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## Neotype designation for *Papilio fulgerator* Walch, 1775 (Hesperiidae: Eudaminae)

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**ABSTRACT.** The discovery that a skipper butterfly *Telegonus fulgerator* (Walch, 1775), previously placed in the genus *Astraptus* Hübner, [1819], is a complex of many similar-looking species-level taxa with different COI barcodes, caterpillar foodplants and body patterns, and subtle differences in adult phenotypes raised a question about which species is the original *T. fulgerator*. To answer this question, being unable to locate its holotype, we designate the **neotype** of *Papilio fulgerator* Walch, 1775, a female specimen from Suriname in the Zoological State Collection, Munich, Germany. This neotype will form the foundation for a comprehensive revision of the *T. fulgerator* complex based on genomic sequencing and analysis augmented with phenotypic considerations.

**Key words:** two-barred flasher, ICZN Code, nomenclature, taxonomy, genomics, biodiversity.

**ZooBank registration:** <http://zoobank.org/90B7916F-146A-477E-9F7D-3432F95F0BF4>

## INTRODUCTION

One of the influential studies that popularized the value of mitochondrial DNA COI barcode sequences for species discovery (Hebert et al. 2004), suggested that a widespread Neotropical skipper butterfly *Astraptus fulgerator* (Walch, 1775) may be a complex of no less than 10 distinct species based on their barcodes, caterpillar foodplants and color patterns, and subtle differences in adult phenotypes. Recently, based on genomic analysis (Li et al. 2019), these species have been assigned to the genus *Telegonus* Hübner, [1819] in the subtribe Eudamina Mabille, 1877. Despite all the ensued controversies (Brower 2006; Brower 2010), we still do not know which one of these species, if any, is *Telegonus fulgerator*, originally proposed by Walch (1775b) in the genus *Papilio* Linnaeus, 1758, where all butterflies were placed at that time. In the absence of primary name-bearing type specimen(s), only the designation of a neotype will define the taxonomic identity of *T. fulgerator*.

