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***Amorphostigma kessleri*, sp. nov. from American Samoa (Odonata:
Coenagrionidae)**

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***Amorphostigma kessleri*, sp. nov. from American Samoa (Odonata: Coenagrionidae)**

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Abstract

This study erects a new taxon for *Amorphostigma* (Fraser, 1925) damselflies inhabiting Tutuila Island, American Samoa and assigns the nomen *Amorphostigma kessleri* to it. Specimens of both sexes are compared with the two species presently included in the genus: *A. armstrongi* Fraser, 1925 and *A. auricolor* Fraser, 1927. The study mentions the preferred generic status of *Amorphostigma* as discussed in Marinov (2022).

Key words: New species, Pacific Odonata, taxonomy, nomenclature

Introduction

Amorphostigma Fraser, 1925 was diagnosed based mainly on wing venation (Fraser 1925). It was claimed to be morphologically closest to *Ischnura* Charpentier, 1840, but possessing the following unique combination of features: males with a large multicelled pterostigma in the fore-wing and the absence of tubercles on abdominal segment 10, and females lacking a spine on the ventral side of abdominal segment eight anterior to the ovipositor. Presently two species are included in this genus: *A. armstrongi* Fraser, 1925 and *A. auricolor* Fraser, 1927. Both are confined to Samoa with the former occurring on Savai'i and Upolu while the latter so far known only from Upolu.

Dijkstra et al. (2014) proposed that *Amorphostigma* should be synonymised with *Ischnura*. This view was supported during studies on the female colour polymorphism published in Willink et al. (2019) and Blow et al. (2021), where authors based their argument on analysis of DNA-sequence data. Therefore, presently the two *Amorphostigma* species given above are included in various online databases (e.g. World Odonata List, Global Biodiversity Information Facility, NCBI Taxonomy) as *Ischnura armstrongi* and *I. auricolor*.

Marinov (2022) opposed to this view. He argued that the separate generic status of *Amorphostigma* should be retained at the time when there is still: a) insufficient sampling within the Pacific islands to propose more plausible taxonomy (Donnelly 1986; Marinov et al. 2015, 2016b), and b) published and unpublished data for about at least 15-20 new taxa of uncertain affinity within the islands of French Polynesia alone (Marinov et al. 2019). Therefore, the present study accepts the generic status of *Amorphostigma* and places the new species in it.

Material and Methods

The material was collected from the island of Tutuila, American Samoa during the period 6-19 July 2014 (see Marinov et al. 2015 for more details).

Adults were caught using an aerial net, killed in 70% ethanol, airdried and transferred to paper envelopes. Diagnostic images were taken in the field for validating coloration in living individuals. The dead insects were examined under a microscope to confirm identification. Microscopic photos for the figures were produced using the Plant Health and Environment Laboratory, Christchurch, Ministry for Primary Industries, equipment in New Zealand. A series of images were taken under high power Nikon AZ100M microscope and stacked with Helicon Focus 6.7.1 software.

Allotype female was not collected from the same habitat as the holotype male. It was assigned by supposition based on overall resemblance by colouration and the assumption that most probably this is the sole representative of the genus *Amorphostigma* on the small island of Tutuila (~142km²).

The following *Amorphostigma* specimens deposited at The Natural History Museum, London, UK (images courtesy of Ben Price, available here: https://data.nhm.ac.uk/dataset/56e7-11e6-c847-4f99-915a-6894bb5c5dea/resource/05ff2255-c38a-40c9-b657-4ccb55ab2-feb?q=Amorphostigma&view_id=6ba121d1-da26-4ee1-81fa-7da11e68f68e&filters=collectionCode%3Abmnh%28e%29&field=associatedMediaCount&value=) were used for the diagnosis of the new taxon: *A. armstrongi*: lectotype male (BMNHE_1685923), allotype female (BMNHE_1685938); *A. auricolor*: lectotype male (BMNHE_1685993), female (BMNHE_1685962; as well as a male *A. armstrongi* (NZAC04145099) deposited at the New Zealand Arthropod Collection (NZAC), Manaaki Whenua Landcare Research, Auckland, New Zealand.

