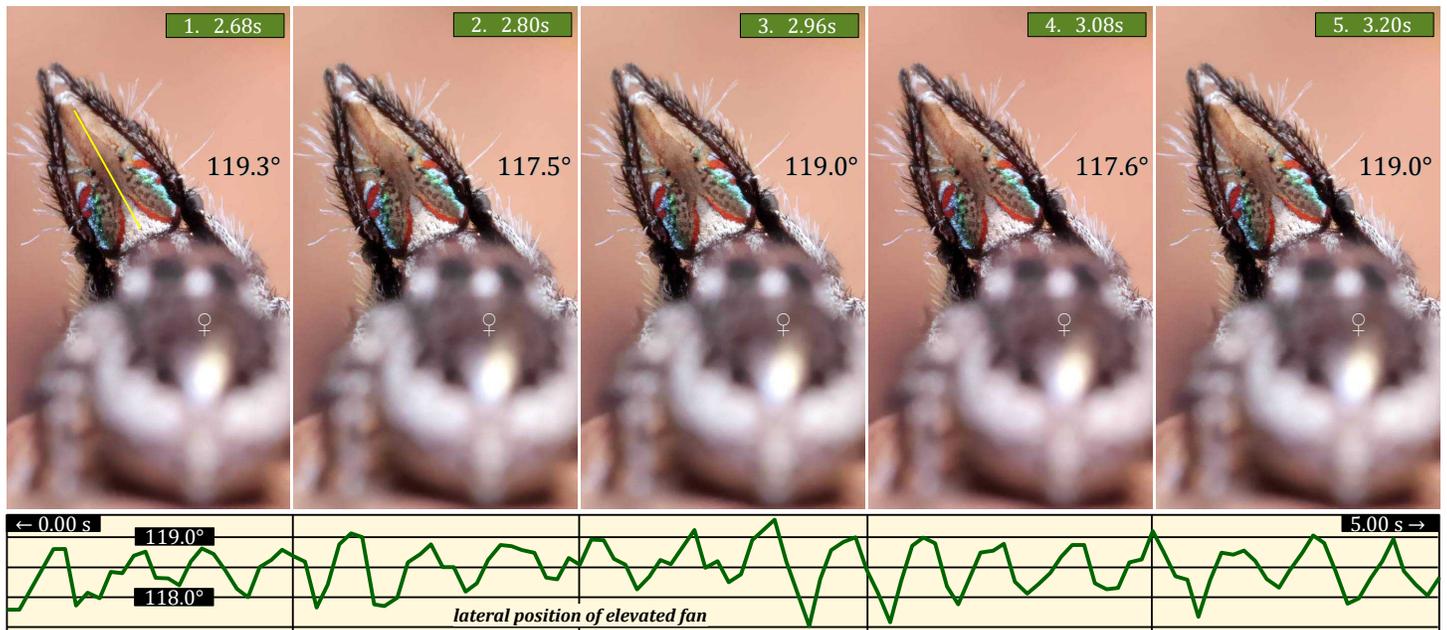


Figure 24. High fan display by a ♂ *Maratus kwenda* (5s, 25 fps), with very low amplitude waving ($\sim 1\text{-}2^\circ$) at a regular pace of $\sim 3.5\text{-}4$ Hz. This particular sequence, with the fan tightly positioned between the bracketed legs III, could also be viewed as the opening sequence of the fan dance that followed it (Figure 25). The female (in foreground) did not move during this sequence.

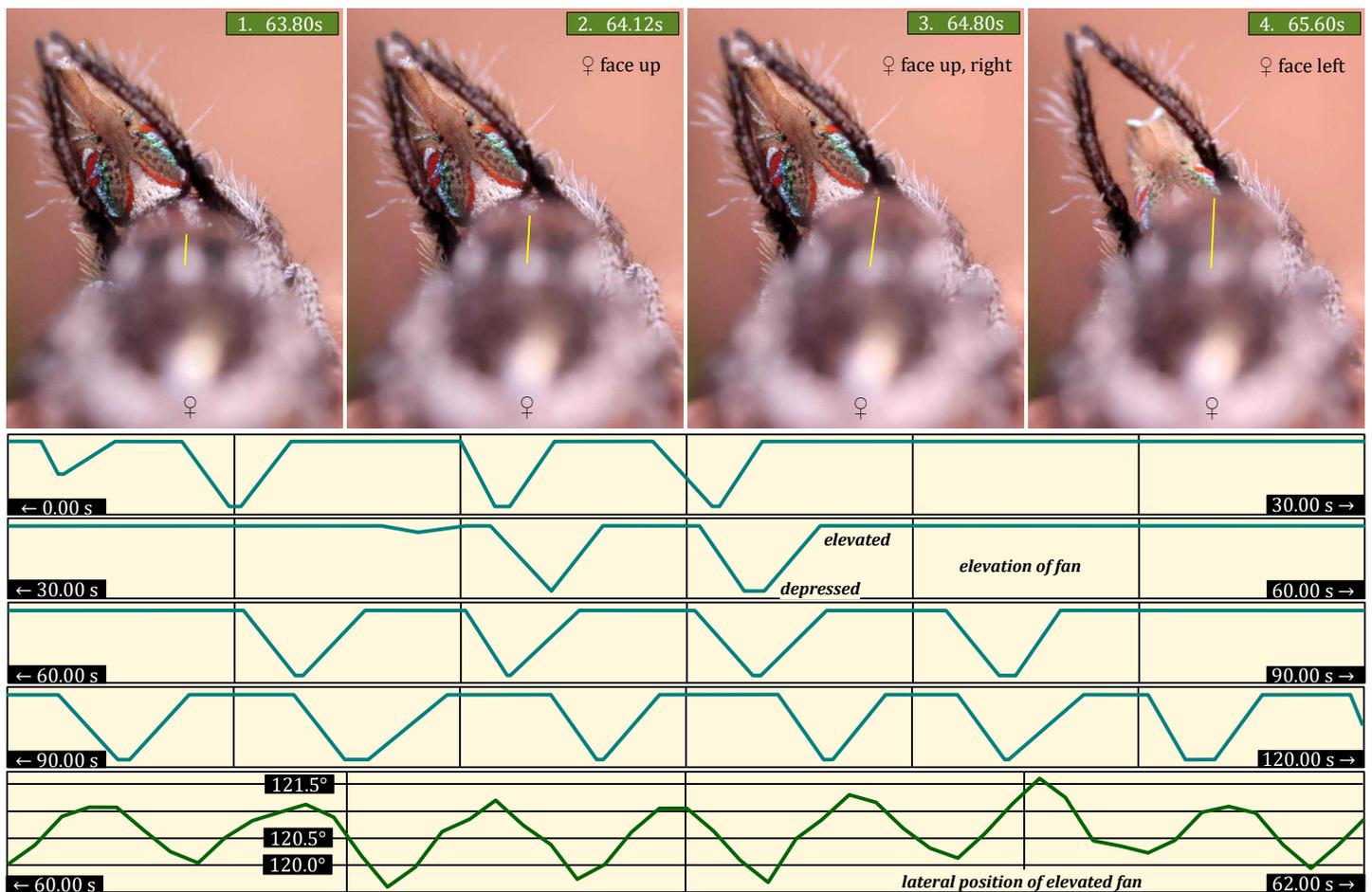


Figure 25. Intermittent depression of the fan during the fan dance of a ♂ *Maratus kwenda* (120s, 25 fps). Fan depression/elevation intervals of ~ 2 s were separated by intervals of $\sim 2\text{-}4$ s, or longer. Regular (~ 4 Hz), low amplitude ($\sim 1\text{-}1.5^\circ$) waving of the fan was also charted for 2s of this display (bottom chart). **1-4**, During this sequence, the female (in foreground, midline at top of carapace shown as yellow line) frequently turned to follow movement by the male.



Figure 26 (continued on next page). Positions assumed during the fan dance by ♂ *Maratus kwenda*. 1-3, 4-7, 9-10, Sequential images from three different displays showing movement of fan during this display. 5, Note elevation of the foot of leg LI (arrow) during the leg tapping phase of this display.



Figure 26 (continued from previous page). Positions assumed during the fan dance by ♂ *Maratus kwenda*. 11-13, 14-16, 17-19, Sequential images from three different displays showing movement of fan during this display.

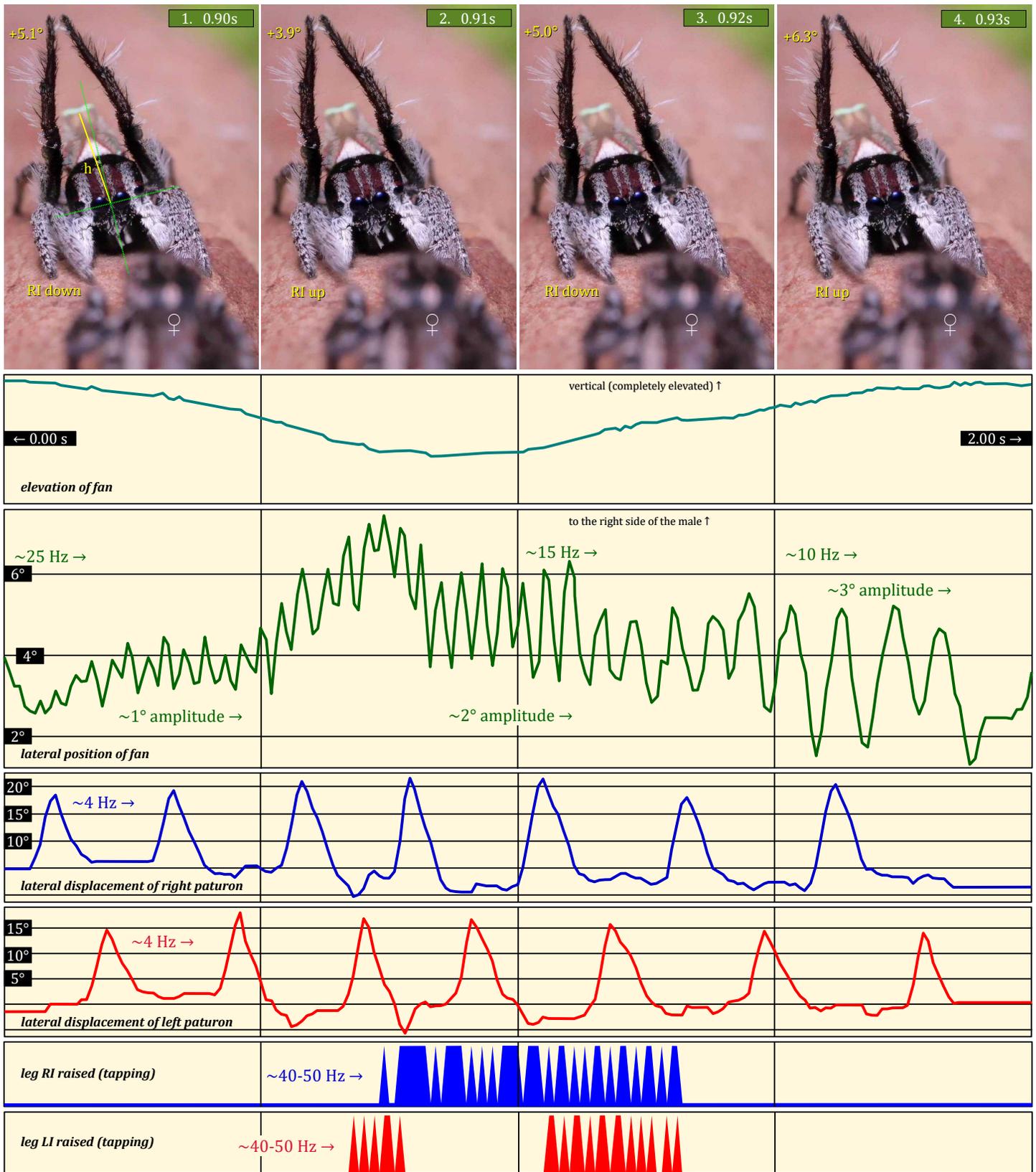


Figure 27. Detailed view of the fan dance of a ♂ *Maratus kwenda* (2s, 100 fps). Relative elevation of the fan was measured as h , as shown in (1). Lateral position of the fan was charted as the angle between the sagittal plane of the spider, one of the green dotted lines in (1), and line h . Lateral displacement of each paturon was charted in a similar manner, as shown in Figure 23. During this sequence, the fan was waved at a low, variable amplitude (~1-3°), at a high rate (10-25 Hz) that was inversely proportional to that amplitude. Movement of each paturon was regular (~4 Hz, strict alternation). High speed (~40-50 Hz) tapping took place only when the fan was depressed (lower two charts). 1-4, Selected frames showing tapping with legs I.

Habitat. *Maratus kwenda* was found along an unpaved rural road called Jacktrack, at a single locality near the southern boundary of the both the Hilliger National Park and the Jarrah Forest Bioregion (dominated by Jarrah, *Eucalyptus marginata*) of Western Australia (Figure 28).



Figure 28. Type locality for *Maratus kwenda* near Jacktrack, a primitive road through mixed sedgeland and Jarrah Forest. This area is part of the Scott River coastal plain ironstone community, known for its endangered flora. All spiders were found at the edge of the sedgeland or seasonal (winter-wet) wetland, but not toward the Jarrah forest in the background.

***Maratus nannup*, new species**

Maratus cf. *candens* Otto & Hill 2024

Type specimens. The holotype male (♂#1), 11 paratype males (♂#2, 5-6, 8-12, 14-16), and 10 paratype females (♀#1-10) were collected ca. 7.5 km S of Nannup, Guthridge Road, Western Australia (34.05135S, 115.76641E, 25 Sep 2024, coll. Jürgen Otto and Paul Winthrop). Two more paratype males (♂#32, 33) and one more paratype female (♀#11) were collected ca. 5 km SW of Nannup along River Road, Western Australia on 3 Nov 2023 by Michelle Peak (♂#32, 34.012167S, 115.731917E; ♂#33, reared in captivity, 34.012222S, 115.731778E; ♀#11, 34.012139S, 115.731972E). All types will be deposited in the Western Australian Museum, Perth.

Etymology. The species group name, *nannup*, noun in apposition, is taken from *Nannup*, a Noongar place name now used for a town near the localities where this species was found.

Diagnosis. *Maratus nannup* can be easily separated from the two related species in the *candens* subgroup, *M. candens* and *M. kwenda*, by examination of the pattern of scales on the fan (Figures 1, 29). The detailed structure of the male pedipalp is not useful for this purpose. Neither is the appearance of females, which look much like those of related species.

Description of male (Figures 1.3, 29-33). Males (n=15) ranged from 4.1-5.5 mm in length. The longest wild-caught adult male was 5.0 mm in length; the male reared in captivity (♂#33) was 5.5 mm in length. The tegulum of each pedipalp is dark brown and glabrous. The pedipalp femur is light brown and translucent. Above, the distal segments of each pedipalp are covered with light yellow or light yellow-orange setae. The clypeus is mostly dark brown and translucent, and may have a tuft of white setae at the center. Each paturon is also dark brown and translucent, except for a tuft of white setae extending to the front from the anteromedial margin. The eye quadrangle has a cover of off-white to light orange setae, with a narrow median stripe, a wider stripe extending behind each AME, and a less distinct stripe behind each PLE, all comprised of dull orange setae. Most of the rear and sides of the carapace are black and glabrous, with off-white to orange setae on either side of the eye region, a distinct marginal band of bright white scales, and a short medial stripe of white setae in the thoracic region. The PME are slightly closer to the PLE than to the ALE.

The top of the opisthosoma is covered by the colourful dorsal opisthosomal plate (or fan) characteristic of *Maratus* species (Figure 29). The ground colour of this plate is black, and it has distinct edges but no significant lateral flaps. Normally the opisthosoma is strongly tapered, but during courtship the fan may be compressed and expanded laterally. At the front there is a prominent marginal band of bright white setae, shaped like a triangle pointed to the rear. The center of the fan is dark blue to violet. Laterally it has black spots on a field of blue to blue-green iridescent scales, with an elaborate pattern of dull red to orange lines. A small triangular tuft of grey to white scales is found above the grey spinnerets, but this may not be visible when the male displays. Below, the opisthosoma is black and mostly glabrous (Figure 31). Below, the coxae, sternum, endites and chelicerae are mostly glabrous, brown or gray, and translucent. Toward the rear long off-white setae extend from the margins of the sternum.

Legs I and II are shorter and about the same length, legs III and IV longer, and legs III by far the longest. The general colour of all legs is similar, with a cover of light brown, light orange, or bright orange (Figures 30.44-30.49) setae. Banding is most evident on legs IV, but indistinct at best on legs I and II. Legs III, which feature prominently in courtship display, are mostly brown and glabrous on the posterior (retrolateral) side (Figure 30.26), but with a dense cover of orange setae on the anterior (prolateral) side (Figure 30.22). Each leg IV has a fringe of short, dark setae on the upper side, and a fringe of longer, orange to white setae extending from the ventral side. A small tuft of bright white setae also extends from the distal tarsus of each leg IV.

The detailed structure of the pedipalp (Figure 33) is similar to that of other *Maratus* species from southwestern Australia, with a projection or bump near the end of the embolus.