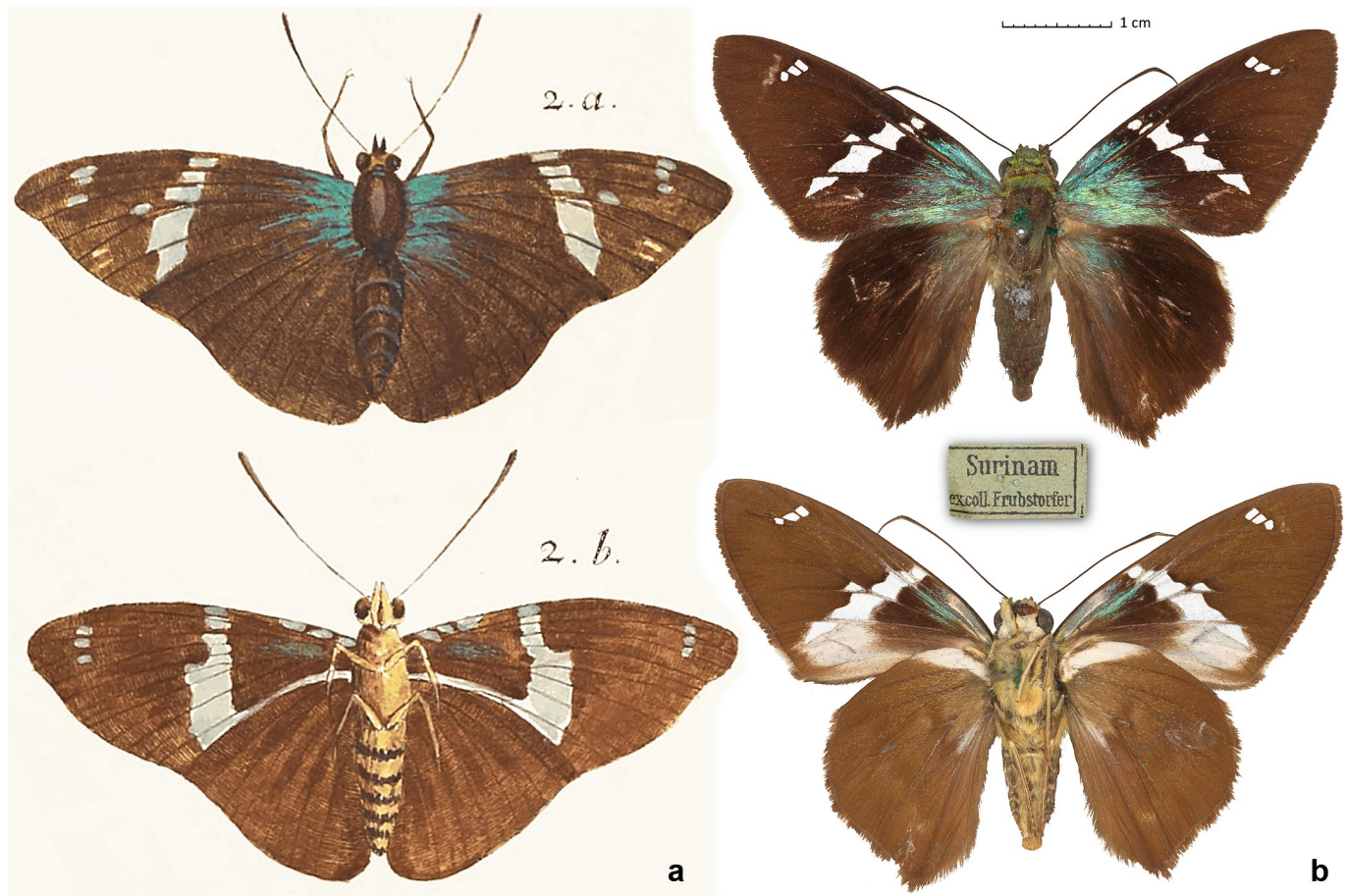
Recent work by Pfeiler and Nazario-Yepiz (2020) did not result in a valid neotype designation for *Papilio fulgerator*, because some of the qualifying conditions given in the article 75.3. of the ICZN Code (1999) were not satisfied, most importantly, 75.3.4. failed, because any mention of “the steps that had been taken to trace” the original type series was lacking. Moreover, a statement to satisfy 75.3.1. that the neotype was “designated with the express purpose of clarifying the taxonomic status or the type locality” of *P. fulgerator* was not given and “evidence that the neotype is consistent with what is known of the former name-bearing type from the original description and from other sources” (Art. 75.3.5.) was not provided. In fact, judging from the photograph of the proposed “neotype” (Pfeiler and Nazario-Yepiz 2020: Fig. 2.5), quite the opposite is the case: the original description (and illustration, reproduced here as Fig. 1a) of *P. fulgerator* states (and shows) that there are 3 subapical hyaline spots on the forewing

(Walch 1775b), but the proposed neotype has four. The original illustration of *P. fulgerator* dorsal side (Fig. 1a above) shows that the spot in forewing cell  $M_3-CuA_1$  is offset distad from the discal band (and the original description mentions the offset spot), but this spot is merged with the band in the proposed neotype.

Furthermore, the Art. 75.3.6. implies that the neotype should come “as nearly as practicable from the original type locality.” Although the type locality was not stated in the original description, both the description (Table 1) and illustrations (Fig. 1a) agree best with the South American phenotype. The nominotypical *P. fulgerator* has been treated as a South American taxon in nearly every publication that followed (Mielke 2005), starting from 1780 (Cramer 1780) that describes and illustrates *P. fulgerator* specimen(s) from Suriname, just five years after the name was proposed (Walch 1775b). Therefore, the choice of a specimen from Mexico as the “neotype” of *P. fulgerator* is at odds with Art. 75.3.6 and goes against the fundamental principle of stability in how names apply to animals (ICZN, 1999). Here, in the interest of nomenclatural stability, we consider that the neotype by Pfeiler and Nazario-Yepiz (2020) was not validly designated, and thus we designate herein a neotype in a manner that satisfies all the requirements set forth by the ICZN Article 75.3, among others, and agrees with the universally accepted and mostly consistent usage of this name during the last 240 years.

