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On two unjustified rankings of Pacific Odonata (Insecta)

Milen Marinov

Biosecurity Surveillance & Incursion Investigation Plant Health Team, Ministry for Primary Industries, 14 Sir William Pickering Drive, Christchurch 8544, New Zealand
Email: milen.marinov@mpi.govt.nz

Abstract

Modifications of nomina proposed for two Pacific Odonata taxa are found to be unsubstantiated. Each has been proposed without the support of taxonomic studies. Herein, it is demonstrated that the raising of the subgenus *Adversaeschna* Watson, 1992 to genus rank and subsuming the genus *Amorphostigma* Fraser, 1925 to *Ischnura* Charpentier, 1840 are not justified. The first, *Adversaeschna*, was a mistake introduced and multiplied widely in nomenclature lists adopted by online databases and other studies. The second, *Amorphostigma*, was based on premature information to propose a plausible taxonomy of a diverse Pacific clade which most likely consists of several taxa deserving of separate generic ranks, supported by preliminary phylogenetic work. Therefore, these nomina should be reverted to reflect current taxonomic revisions. *Adversaeschna* should be considered as a subgenus of *Aeshna* Fabricius, 1775 and *Amorphostigma* as a nomen of generic rank.

Key words: generic taxonomy, nomenclatural ranks, new combination, *Adversaeschna*, *Ischnura*, *Amorphostigma*, *Pacificagrion*

Introduction to the terminology

The terminology adopted here follows the proposals of the Linz Zoocode Committee (LZC). Selected terms, relevant to the discussions on the taxonomy and nomenclature of two Pacific Odonata taxa, are briefly presented below. For more details see Dubois et al. (2019).

Dubois (2000) proposed the term ***zoonymology*** for the study and theory of concepts related to the zoological nomenclature. He discussed the way the new scientific names (***nomina***, hereafter) have been proposed and modified following taxonomic or nomenclature studies. Every nomen of species rank is to be a unique combination of two words in a particular association to each other (termed as onymorph by Smith & Pérez-Higareda 1986) which could be assigned to a concept only once—at the time when the taxon is introduced as new to science. The introduction and the validation, if appropriate, of a nomen results from a ***nomenclatural process*** (***catastasy***, hereafter) which follows three stages (Dubois et al. 2019): [1] nomenclatural availability; [2] taxonomic allocation; and [3] nomenclatural validity and correctness. A fourth stage, registration, is sometimes implemented in some recent studies, especially for works published online, but it is not indispensable. This process allows for an unambiguous association of a nomen to a nomen-bearer (***onomatophore***, hereafter) which for a taxon of species rank in present day taxonomy is a single specimen (***onymophoront***, hereafter) having its own author and date. Complying with these standards assures the uniqueness of a taxon any time someone refers to it for whatever reason.

One nomen once introduced and made available (***promulgated*** as suggested by Dubois 2020) cannot be changed. Modification do happen which may result in changes of the onymorph (***protonymorph*** for the original and ***aponymorph*** for any subsequent) following taxonomic studies, correcting the Latin spelling (nomenclatural correctness); however, these are not considered as changes of the nomen which has already been assigned to the concept following the steps in the catastasy given above. Although these actions may result in nomenclatural changes, they are not considered as nomenclatural acts in general term (***onomatergy***, hereafter). Therefore, they are not regulated by the International Code of Zoological Nomenclature (Code, hereafter; Anonymous 1999).

This is a very brief introduction to well-known principles in zoological taxonomy and nomenclature. What is presented above should not come as a surprise or as novel to anyone working in this field. However, it is relevant to bring these important points forward in order to address two cases with proposed modifications of nomina in the Pacific representatives of the insect order Odonata, which in the view of the author have not been substantiated. Short discussions of the implications of such practices are provided as well.

Study cases in Pacific Odonata taxonomy and nomenclature

Subgenus *Adversaeschna* Watson, 1992 (Odonata: Aeshnidae)