Morphological description follows Garrison et al. (2010). Abbreviations used: AL, abdomen length excluding appendages; FW, fore wings; HF, hind femur; HW, hind wings, S1-10, abdominal segments 1 to 10.

All measurements in millimetres (mm).

All specimens reported in the present study were collected by the author and deposited at NZAC.

Results

Amorphostigma kessleri, sp. nov.

(Figures 1-6)

Holotype. Male (NZAC04138314, NZAC), TUTUILA ISLAND, American Samoa, seepage roadside below the village of Aoloafou, 14.3176S, 170.7615W, 374 m a.s.l., 11 July 2014.

Paratypes. TUTUILA ISLAND, 1 ♂ (NZAC04142717, NZAC), river by the village of Fagalii, 14.3113S, 170.8219W, 37 m a.s.l., 12 July 2014; 1 ♂ (NZAC04144268, NZAC), seepage roadside below the village of Aoloafou, 14.3176S, 170.7615W, 374 m a.s.l., 11 July 2014; 3 ♀♀ (NZAC04139321, NZAC04231075, NAZC04147064, NZAC), National Park of American Samoa, river by the village of Amalau, 14.2575S, 170.6586W, 52 m a.s.l., 14 July 2014; 1 ♀ (NZAC04143602, NZAC), a cascade of roadside pools above the village of Aua, 14.2688S, 170.6533W, 76 m a.s.l., 13 July 2014; 1 ♀ (NZAC04231076, NZAC), seepage above the village of Masefau, 14.2613S, 170.6224W, 20 m a.s.l., 18 July 2014; 1 ♀ (NZAC04137339, NZAC), seepage SW of the village of Fagamalo, 14.3027S, 170.8111W, 85 m a.s.l., 12 July 2022; 1 ♀ (NZAC04139231, NZAC), seepage roadside E of the village Agugulu, 14.3339S,

170.8178W, 16 m a.s.l., 12 July 2014; 2 ♀♀ (NZAC04142540, NZAC04231077, NZAC), Leele Stream above the village of Fagasa, 14.2895S, 170.7160W, 94 m a.s.l., 13 July 2014.

Allotype. 1 ♀ (NZAC04139301, NZAC), a cascade of roadside pools above the village of Aua, 14.2688S, 170.6533W, 76 m a.s.l., 13 July 2014.

Etymology. The name, a noun in the genitive case, was selected by the "Biologische Gesellschaft für das rheinisch-westfälische Industriegebiet" (Biological Society for the Rhine-Ruhr-Industrial Area) to honour the 25 year leadership of Norbert Kessler whose work left the now hundred year old society (1921 - 2021) prospering and made it an important institution for nature education in this area.

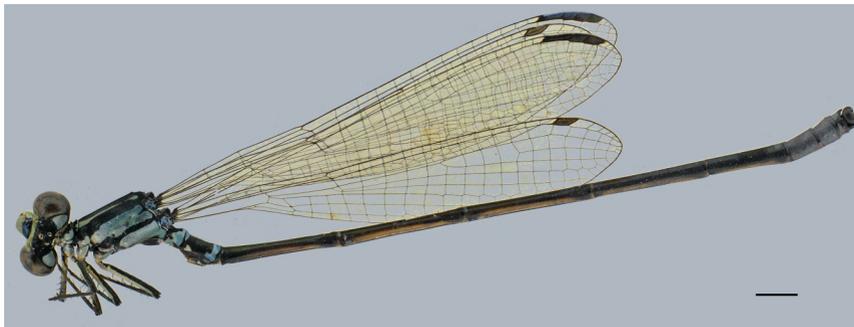


Figure 1. *Amorphostigma kessleri*. Holotype male, habitus (scale bar 0.5 mm).

Head (Fig. 2). Labium uniformly pale yellow; front part of face largely greenish with blue hue with the exception of tips of mandibles (dark red), blue anteclypeus and black developed as follows: across the base of labrum continuing dorsally between the border of mandibles and sides of anteclypeus, entire surface of postclypeus and triangular area raising up on the frontal part of the face; the rest of the head with black starting as a transverse straight line along the ridge cutting through the posterior faces of the toruli, scapes, pedicels (flagella missing) posteriorly towards the occipital lobes; black area with green metallic sheen around the ocelli only, for the rest black replaced with a pale spot anterior of the medial ocellus and blue roughly pear-shaped spots on the occipital lobes.