### The original description and illustrations of *Papilio fulgerator*

The name *Papilio fulgerator* was proposed by Walch (1775b) from a single specimen, the holotype by monotypy (ICZN Code Art. 73.1.2.), accompanied by a one-sentence summary in Latin and a long, nearly two-page description in German. To facilitate future studies of the original description by English speakers, we provide its interpretation in German (the 2<sup>nd</sup> sentence is in Latin) as text and a literal



**Fig. 1.** *Telegonus fulgerator* (Walch, 1775): **a.** illustrations from Walch (1775b), rotated from the original, labels (2.a. and 2.b.) repositioned; **b.** neotype ♀ from Suriname in ZSMC, designated herein; dorsal (above) and ventral (below) views of both.



**Table 1.** The original description of *Papilio fuligator* from Walch (1775b: 115–116) and its literal translation. See text for an interpretive translation.

Images of the original	Interpretation of the original	Word-to-word, literal translation
<p>V. Fulgurator, der blaue Strahl Taf. I. N. 2. a. und b. Eques alis fuscis area cyaneo-viridi radiata, linea primorum albida interrupta, tribus albidis punctis.</p> <p>Ein Tagvogel der vierten Geschlechtsgröße, hält nicht völlige drey Zoll.</p> <p>Bey der vordern Seite ist die Grundfarbe der Ober- und Unterflügel braun, und zwar etwas dunkler, als in der Zeichnung.</p> <p>In der Mitte der Oberflügel zieht sich etwas schiefwärts die Länge herunter ein Streif, der aus vier weissen unbefederten und folglich halb durchsichtigen vier-eckigten Flecken zusammengesetzt ist, neben ihm, nach der Seitenkante zu, ist ein länglich runder Flecken von gleicher Beschaffenheit. In einiger Entfernung nach dem obern Rande der Flügel zu, stehen drey kleine, gleichfalls von weisser Farbe und halb durchsichtig. Von der Wurzel beyder Flügel an, fast rings um den Körper, hat er eine sehr schöne silbergrüne Farbe von einem ausnehmenden Glanz. Diese wird nicht durch Federn, sondern durch ziemlich starke Haare hervorgebracht, die über den braunen Federn liegen, und unter welchen die braune Farbe hervorschimert. Mit gleichen Haaren muß der Rücken dieses Vogels, wie es scheint, besetzt gewesen seyn, wenigstens zeigen sich oben unter dem Kopf beym Anfang des Rückens eben dergleichen Haare. Dieser aber ist bey diesem Exemplar glatt, unbehaart, glänzend und gleicht einer Horn-</p>	<p>V. Fulgurator, der blaue Strahl Taf. I. N. 2. a. und b. Eques alis fuscis area <b>cyaneo-viridi</b> radiata, linea primorum albida interrupta, <b>tribus</b> albidis <b>punctis</b>.</p> <p>Ein Tagvogel der vierten Geschlechtsgröße, hält nicht völlige drey Zoll.</p> <p>Bey der vordern Seite ist die Grundfarbe der Ober- und Unterflügel braun, und zwar etwas dunkler, als in der Zeichnung.</p> <p>In der Mitte der Oberflügel zieht sich etwas schiefwärts die Länge herunter ein Streif, der aus vier weissen unbefederten und folglich halb durchsichtigen vier-eckigten Flecken zusammengesetzt ist, <b>neben ihm</b>, nach der Seitenkante zu, ist ein länglich <b>runder Flecken</b> von gleicher Beschaffenheit. In einiger Entfernung nach dem obern Rande der Flügel zu, stehen <b>drey</b> kleine, gleichfalls von weisser Farbe und halb durchsichtig. Von der Wurzel beyder Flügel an, fast rings um den Körper, hat er eine sehr schöne <b>silbergrüne Farbe</b> von einem ausnehmenden Glanz. Diese wird nicht durch Federn, sondern durch ziemlich starke Haare hervorgebracht, die über den braunen Federn liegen, und unter welchen die braune Farbe hervorschimert. Mit gleichen Haaren muß der Rücken dieses Vogels, wie es scheint, besetzt gewesen seyn, wenigstens zeigen sich oben unter dem Kopf beym Anfang des Rückens eben dergleichen Haare. Dieser aber ist bey <b>diesem Exemplar</b> glatt, unbehaart, glänzend und gleicht einer Horn-</p>	<p>V. Fulgurator, the blue glimmer Pl. I. N. 2. a. and b. Knight wings brown area <b>cyano-green</b> radiant, band of forewings white interrupted, <b>three</b> white dots.