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Paragomphus sofiae sp. nov.—a new spotted species of Hooktail from Madagascar (Odonata: Anisoptera: Gomphidae)

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Abstract

Paragomphus Cowley, 1934 is a large palaeotropical dragonfly genus with four species previously described from Madagascar. The species identity of three of them requires confirmation, and only *Paragomphus fritillarius* (Selys, 1892) did not raise any taxonomical doubts. In this paper, a new species, *Paragomphus sofiae* **sp. nov.** from the Sofia River basin in lowlands of northern Madagascar, is described and compared to superficially very similar *P. fritillarius*. Identification of both species was possible only by comparing their hamules with the type specimens of *P. fritillarius* in the Selys' collection, because the literature contained neither illustrations nor detailed descriptions of its secondary genitalia. Regardless of the great similarity in the colour pattern, these species have turned out to be well-defined and differ by their notably distinct hamules and caudal appendages. They also seem to be spatially and ecologically separated: although both inhabit clearwater and sandy watercourses, *P. sofiae* has been recorded in open large, braided rivers so far and *P. fritillarius* in smaller rivers and streams. Considering the new knowledge of confusing interspecies similarity and species-specific hamules and cerci, all previous records of *P. fritillarius* require confirmation; the discovery of further species from the *fritillarius*-group is potentially possible.

Key words: systematics; dragonflies; gomphid; species description; endemic species; *Paragomphus fritillarius*; Malagasy Region

Introduction

The April 2020 Madagascar odonate checklist included 173 species, several of which requiring revision and confirmation of their species status. Considering about 20 still unnamed species from collections and several other species that may yet to be confirmed, the total number of odonate species was estimated at over 200 (Dijkstra & Cohen 2021; Dijkstra 2022). The subsequent description of six new species of *Nesocordulia* McLachlan, 1882 (Bernard *et al*. 2025), four of which were not included in the above estimate, not only confirmed this estimate but suggested that the odonate species richness on Madagascar is even greater. With this discovery, 179 species of odonates were formally named and the very high degree of endemism of Madagascar's Odonata reached two thirds of Anisoptera and 80% of all odonates; it is even higher considering already known but not yet named species.

Gomphidae seem to be poorly represented in Madagascar, only making up a small proportion (5%) of its odonates and being taxonomically less diverse in comparison to the African mainland (Dijkstra & Cohen 2021; Dijkstra 2022). Nine species, possibly all endemic, from three genera and two subfamilies were described, namely three species of *Isomma* Selys, 1892 from Phylogomphinae, and four species of *Paragomphus* Cowley, 1934 and two species of *Onychogomphus* Selys, 1854 representing Onychogomphinae. However, for several of these species, both the species identity and systematic position have not yet been resolved, and additional species are likely still awaiting discovery (Dijkstra & Cohen 2021; Dijkstra 2022).

These taxonomic problems concerned three of the four species of *Paragomphus*. The species identity of *P. madegassus* (Karsch, 1890) in relation to the continental *P. genei* (Selys, 1841), as well as that of *P. obliteratus*

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(Selys, 1892) and *P. z-viridum* Fraser, 1955 to *P. madegassus*, was uncertain (Dijkstra & Cohen 2021; Dijkstra 2022). Only distinctive *P. fritillarius* (Selys, 1892) did not raise any doubts.

During our expedition to northern Madagascar, we obtained specimens of two very similar *Paragomphus* species, but it remained unclear which was *P. fritillarius* described by Selys in 1892, and which had been unknown so far. Neither the Selys' description without illustrations nor the Séverin's iconography of the Selys' collection housed at Royal Belgian Institute of Natural Sciences in Brussels (RBINS 2025) allowed us to determine which was the previously known species and which new one. Fraser's (1956) description and drawings of *P. fritillarius* also failed to resolve this problem, raising additional doubts as to which species Fraser was actually dealing with. First of all, the key feature, the hamule, had never been described before. Only photographs of the *P. fritillarius* types from the Selys's collection, received from RBINS, have solved this dilemma: although these specimens are preserved in poor condition, the hamule is easily recognisable, allowing us to unambiguously determine "who is who" in this pair of similar gomphids. Consequently, we here describe the new *Paragomphus* species from Madagascar and compare it with its relative.