Thorax (Fig. 3). Prothorax almost completely black on dorsally except for blue on the anterior lobe, black descends from the posterior lobe going forwards as a weak dark line towards the venter. Pterothorax black with blue developed as follows: humeral stripes running from the mesostigmal plates towards alar areas continuously narrowing posteriorly and interrupted about 1/3 from the wing bases, area with parallel sides occupying ventral half of mesepimera and 2/3 of the dorsal part of metepisterna saved for a triangular spot at the base of interpleural suture, more than 2/3 of the ventral part of metepimera, posterior corners of both meso- and metainfraepisterna, triangular spot on posternum. Legs predominantly black, coxae bluish on the lateral and posterior faces, green to yellow-green along the anterior faces of trochanters and femora, black becomes deep dark yellow to red at the tips of tibiae, tarsi and claws.

Wings (Fig. 4). Hyaline; arculus distal to 2Ax in all wings, CuP situated distally from the petiole at a distance equal or longer the length of the vein, its position is at about the middle



Figure 2. *Amorphostigma kessleri*. Holotype male, head, frontal view.



Figure 3. *Amorphostigma kessleri*. Holotype male, head and thorax.

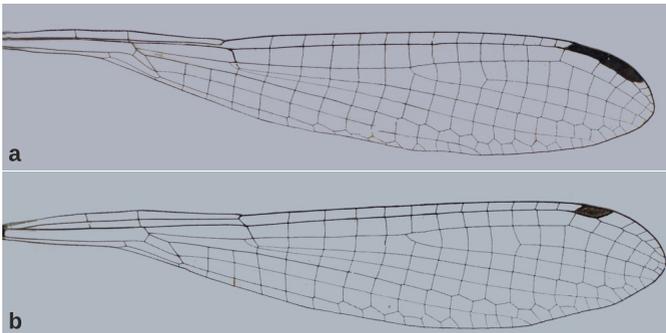


Figure 4. *Amorphostigma kessleri*. Holotype male, wings: a) FW, b) HW.

to slightly distally between two antenodal crossveins in both wings; arculus distal to 2Ax in all wings; pterostigmata differs between the two pairs: in FW it is mostly with blue metallic sheen on the dorsal face and occupies four cells on the right and three cells on the left wings, in HW they are dark yellow with almost rhomboidal shape, costal sides slightly longer than proximal sides; FW: 13/13 Px, RP2 at 6th Px; HW: 11/11 Px, RP2 at 4.75th Px.

Abdomen. Predominantly black on dorsum and dark yellow ventrally with blue developed as follows on: S1 (posterior 1/3 of the disk and large lateral area), S2 (two bars at the posterior end almost coming to a contact on the dorsum, descending towards the ventral side forming a foot-shaped spot, additional spot under the “heel” and a pale blueish spot with roughly triangular shape at the antero-ventral corner), S3-6 (each with a pair of spots at the anterior end touching the preceding segment), S7 (similar pair with darker colour at the anterior end and a semi-circular spot on the disk towards the posterior end of the segment), S8-9 (uniformly dark blue with slight black streaks laterally on S8 and black along the carinae of both segments at the posterior ends), S10 (characteristic black-blue pattern, cf. Fig. 5a, note the bilobed middle section at the posterior end); terminal abdominal appendages (Fig. 5): cercus black with dark yellow and blue edges, enlarged and concaved, similar length to S10; paraproct about half the length of cercus, parallel sided at the bases with outer side elongated in hook-like structure with its tip curved inside; penis as on Figure 6.

Measurements (in mm): AL 28; HW 18; HF 2.5.



Figure 5. *Amorphostigma kessleri*. Holotype male, terminal abdominal appendages and penis: a) dorsal view, b) lateral view, c) postero-lateral view showing the bowl-like appearance of the cerci.