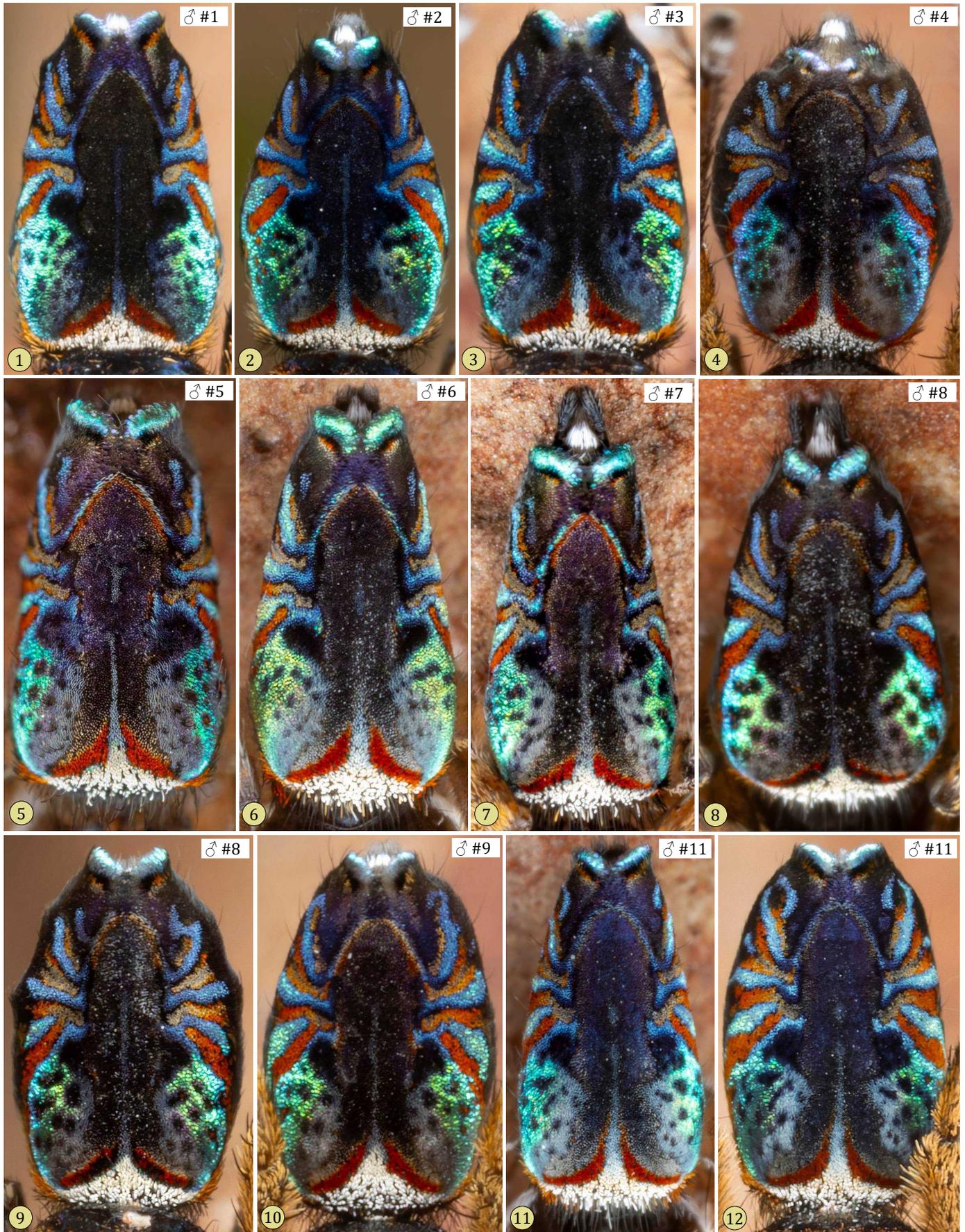


Figure 29 (continued on next page). Dorsal opisthosomal plate, or fan, of ♂ *Maratus nannup*. 8-9, 11-12, Note the difference in appearance of the fan when it is compressed and laterally expanded during courtship display (9, 12).

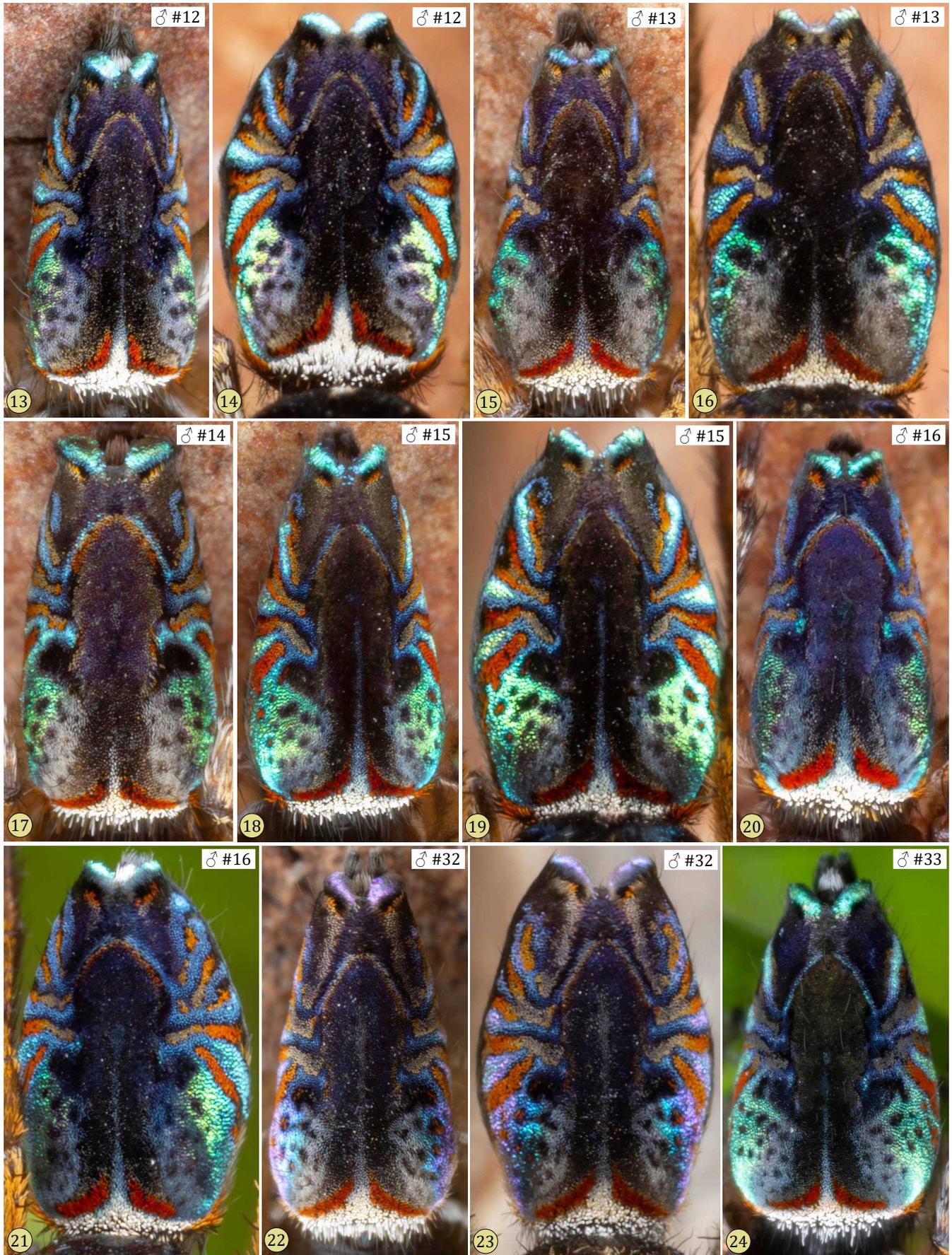


Figure 29 (continued from previous page). Dorsal opisthosomal plate, or fan, of ♂ *Maratus nannup*.

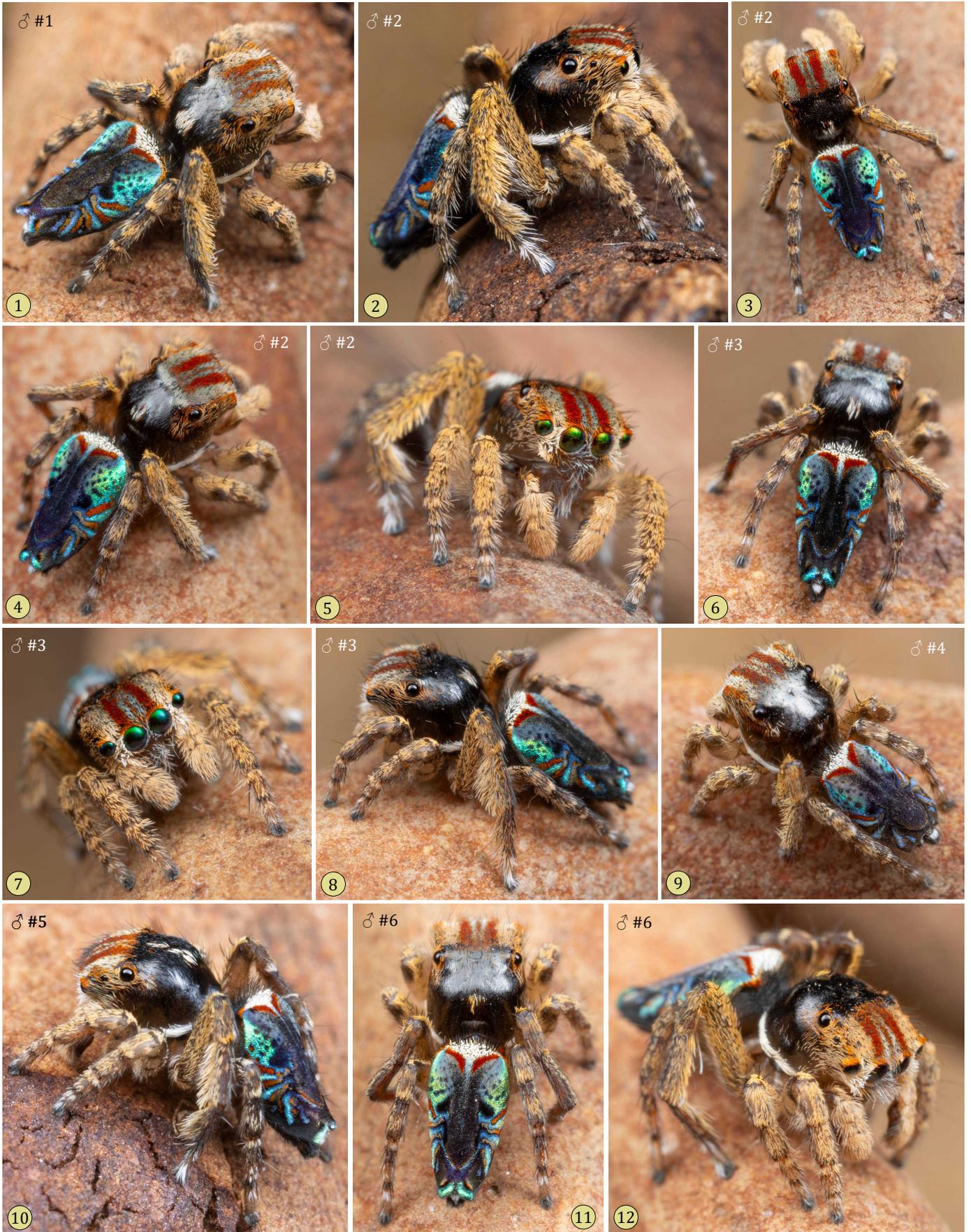


Figure 30 (continued on next page). Living ♂ *Maratus nannup*.



Figure 30 (continued from previous page, continued on next page). Living ♂ *Maratus nannup*.



Figure 30 (continued from previous page, continued on next page). Living ♂ *Maratus nannup*. **26**, Rear view of a male during courtship display, showing black, glabrous underside of opisthosoma and the prominent fringes along the ventral side of each leg III. The rear of legs III is also dark brown and glabrous.



Figure 30 (continued from previous page). Living ♂*Maratus nannup*. 42, Note the dark brown, glabrous femur and tegulum of each pedipalp.



Figure 31 (continued on next page). Ventral views of living ♂ *Maratus nannup*.



Figure 31 (continued from previous page). Ventral views of living ♂ *Maratus nannup*.

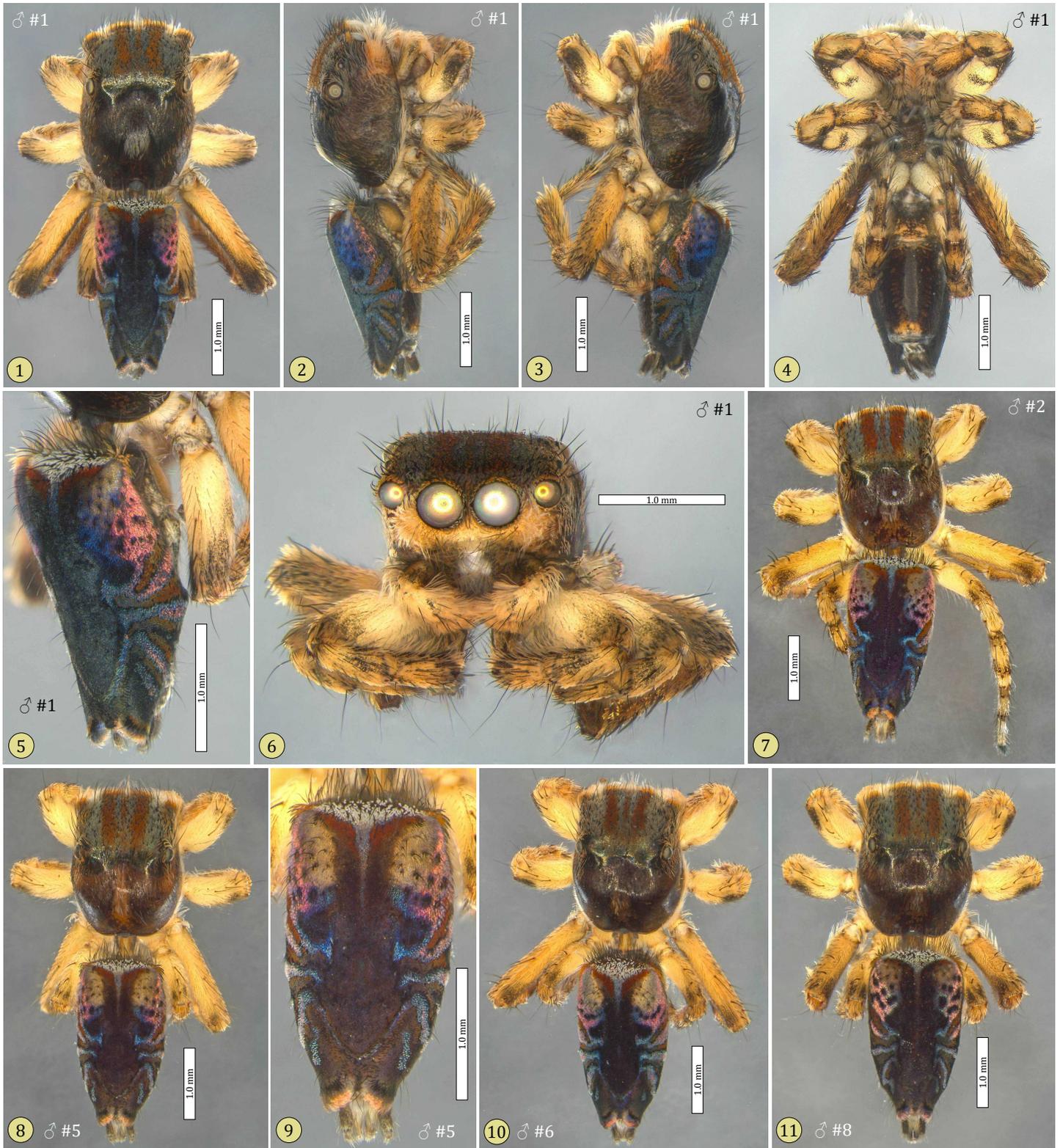


Figure 32 (continued on next page). Types for ♂ *Maratus nannup*, in alcohol solution.

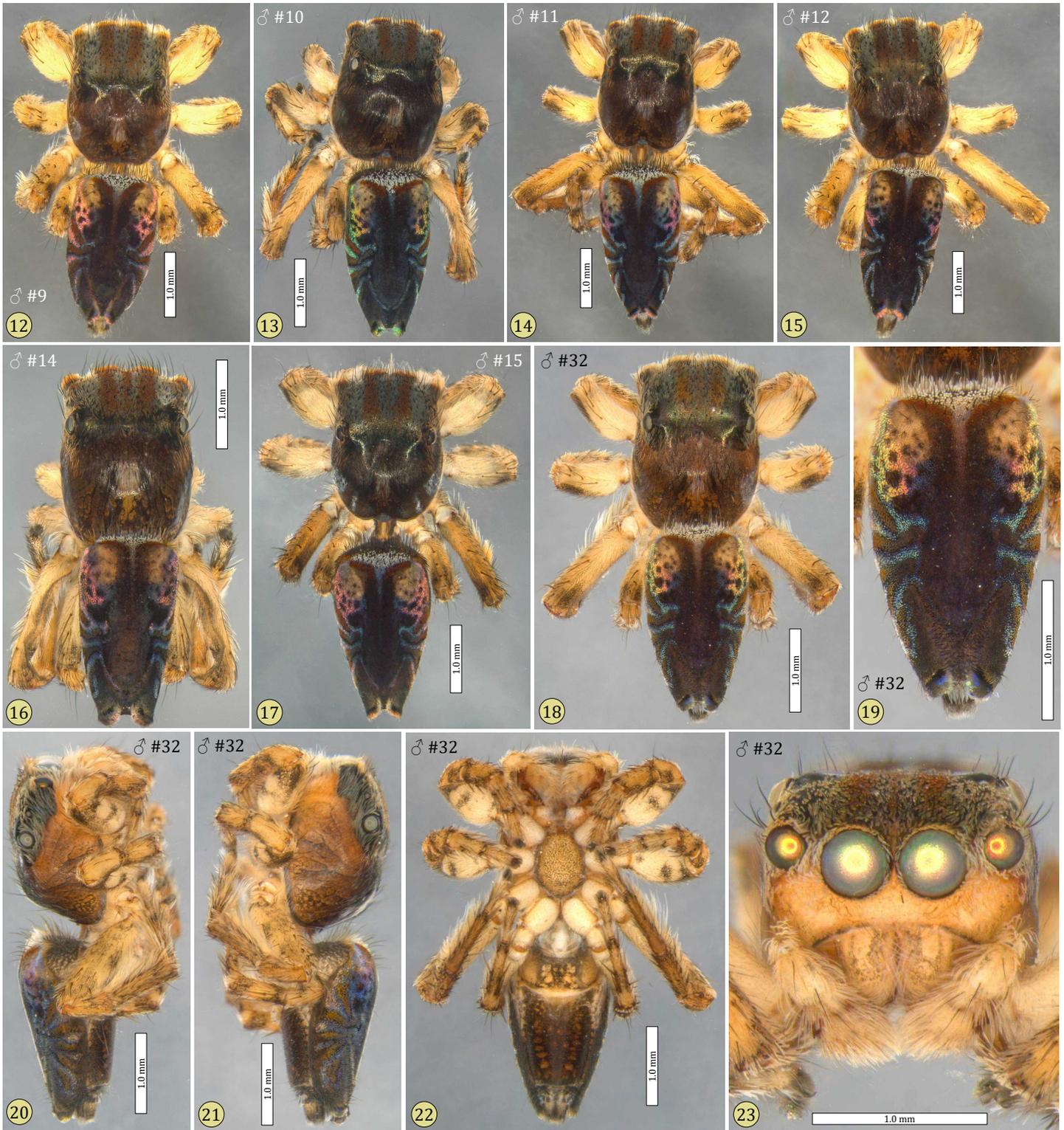


Figure 32 (continued from previous page, continued on next page). Types for ♂ *Maratus nannup*, in alcohol solution.