Watson (1992) analysed the Australasian *Aeshna brevistyla* Rambur, 1842 and concluded it was "… more closely allied to the specialised Papuan and New Caledonian genus *Oreaeschna* …" because "… although a possible forerunner of *Oreaeschna*, *Aeshna brevistyla* is basically a species of *Aeshna* sens. lato. …" The author introduced a subgenus *Adversaeschna* and provided a diagnosis, therefore fulfilling the requirements for availability of the new nomen according to the Code. The etymology of the nomen was discussed by Endersby & Fliedner (2015) and also recalled Watson's (1992) decision to introduce this taxon as a subgenus. However, presently the majority of published resources (both printed or online) on Australian fauna are using this nomen as a separate genus. The cause of this mistake is unclear, but could probably be related back to two sources: Corbet (1999: 4) referred to it as "… the newly designated genus *Adversaeschna* …" and Davies (2002) claimed that "… Watson (1992) … put the Australian species [*A. brevistyla*] into a new genus, *Adversaeschna* …" (square brackets added to specify the species identity). Endersby (2010) suggested that Corbet (1999) "renamed" *Aeshna brevistyla* as *Adversaeschna brevistyla*. This claim is technically incorrect because as pointed out above once a nomen is assigned to a taxon it cannot be changed, so the taxon cannot be renamed. An onomatergy, such as the catastasy, is a legislative act (following the three steps outlined above) which happens only once – at the time of promulgation. Modifications which may happen to the nomen later on, may be based on taxonomic or nomenclature studies. However, the nomen still has the same onomatophore, author and date, therefore the new form is a subsequent onymoprh (aponymorph) of the existing nomen.

Endersby (2010) too acknowledged that Watson (1992) had proposed *Adversaeschna* as a subgenus of *Aeshna*. However, he decided to use it as a generic rank following information included in a number of checklists and personal correspondence with an Australian taxonomist (G. Theischinger) who believed the taxon required a separate generic

rank. Indeed, in the latest account on the Australian fauna, Theischinger & Hawking (2021) included *Adversaeschna* as a genus, but, there is still not a published resource to justify a taxonomic change which will require the aponymoph. *Adversaeschna* may indeed deserve a separate genus status and I have shared this opinion in conversations with other taxonomists. At this stage, although taxonomists have thought to propose an onymorph at various times having looked at specimens from the species such a proposal has never been published with scientific evidence (i.e., a hypothesis). Therefore, the form "*Adversaeschna brevistyla*" used so widely in the nomenclature of the Australian, New Caledonian and New Zealand Odonata should be supressed. This form was introduced by mistake and the correct onymoprh of the nomen should be *Aeshna* (*Adversaeschna*) *brevistyla* Rambur, 1842.

Genus *Amorphostigma* Fraser, 1925 (Odonata: Coenagrionidae) (Fig. 1)

Fraser (1925, 1926, 1953) introduced the following two new genera and four new species: *Amorphostigma* Fraser, 1925 (*A. armstrongi* Fraser, 1925; *A. auricolor* Fraser, 1926) and *Pacificagrion* Fraser, 1926 (*P. lachrymosa* Fraser, 1926; *P. dolorosa* Fraser, 1953) for taxa endemic to the islands of Samoa. *Amorphostigma* was diagnosed mainly on wing venation. It was claimed to be morphologically closest to *Ischnura* Charpentier, 1840, but possessing the following unique combination of features: males with a 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 apical to the ovipositor. *Pacificagrion* was also proposed to be close to *Ischnura*, with differences observed in the shape of the pterostigma and the structure of the male appendages which the author considered to be more complex than those found in *Ischnura*. Fraser (1927) introduced four new species endemic to Samoa and placed them in the genus *Ischnura*: *I. albistigma*, *I. buxtoni*, *I. chromostigma*, *I. haemastigma*, to which Fraser (1953) added *I. sanguinostigma*. The author provided descriptions of the specimens, but the diagnoses were only briefly outlined, referring mainly to the general resemblance of these new species to congeners from other parts of the world. Therefore, it was not clear which features determined the generic placement of the Samoan species. Fraser (1927) commented on the resemblance of Samoan *Ischnura* to the *Amorphostigma* and illustrated male terminal abdominal appendages of *I. haemastigma* in comparison to *A. armstrongi* and

Figure 1: *Amorphostigma* sp. nov. from Tutuila, American Samoa. Photo: M. Marinov.

I. buxtoni to *A. auricolor*. Also, *I. albistigma* was found to be "… closely related … especially to *A. armstrongi* …". Moreover, Fraser made an important remark from personal correspondence with Dr. Clarence H. Kennedy who had examined the penis structures of both *A. armstrongi* and *P. lachrymosa* and agreed they were typical of *Ischnura*. This was used as evidence of a possible close relationship between representatives of the three genera *Amorphostigma*, *Ischnura* and *Pacificagrion*. Unfortunately, in his studies on the penis structures carried out at the time, Kennedy (1919) did not include any of the Pacific representatives. Moreover, no illustrations of the Coenagrionidae from this part of the globe were provided by any of the researchers either. Therefore, no comparative studies on the genitalia were ever published.