Material and methods

The examined material includes specimens of two *Paragomphus* species, *P. fritillarius* and the new species, both obtained by Rafał Bernard and Bogusław Daraż during their expedition to northern Madagascar in 2023 and kept at Natural History Collections of the Adam Mickiewicz University in Poznań, Poland (NHC), as well as the 19th century lectotype and paralectotype of *P. fritillarius* from the de Selys-Longchamps' collection housed at RBINS. All the 21st century specimens were photographed, examined and described in detail by RB and BD while the 19th century specimens were photographed in RBINS by Tim Laebens due to courtesy of Jérôme Constant as manager of the Odonata collection and Wouter Dekoninck as general curator of the entomological collections. In the section describing the holotype of the new *Paragomphus* species, references are also made to the figures illustrating its living paratype (Figs 5a,b,c), but only for features that are identical in the paratype to the holotype and are even better (or only) visible in the used paratype photograph. We believe that, from a practical perspective, it is very useful to see these features in a living specimen.

Aside from describing the new *Paragomphus* species, we compare it with seemingly very similar *P. fritillarius*, using specimens of the latter both collected by us and the lectotype from RBINS. To further aid comparison, we provide photo collages, showing as many diagnostic details as possible, and we have also prepared comparative figures of key structures such as the male caudal appendages and hamules to better illustrate details invisible in photographs.

All measurements (lengths) are given in mm; they were taken with an accuracy of 0.1 mm using a calliper and the DLTCamViewer computer program (in the photographs). The terminology of external morphology was based on Dijkstra & Clausnitzer (2014). The following terms are equivalent (to Ris 1921): mesokatepisternum (mesinfraepisternum); metakatepisternum (metinfraepisternum). Abbreviations. Ax: antenodal cross-veins; Fw: forewing(s); Hw: hindwing(s); Pt: pterostigma; Px: postnodal cross-veins; S1–10: abdominal segments 1–10.

Results

Paragomphus sofiae Bernard & Daraż sp. nov. – Sofia Hooktail

http://zoobank.org/urn:lsid:zoobank.org:act:F7A6827A-F6B4-463C-BDCA-56B461DD0189
Figs 1a,c,e,g, 2a,c,e, 3a,c, 4, 5a,b,c

Etymology. The name, a noun in apposition, refers to the beautiful Sofia River, where the species was discovered. The origin of the river name is unknown; in this or similar spelling it occurs on maps in the 19th century, earliest found as Soffea (Vandermaelen 1827).

Type material. Holotype male (NHC-T-INS-000018) and two paratype males (NHC-T-INS-000019, NHC-T-INS-000020) from eastern banks of the Sofia River, 2 km N of Antsatramalaza, 15.5983° S, 48.5613° E, 250 m asl, Sofia Region, Madagascar, 28.11.2023, leg. R. Bernard and B. Daraż. Third paratype male (NHC-T-INS-000021)

obtained at a water body at the Bemarivo River (in the Sofia River basin), 4 km ESE of Tsarahasina, 15.7785° S, 47.6134° E, 30 m asl, Sofia Region, Madagascar, 16.12.2023, leg. R. Bernard and B. Daraż.

FIGURE 1. Comparison of males of *Paragomphus sofiae* **sp. nov.** (holotype, left column) and *Paragomphus fritillarius* (right column). (a) and (b) habitus in lateral view with head in dorsal view; (c) and (d) S10 and caudal appendages in lateral view; (e) and (f) S10 and caudal appendages in dorsal view; (g) and (h) S10 and caudal appendages in ventral view. Photos by Bogusław Daraż.