Figure 6. *Amorphostigma kessleri*. Holotype male, penis, lateral view.



Description of allotype

(Figs 7-11)

Head (Fig. 8). Labium uniformly pale yellow; labrum tri-coloured with dark transverse bar at the base along the border with anteclypeus, yellow anterior edge and pale blue in between; face yellow on following parts: almost entire mandible (saved for dark red tips), anteclypeus, genae up to about the dorsal tips of toruli, yellow becoming darker to almost dark orange in between antennal bases; postclypeus black with slight metallic sheen; additional black spots/areas as follows: posterior corners of mandibles at the ventral and dorsal ends, widely obtuse triangle dorsally of the postclypeus with the angle projected up on the face; dorsal part of the head (including antennal segments) black except for the following areas: two triangular dark orange occipital spots with a transverse bar with irregular shape in between; spot with the same colour in front of median ocellus; posterior part of the head covered with white pruinescence.

Thorax (Fig. 9). Prothorax almost entirely black with white pruinescence, yellow along the anterior edge of the anterior lobe and lateral 1/3 to the ventral edge of the segment. Pterothorax with humeral bars running with almost parallel sides from the mesostigmal plates to almost touch alar areas, bars slightly wider at both sides, rest of mesepisterna black with green sheen; other three segments of the pterothorax predominantly yellow with black areas as follows: dorsally on the mesepimera occupying almost half of the segment at the anterior part and nearly touching the mesopleural suture, running ventrally along the posterior edges of mesepimera and metepisterna, projecting along the interpleural suture, complete cover of the metapleural suture with expansions dorsally and ventrally in the corresponding segments; mesoinfraepisterna predominantly black with yellow postero-ventral corners; meta-infraepisterna yellow with a dark bar running at the middle of the disk; posternum yellow with black posterior edge. Legs: coxae and trochanters almost entirely yellow with smoky areas mainly at the posterior faces; femora yellow on the anterior faces, dark posteriorly; tibiae dark yellow, darker at both ends; claws dark yellow. Whole surface covered with white pruinescence till about bases of tibiae.



Figure 7. *Amorphostigma kessleri*. Allotype female, habitus (scale bar 0.5 mm).

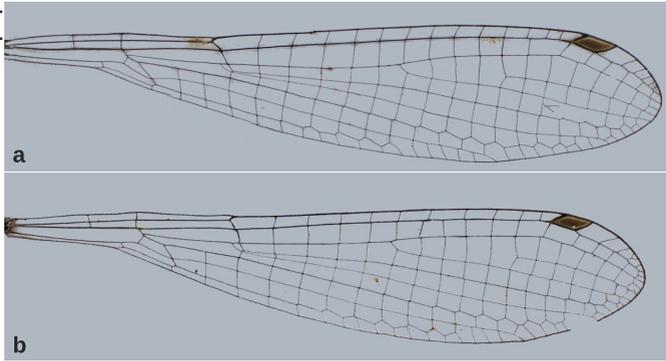


Figure 8. *Amorphostigma kessleri*. Allotype female, head, frontal view.



Figure 9. *Amorphostigma kessleri*. Allotype female, head and thorax.

Figure 10. *Amorphostigma kessleri*. Allotype male, wings: a) FW, b) HW.



Wings (Fig. 10). Similar to holotype except: arculus at 2Ax in FW and slightly distal in HW; pterostigmata light, pale yellow-brown occupying one cell in all wings; FW: 13/12 Px, RP2 at 5.75th Px; HW: 11/10 Px, RP2 at 4.75th Px.

Abdomen. Tergites almost uniform black dorsally and yellow ventro-laterally except for S1-2 (dark along the ventral sides) and S10 (dark all over), dorsal areas of S8-9 with weak white pruinescence marking eventual posterior spots in life; S3-7 with a pair of yellow lateral bars at the anterior end separated from each other by the dark dorsal area and from the black on the ventral sides at the anterior; sternites: S1-7 black for almost entire surface except for yellow areas posteriorly, S8 black with two pairs of dark yellow lateral spots; cerci black, paraprocts dark with yellow posterior edges; ovipositor (Fig. 11) bi-coloured with black proximal area becoming lighter towards the tip and dark yellow distal area.