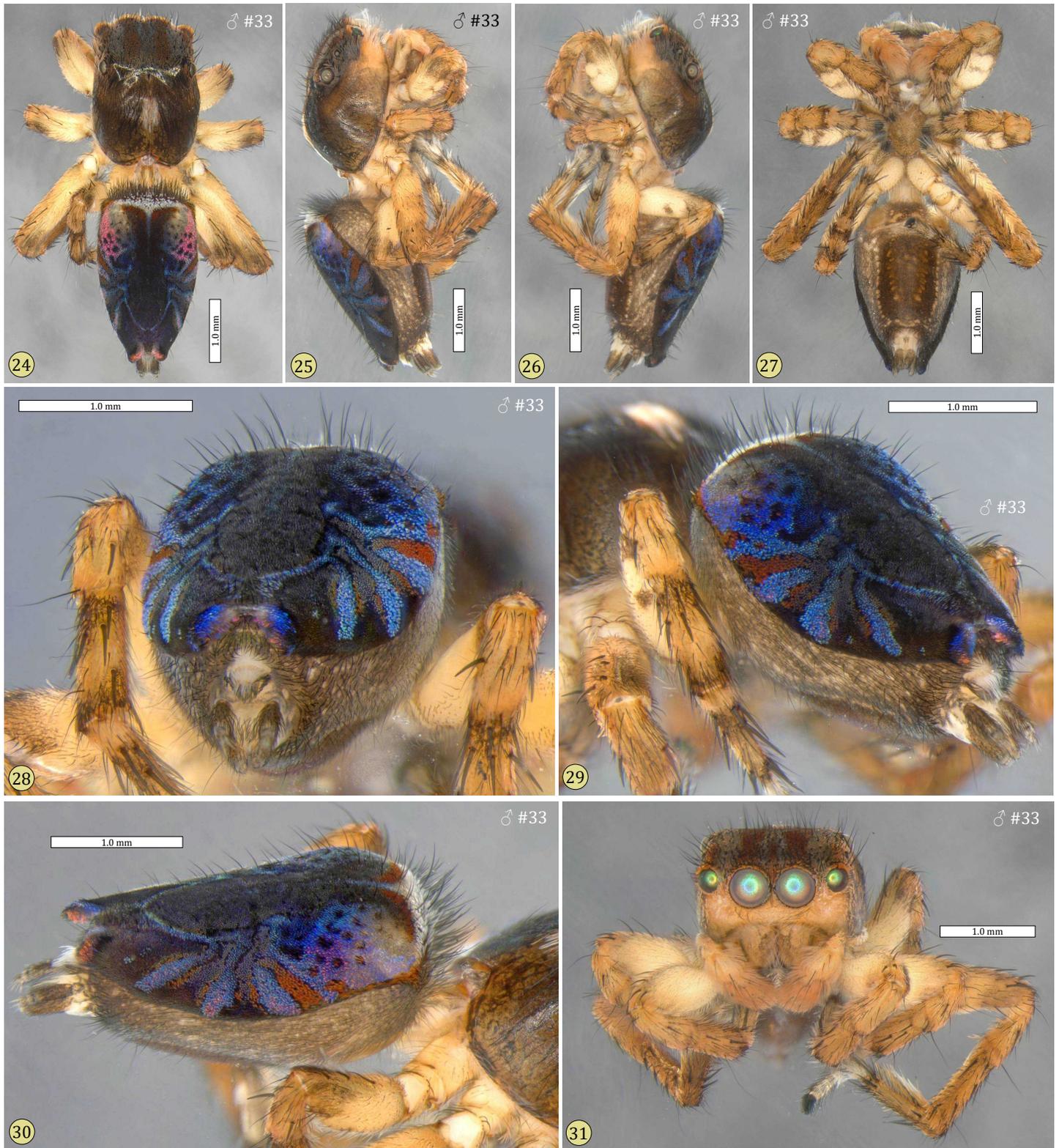


Figure 32 (continued from previous page). Types for ♂ *Maratus nannup*, in alcohol solution.

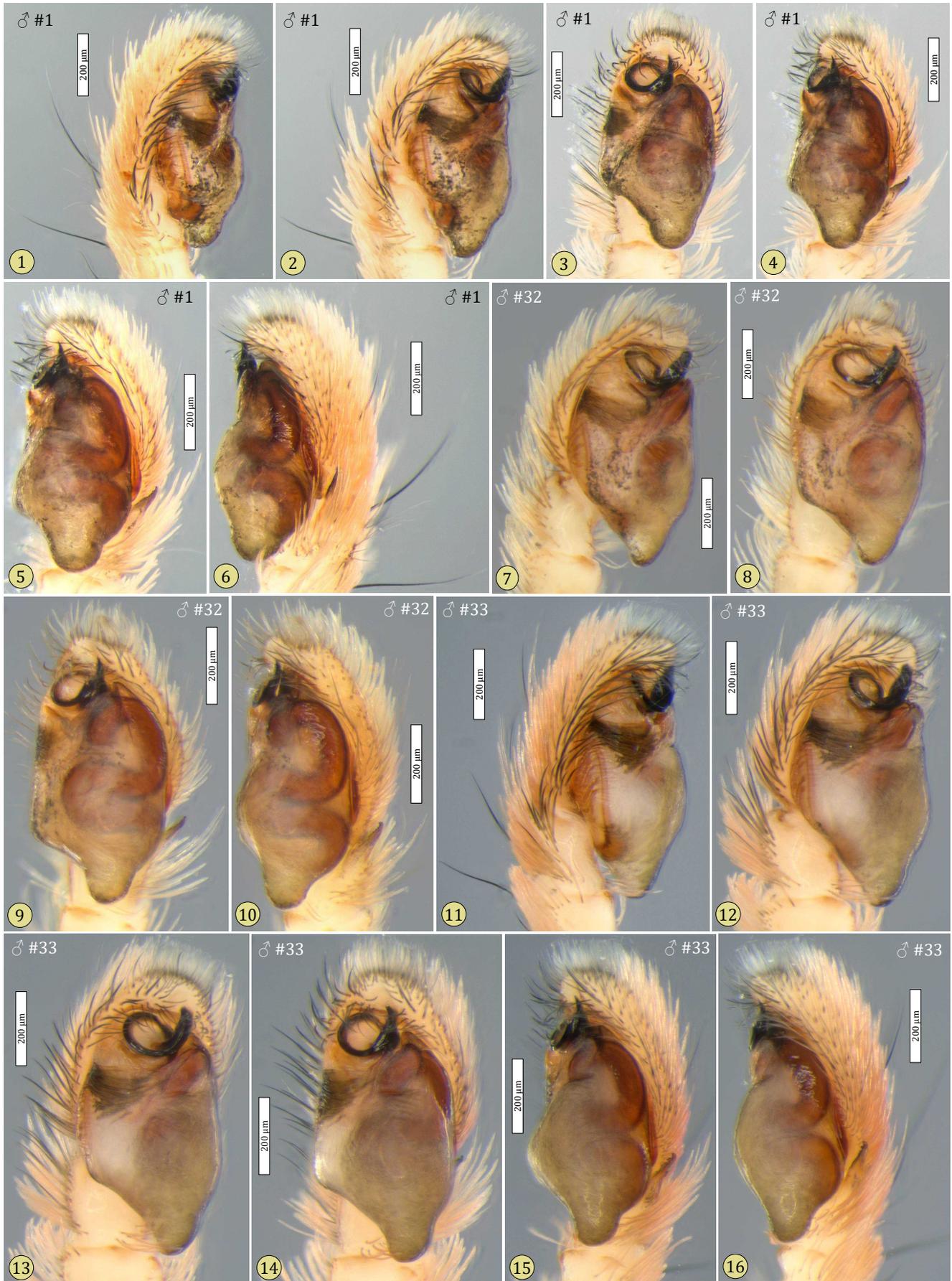


Figure 33. Medial to retrolateral views of left pedipalp for ♂ *Maratus nannup* types.

Description of female (Figures 34-37). Female *Maratus nannup* (n=11) ranged from 5.0-6.2 mm in length. In all respects they are very similar to females of *M. kwenda*. The pedipalps are brown, translucent with a uniform cover of off-white setae. Cuticle at the top of the carapace is dark brown to black in colour; on the front and sides the carapace is lighter brown and translucent. Longer off-white setae extend in a medioventral direction from the clypeus. The chelicerae are mostly lighter brown and translucent, but have a number of off-white setae extending from the front of each paturon. The eye quadrangle has a cover of mixed orange-brown and off-white scales, interrupted by a dark brown stripe extending to the rear behind each AME. Behind this a short mediothoracic patch (or stripe) of off-white or dull orange setae is present. As in the male, the PME are slightly closer to the PLE than to the ALE. An incomplete cover of light orange-brown or off-white setae is present on the sides of the carapace, but there is no marginal band.

Stout off-white setae extend to the front from the dorsal opisthosoma. The dorsal opisthosoma is generally dark brown, interrupted by small patches of light brown or off-white setae, and an indistinct middorsal stripe of lighter setae is present. There is a wide and irregular band of off-white setae around the sides of the opisthosoma, usually continuous with a uniform cover of off-white setae on the underside of the opisthosoma (Figure 35), which is very light brown or tan with many small darker spots. A small white triangular tuft of setae is present above the grey to brown spinnerets. Below, the coxae, sternum, endites and chelicerae are light brown, translucent and mostly glabrous, with longer off-white setae extending to the rear from the sternum.

Legs I and II are shorter and about the same length, legs III and IV longer and about the same length. All legs are similar in colour, mostly brown with indistinct banding produced by scattered off-white setae and black pigmented cuticle near the joints. The eipgynum (Figure 37) is much like that of related *Maratus*, with a large spermatheca behind a large window of similar or smaller size, on either side.



Figure 34 (continued on next page). Living ♀ *Maratus nannup*.



Figure 34 (continued from previous page, continued on next page). Living ♀ *Maratus nannup*.



Figure 34 (continued from previous page, continued on next page). Living ♀ *Maratus nannup*.



Figure 34 (continued from previous page, continued on next page). Living ♀ *Maratus nannup*.



Figure 34 (continued from previous page). Living ♀ *Maratus nannup*.

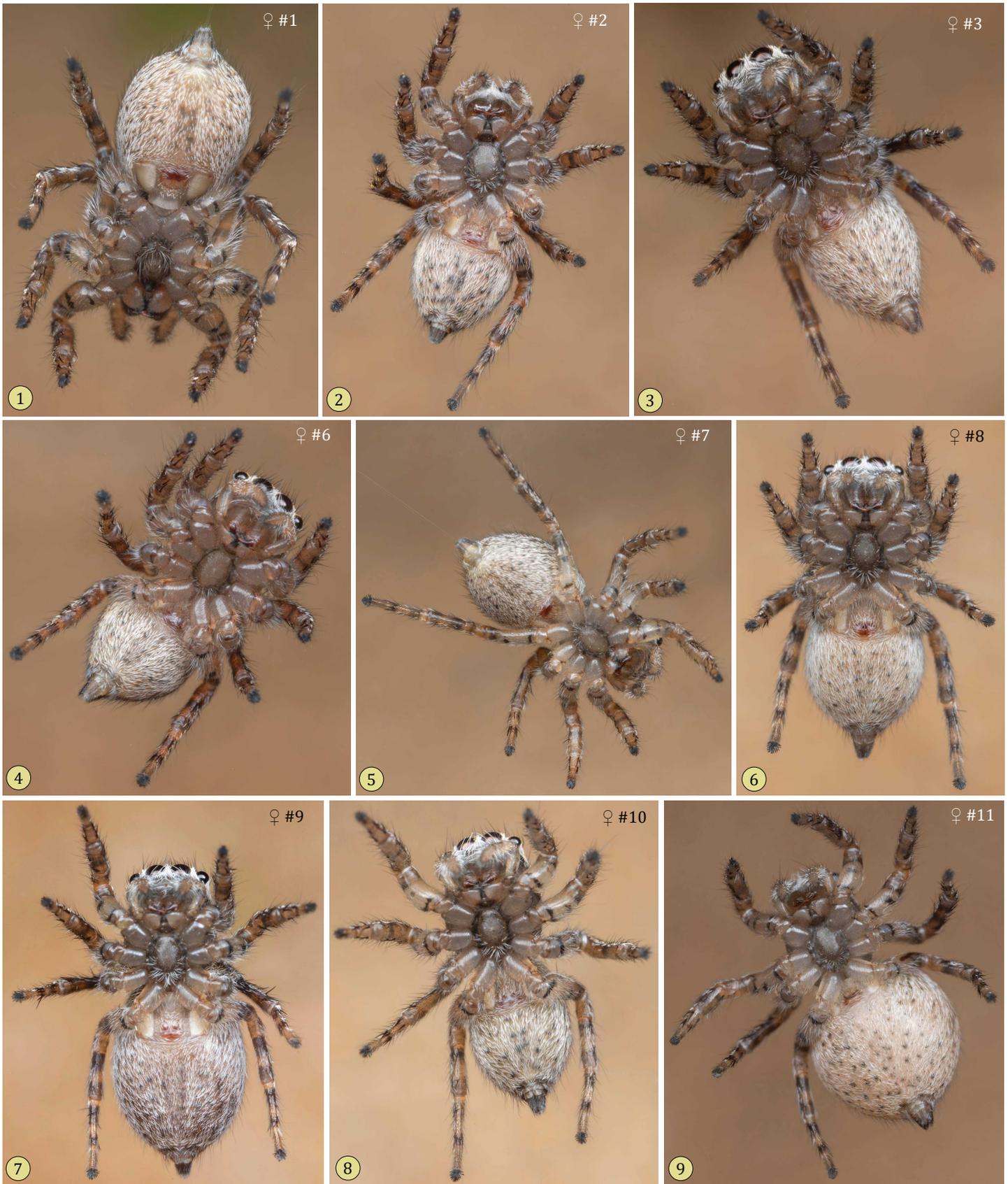


Figure 35. Ventral views of living ♀ *Maratus nannup*.

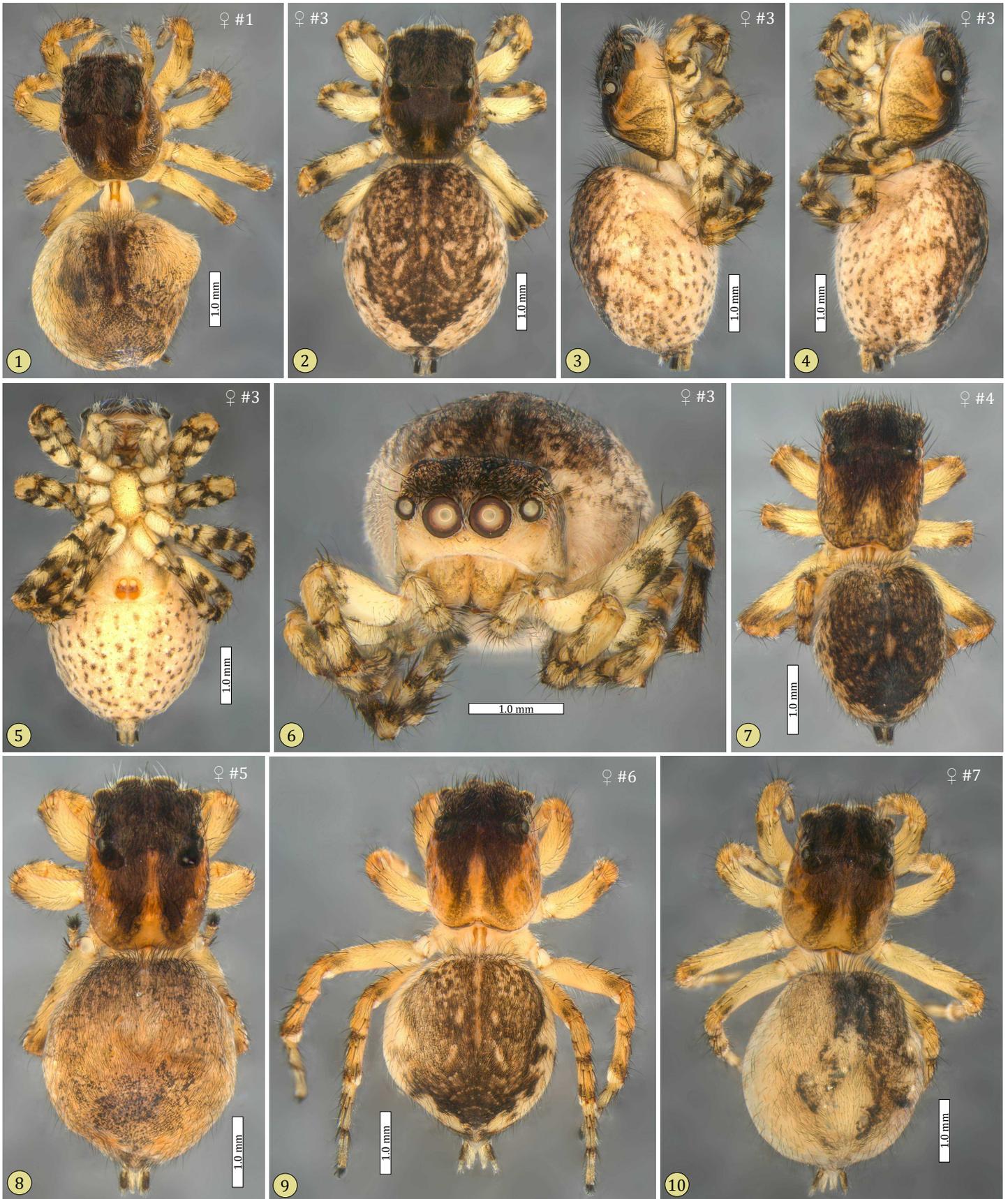


Figure 36 (continued on next page). ♀ types for *Maratus nannup* in alcohol solution.