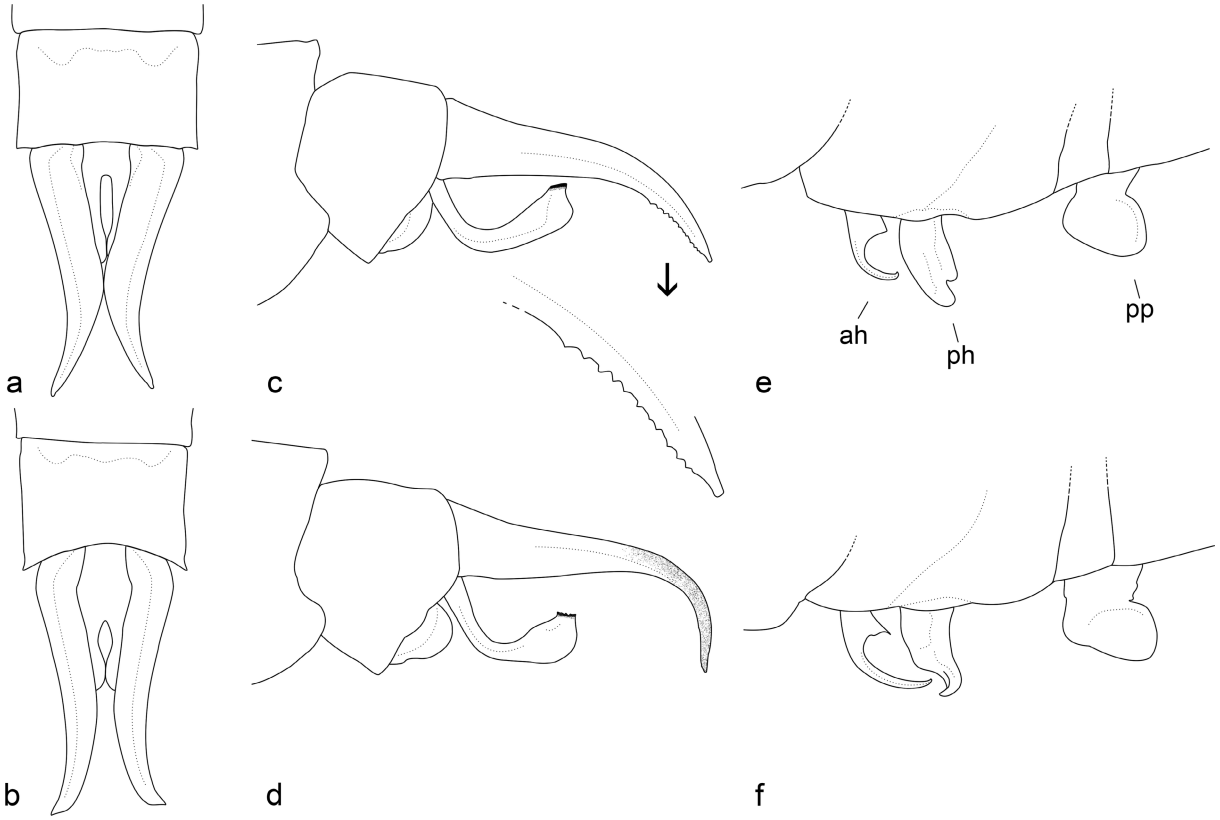

FIGURE 2. Male caudal appendages in dorsal view (a, b), and lateral view (c, d), and secondary genitalia in lateral view (e, f) of *Paragomphus sofiae* **sp. nov.** (upper row) and *Paragomphus fritillarius* (lower row). In figure (c), the cercus tip is additionally enlarged to show the denticles. Abbreviations. ah, anterior hamule; ph, posterior hamule; pp, penial peduncle. Hair-like setae not illustrated.