Measurements (in mm): AL 24; HW 17.5; HF 2.5.



Figure 11. *Amorphostigma kessleri*. Allotype female, ovipositor.

Variations in paratypes

Males almost identical to the holotype with main variations laterally on S1-2 and dorsal spot on S7 lacking. Variations in wings: FW: 12/12 Px, RP2 at 6th Px; HW: 11/11 Px, RP2 at 5th Px.

Females similar to allotype in general colour pattern, two immature specimens without black on the legs (not included in the measurements below); other specimens variously pruinescent, differences observed in the shape of dorsal spots on S8-10 most likely age dependent.

dant; ovipositors not bi-coloured in one specimen and almost completely dark in one specimen. Variations in wings: FW: 12-14/15 Px, RP2 at 4.75-6th Px; HW: 10-12/10-11 Px, RP2 at 4.75-5th Px.

Measurements (in mm). males: AL 25-28.5; HW 16.5-18; HF 2.4-2.8; females: AL 23.5-27; HW 17-19.5; HF 2.3-2.8.

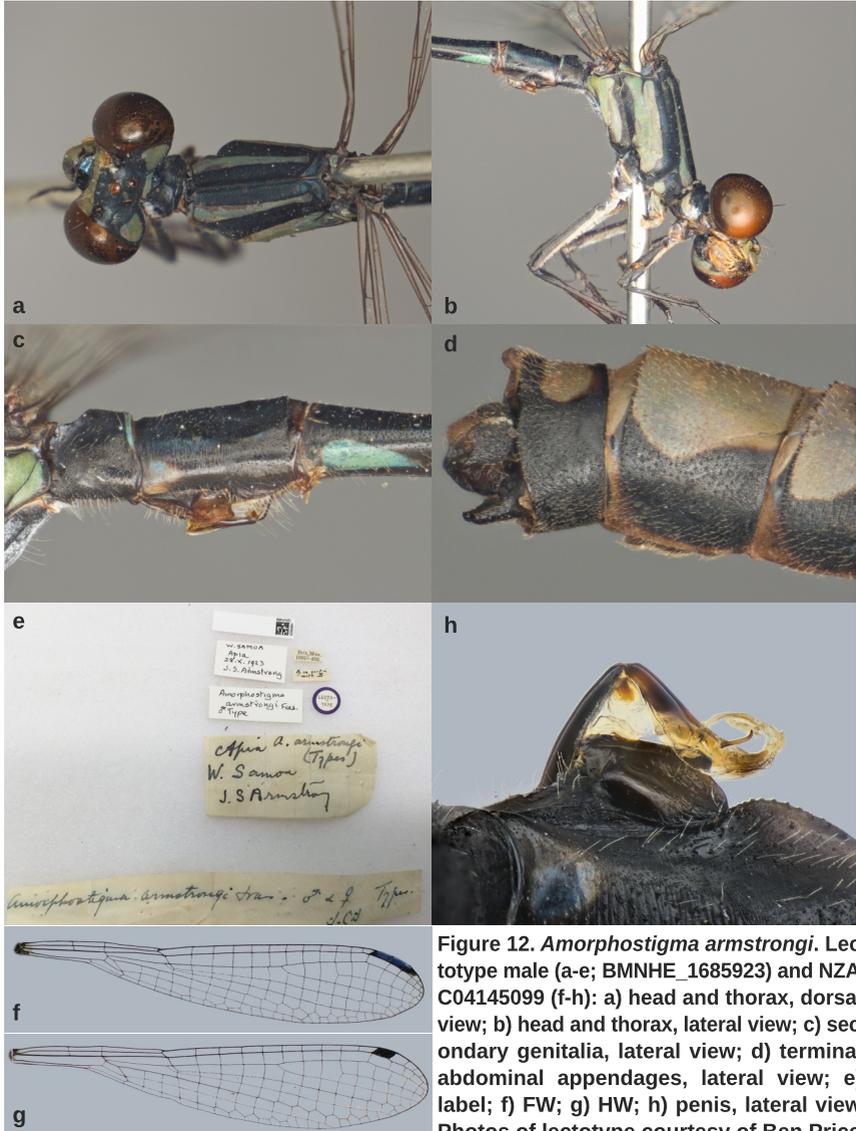


Figure 12. *Amorphostigma armstrongi*. Lectotype male (a-e; BMNHE_1685923) and NZA-C04145099 (f-h): a) head and thorax, dorsal view; b) head and thorax, lateral view; c) secondary genitalia, lateral view; d) terminal abdominal appendages, lateral view; e) label; f) FW; g) HW; h) penis, lateral view. Photos of lectotype courtesy of Ben Price.