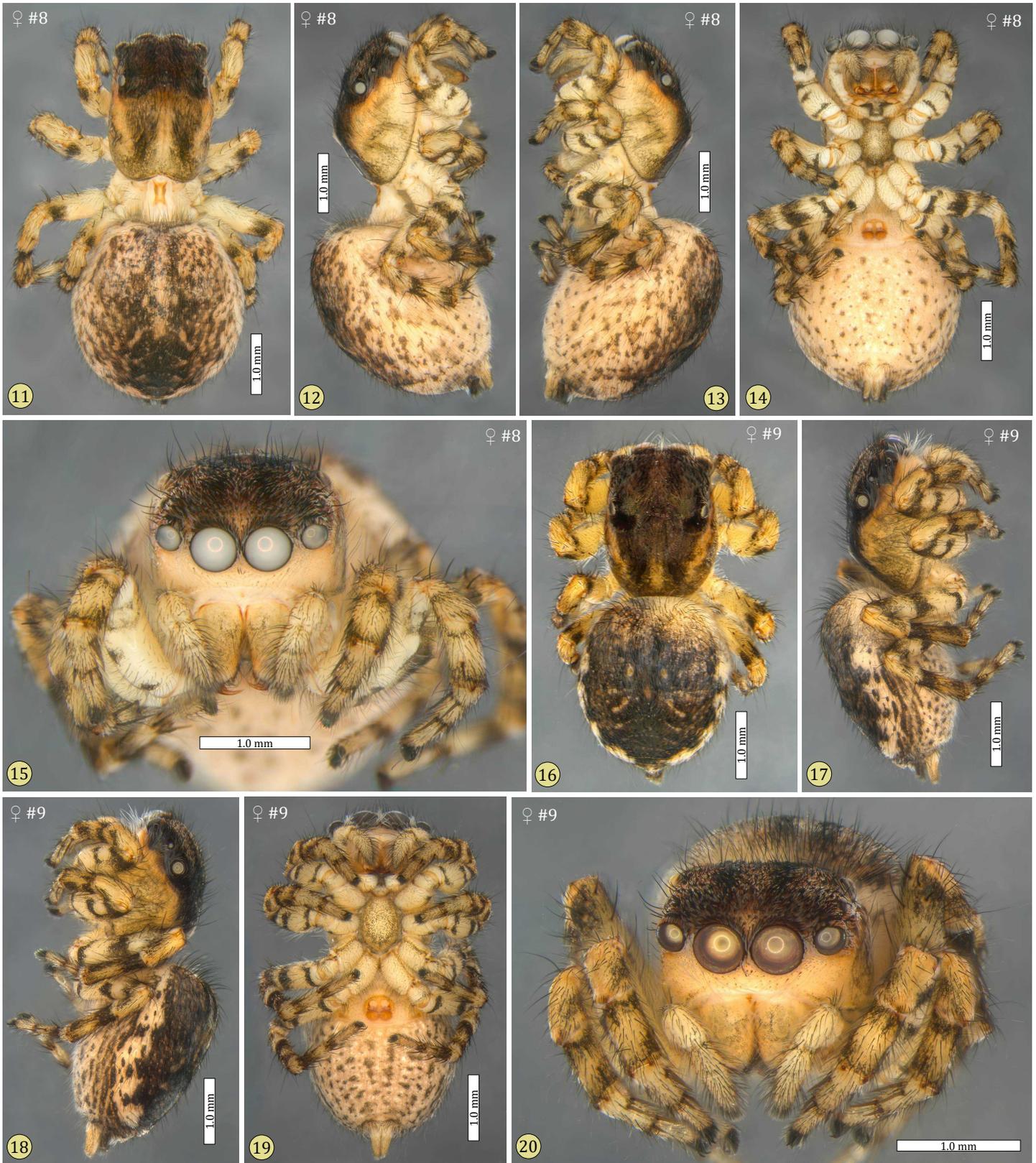


Figure 36 (continued from previous page, continued on next page). ♀ types for *Maratus nannup* in alcohol solution.

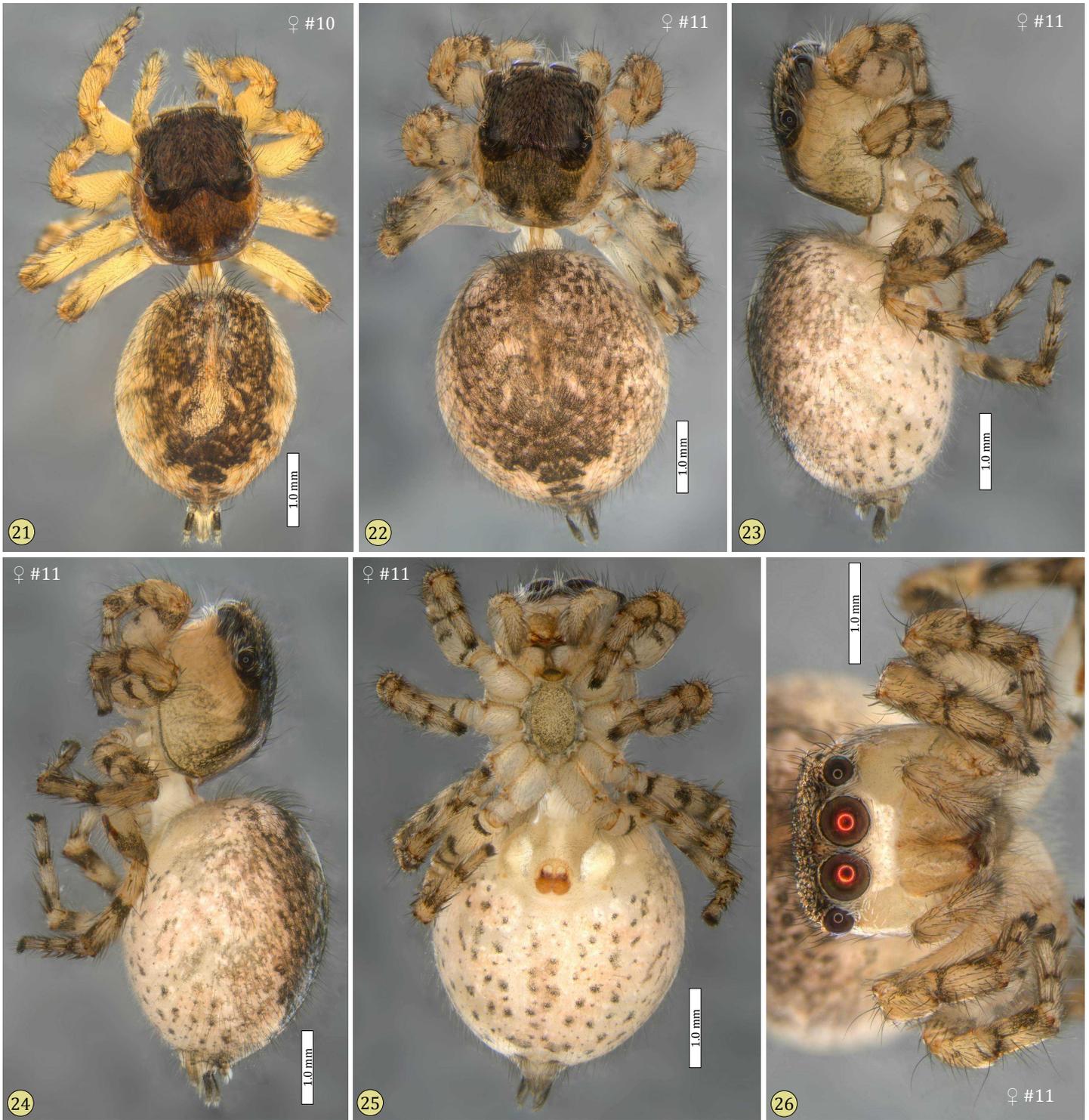


Figure 36 (continued from previous page). ♀ types for *Maratus nannup* in alcohol solution.

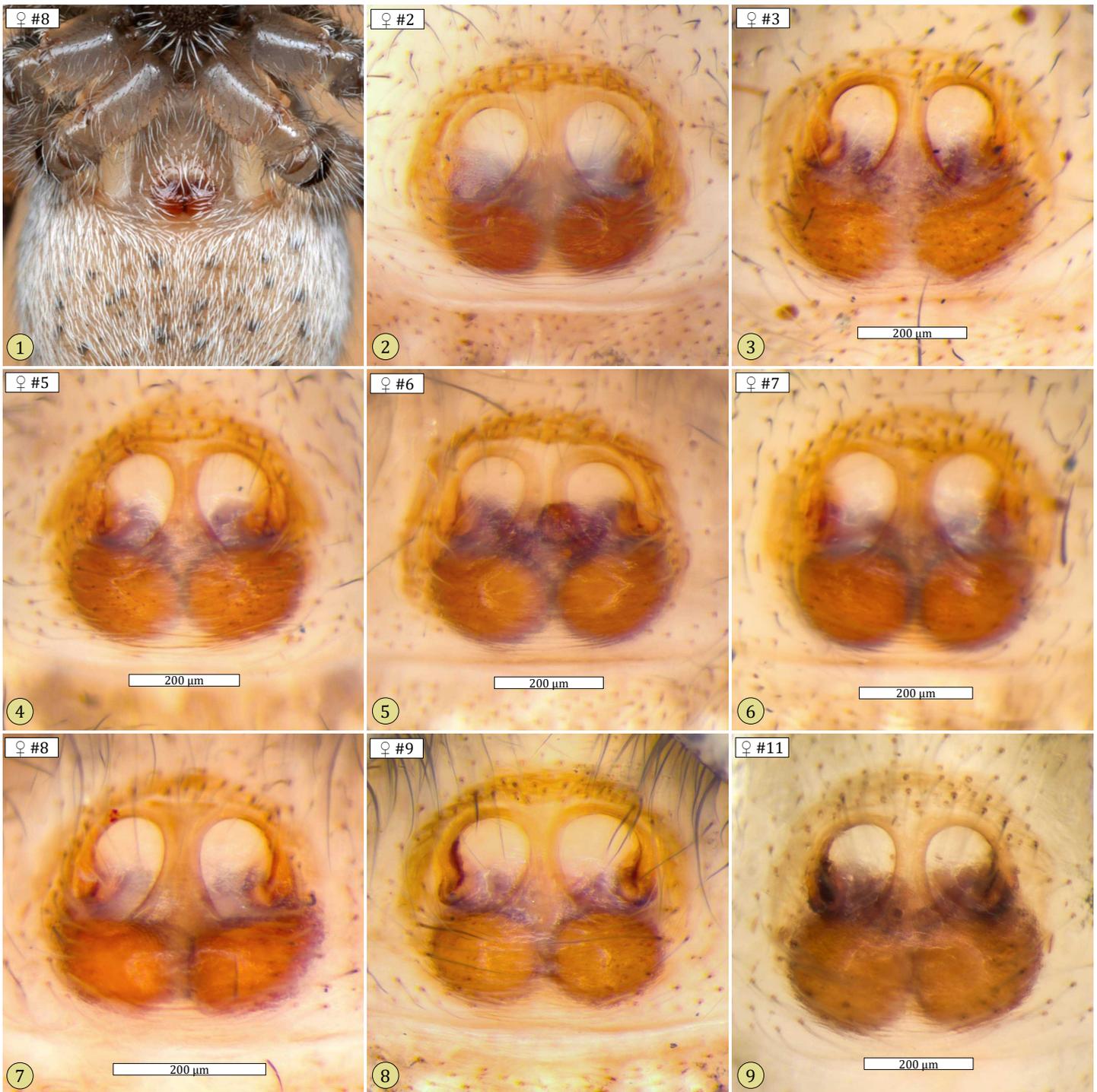


Figure 37. Ventral view of epigynum for ♀ types, *Maratus nannup* **1**, View of epigynum of a living female. Note the prominent windows at the front where the copulatory ducts originate. **2-9**, Epigyna in alcohol solution.

Penultimate male. Immature salticids tend to appear like small adult females. However sometimes the penultimate males are marked in a distinctive manner. Like adult males, penultimate male *Maratus nannup* (Figure 38) are black, with well-defined dull red-orange stripes behind the AME. All of their legs are similar in color and distinctly banded, and the high-contrast figure on their dorsal opisthosoma (Figures 38.6, 38.8) outlines the general pattern (dark center, radiating lines) seen in the adult fan.



Figure 38. Penultimate ♂ *Maratus nannup* (♂ #33).

Courtship display (Figures 39-48, 50-57). Displays by the male *Maratus nannup* (Table 2), as observed under simulated field conditions and recorded on video in the laboratory, were similar to those of both *Maratus candens* and *M. kwenda*. The most distinctive displays of all three species were the caliper dance, which appears to represent an attempt to secure the attention of a nearby female, and the fan dance, which is closely followed by an attending female. The former includes a series of very rapid steps by the male as it moves around the female; the later is a more subtle display in place.

Table 2. Displays of the male *Maratus nannup*.

display	position of female	description	Figures
1. single leg III wave	may be in sight but not facing the male	in place, leg III extended with variable (vertical to horizontal) elevation, waved at low amplitude (~2-5°) and low frequency (~1 Hz), fan depressed or elevated but not waved	39-40, 41.1-41.2, 41.4
2. high two leg III wave	probably sighted to the front of the male	in place, elevation of both legs III to a vertical position, fan depressed or elevated	41.3, 41.7
3. wide two leg III wave	within sight	with partly to fully elevated fan; each leg III is waved through an amplitude of ~1-3° at a low frequency (~1 Hz), not synchronous or loosely synchronous	41.5-41.6, 42.1-42.3
4. caliper dance	within sight and may be closer to the male	with legs III extended and elevated to a variable extent but usually separated, the male makes a series of intermittent (104 Hz) steps to one side and then the other, facing the female at all times; between steps legs III gradually separate as the fan is raised in the sagittal plane; at the onset of each step legs III are suddenly brought together as the fan is lowered	41.8-41.13, 43-44
5. high fan	close to male, but female may not be facing to follow male movements	one or (usually) both legs III extended and held in place; if both legs extended legs III may be widely separated or aligned in a near-vertical position, often flexed at the tibia-metatarsus joint; the fan is usually elevated to a near-vertical position and may be expanded laterally; the fan is waved from side to side at a variable rate (2.5-4 Hz) and a variable amplitude (2-12°)	42.4-42.6, 45-47
6. fan dance	facing and approaching the male, turning to follow each movement made by the male	display in place with both legs III extended and held in a near-vertical position, usually with the tarsi of the two legs in contact; during a series of long (~3-4 s/cycle, or ~0.3 Hz) cycles the fan is alternately elevated to a high position, then moved down to a low position; elevation of the male above the substrate varies but the male often rise high above the substrate so that the dark black venter of the opisthosoma, often moving rapidly from side to side at a high rate (~12-25 Hz, amplitude 5-10°) can be seen clearly from the front by the female; when elevated movement of the fan is relatively slight by comparison; usually when the opisthosoma is in a lower position each paturon of the chelicerae moves laterally, with both usually moving in the same direction (to the right or to the left of the observer) at the same time; no leg I tapping (<i>tap dance</i>) was observed	48, 50-57

There are noticeable differences between the fan dance of *Maratus kwenda* and that of *M. nannup*. First, like *M. candens* (Otto & Hill 2022), male *M. nannup* often rise above the substrate to display the underside of their opisthosoma to the attending female. By comparison, movement of the opisthosoma by *M. kwenda* during this display is limited mostly to rotation from an elevated, vertical position to a horizontal position in the sagittal plane. It is noteworthy that the venter (underside of the opisthosoma) of the *M. kwenda* male is light brown with a uniform cover of short off-white setae, whereas the venter of both *M. candens* and *M. nannup* males is jet-black and glabrous. During display of the venter, *M. nannup* may move (or vibrate) the opisthosoma rapidly from side to side at ~12-25 Hz, with an amplitude as great as 10°. Movement by the attending female during this display shows that this movement is being followed.

In addition, we have not observed leg I tapping in any form in the fan dance of either *M. candens* (see Otto & Hill 2022) or *M. nannup*, as we observed in *M. kwenda*. In our recent study of *felinus* subgroup peacock spiders (*M. felinus*, *M. lynx*, *M. miles*; Otto & Hill 2024) we described a *tap dance* (corresponding to the fan dance described here), in which tapping of legs I (but not movement of the chelicerae) was an important feature for all three species. As shown in our map (Figure 2), the locality where *M. kwenda* was found is close to the the three localities associated with the *felinus* subgroup. At the same time, members of that subgroup have a number of other characters, including several details of the male courtship display, that support our view that *M. kwenda* is much more closely related to the other *candens* subgroup species (*M. candens* and *M. nannup*).

The final approach of a male *Maratus nannup* to a courted female is shown in Figure 49.



Figure 39. Single leg waves by three ♂ *Maratus nannup*. **1-3**, Sequential photographs showing movement of the extended leg LIII, first down, then up. Hyperextension at the tibia-metatarsus joint is associated with extension of long setae on the underside of the LIII metatarsus. Note also that the rear of this leg is dark and glabrous.