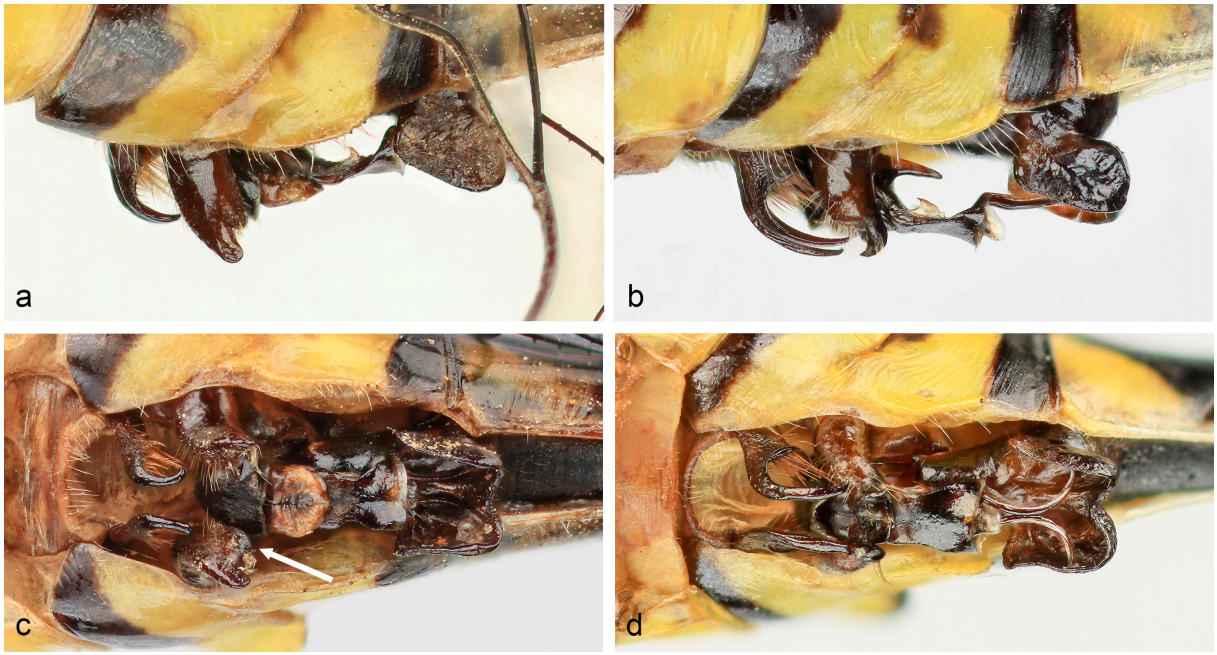

FIGURE 3. Comparison of secondary genitalia of *Paragomphus sofiae* **sp. nov.** (left column) and *Paragomphus fritillarius* (right column). (a) and (b) in lateral view with penis partly exposed; (c) and (d) in ventral view slightly tilted laterally for better presentation of the posterior hamule. The white arrow in figure (c) shows a centripetal protrusion at the base of the posterior branch of the posterior hamule. Photos by Bogusław Daraż.

Description. Holotype male. Total length 47.0, abdomen (excluding appendages) 32.3, Fw 26.3, Hw 24.2, Fw Pt 3.1, cerci 3.1. Fw Ax 12, Fw Px 9, Hw Ax 9, Hw Px 8–9.

Head. Face black, marked extensively with yellow: the four black bands/areas are interspersed with four yellow ones (Fig. 5b). Vertex black. Postfrons black centrally with two large yellow spots laterally (Figs 1a, 5c). Antefrons mostly yellow with a black dorsal frontlet (Fig. 5b). Postclypeus mostly yellow with a black trapezoidal band along its lower margin. Anteclypeus yellow (Fig. 5b). Mandibles (mandible bases, mandibular cheeks) yellow with narrow darkened margins. Genae yellow. Labrum variegated, with brown to black margins, black centre and two large lateral yellow spots (Fig. 5b). Lateral lobes of labium yellow with brown inner margins and the median lobe yellow to brown distally. Occiput yellow with black lateral margins. Postgenae black to dark brown with yellow markings. Eyes when alive are grassy green: light with a yellowish admixture in the dorsal half and dark with a whitish streak in the ventral half (Figs 5b,c).

Thorax. Prothorax black dorsally to dark brown ventrally, with a lateral yellow spot. Sides of the synthorax dark brown to black, yellow-spotted (Figs 1a, 5a). Crest of the middorsal carina black with a brownish-yellowish spot (Fig. 1a). Collar yellow, its two spots narrowly separated from each other (Fig. 5c). On the mesepisternum, the postdorsal stripe represented by a large oblong yellow spot well-separated from the collar. The yellow antehumeral stripe divided into a large elongated spot situated more ventrally and a small semioval dorsal spot (Figs 1a, 5a,c). Mesokatepisternum brownish dorsally to yellowish ventrally. The mesepimeral stripe consists of two barely touching, uneven yellow spots, the smaller and more squarish upper spot, and the more elongated, drop-like lower spot (Fig. 1a). The metepisternal stripe divided into three well-separated spots, one on the metakatepisternum below the metastigma, and two above the metastigma, the middle one being the largest (Figs 1a, 5a). The metepimeral stripe is a large, broadly T-shaped spot covering most of the metepimeron (Figs 1a, 5a). Poststernum brown with a lighter brownish to yellowish anterior corner (Figs 1a, 5a).

Legs. Coxae and trochanters yellow to brownish. Femora combining brown and yellow in various proportions and blackening distally: they are mostly brown in hindlegs and with yellow ventrolateral surfaces in mid- and forelegs (Figs 1a, 5a,c). Tibiae black, with thin longitudinal yellow stripes on the dorsolateral surface in fore- and midlegs (Figs 5b,c).

Wings. Membrane hyaline, costa yellow. Pt relatively wide compared to the width of adjacent rows of cells and black (Fig. 1a).

FIGURE 4. Abdomen of *Paragomphus sofiae* **sp. nov.** in dorsal view. Photo by Bogusław Daraż.