Donnelly (1986) and Marinov et al. (2015) questioned the placement of the Samoan endemic species in the genus *Ischnura* and suggested that they may deserve a separate genus status. Marinov et al. (2016) elaborated on this topic, comparing 18 Pacific species inhabiting islands from New Caledonia and east to French Polynesia included in *Ischnura* and *Hivaagrion* Hämäläinen & Marinov, 2014. They presented a discussion on the necessity of more studies on the taxonomy of these species because (with exception of *H. halecarpenteri* (Mumford, 1942); *I. cardinalis* Kimmins, 1929; *I. jeanyvesmeyeri* Englund & Polhemus, 2010) the general plan of the male terminal abdominal appendages was found to be quite similar to that of *Amorphostigma*. Marinov et al. (2019) commented that based on published studies and unpublished data there were at least 15–20 species new to science in the islands of French Polynesia. Establishing these unknown species and integrating them into a revision of the Pacific Coenagrionidae should be a priority for future taxonomic and evolutionary studies, in order to stick to the following taxonomic practices: sufficient sampling, building plausible phylogeny, conceptualising the taxonomy based on workable hypotheses and testing them from morphological, molecular, biogeographical and other perspectives, before proposing nomenclatural changes.

Unfortunately, the points made above, dating back nearly a century ago, have not been considered in two more studies on the female polymorphism in *Ischnura* lead by the same team of authors (Willink et al. 2019; Blow et al. 2021). The authors of these studies proposed the aponymorph *Ischnura armstrongi* for the taxon *Amorphostigma armstrongi*. Willink et al. (2019) included this taxon with the proposed new combination in their Figure 5 without a justification of the new generic placement. The probable reason for this decision is given in Blow et al. (2021) who claimed that "Dijkstra et al. (2014) subsumed *Amorphostigma* into *Ischnura*, and recent molecular data support this change (Willink et al. 2019)". The authors also referred to the nomina *Ischnura* and *Pacificagrion* as used in the online database World Odonata List (WOL) (presently available as Paulson et al. 2021) arguing that WOL "… maintains a taxonomic classification of Odonata with currently valid names." There are very serious issues with these two claims and such a practice in taxonomy which I investigate below.

[1] Dijkstra et al. (2014)' study is of great importance for the contemporary taxonomy of the suborder Zygoptera. It was based on a molecular phylogenetic reconstruction using mitochondrial (16S, COI) and nuclear (28S) data from 59 % of the 310 genera recognised within the suborder. This is indeed a remarkable achievement, but unfortunately, none of the Pacific representatives discussed above were included in the analysis. The claim made by Blow et al. (2021) is most likely based on a single sentence in Dijkstra et al.

(2014: 83) saying: "*Amorphostigma* Fraser, *Boninagrion* Asahina, *Rhodischnura* Laidlaw and probably *Pacificagrion* must be subsumed into *Ischnura* (O'Grady & May, 2003; Hovmöller, 2006; Karube et al., 2012)." Obviously, Dijkstra et al. (2014) made this proposal following the three cited studies. However, the authors did not investigate representatives of *Amorphostigma* and *Pacificagrion* in their molecular phylogeny. The issue is that none of the cited studies categorically proposed subsuming of *Amorphostigma* into *Ischnura*. A short review of the three sources is presented below:

[1.1] O'Grady & May (2003) presented a cladistic study using morphological characters. They included only *A. armstrongi* from the above mentioned Pacific representatives. They concluded that there was a close relationship between *Ischnura*, *Boninagrion* and *Amorphostigma* which appeared as one clade. However, these authors did not propose a new status for these taxa. If *Pacificagrion* or any other of the Samoan endemics, presently included in *Ischnura*, had been involved in this study, the results would possibly have shown a different taxonomic arrangement, most likely similar to that discussed below in Karube et al. (2012).

[1.2] *Boninagrion* was synonymised with *Ischnura* by Karube et al. (2012) on the basis of morphology and molecular results. The same study analysed *Amorphostigma* and *Pacificagrion* but the authors stated that they did not have strong support from mitochondrial data and did not propose any further taxonomic and nomenclatural changes for the Pacific taxa discussed here.

[1.3] Hovmöller (2006) published a molecular study which did not include any of the Pacific taxa discussed herein. In fact, with the exception of a single *Ischnura aurora* (Brauer, 1865) specimen from Australia, no other species from the Pacific area was included. Probably Dijkstra et al. (2014) cited Hovmöller (2006) in support of their claim for subsuming *Rhodischnura* into *Ischnura*, but this topic is irrelevant to the present investigation.