</p> <p>A diurnal bird of the fourth size-group, holds not complete three inches.</p> <p>On the dorsal side is the ground color of the fore- and hindwings brown, and actually a little darker than in the drawing.</p> <p>In the middle of forewing stretches itself somewhat obliquely [to] the length down a stripe, which from four white unscaled and therefore half transparent quadrangular spots composed is, <b>besides it</b>, towards the side edge of, is an elongated <b>round spot</b> of the same nature. In some distance towards the upper margin the wing of, there are <b>three</b> little, likewise [spots] of white color and half transparent. At the base both wings of, virtually around the body, has it a very beautiful <b>silver-green color</b> of an exceptional shine. This comes not through scales, but brought about quite intense hairs spawned, that above the brown scales lie, and under which the brown color through shines. With the same hairs must the back of this bird, as it seems, occupied have been, at least show themselves above under the head at beginning of back even suchlike hair. This [back] however is in <b>this specimen</b> smooth, hairless, shiny and resembles a cornea, that in this butterfly incomparably stronger is than in other diurnal birds even [of] the same size.</p> <p>On the ventral side is the ground color [of] both wings, the fore and hind, paler brown than on the dorsal. At the base of forewings reveals itself likewise silver-green very shiny hairs, but in far lesser number, amassed them only some streaks held. The hindwings are of which entirely devoid. The white hyaline spots are naturally even the same, that they on the dorsal side of this wing already noticed having, only with the difference, that the lower spots yet one another white scaled and consequently opaque spots next [to] itself has, and with it a whole makes. Hence is from it, if someone it against the light holds, only about the third part [is] half transparent.</p>

translation to match with German (Latin) words (Tab. 1). Our interpretive translation of the description is: “V [Fifth species]. Fulgurator [Latin name], the blue glimmer [German name] Pl[ate]. I [One]. N[umber]. 2. a. and b. [A summary in Latin is next.] A Knight [i.e., *Papilio Eques* of Linnaeus (1758)] with brown wings, a **cyano-green** radiant area, a broken white band on forewings, and **three white dots**. [A detailed description in German follows.] A diurnal butterfly from the fourth size group [i.e., with a wingspan between 2 and 4 inches (Walch 1775a)], the wingspan is a little less than three inches. On the dorsal side, the ground color of the forewing and hindwings is brown, and actually slightly darker than in the drawing [2. a.]. In the middle of the forewing, there is an oblique discal band composed of four unscaled and therefore hyaline quadrangular spots; **besides the band**, towards the outer margin, there is an **oval spot** of the same kind [as in the band]. Away from the band, near the costal margin, there are **three little spots** of the same [as the band] white color and hyaline. At the base of both wings, virtually around the body, it [the butterfly] is of a very beautiful **silver-green color** of an exceptional shine. This shine comes not from