Abdomen. Colour pattern divided into two sections: S1–6 black with a bright yellow pattern of paired spots, while S7–10, forming a club, mostly reddish to rusty brown with less regular, partly diffused yellow markings (Figs 1a, 4, 5a). The lateroventral spot on each side of S1 large. The similarly located spot on each side of S2 even larger, two branched, with the anterior branch also covering the auricle (Figs 1a, 5a). Still on S2, a single spot on the dorsal carina, extending along the almost whole of the segment (Fig. 4). The dorsal pattern on S3 is more complex and consists of two spots on each side along the dorsal carina; the anterior spot does not cross the supplementary transverse carina and the posterior one crosses half of the segment's length (Figs 4, 5a). On S3, the stripe along the ventral carina broadly yellow; at base the colour extended laterally but not reaching the dorsal spots. On S4–6, the yellow pattern gradually reduces (Figs 1a, 4, 5a). It consists of two spots: (a) an anterior transverse spot, extending along the whole segment's height and being narrow centrally and broadened dorsally and ventrally; and (b) a

posterior dorsal spot, on S4 reaching half of the segment's length, on S5 already small, and on S6 totally lacking. S7 with an anterior dorsolateral yellow marking, crossing the supplementary transverse carina and reaching 40% of the segment's length dorsally. Along the ventral carina, this marking is prolonged as a stripe far posteriorly (Figs 4, 5a). The rest of S7 dark reddish brown. S8 and S9 reddish to rusty brown. On S7–9, a small black spot situated laterally on rings of posterior field of tergites (Figs 1a, 5a). S10 reddish to rusty brown with diffuse yellowish markings. Foliations much larger on S8 than on S9, reddish brown with a broad black margin (Figs 1a, 4, 5a).

Secondary genitalia. In lateral view, the anterior hamule evenly sickle-shaped, tapering markedly towards the apex, and directed posteriorly (Figs 2e, 3a). The posterior hamule distinctly more compact in structure, in lateral view with two adjacent branches on a common stout stem: the anterior branch is much longer than the posterior one and both are rounded apically (Figs 2e, 3a). In ventral view, a stout centripetal protrusion is visible at the base of the posterior branch of the posterior hamule (Fig. 3c). Hood of penial peduncle (vesicle) oval, brown (Figs 2e, 3a).

Caudal appendages. Almost uniformly reddish orange, darker basally (Figs 1c,e,g, 5a). In lateral view, cerci stout in their basal half and gradually narrowing distally, tapered to a finely pointed apex (Figs 1c, 2c). They are rather gently and gradually curved downwards in the distal third of their length, with an obtuse angle (about 140°) between the straight anterior part and the curving posterior part. Eleven tiny black denticles along the ventral ridge of cerci tips (Figs 1c,g, 2c). In dorsal view, tips of cerci divergent (Figs 1e, 2a). In ventral view, cerci appear twisted with diverging and narrowing tips (Fig. 1g). Epiproct, in lateral view, half as long as the cerci, arched down, with its distal half ascending and broadening gradually, being broadest at the subapical level, and with minute black apical denticles (Figs 1c, 2c). In ventral view, the epiproct deeply divided into two cudgel-like branches, each with a slightly distended 'head' and a black apical edge located laterally (Fig. 1g).

FIGURE 5. *Paragomphus sofiae* **sp. nov.**, male (paratype). (a) habitus in dorsolateral view; (b) head in frontal view; (c) head and synthorax in laterorostral view. Photos by Bogusław Daraż.

Variation in paratype males. Total length 47.1–48.5, abdomen (excluding appendages) 32.3–33.8, Fw 26.3–27.4, Hw 24.6–25.6, Fw Pt 3.5–3.7, cerci 3.0. Fw Ax 12–13, Fw Px 7–9, Hw Ax 9–10, Hw Px 8–10. Variation in colouration is limited to small differences in the proportions of dark and yellow colours. A good example is the crest of the synthoracic middorsal carina, which, unlike the mostly black crest in the holotype (Fig. 1a), is black with a central yellow spot in one paratype and yellow with a black distal tooth in two other paratypes (Figs 5a,c). The following features also exist in slightly more yellow version(s) in one to three paratypes compared to the holotype: (a) vertex not uniformly black, but with two or three minute yellow spots/stripes; (b) antefrons slightly more yellow with a black frontlet being discontinuous and declining laterally (Fig. 5b); (c) labrum predominantly yellow, with less marked dark margins; (d) labium more uniformly yellow, without darker inner margins of lobes; (e) occiput

more broadly yellow (Figs 5b,c); (f) a broader yellow stripe along the ventral carina of S3, extending up to three quarters of the segment's length (Fig. 5a); (g) a dorsal posterior yellow spot (minute) on each side of S6; and (i) S8 diffusely yellowish basally (Fig. 5a). On the contrary, two yellow spots of the mesepimeral stripe are more broadly separated by black colour in two paratypes than in the holotype.

Female. Unknown.

FIGURE 6. Habitat of *Paragomphus sofiae* **sp. nov.** at the type locality, the Sofia River, Antsatramalaza. Photos by Bogusław Daraż.