The discussion of the three sources cited in Dijkstra et al. (2014) shows that no study at the time was in support of synonymising *Amorphostigma* with *Ischnura*. Therefore, the suggestion made in Blow et al. (2021) was based solely on the molecular phylogeny presented in Willink et al. (2019), which was included on a single figure without any additional analysis of relationships between the taxa involved. A phylogenetic tree based on the molecular data from the two studies (Willink et al. 2019 and Blow et al. 2021) is shown on Figure 2 in here. It shows very interesting results. The clade marked as "Clade I" consists mainly of the following species endemic to certain Pacific islands: *A. armstrongi* (Savai'i, Upolu), *P. lachrymosa* (Upolu), *Ischnura pamelae* Vick & Davies, 1988 (New Caledonia), *I. cardinalis* (Raiatea, Bora Bora, Taha'a) and *I. taitensis* Selys, 1876 (Tahiti). Most likely *Amorphostigma* sp. and *Pacificagrion* sp. are specimens used in Marinov et al. (2015), from which I supplied information to the principal author of the Willink et al. (2019) study. The last two taxa in this clade are *I. aurora*, now widely distributed across the Pacific (but check Marinov 2015 for discussion on the biogeography of the Pacific representatives of the genus), and *I. pruinescens* (Tillyard, 1906), confined to Australia and New Guinea.

As mentioned above, several authors have proposed that the Pacific taxa included in the "Clade I" (Fig. 2) need a revision and have suggested that their current placement

in the genus *Ischnura* may not be substantiated. Therefore, instead of proposing a new generic assignment of *A. armstrongi* under *Ischnura*, the molecular results in both Willink et al. (2019) and Blow et al. (2021) actually show that the Pacific representative may be phylogenetically different from *Ischnura*. Instead of synonymising *Amorphostigma* with *Ischnura* the phylogenetic tree shows that it may make more sense to afford a new generic status to Clade I, including *Pacificagrion* and even species such as *I. aurora*, *I. pamelae*,

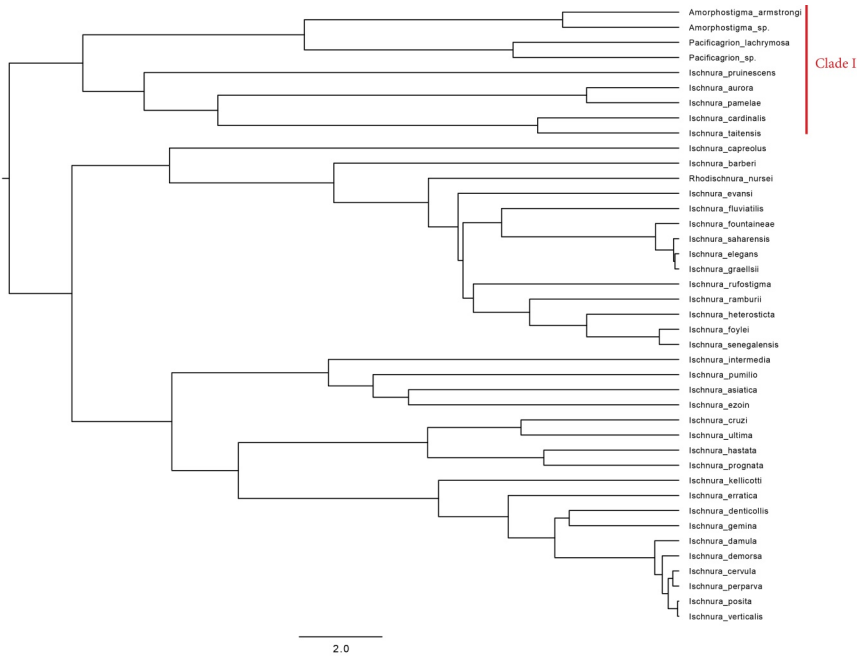

Figure 2. Molecular phylogeny of *Ischnura* reproduced using the data of Willink et al. (2019), Blow et al. (2021). Clade I is added in here to show the Pacific and Australian representatives of family the Coenagrionidae discussed in the present study.

I. cardinalis and *I. taitensis*. However, as pointed out above, such a claim should be opened to a larger discussion involving more species and genera from the region. With more than 20 species pending introduction as new to science, many of the Samoan endemics not yet resampled since Fraser's descriptions (1925, 1927, 1953) and likely new taxa from the less studied areas of Marquesas and Austral island groups (to name but two localities), proposing an aponymorph in studies which did not investigate the taxonomy of the group, but female polymorphism, is premature. The taxonomy of the Coenagrionidae from this part of the Pacific needs much more work to have robust arguments for any taxonomic, and consequently nomenclatural, changes.