Figure 13. *Amorphostigma armstrongi*. Allotype female (BMNHE_1685938): a) head and thorax, dorsal view; b) head and thorax, lateral view; c) ovipositor, lateral view; d) label. Photos courtesy of Ben Price.

Differential diagnosis

Amorphostigma kessleri compares with its congeners *A. armstrongi* (Figs 12-13) and *A. auricolor* (Figs 14-15) as follows: Specimens representing the three taxa share males (modified FW pterostigmata as in Figures 4a, 12f, 14a; general plan of abdominal appendages with expanded cerci and hook-like paraprocts as in Figures 5b, 12d, 14d; general thoracic pattern as on Figures 3, 12b, 14b; overall roughly triangular occipital spots as on Figures 3, 12b, 14b), females (ovipositors with similar structure, ventral spine on S8 lacking as on Figures 11, 13c, 15c; shape of the occipital spots as on Figures 9, 13a, 15a). *Amorphostigma auricolor* can be distinguished by the following general colourations (*A. armstrongi* and *A. kessleri* in parentheses): yellow ground colour (blue), pale postclypeus (black), reduced occipital spots with blue not reaching the posterior of the lobes (blue expanded to the posterior of the lobes), unicoloured yellow legs (predominantly black with blueish anterior surfaces); yellow FW pterostigmata in males (blue). *Amorphostigma armstrongi* and *A. kessleri* are similar in general colour pattern with both sexes of the former being a bit darker. Males have distinct abdominal appendages with cerci in *A. kessleri* enlarged and concave at the interior surfaces superficially resembling a bowl-like structure (Fig. 5), while cerci in *A. armstrongi* expanded in a much flatter structure (Fig. 12d). Penises are illustrated