Differential diagnosis. *Paragomphus sofiae* is remarkably similar to *P. fritillarius* in the yellow pattern of its head, synthorax and abdomen, and in the reddish brown tip of the lattermost (Figs 1a,b), but it is slightly smaller,

with male Hw 25.0 (24.2–25.6, N=4) versus 27.3 (26.6–27.9, N=3), and distinct by its unique hamules and caudal appendages. The anterior hamule of *P. sofiae* is much shorter with similar proportions of its parts, the basal stouter section and the decurved distal section, while in *P. fritillarius*, the distal section is much longer resulting in the much larger overall hamule being more scythe-shaped than the regular sickle of the former species (Figs 2e,f, 3). In lateral view, the posterior hamule of *P. sofiae* looks a bit like a mirror image of that in *P. fritillarius*: in the former species the finger-like anterior branch of the hamule is much longer than its posterior branch, while in the latter species only the claw-like posterior branch is recognisable (Figs 2e,f, 3a,b). Cerci in *P. sofiae* versus *P. fritillarius*: (a) are uniformly reddish orange versus black-tipped (Figs 1c,d); (b) are downcurved at an obtuse angle versus abruptly bent down at a right angle (Figs 1c,d, 2c,d); (c) in lateral view, are narrowed gradually versus consisting of two contrasting sections, a strong proximal part and a much thinner distal part (Figs 1c,d, 2c,d); and (d) are armed with a regular row of 10–11 small black denticles along the ventral ridge of the tip versus have only minute and hardly recognisable and less regularly situated denticles there (Figs 1g,h). Epiproct of both species is deeply divided into two cudgel-like branches whose stems are proportionately much longer in *P. sofiae* than in *P. fritillarius* (Figs 1g,h).

FIGURE 7. *Paragomphus fritillarius*, lectotype male (RBINS). (a) habitus mostly in lateral view; (b) labels; (c) head in rostral view; (d) secondary genitalia in lateral view; (e) S10 and caudal appendages in lateral view. Photos by Tim Laebens (RBINS).

Distribution and ecology. *Paragomphus sofiae* is known from two localities situated 103 km apart in the Sofia River basin in lowlands of northern Madagascar (Fig. 8), in the ecoregion of Madagascar Dry Deciduous Forest (One Earth 2025) and the hydrographic ecoregion of Northwestern Basins (Sparks & Stiassny 2022). The Sofia River, certainly providing the larval microhabitats for *P. sofiae*, is large but shallow, with the sandy river bed 200–300 m broad, in many places only partly covered by water at the beginning of the rainy season. This is a braided river consisting of a network of multiple shallow channels splitting and merging around many sand bars (Fig. 6). The flow rate is rather low, water is transparent and mostly a few to 40 cm deep, and bottom deposits are

sandy and unvegetated. The river flows through an open, partly cultivated landscape, only with a narrow tree and bushy rim along the riverbanks. Males of *P. sofiae* were only observed in these wooded edges, where they perched on vegetation in sunny places. In the second location, the male obtained at standing water most probably originated from the adjacent Bemarivo River which also is quite large in its lower reaches (about 115–200 m broad) and sandy, but more concentrated and with far fewer sand bars. It also flows through an open, cultivated landscape.

Paragomphus fritillarius (Selys, 1892) – Spotted Hooktail

Paragomphus fritillarius, used for the comparison with *P. sofiae*, was collected at two localities in the Sofia Region, north-eastern Madagascar: (a) a small sandy and rocky river in Antsiatsiaka, 16.0589° S, 49.1088° E, 783 m asl, 30.11.2023, 1 male, leg. R. Bernard and B. Daraż; and (b) a large sandy stream in the foothills of the Marotandrano massif, 16.2654° S, 48.836° E, 644 m asl, 09.12.2023, 2 males and 1 female, leg. R. Bernard and B. Daraż (Fig. 8).

The key features of these individuals are identical to those of the species lectotype and paralectotype. The lectotype is shown here (Fig. 7) since the original description (Selys 1892), lacking illustrations and some features, turned out to be ambiguous and insufficient in the face of the discovery of the new, similar species.