[regular] scales, but from quite dense hair-like scales that are on top of [regular] brown scales, and below which [hairs] the brown color is seen through. The thorax of this butterfly must have been covered with the same hairs on the dorsal side, at least they are still present by the head at the beginning of thorax. However, in **this specimen**, the thorax is smooth, hairless, shiny and resembles a cornea, and the thorax in this butterfly is incomparably stronger than in other diurnal butterflies of the same size. On the ventral side, the ground color of both wings, the fore- and hind[wing], is paler brown than on the dorsal side. At the base of the forewings similar silver-green very shiny hairs are present, but in far smaller number, amassed in streaks. The hindwings are entirely devoid of these hairs. The white hyaline spots are expectedly the same as described for the dorsal side of the wing, only with the difference that the lower spot has yet another spot, white scaled and consequently opaque, next to it and they form a single spot together. Because of this, if one holds it [the butterfly] against the light, only about a third part [of the white spot] is semi-transparent.”

Several critical points are highlighted in the description above (underline and bold) and in Tab. 1 (red). First, a mention of “this specimen” (shown in bold font above) and no others followed by the description of its defect (scales rubbed off the thorax dorsal side) and merely a hypothesis that the thorax should be covered with “silver-green” hairlike-scales, suggesting that Walch did not have any other specimens with less damage, implies that this specimen is the holotype by monotypy. The holotype was likely a female, judging by the wing shape from the original illustration (Fig. 1a): rounder wings, convex forewing costal margin. However, these illustrations are not particularly accurate (see below), as judged at least by the differences from one copy to another. Second, the characters that differ between the taxa in the *T. fulgerator* complex are underlined above. Per the original description augmented with illustrations (Fig. 1a), *Papilio fulgerator* differs from other taxa by the following three characters. We regard these characters as differentiating *T. fulgerator* from other taxa. First, the shiny overscaling over the dorsal side of the thorax, abdomen and wing bases is greenish rather than blue. This is the major character used by Evans (1952) to distinguish nominotypical and exclusively South American *T. fulgerator* from *Telegonus azul* (Reakirt, [1867]) that he placed as a subspecies of his *Astraptes fulgerator*. Second, *T. fulgerator* has 3 subapical hyaline spots, not four or five as in other species. The lack of the 4<sup>th</sup> spot is characteristic of South American specimens, although some specimens from Central America also lack this spot. Third, the spot in the forewing cell M<sub>3</sub>-CuA<sub>1</sub> is offset distad from the discal band in *T. fulgerator*. This character is unusual among *T. fulgerator* complex specimens and therefore is important in differentiating of *T. fulgerator* from other taxa.

### The type locality of *Papilio fulgerator*

The original description did not provide any data for the holotype of *P. fulgerator*. Its provenance and therefore the type locality are unknown. However, the characters given in the description (see above), in particular, the greenish rather than blue overscaling of the wing bases, suggest a South American origin of the holotype (Evans 1952). The only other species described by Walch in the same publication with *P. fulgerator* is *Papilio luctuosus* currently regarded as a junior subjective synonym of *Archaeoprepona demophon demophon* (Linnaeus, 1758), also a South American taxon, mostly from the Guianas. Two other Neotropical butterfly species ever proposed by Walch (1775a) are *Papilio capucinus*, a valid species in the genus *Adelpha* Hübner, [1819], and *Papilio simplex*, currently a junior subjective synonym of *Panhiades aeolus* (Fabricius, 1775), and both are South American.