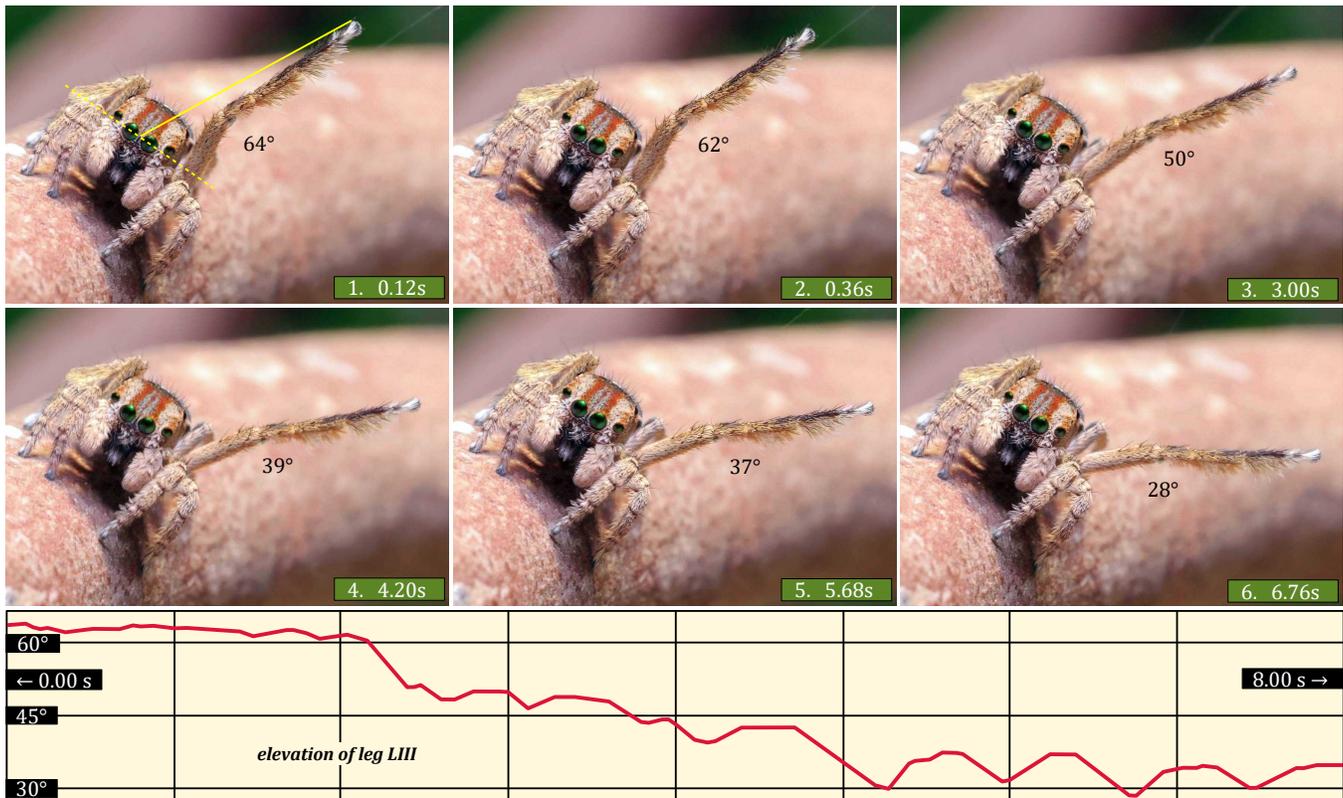


Figure 40. Single leg wave by a ♂ *Maratus nannup*, recorded with 25 fps video. After 2 s, leg LIII was slowly lowered. Waving during this interval was slow (~1 Hz) with a very low amplitude (~2°).

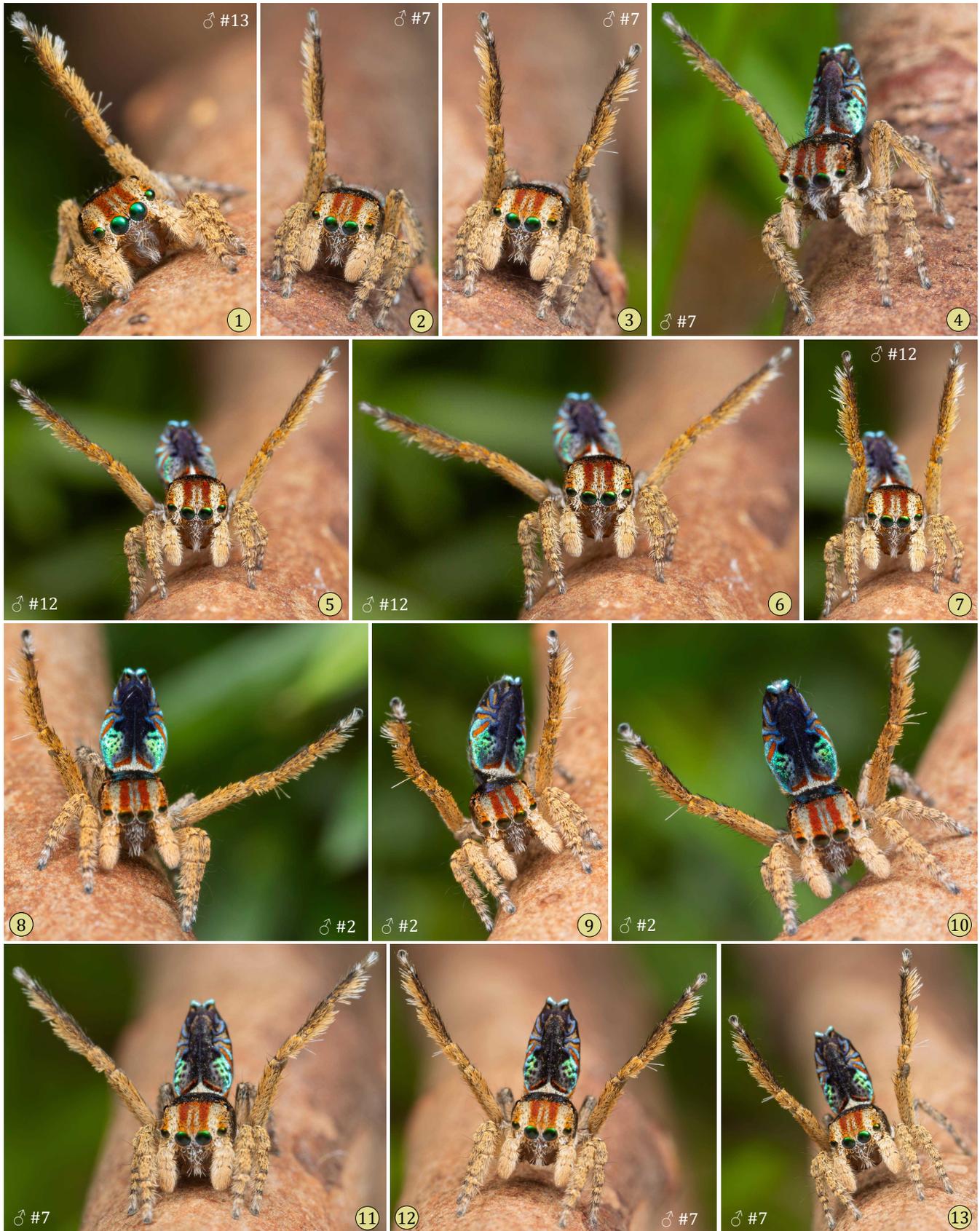


Figure 41. Courtship display by ♂ *Maratus nannup*. **1**, High single leg wave. **2-3**, Transition from single leg wave to a high two leg wave. **4**, Single leg wave with partly elevated fan. **5-7**, Sequential images showing a wide two leg wave, transitioning to a high two leg wave. Only the extended legs III moved during this sequence. **8-13**, Two sequences (8-10, 11-13) showing the side-to-side movement characteristic of the caliper dance.

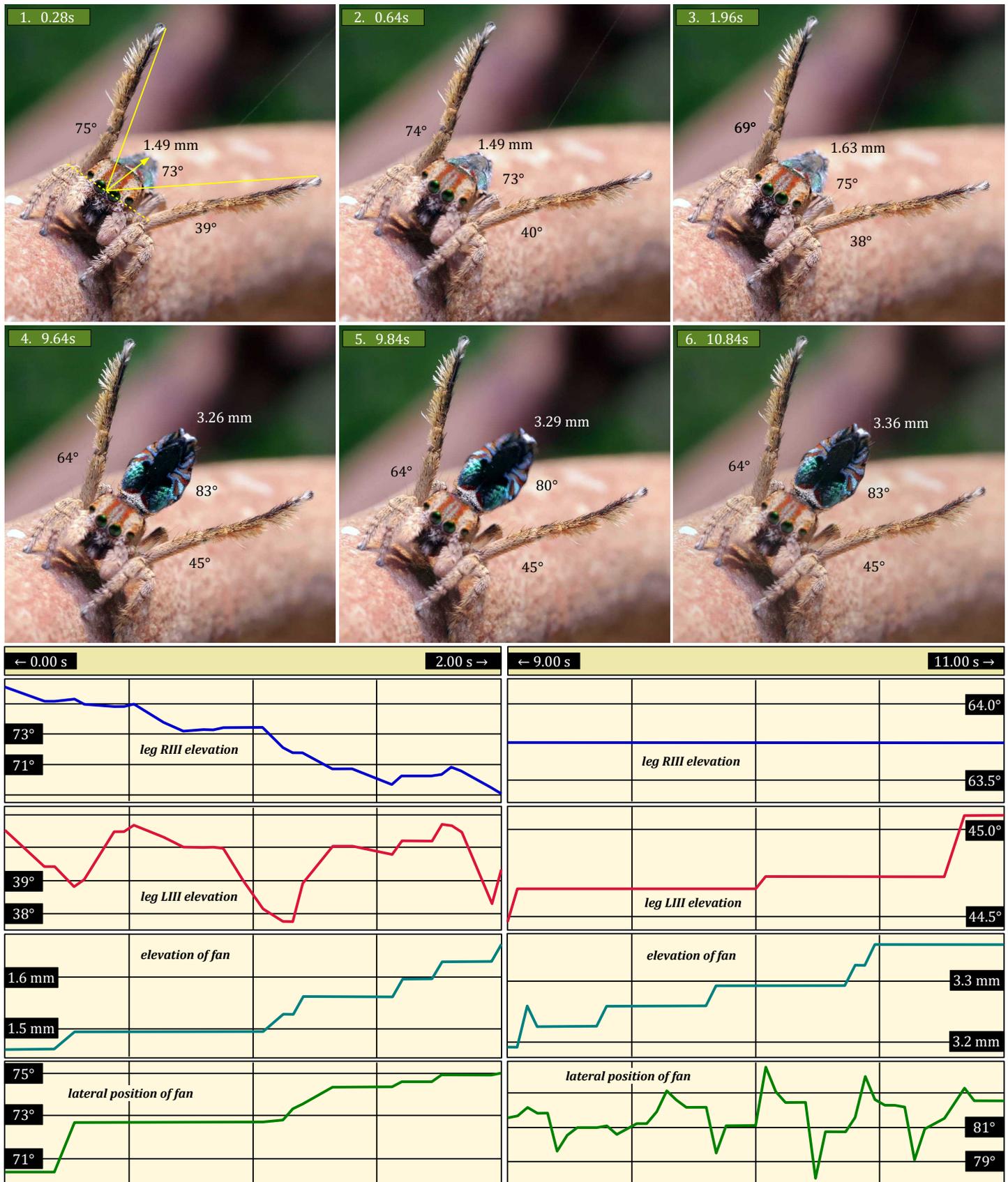


Figure 42. Two sequential segments (each 2s long) showing courtship display by a ♂ *Maratus nannup*, based on a 25 fps video record. **1-3 (left charts)**, Early display with a *wide two leg wave* and partly elevated fan. Slow (~1-2Hz) LIII waves of low (~2-3°) amplitude were observed. **4-6 (right charts)**, As the fan was raised this transitioned into a *high fan display* (~3 Hz, amplitude ~4-6°). During this display legs III were mostly kept in place, and only the fan was moved.

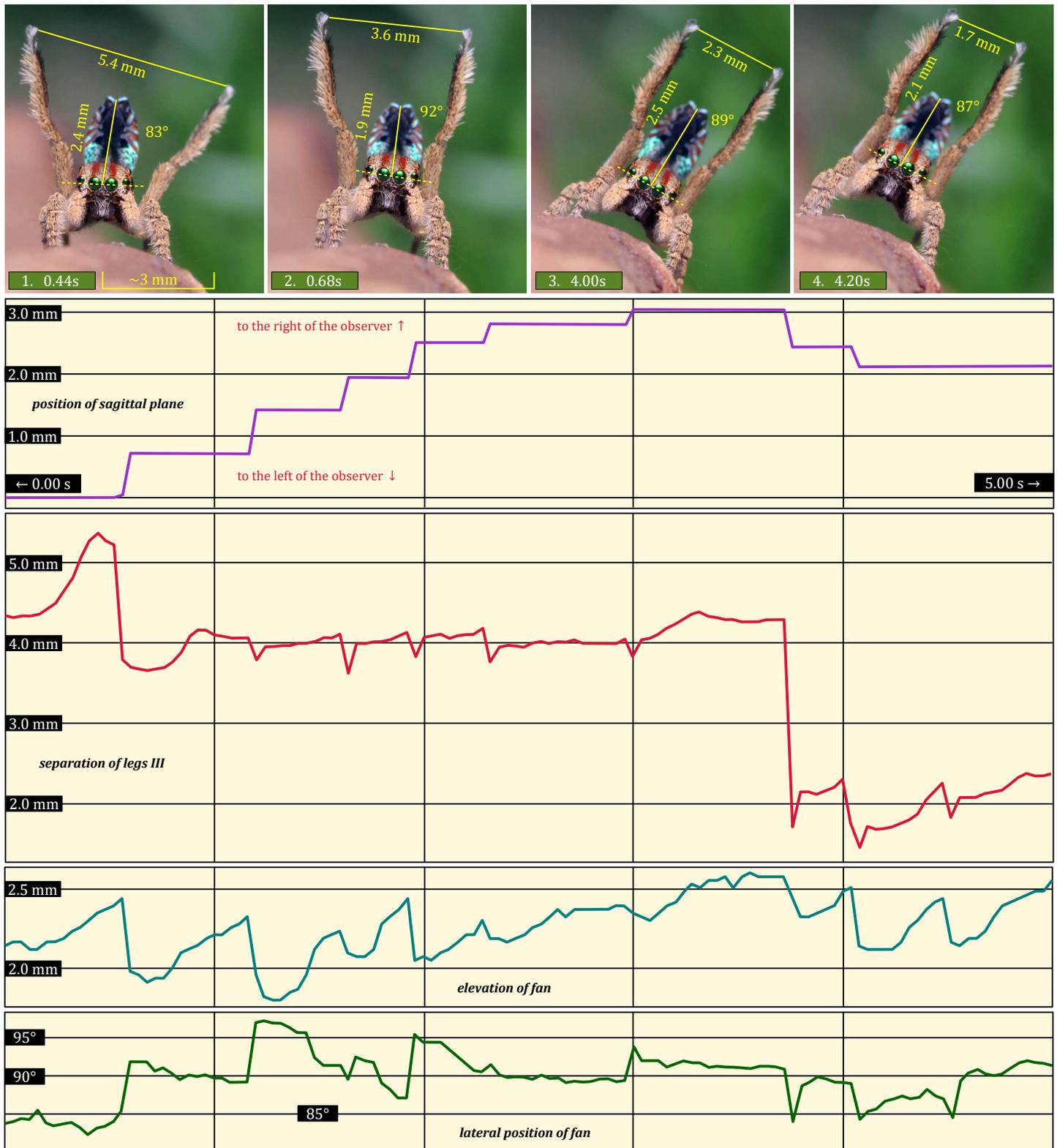


Figure 43. Caliper dance by a ♂ *Maratus nannup*, based on a 25 fps video record. During each step (top chart), legs III were quickly brought together, but in many cases the amplitude of this movement was not great. The fan was also quickly lowered during each step, by about 0.5 mm. This was accompanied by lateral movement (or waving) of the fan at a low to moderate amplitude (bottom chart). Frequency of steps varied from 0-3/s.

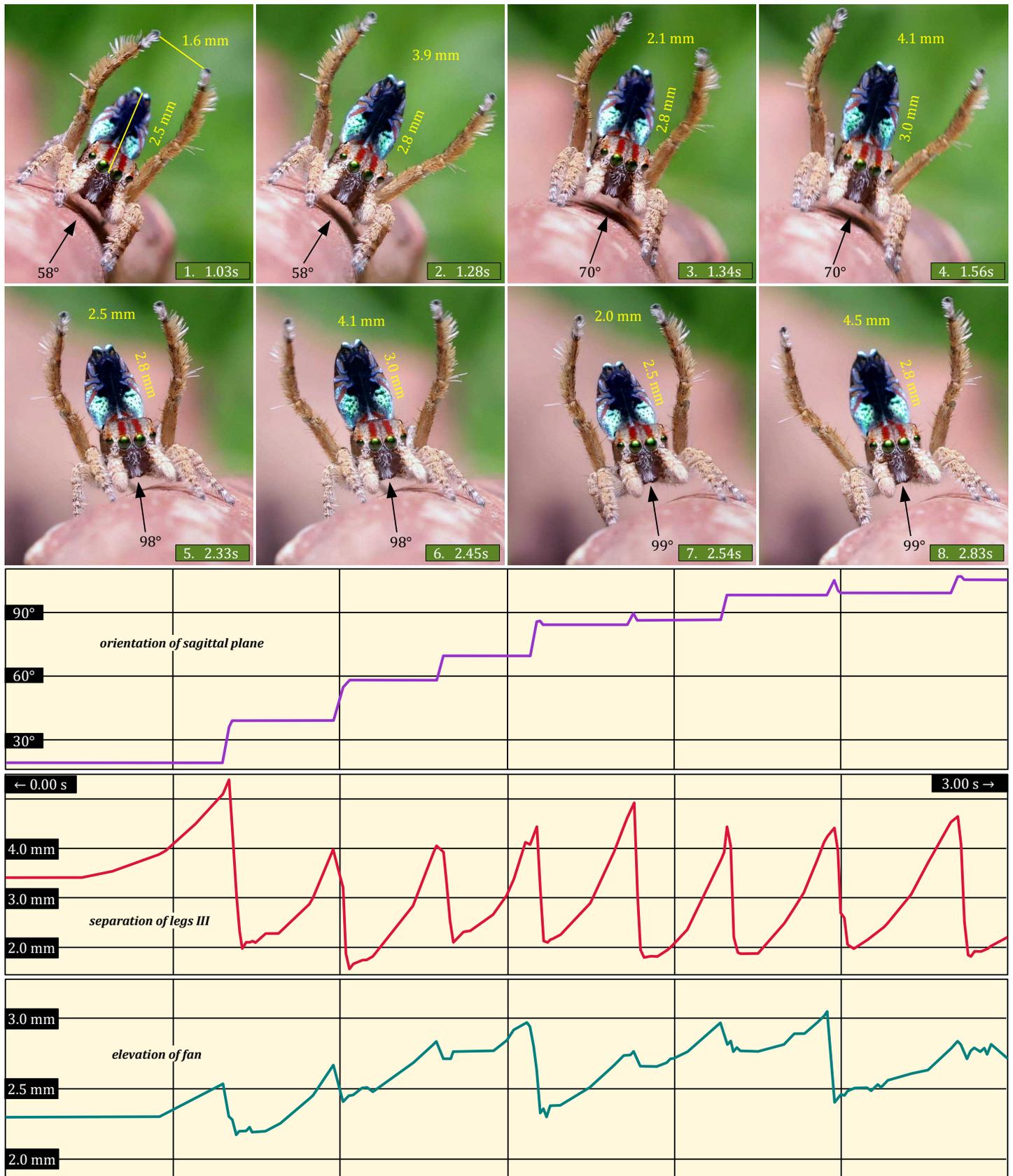


Figure 44. Caliper dance by a ♂ *Maratus nannup*, based on a 100 fps video record. In this sequence movement of legs III, involving slow separation and rapid convergence (caliper movement each time that the spider made a step) was more uniform and of a greater magnitude than that shown in Figure 43. Stepping also took place at a more consistent (~3 Hz) rate as this male moved to the left of the observer. With higher temporal resolution, the relatively slow separation of legs III, accompanied by elevation of the fan, prior to each sudden step is more obvious.