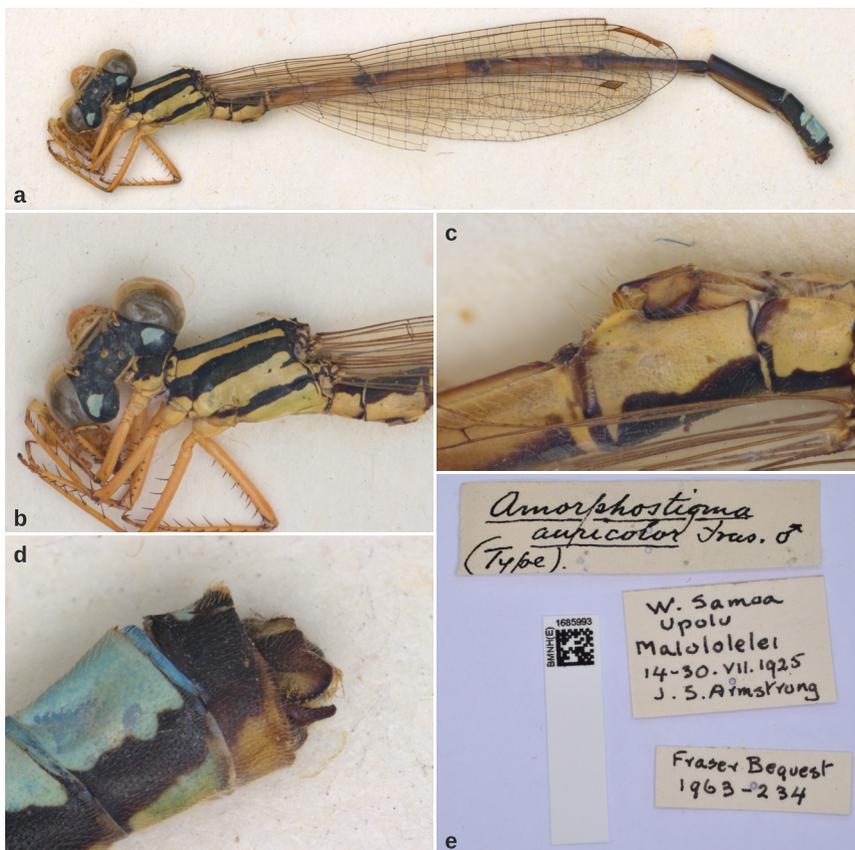


Figure 14. *Amorphostigma auricolor*. Lectotype male (BMNHE_1685993): a) habitus; b) head and thorax, lateral view; c) secondary genitalia, lateral view; d) terminal abdominal appendages, lateral view; e) label. Photos courtesy of Ben Price.

on Figures 6 and 12h. Females can be distinguished reliably by the colouration with *A. armstrongi* having a wider dark bar along metapleural suture (Fig. 13b) compared to *A. kessleri* (Fig. 9).

Discussion

Amorphostigma populations on Tutuila Islands have been discussed in Donnelly (1986) and Marinov et al. (2015). Both studies suggested that erecting a new species was justified, however, so far none of the authors has acted on this.

Marinov et al. (2015) commented on observed size variations among the *Amorphostigma* individuals on the island and considered two possible explanations: a) some of these to be *A. armstrongi*, or b) they may deserve another separate species status.

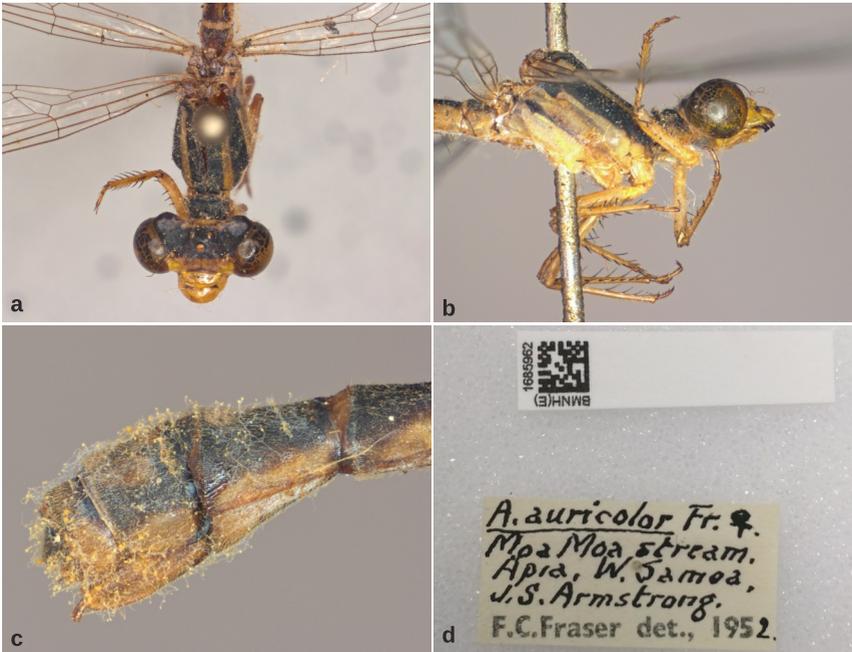


Figure 15. *Amorphostigma auricolor*. Female (BMNH_E_1685962): a) head and thorax, dorsal view; b) head and thorax, lateral view; c) ovipositor, lateral view; d) label. Photos courtesy of Ben Price.

Neither of these options has been explored any further because to the best of my knowledge no further Odonata studies have been carried on Tutuila Island. Moreover, body size has been proven to be a not reliable character in species definition. Donnelly (1990) reported a size range of 11 mm in Fijian *Nesobasis selysi* Tillyard, 1924 and Marinov et al. (2016a) demonstrated that body lengths can vary within about 15 mm in the New Zealand *Xanthocnemis zealandica* (McLachlan, 1873). Therefore, the proposals of new taxonomic arrangements should be suggested after careful considerations of various characters and not based solely on observed differences at any level of organisation – from molecular (DNA) to macrostructural (morphology), biogeography, etc. (Pinto et al. in press). Systematists should base their taxonomy on distinctiveness and not on differences (Mayr 1957).