Furthermore, according to his other publication, Walch received his specimens from a certain Mr. Günther, who may have acquired them at auction in the Netherlands (Walch 1775a: 123). On page 127 of the same work Walch states that the specimens were mostly from the “East Indies”, but some were also from the “West Indies”, the last meaning most probably Suriname. In those times, “West Indies” were not restricted to the islands, but more broadly meant “West Indian territories” that included also the mainland, e.g., Suriname and Guyana (Muhlenfeld 1944). Providers of specimens sold at auction in the Netherlands in the second half of the 18th century most likely acquired them from the Dutch possessions in America,

like Aruba, Bonaire, Curaçao, etc. and especially, Suriname and what later became Guyana (“Berbice”, “Demerara” and “Essequibo”). For instance, Cramer and Stoll described numerous taxa coming from Suriname and what later became Guyana (Cramer 1775–1780; Stoll 1780–1782). For *P. capucinus*, Walch gives “East Indies” as its locality, whereas for *P. simplex* he states it came “probably” from the East Indies, although he couldn’t be sure because the specimen had been in a box with specimens from both the East and West “Indies.”

Just five years after Walch’s description of *P. fulgerator*, this name was applied by Cramer (1780) to specimen(s) from Suriname. While it is uncertain that Cramer’s *P. fulgerator* is conspecific with Walch’s holotype, the name *P. fulgerator* has been used for a South American taxon in nearly all publications that followed (Mielke 2005). For all these reasons, it is most likely that the type locality of *P. fulgerator* is in South America, possibly in Suriname. The application of the name to South American specimens has been stable for over 240 years, which is an important consideration because nomenclatural stability is one of the underlying principles laid out in the Introduction to the ICZN Code (1999).

### **Possible issues with the original illustrations of *Papilio fulgerator***

While the dorsal illustration truthfully depicts the lack of greenish overscaling on the thorax of the holotype, as mentioned in the description with the hypothesis that it was simply rubbed off but was there to begin with, even the original description of *P. fulgerator* pointed out one inaccuracy of the accompanying illustration: the actual color of the holotype dorsal side of the wings is darker than illustrated (Fig. 1a above, Tab. 1). Inspection of both illustrations (dorsal and ventral) that are of the same specimen (holotype by monotypy) reveals differences between them. For instance, the forewing subapical spots differ in shape, size, and relative placement. Importantly, the pale spot near the base of the forewing cell  $M_3-CuA_1$  so clearly shown on the dorsal image, mentioned in the original description, and used as one of the diagnostic characters for *P. fulgerator*, is integrated into the discal band on the ventral image. The merge of the spot with the band is possible due to the framing of hyaline spots with white scales (as mentioned in the description) present only on the ventral side. Seemingly, the offset spot is simply connected to the discal band by white scales missing on the dorsal side. Even if this is so, the distance from the distal end of this spot to the basal margin of the band appears much larger on the dorsal image than on the ventral one, suggesting that the spot may be removed unrealistically far from the band on the dorsal illustration, or placed too close to the band on the ventral illustration, or both. In either case, the drawings are likely to be inaccurate. For instance, the dorsal image shows two pale streaks near the margin of forewing cell  $CuA_1-CuA_2$  (Fig. 1a, not present in all copies of the work). There are no currently known species with such character, and it does not fit the wing pattern ground plan of Eudaminae. Therefore, we suspect that these spots, pictured on both the left and right forewings on the dorsal, but not ventral, views refer to a scale loss due to damage.

The ventral side illustration is either inaccurate or does not depict an immediate member of the *T. fulgerator* complex. The pale stripe at the hindwing base by the humeral area and near the costa is lacking, and the only currently known species that would agree with this character and resemble the rest of the drawing is *Telegonus fulgor* Hayward, 1939. Therefore, it is possible that the image shows *T. fulgor*. It is exceedingly difficult to separate *T. fulgerator* complex species from *T. fulgor* in dorsal view, and the original illustration does not distinguish between the two species. It is also possible that the basal white area existed in the holotype, but it was either not illustrated by mistake, depicted as a narrow rim by the costa (which actually seems to be on the forewing instead), rubbed off when the specimen was spread, or the hindwings were attached from a different species during specimen repairs. It is well known that a number of 18<sup>th</sup> century specimens were “repaired” by adding “patches” of wings or even entire wings from other specimens or even species; in some extreme cases, wing edges were “clipped off”, as they were possibly ragged. As an example, see the images of the holotype of *Siderone galanthis* (Cramer, 1775) on the Butterflies of America website (Warren et al. 2016). Moreover, the illustrated hindwing shape with the angled apex is not known for any Eudaminae. A very similar hindwing shape is depicted in

other species proposed by Walch (1775a): *A. capucinus* and *P. aeolus* (=simplex), not known to have the angled apex either, revealing inaccuracies in all these illustrations.