Figure 45. Photographs of *high fan* display by ♂ *Maratus nannup*. **1**, Display of the fan without elevation of legs III. **3-4**, Note changes in the lateral expansion of the fan during this sequence. **5-8**, In this sequence the fan was waved at a low amplitude. **10-11**, Transition from one to two elevated legs III. Unlike most fan dance displays, the tarsi of legs III are separated.

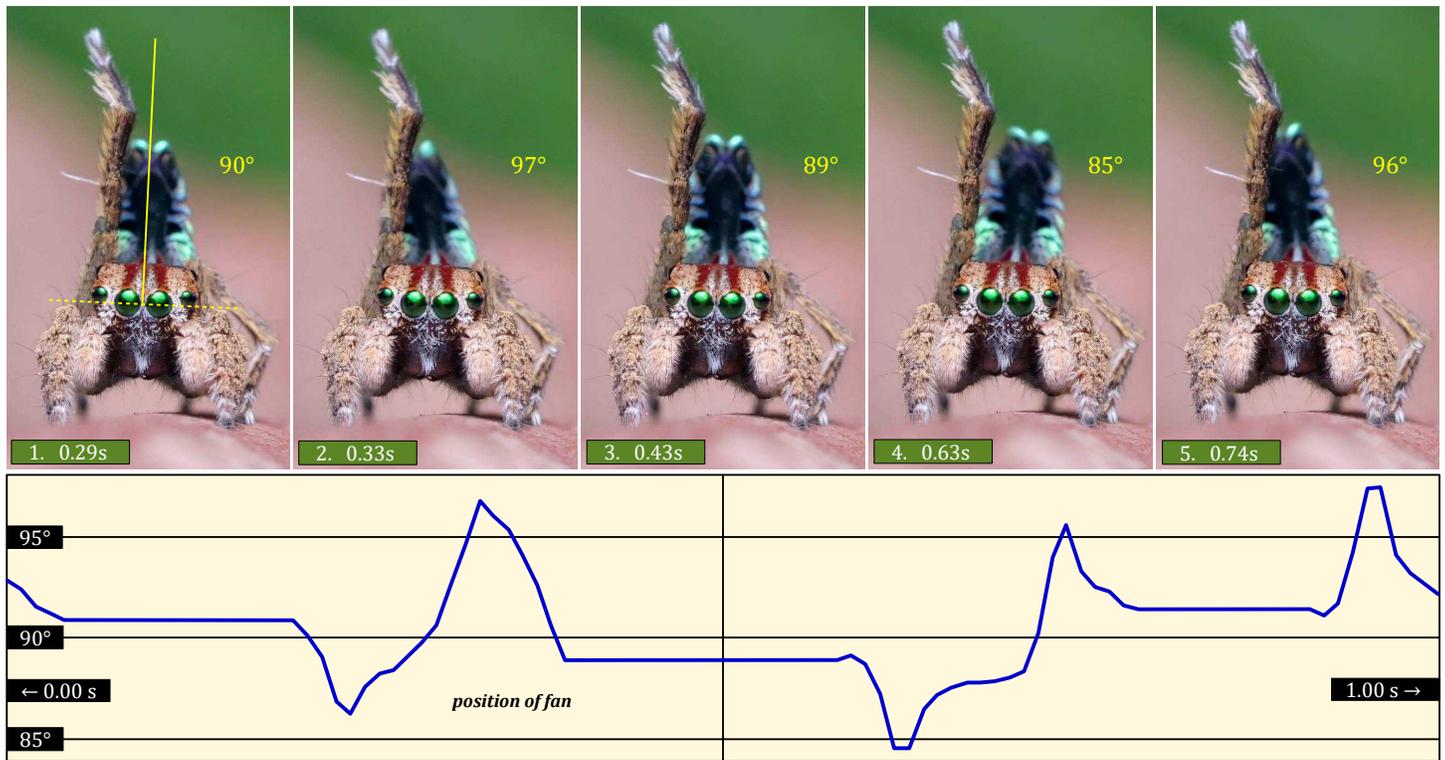


Figure 46. High fan display by a ♂ *Maratus nannup*, based on a 100 fps video record. Intermittent waves of the fan were observed at ~4Hz (amplitude ~10°). Here only leg RIII was extended and elevated.

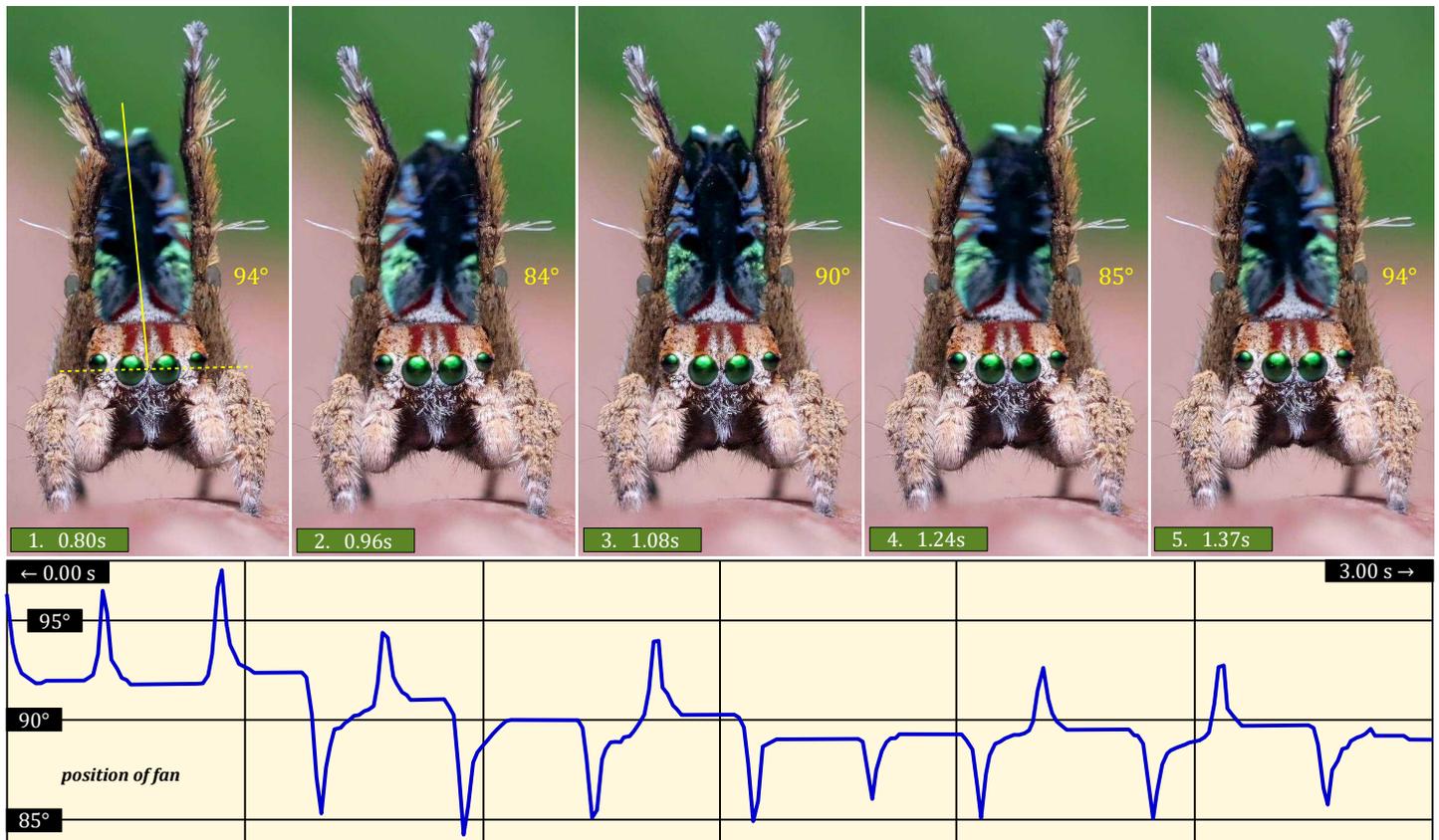


Figure 47. High fan display by a ♂ *Maratus nannup*, based on a 100 fps video record. This sequence, with the fan fully elevated between both legs, followed the sequence shown in Figure 46. Note flexion at the tibia-metatarsus joint of each leg III. The frequency (~4 Hz) and amplitude (~5-10°) of waves is similar to that shown in Figure 46.

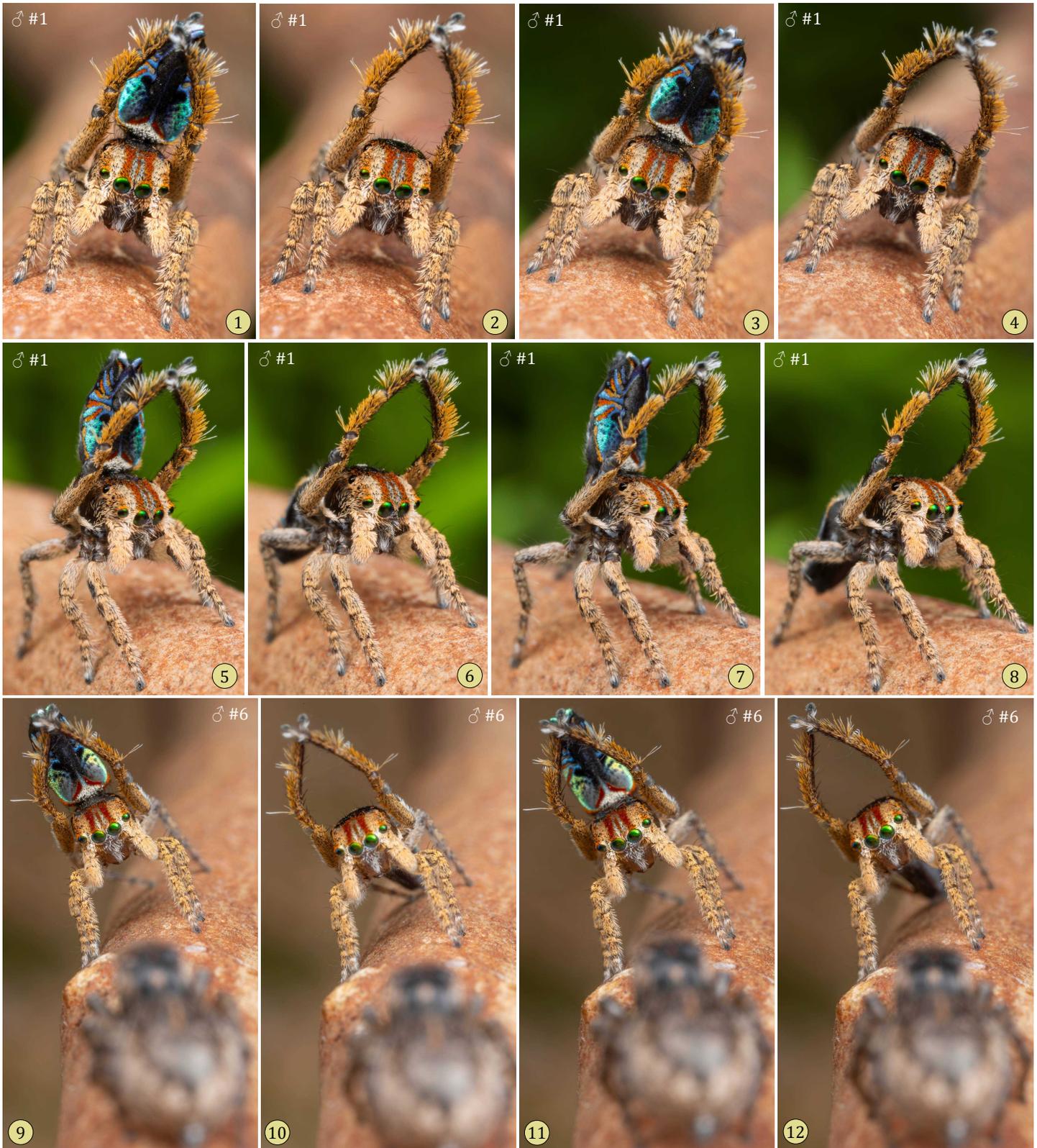


Figure 48 (continued on next page). Fan dance displays by ♂ *Maratus nannup*. Three sets (1-4, 5-8, 9-12) of sequential images are shown here. During this display, legs III are held in a vertical position, usually (but not always) touching, as the fan is alternately moved up to a vertical position, and then down to touch the substrate. **9-12**, Notice how the attending female (blurred object in the foreground) alternately turned up and to the left to look at the elevated fan (9, 11), and down and to the right (10, 12) to look at the black venter (underside) of the opisthosoma. In the latter position, the opisthosoma may be moved rapidly from side to side.



Figure 48 (continued from previous page, continued on next page). Fan dance displays by ♂ *Maratus nannup*. 13-14, 17-21, Display sequences in a low position. 15-16, 22-26, 27-28, 29-30, Display sequences in a high position.

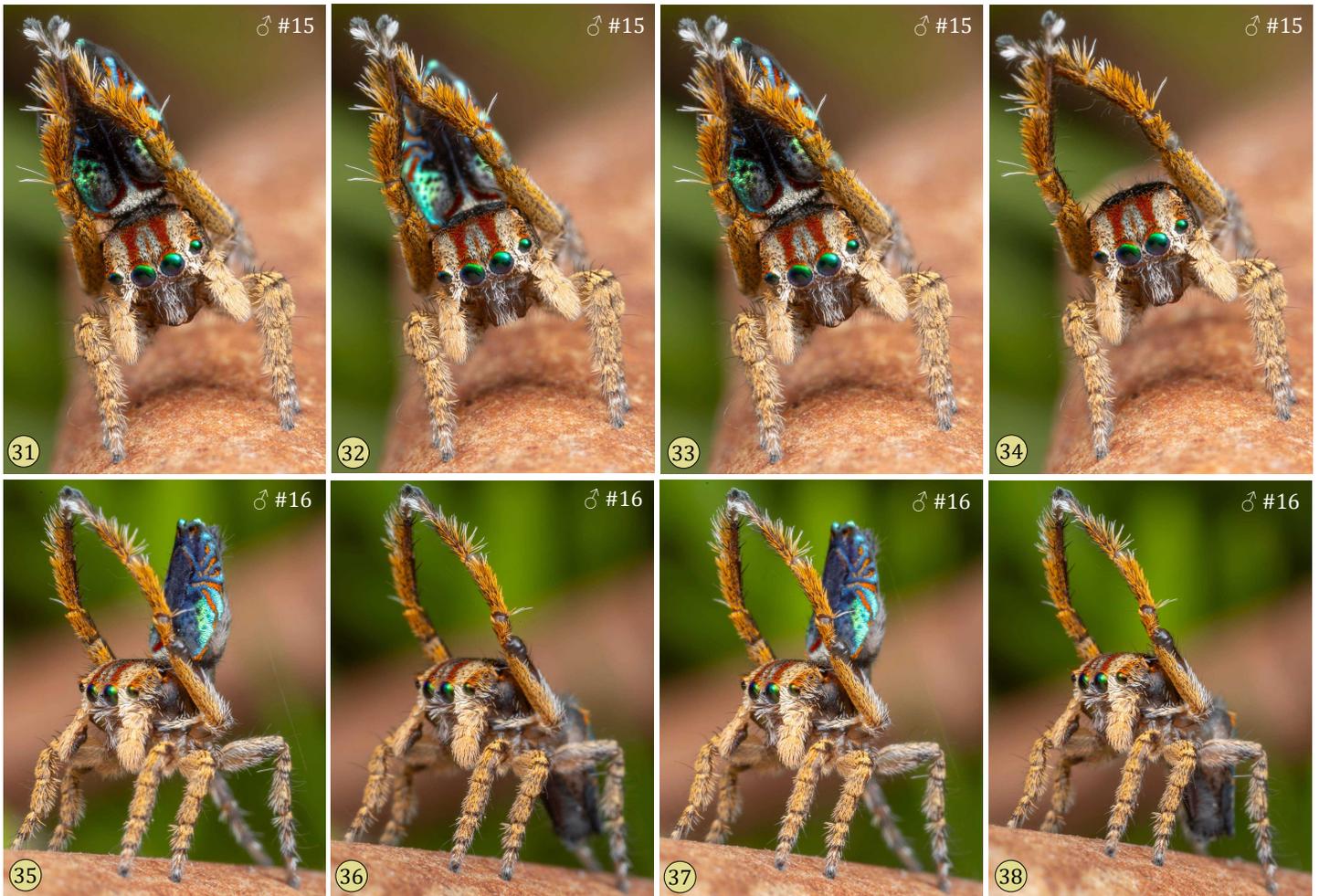


Figure 48 (continued from previous page). Fan dance displays by ♂ *Maratus nannup*. 31-34, One sequence. Note the change in colour and brightness of the iridescent scales of the fan as it was lowered (32). 35-38, A different sequence.



Figure 49. Initiation of mating by *Maratus nannup* on the underside of a stem. Previous observations have also suggested that this relatively safe and concealed mating position, chosen by a receptive female, is preferred by many *Maratus* species. 1-2, Initial contact (1) followed by advancement of the male (2). 3-4, Progression of a male from a fan dance display at less than 1 cm from a female (3) to mounting (4).