These were the guiding thoughts in Marinov (2022) who commented on the previous suggestion to merge *Amorphostigma* into *Ischnura*. Such a change, even if really required, should happen after a larger revision of the Pacific Coenagrionidae integrating all material into what Marinov (2022) briefly discussed as a recommended practice in taxonomy: sufficient sampling, conceptualising the taxonomy based on explanatory hypotheses of the observed shared characters before proposing nomenclatural changes. At this stage we know of a large material on Coenagrionidae which has been collected from various places within the Pacific islands and either never published or integrated into more detailed taxonomic studies. Therefore, the new species erected here is placed in the genus *Amorpho-*

stigma, which should be retained as a valid genus unless proven otherwise by more detailed studies recommended in previous studies, e.g. Donnelly (1986), Marinov et al. (2016, 2019), Marinov (2022).

Acknowledgements

This publication comes after a discussion with Thomas (Nick) Donnelly who was the actual discoverer of the *Amorphostigma* populations on Tutuila Island. My visit to the type locality in 2014 was provoked by the curious observations which Nick described in his 1986 paper (cited in the text) and guided by his instructions where to go and what to look for. I recently contacted Nick seeking for his advice and he agreed for me to publish this observation on my own. Therefore, I would like to mention Nick's name here first with my deepest gratitude for his support in this study and trust as a colleague!

I am also grateful to the financial support received by Klaus-Jürgen Conze (via International Dragonfly Fund) who selected the nomen in dedication of Norbert Kessler (see Etymology). This fund will be used in other studies of the Pacific Odonata.

Ben Price, The Natural History Museum, London, UK, is thanked for photos of the specimens of *A. armstrongi* and *A. auricolor*.

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Authors can choose the best way for them to submit their manuscripts between these options: a) via e-mail to the publisher, or b) on a CD, DVD or any other IBM-compatible device. Manuscripts should be prepared in Microsoft Word for Windows.

While preparing the manuscript authors should consider that, although the journal gives some freedom in the style and arrangements of the sections, the editors would like to see the following clearly defined sections: Title (with authors names, physical and e-mail addresses), Abstract, Introduction, Material & Methods, Results, Discussion, Acknowledgments and References. This is a widely used scheme by scientists that everyone should be familiar with. No further instructions are given here, but every author should check the style of the journal.

Authors are advised to avoid any formatting of the text. The manuscripts will be stylised according to the font type and size adopted by the journal. However, check for: a) all species names must be given in italic, b) the authority and year of publication are required on the first appearance of a species name in the text, but not thereafter, and c) citations and reference list must be arranged following the format below.

Reference cited in the text should read as follows: Tillyard (1924), (Tillyard 1924), Swezey & Williams (1942).

The reference list should be prepared according to the following standard:

Swezey, O. & F. Williams, 1942. Dragonflies of Guam. Bernice P. Bishop Museum Bulletin 172: 3-6.

Tillyard, R., 1924. The dragonflies (Order Odonata) of Fiji, with special reference to a collection made by Mr. H.W. Simmonds, F.E.S., on the Island of Viti Levu. Transactions of the Entomological Society London 1923 III-IV: 305-346.

Citations of internet sources should include the date of access.

The manuscript should end with a list of captions to the figures and tables. The latter should be submitted separately from the text preferably as graphics made using one of the Microsoft Office products or as a high resolution picture saved as a .jpg .tif or .ps file. Pictures should be at least 11 cm wide and with a minimum 300 dpi resolution, better 360 dpi. Line drawings and graphics could have 1200 dpi for better details. If you compose many pictures to one figure, please submit the original files as well. Please leave some space in the upper left corner of each picture, to insert a letter (a, b, c...) later. Hand-made drawings should be scanned and submitted electronically. Printed figures sent by the post could be damaged, in which case authors will be asked to resubmit them.

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