### Neotype designation for *Papilio fulgerator* Walch, 1775

Because taxonomic research on the *T. fulgerator* complex requires DNA analysis, genomic sequencing of the *P. fulgerator* holotype is necessary. We undertook the following steps to find the holotype of *P. fulgerator*. First, we searched the literature for its whereabouts and information about primary types of other taxa described by Walch (1775a, b). We were not able to find a report of a specimen curated as the holotype of *P. fulgerator*, and information we found suggested that the Walch types of butterfly names were lost (Steinhauser 1987; Pelham 2008). Second, we contacted the Institute of Zoology and Evolutionary Research in Jena, Germany, a city where Johann Ernst Immanuel Walch [1725-1778] was educated, lived, and died (Wikipedia contributors 2022). Gunnar Brehm and Bernhard Bock searched the Jena collections and were not able to find the holotype. The former curator Dietrich von Knorre said that over his tenure he has not come across any information about the specimens used by Walch in his works (Walch 1775a, b). Third, N.V.G. visited the following collections that contain many historical specimens and inspected their Hesperidae holdings looking for old specimens that match the information we gathered about the holotype: Natural History Museum, London, UK (BMNH), Museum für Naturkunde, Berlin, Germany (MFNB), Muséum National d'Histoire Naturelle, Paris, France (MNHP), Naturalis Biodiversity Center, Leiden, Netherlands (RMNH), and Zoologische Staatssammlung München, Germany (ZSMC). The search failed and the holotype was not found. Therefore, we believe that the holotype is lost. The same conclusion has been also reached by others (Steinhauser 1987; Pelham 2008).

In the absence of the holotype, we proceed below with the neotype designation, because there is an exceptional need to clarify the taxonomic identity of *P. fulgerator* and define this species objectively by a single specimen due to cryptic species in the *P. fulgerator* complex (Hebert et al. 2004; Brower 2010). Currently, it remains unclear which one (if any) of these species is *P. fulgerator*, and DNA information from the neotype specimen is critical for future studies of the complex, because the cryptic diversity has been revealed by DNA analysis. *Papilio fulgerator* is the oldest name of the namesake complex, and the lack of clarity about which species it applies to impedes any meaningful taxonomic work on the group. Moreover, to confuse the matters even further, an invalid neotype has been proposed recently (Pfeiler and Nazario-Yepiz 2020). For all these reasons, we believe that this situation qualifies as an exceptional need.

We looked for candidate neotype specimens in several collections across the world to find one that fits best what we know about *P. fulgerator*. Importantly, the specimen should be from Suriname or Guyana and should match as closely as possible the original description and illustrations. After these investigations, we hereby designate the specimen shown in Fig.1b, a female, bearing the following two labels, one green [ Surinam | ex coll. Fruhstorfer ] and the other white [ DNA sample ID: | NVG-18057D11 | c/o Nick V. Grishin ] as the **neotype** of *Papilio fulgerator* Walch, 1775. The neotype has scales rubbed off the thorax above (as the holotype!) and a pale streak from some scale loss distad of the left forewing subapical hyaline spots. The neotype is in the Zoological State Collection, Munich, Germany (Zoologische Staatssammlung München, ZSMC) and is designated to clarify the taxonomic status and the type locality of *P. fulgerator*. According to the label of the neotype, the type locality of *Telegonus fulgerator* becomes Suriname, which is consistent with nearly all the literature about this taxon (Mielke 2005) and deduced to be in South America from its phenotype, although no data were given for the holotype in the original publication (Walch 1775b). The neotype was collected prior to 1923, because Hans Fruhstorfer died in 1922. If the neotype was collected by Fruhstorfer himself, it is possible that it was in 1886–1888, when Fruhstorfer lived in Brazil (Lamas 2005). However, it is more likely that the specimen was collected by Julius Michaelis, who supplied Fruhstorfer with entomological specimens from Suriname in 1898–1899.