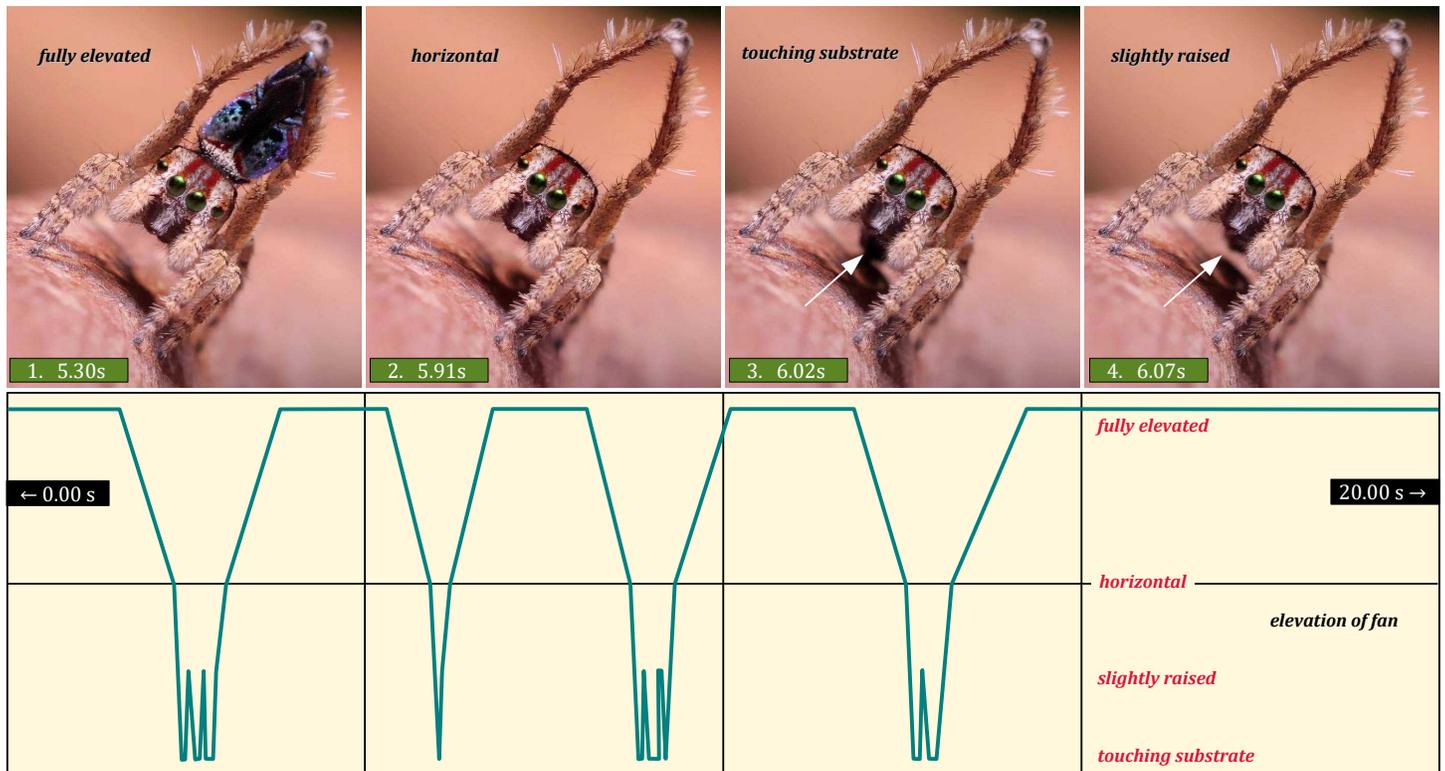


Figure 50. Fan dance display by a ♂ *Maratus nannup*, based on a 100 fps video record. Only four positions (fully elevated, horizontal, slightly raised, and touching substrate) were measured to produce this chart. Lowering of the fan took place intermittently (~3-4s intervals, ~0.3 Hz).

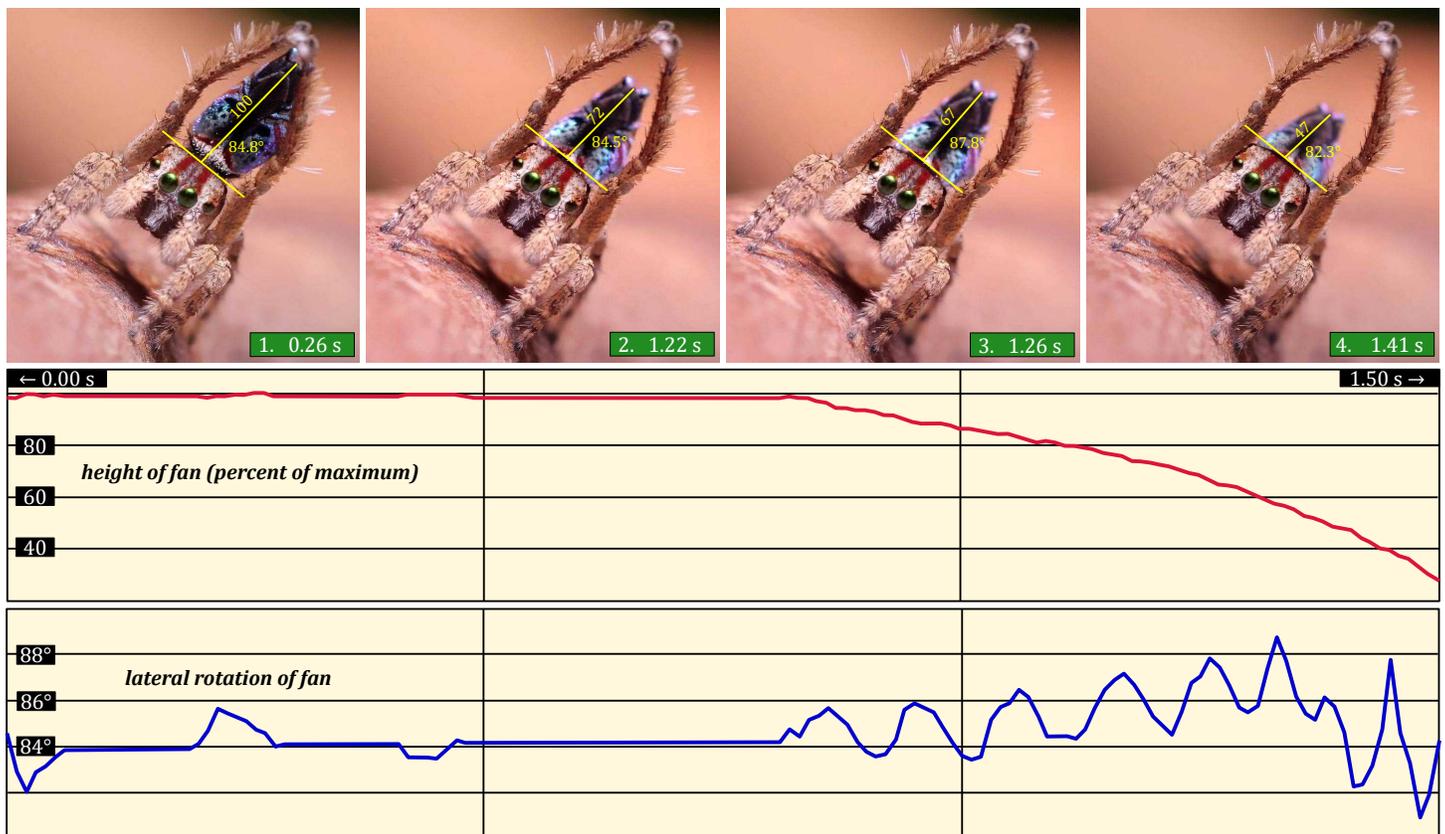


Figure 51. Part of a fan dance display by a ♂ *Maratus nannup*, based on a 100 fps video record. With more temporal resolution, lateral movement or waving of the fan through a low amplitude (~2-4°) was observed as the fan was slowly lowered to the rear.

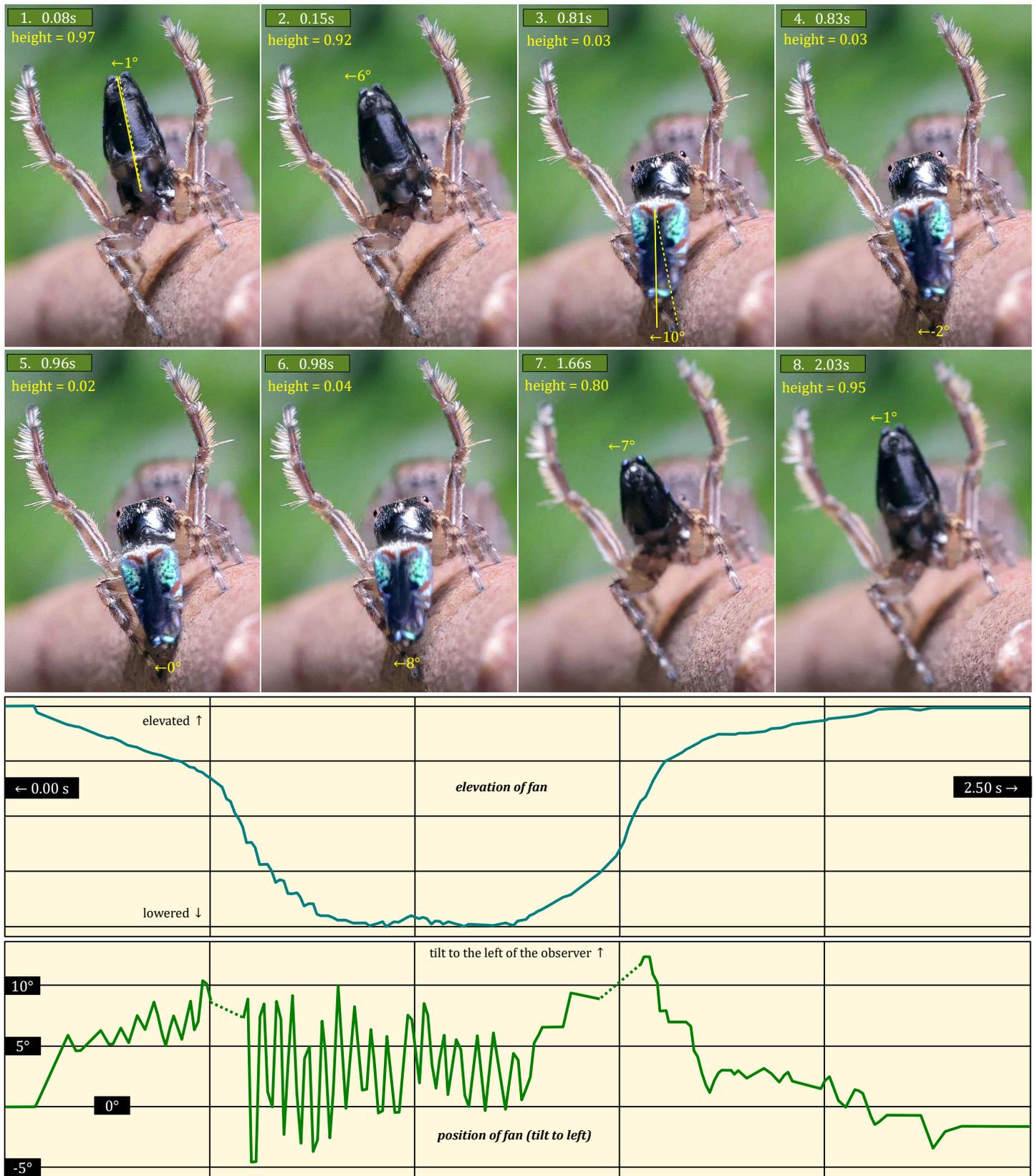


Figure 52. Fan dance display by a ♂ *Maratus nannup* viewed from the rear, based on a 100 fps video record. Dotted lines in the lower chart mark intervals in which the tilt of the fan could not be measured. At its lowest position, the fan was waved (or vibrated) at ~24 Hz, with an amplitude that varied from 0 to 14°. In this sequence, legs III were not in contact.

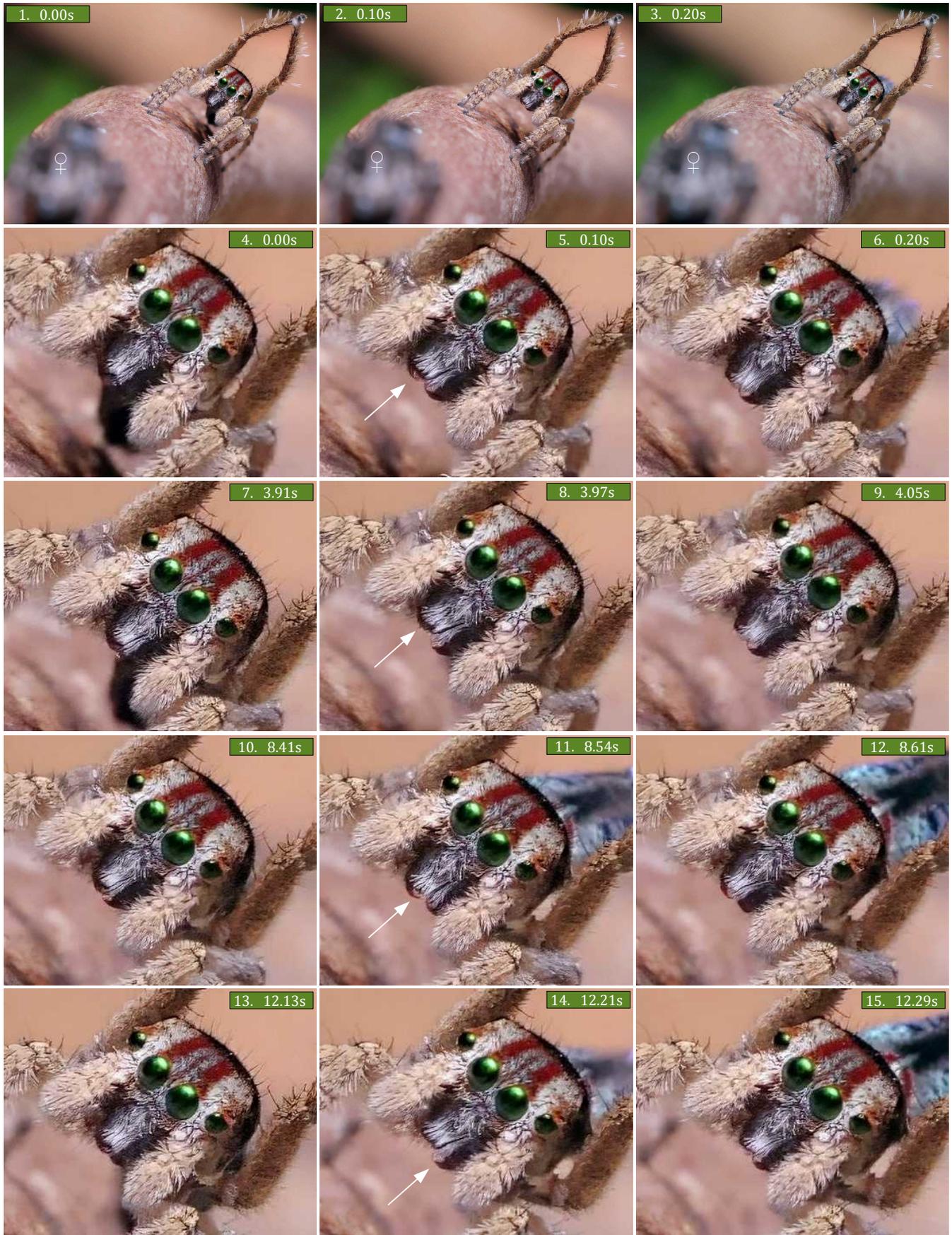


Figure 53. Selected frames from the fan dance display by a ♂ *Maratus nannup* based on a 100fps video record. Intermittently, as indicated by arrows in the center frames, one or both of the chelicerae were moved from side to side.

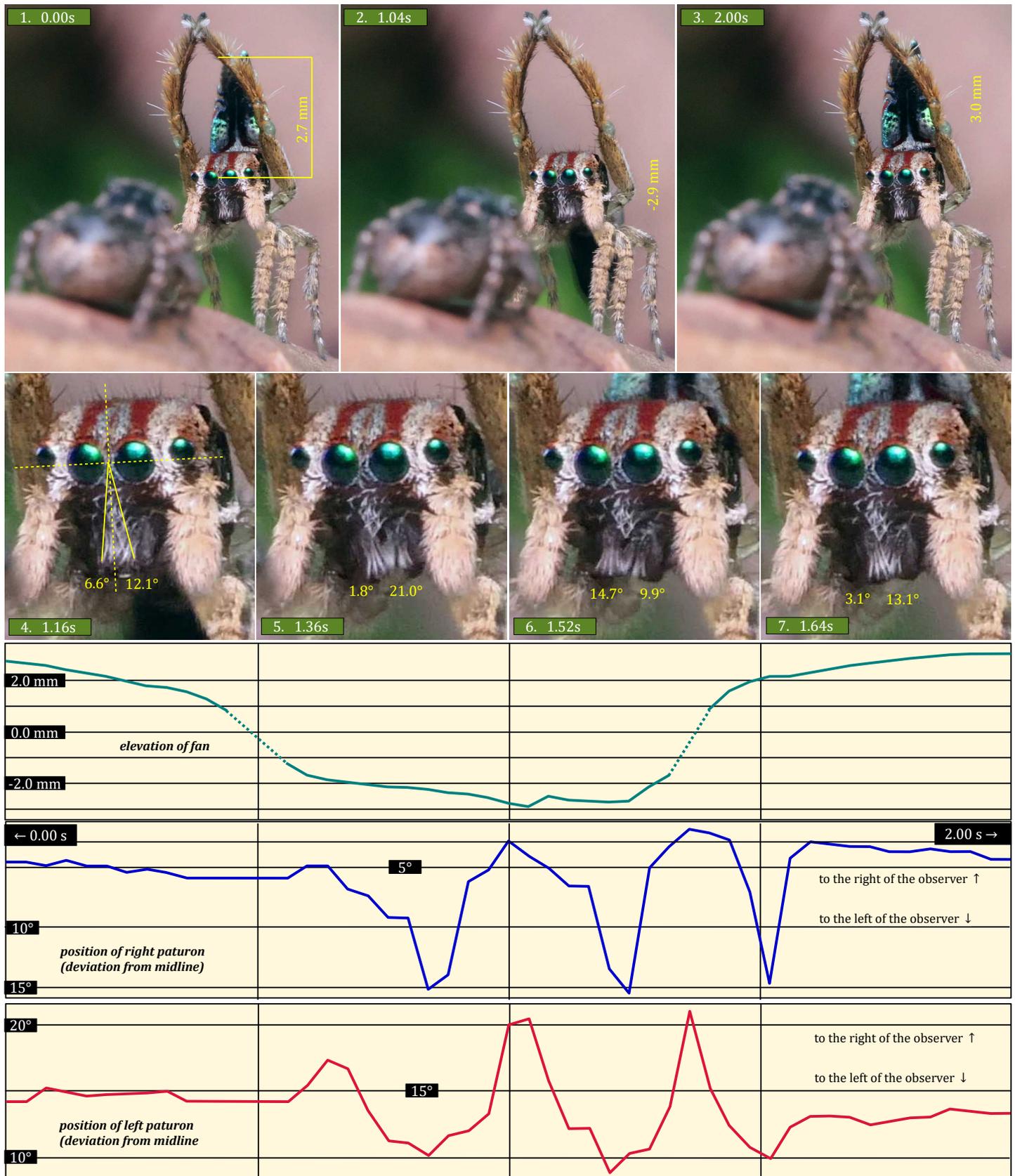


Figure 54. Lateral movement of the chelicerae during the fan dance display by a ♂ *Maratus nannup* based on a 100fps video record. As shown in (4), the orientation of a specific seta on the front of each paturon was measured to determine the relative position of that paturon. Each paturon was moved with an amplitude of ~10° at ~3 Hz when the fan was in a lower position. In general, both chelicerae were rotated in the same direction (to the left or to the right of the observer) at the same time.