[2] Blow et al. (2021) claimed they have used the nomina *Ischnura* and *Pacificagrion* following WOL, "… being a source which maintains a taxonomic classification of Odonata with currently valid names." However, WOL is an online database which does not give information on the nomenclatural availability or validity of the nomina in the sense of the

Code. The administrators of the WOL are very precise in their updates of the online database with all nomenclatural changes and their tireless job is, frankly, inspirational. However, they are not a governing body which would check for the validity of nomina or the taxonomy of the order. WOL is a list of nomina and as such it is sitting in the domain of nomenclature, not taxonomy. The list reflects nomenclatural changes (resulting from onomatergies or not) and the administrators update it with whatever is supplied to them as final outcomes from published studies. The functionality of this list depends on the taxonomists and accuracy of their studies. Like other online databases, WOL is a convenient resource for retrieving nomenclature information. However, taxonomists should use the nomina listed there with caution. As scientists we are supposed to analyse the scientific information and evaluate the appropriateness of the proposed changes based on what we have developed for ourselves as 'best practice' (more in the Discussion below).

One last point when taking the data presented among the figures from the two studies (Willink et al. 2019, Blow et al. 2021), displayed as Fig. 2 herein. The authors proposed a new taxonomic status for *A. armstrongi*, but left *Pacificagrion* as a genus. If, based on the sample size they worked with, the subsuming of *Amorphostigma* under *Ischnura* is justified, why then were the two taxa included in the tree as *Pacificagrion* kept as members of this genus and not subsumed into *Ischnura* as well? Both appear closer to *A. armstrongi* than any other of the Pacific species presently included in the genus *Ischnura*!

Conclusion

Adhering to the 'best practices' in taxonomy by scientists is imperative. Compliance with scientific legislation (the Code) is a rule, not a recommendation (Dubois et al. 2021). Two important discussion points must be considered here: [1] how to define the 'best practice', and [2] what should taxonomists do for nomenclatural novelties which come from taxonomic changes and are not regulated by the Code?

'Best practice' may be understood too widely and could be very subjective. Detailed debate is not intended in here, but I think it is necessary to bring up a few points only which I consider relevant to the study cases of the two nomina in the Pacific Odonata addressed herein.

Taxonomy is an evolutionary science which delimits taxa based on distinctiveness and not on difference (Mayr et al. 1953). Evolution is not a process with a fixed end, but is ongoing, resulting in modification of the organisms' attributes (at any level from phenetic expressions down to the molecules, biogeography, ecology, etc.) which we use to classify taxa as separate groups. Taxonomists proposing new changes in taxonomy should select and weigh the characters they intend to use for their analyses (Borkent 2018). However, regardless of the characters selected for a taxonomic study, they will only be a subset of the total ones, the choice depending on available technologies, methods and traditions in research (Löbl 2014). Therefore, the proposed changes of the taxonomic status should be made after a dense taxon sampling (Vences et al. 2013).

Nomenclatural changes should follow the updated taxonomy. Onomatergies require implementation of the three steps outlined in Dubois et al. (2019) and presented at the Introduction of the present work. Non-compliance with one of them will make the nomen unavailable, unallocated or invalid in the sense of the Code which could be proven and dis-

missed by a reviewer of the group or other researchers. However, changes of the original onymorph are not regulated by the Code, because they are a matter of taxonomy, not of nomenclature, hence not the results of rules that could be accepted or disregarded by the consecutive scientists working on the group. Whenever they happen, we expect that the scientists proposing the change have followed what they have considered as a best practice stepping on a firm theoretical ground, considering all previous studies on the group, working on as many taxa as available and using various explicit methods, i.e., made the best hypothesis possible. Failure to take any of these steps may result in unnecessary updating of nomenclature lists which may later be required to be reverted back to the previous stage.

Two similar cases were presented above concerning the nomina of the Pacific Odonata for where I have demonstrated that we do not have enough published taxonomy to justify the proposed nomenclatural changes: [1] elevating *Adversaeschna* to genus rank was a mistake multiplied by numerous online resources, and [2] subsuming of *Amorphostigma* to *Ischnura* was premature in the lack of sufficient material and is contradictory to previous morphological studies outlined in Donnelly (1986) and Marinov et al. (2015, 2016). Therefore, I appeal to the databases administrators using these two nomina to restore the original nomenclature ranks given to these taxa: subgeneric for *Adversaeschna* and generic for *Amorphostigma*.

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

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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.

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