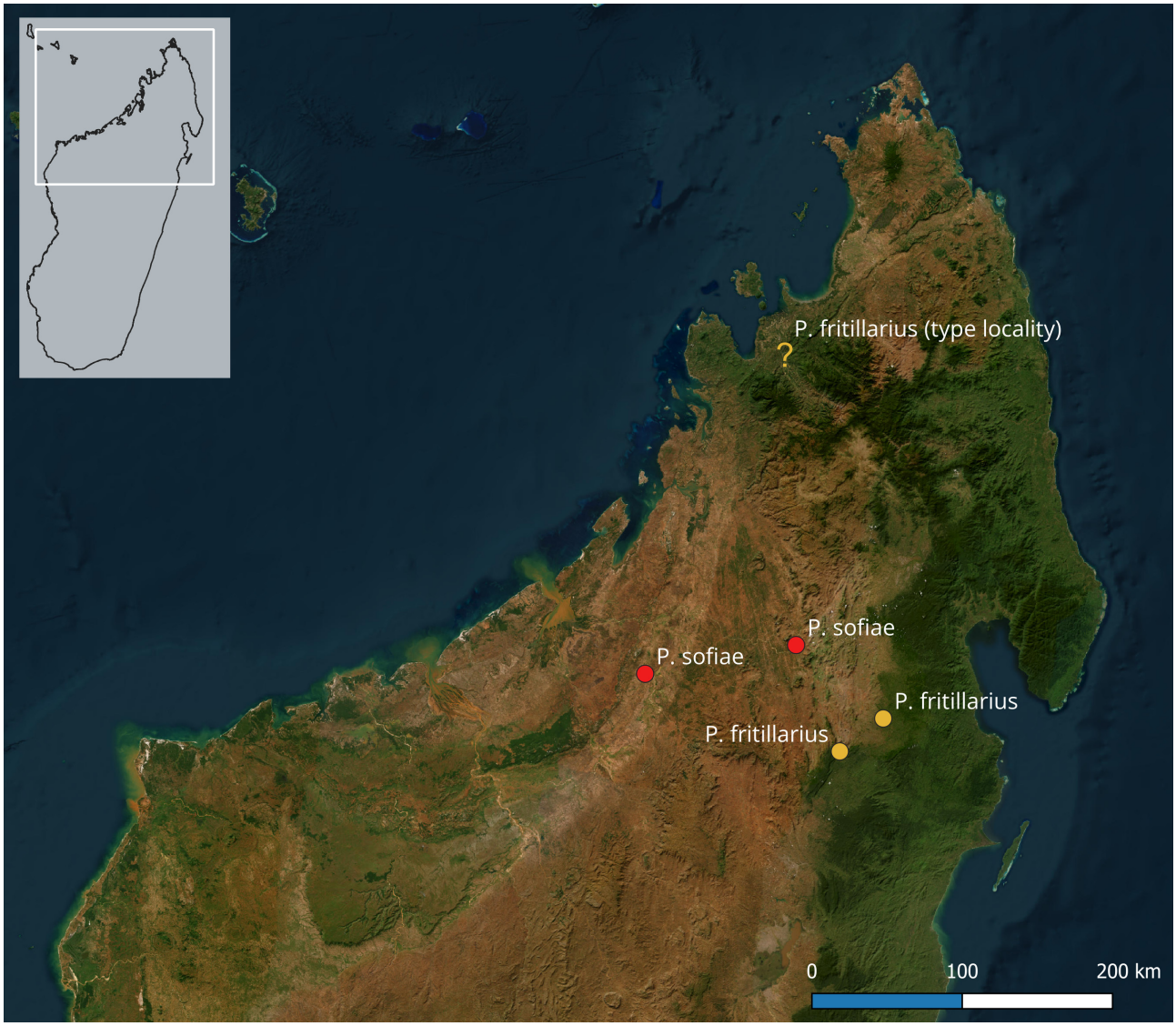

FIGURE 8. Localities of *Paragomphus sofiae* **sp**. **nov**. and confirmed specimens of *P. fritillarius* in northern Madagascar. The question mark indicates the most likely type locality of *P. fritillarius*.

A clarifying addition also is necessary for the species locus typicus. Selys (1892) gave "Rumena valley, Mayanga". Fraser (1956) most probably did not find this site because he asked if it was perhaps Ramena in Majunga Province. In fact, the name "Ramena" (not Rumena) is given on the lectotype and paralectotype oldest labels, being slightly unclearly written on the former (Fig. 7b) but almost calligraphed on the latter. We have not found any Ramena valley in the former Mahajanga province (= Majanga or Majunga on the 19th century maps). At the beginning of the 1890s, however, there was no province yet, and simply the region associated with Majanga, the nearest large town, was given. Thus, in our opinion, the locus typicus was most probably the Ramena River, a sandy tributary of the Sambirano River, which was located near the border of the later Mahajanga province, about 25 km from the seacoast.