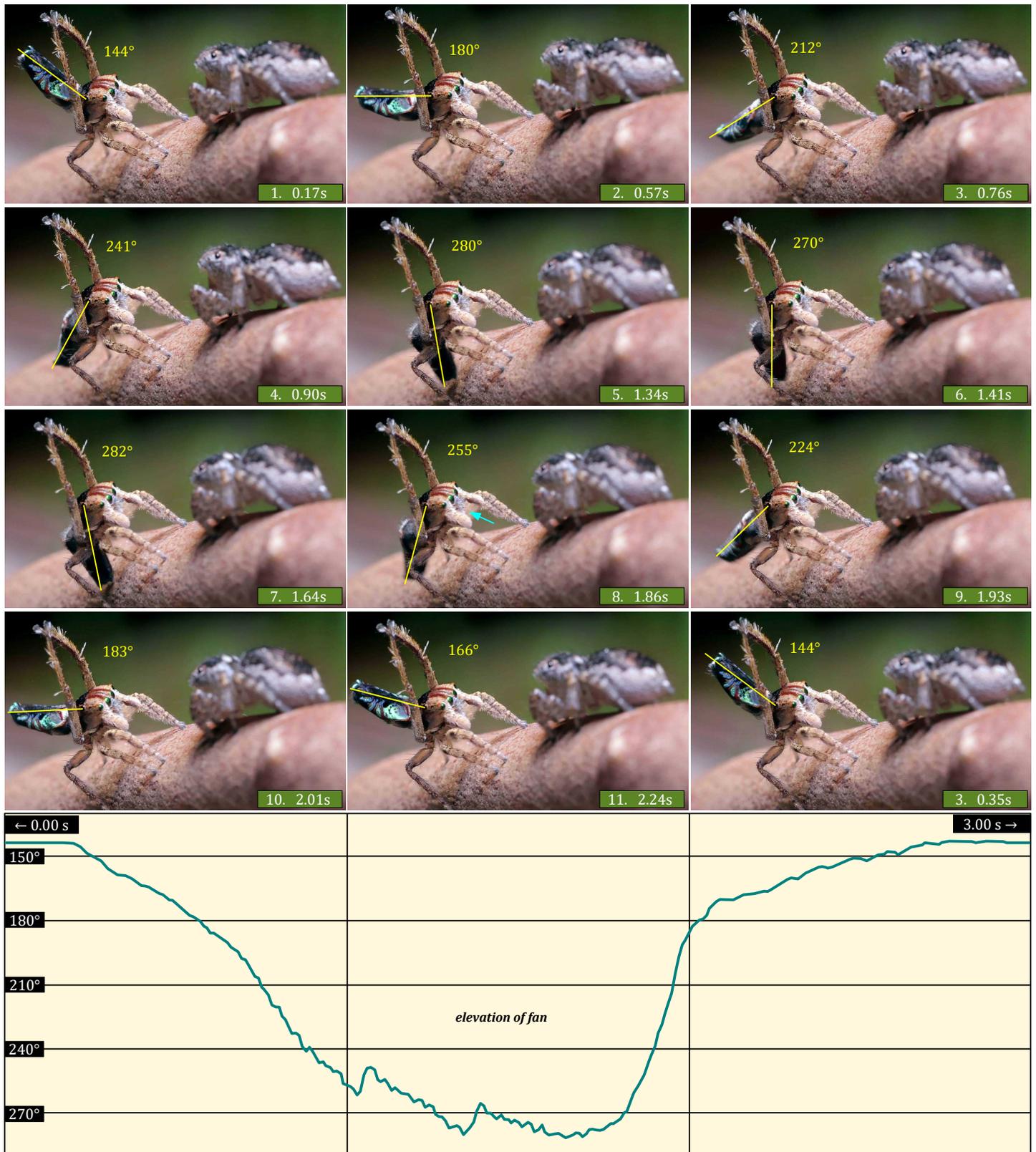


Figure 55. High resolution view of fan elevation during the fan dance of a ♂ *Maratus nannup* based on a 100 fps video record. At its lowest position, the fan went through several cycles of slight elevation (see Figure 50), with continuous movement or vibration at ~25 Hz (see Figure 52). From this perspective the transition of the fan through a horizontal orientation could be measured as shown in (1).

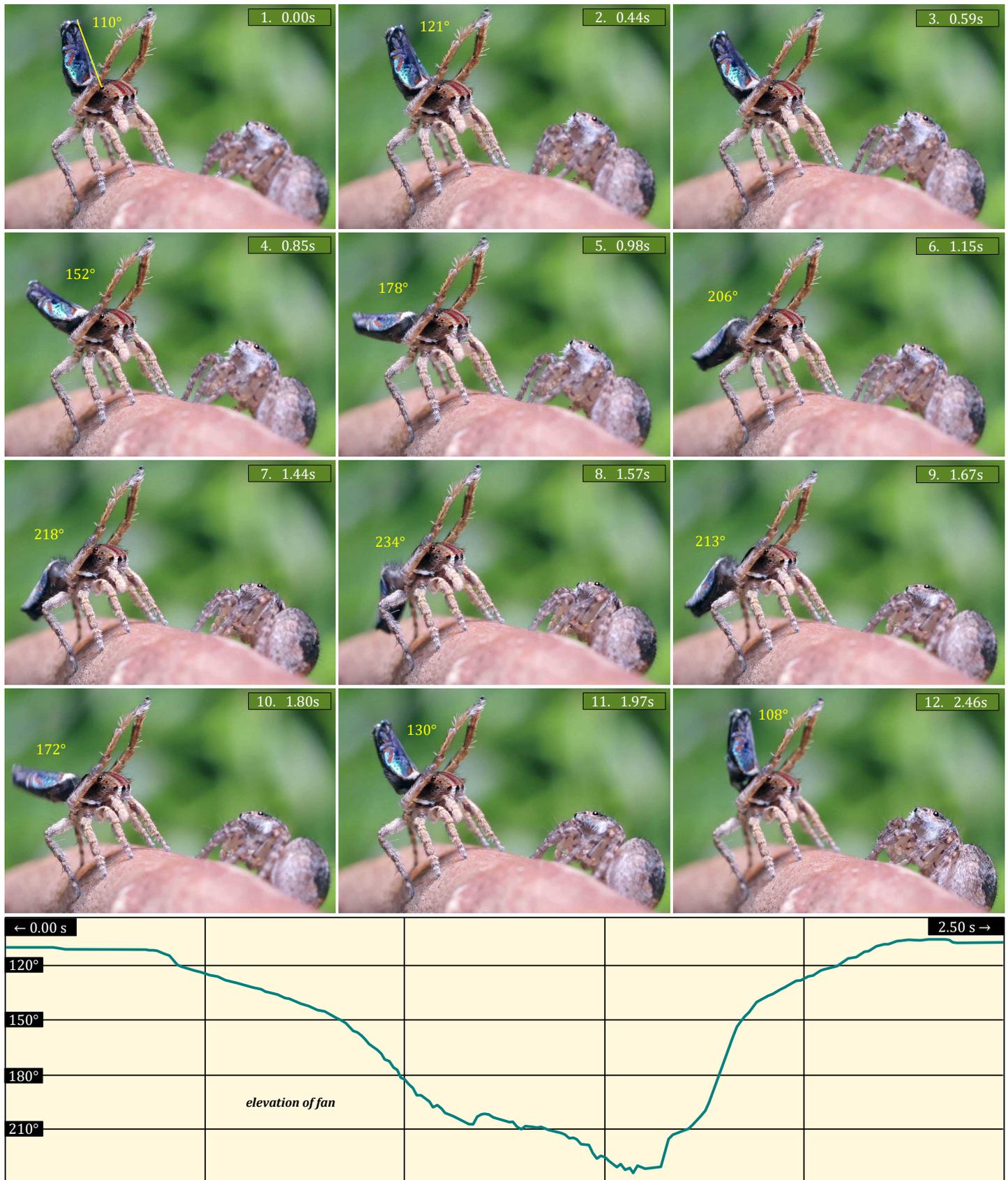


Figure 56. A second high resolution view of fan elevation during the fan dance of a ♂ *Maratus nannup* based on a 100 fps video record. Changes in the direction faced by the attending female, to observe the fan, can be seen by comparing frames 5-7 (turning down to face the lower fan) and frames 11-12 (turning up to face the raised fan).

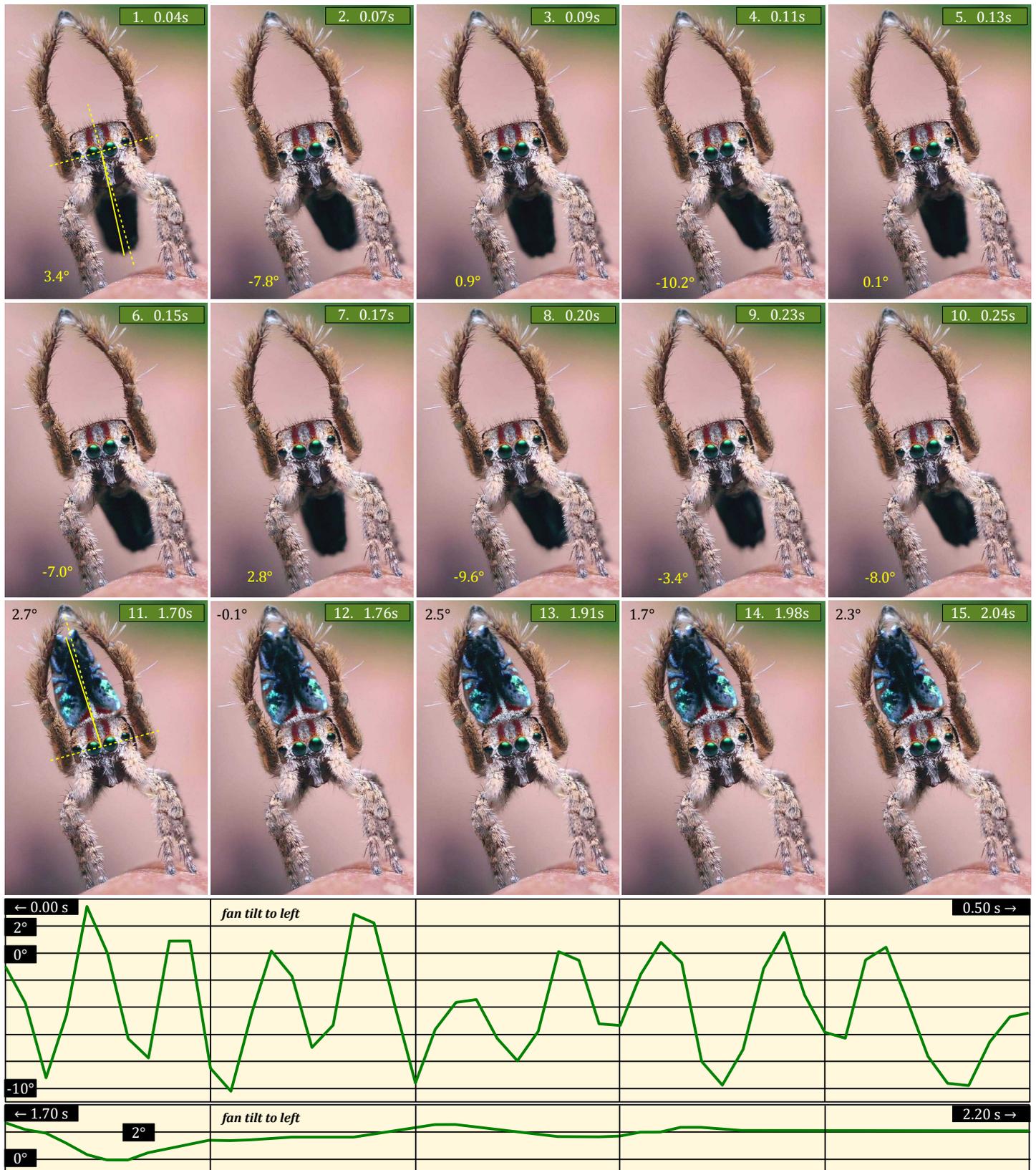


Figure 57. Lateral tilt of the fan during the fan dance of a ♂ *Maratus nannup*, based on a 100 fps video record. **1-10 (upper chart)**, At its low position, the fan was waved at a regular rate of ~20 Hz (amplitude 6-12°). The photographs, taken from the perspective of the observing female, clearly show this distinctive display of the black, glabrous venter of the male opisthosoma. **11-15 (lower chart)**, Only slight and irregular waving of the fan was observed when it was elevated.

Habitat. The Jarrah forest habitat where *Maratus nannup* were found is shown in Figure 58.



Figure 58. Jarrah forest habitat of *Maratus nannup*. **1-2**, Two males at the type locality, near Guthridge Road 7.5 km south of Nannup in the southwestern corner of Western Australia (see Figures 2-3 for map). **3-5**, Type locality. **6-7**, Second locality where these spiders were found, 5 km SW of Nannup along River Road. Photo credits: 6-7, Michelle Peak.

Acknowledgements

We thank James McMulkin (*M. kwenda*) and Michelle Peak (*M. nannup*) for sharing their discoveries and, with Paul Winthrop, for assistance with the collection of these spiders. We also thank Michelle Peak for providing us with habitat photos for *M. nannup*, and OpenStreetMap contributors. We acknowledge the assistance of the Department of Biodiversity, Conservation and Attractions (DBCA) of Western Australia in granting the permits required for this work. Unless otherwise indicated, all photographs in this paper are © Jürgen C. Otto.

References

- Ball et al. 2020.** J. W. Ball, T. P. Robinson, G. W. Wardell-Johnson, J. Bovill, M. Byrne, P. G. Nevill. Fine-scale species distribution modelling and genotyping by sequencing to examine hybridisation between two narrow endemic plant species. *Scientific Reports* 10 (1562): 1-12.
- Brundrett 2021.** Mark C. Brundrett. One biodiversity hotspot to rule them all: Southwestern Australia—an extraordinary evolutionary centre for plant functional and taxonomic diversity. *Journal of the Royal Society of Western Australia* 104: 91-122.
- Cook et al. 2015.** Lyn G. Cook, Nate B. Hardy, Michael D. Crisp. Three explanations for biodiversity hotspots: small range size, geographical overlap and time for species accumulation. *New Phytologist* 207: 390-400.
- Gebremeskel et al. 2023.** Angsom Gebremeskel, Maria Salnitska, Valeria Krivosheeva, Alexey Solodovnikov. 5 Oct 2023. Microendemism pattern and *Wolbachia* infection of *Quedius obliquiseriatus* (Coleoptera, Staphylinidae), a montane rove beetle endemic of the North-Western Caucasus. *Alpine Entomology* 7: 153-166.
- Halstead 2019.** Boronia Halstead. The South West Australian Floristic Region (SWAFR) – a global biodiversity hotspot. *Online at* https://www.friendsanbg.org.au/guidesweb/couch/uploads/file/2019_halstead_swwa_floristic_region_slides_notes-2.pdf
- Harrison & Noss 2017.** Susan Harrison, Reed Noss. Endemism hotspots are linked to stable climatic refugia. *Annals of Botany* 119: 207-214.
- Hlebec et al. 2023.** Dora Hlebec, Martina Podnar, Mladen Kučinić, Danilo Harms. Molecular analyses of pseudoscorpions in a subterranean biodiversity hotspot reveal cryptic diversity and microendemism. *Scientific Reports* 13: 430-1-13.
- Karsch 1878.** F. Karsch. Diagnoses Attoidarum aliquot novarum Novae Hollandiae collectionis Musei zoologici Berlinensis [Descriptions of several new salticids from Australia in the collection of the Berlin Museum]. *Mitteilungen des Münchener Entomologischen Vereins* 2 (1): 22-32.
- Nge & Skeels 2025.** Francis J. Nge, Alexander Skeels. 30 Jun 2025. Diversification patterns of the southwest Australian biodiversity hotspot reveal a novel macroevolutionary pathway to plant hyperdiversity. *New Phytologist* (doi: 10.1111/nph.70330): 1-15.
- Otto & Hill 2022.** Jürgen C. Otto, David E. Hill. 9 Apr 2022. *Maratus candens*, a new peacock spider in the *linnaei* group from southwestern Australia (Araneae: Salticidae: Euophryini). *Peckhamia* 263.1: 1-33.
- Otto & Hill 2024.** Jürgen C. Otto, David E. Hill. 12 Aug 2024. Two new peacock spiders in the *linnaei* group from Western Australia (Araneae: Salticidae: Euophryini: Australphryni: *Maratus*). *Peckhamia* 318.1: 1-85.
- Platania & Gómez-Zurita 2023.** Leonardo Platania, Jesús Gómez-Zurita. Analysis of intrinsic evolutionary factors leading to microendemic distributions in New Caledonian leaf beetles. *Scientific Reports* 13 (6909): 1-13.
- Vences et al. 2009.** Miguel Vences, Katharina C. Wollenberg, David R. Vieites, David C. Lees. 6 Jun 2009. Madagascar as a model region of species diversification. *Trends in Ecology and Evolution* 24 (8): 456-465, & supplemental material.