While mostly agreeing with the original description/illustrations of *P. fulgerator* (greenish wing bases, three subapical forewing spots, and a spot in cell M<sub>3</sub>-CuA<sub>1</sub> protruding distad from the forewing

discal band: Fig. 1 and Tab. 1 provided as the evidence), the neotype differs in the following three characters. First, it has the base of the ventral hindwing at costa white, as all known members of the *T. fulgerator* complex, and not brown, as in the illustration (Fig. 1a below), a character not mentioned in the description and not figured. Second, its hindwing shape is typical for *Telegonus*, and not angled at the apex as in the illustration (Fig. 1a), a shape not known in any Eudaminae species. Third, the neotype lacks a doublet of pale streaks by the outer margin in the dorsal forewing cell CuA<sub>1</sub>-CuA<sub>2</sub>, unknown in HesperIIDae and not mentioned in the description but shown in at least one copy of the illustration (Fig. 1a above), while not apparent in some other copies. Despite these differences, even if the holotype, now lost, was not conspecific with the neotype, then, in the interest of stability of nomenclature, the *P. fulgerator* neotype should still be a member of the *T. fulgerator* complex from South America, preferably from Suriname. The name *fulgerator* has been stably applied to South American specimens of this complex (Mielke 2005) since Cramer (1780), just five years after the original description (Walch 1775b), and preserving this stability by the neotype is desirable.

Furthermore, to stimulate DNA-based studies of the *T. fulgerator* complex, we obtained whole genome shotgun sequence of the neotype from its leg sample using our previously developed protocols (Li et al. 2019; Cong et al. 2021), and deposited the resulting sequence reads in the NCBI database <<https://www.ncbi.nlm.nih.gov/>> under BioSample SAMN31509877. The COI barcode sequence of the neotype, sample NVG-18057D11, GenBank accession OP740376, 658 base pairs is:

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AACTTTATATTTTATTTTGAATTTGAGCAGGATTAATTGGAACCTCACTAAGATTACTTATTCGAACCTGAATTAGGAACCTCCAGGATCTTTAATTGGAGATGACCAAATTTATAATACA
ATTGTTACAGCTCACGCATTATTATAATTTTATAGTTATACCTATTATAATTGGAGGATTTCGGAATTTGACTAGTCCCATTAATAATAGGTGCCCCAGATATAGCTTTCCCCCGTA
TAAATAATATAAGATTTTGATTATTGCCCCCATCTTAACCTTTATTAATTTCAAGAAGAATTGTTGAAAATGGGGCTGGTACAGGATGAACAGTTTATCCCCCTCTTCATCCAACATTGC
CCATCAAGGAGCTTCTGTTGATTAGCAATTTTCTCTTCATCTTCCCGGTATTTTCATCAATCTTGGGGCTATTAATTTTATTACAACAATTATTAATATGCGAATTAATAATTATCT
TTTGATCAATACCATTTTGTGTTGAGCTGTAGGAATTACAGCATTATTATTACTTTCATTACCTGTCTTAGCAGGTGCTATCACTATATTACTAACAGACCGAAATTTAAATACTT
CTTTTTTGATCCTGCAGGTGGAGGAGATCCAATTTTATATCAACATTTATTT
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Finally, this neotype is not designated as an end in itself, but as the first and necessary step in a comprehensive revision of the *T. fulgerator* complex based on genomic sequence analysis augmented with phenotypic considerations. Our neotype designation will enable rigorous taxonomic studies of this taxonomic group, not possible before.

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