Discussion

The great external similarity of *P. sofiae* and *P. fritillarius* and their greatly overlapping intraspecies variations in the colour pattern of the head, synthorax and abdomen have failed to find reliable interspecies differences in the colouration. While such similarity of the somatic colour pattern might superficially suggest close relationships of these species, their more conservative features, such as the caudal appendages and especially the hamules, are notably distinct, suggesting that their divergent evolutionary history may be longer. These clear differences have been supported by the results of preliminary molecular analyses, which have indicated a relatively large genetic distance between them, similar to the distances separating them from some continental *Paragomphus* species from the *fritillarius*-group (the authors' own unpublished data which will be the subject of a separate publication on the Malagasy representatives of the genus).

The great external similarity between imagines of *P. sofiae* and *P. fritillarius* could therefore suggest that they are subject to similar selection pressure, i.e., similar habitat conditions. Data collected so far are too limited to draw definitive conclusions, but it appears that there is at least significant spatial-habitat segregation (if not total separation) between these species regarding larval habitats, but imagines most probably occur in similar riverside habitats. As our observations have shown, both species inhabit watercourses with sandy bottom sediments, which is typical of the genus *Paragomphus*, whose awl-shaped and short-legged larvae almost 'swim' among the grains (Dijkstra 2025). *Paragomphus fritillarius* inhabits, however, larger streams and perhaps only smaller rivers, while *P. sofiae* has been recorded at large and open rivers with extensive shallow water areas. While the microclimatic conditions may differ significantly between the larval habitats of these species, some of these conditions (e.g., light and shade) may be very similar in both riverside habitats of imagines, on the banks overgrown by gallery formations of trees and shrubs.

It is not yet known whether *P. sofiae* is restricted to the Sofia River basin, but it is certainly not isolated geographically from *P. fritillarius*. In northern Madagascar, both species were found at localities situated in the same Sofia River basin and separated by 80 kilometers without any significant geographical barriers in-between (Fig. 8). However, *P. fritillarius* appears to be more widespread, having been found in basins of various rivers, e.g., in the Sambirano River basin in the North-West, and in both west-flowing (the Sofia River basin) and east-flowing (the Mananara River basin) rivers in the North-East (Fig. 8).

It is worth emphasizing that *P. sofiae* was not discovered in particularly taxonomically promising conditions, such as isolated highlands or eastern rainforests, housing most of Madagascar's endemic biodiversity, especially that dependent on water, such as odonates (Dijkstra & Cohen 2021; Dijkstra 2022), mayflies (Elouard *et al*. 2022), freshwater shrimps (Short 2022), and amphibians (Vences *et al*. 2022). The species was not found even in smaller watercourses, which harbour the richest endemic odonate fauna (see Dijkstra & Cohen 2021; Dijkstra 2022). The discoveries in large rivers flowing through open terrain have thus demonstrated that an unknown dragonfly species can still be found in Madagascar even in such common habitats. They have also provided evidence of the still low level of knowledge of the odonates of Madagascar, resulting from the lack of recent systematic and large-scale research (Dijkstra & Cohen 2021; Dijkstra 2022, 2025). However, the Sofia River and its larger tributaries may not be such 'ordinary' large rivers after all. It seems that their microhabitats may be particularly suitable for some taxa due to the combination of the braided river pattern, clear and shallow water and sandy bottom sediments. The importance of the Sofia River basin for microendemic aquatic fauna has been indicated by discoveries of fish species only restricted to the Sofia River (Loiselle & de Rham 2022) and especially to its tributaries, Amboaboa and Mangarahara (Ng & Sparks 2022; Stiassny 2022; Stiassny *et al*. 2022).

Considering the described situation, Madagascar may still harbour other *Paragomphus* species similar to *P. fritillarius*, which have not yet been discovered or identified so far due to the lack of illustrations and knowledge of what a true *P. fritillarius* should look like. This may be indicated, for example, by photographs on the iNaturalist website, with *Paragomphus* individuals identified as *P. fritillarius* (https://www.inaturalist.org/observations?verifiable=true&taxon_id=518240; accessed 16 October 2025): in fact, at least one of these individuals seems to be another unknown species. Therefore, all previously collected data on *P. fritillarius* should be, if possible, checked and confirmed in collections or in photographs with the use of the present knowledge of cerci and hamules of true *P. fritillarius* and *P. sofiae.* On the other hand, during field research, photos of *P. fritillarius* alone may prove insufficient and therefore unreliable, so it is worth catching an individual for the collection or at least taking a photo in hand documenting the caudal appendages and secondary genitalia. We would not be surprised if descriptions of further species from the *fritillarius*-group appeared in the following years due to such a methodical approach.

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