

Bryanites graeffii sp. n. (Coleoptera, Carabidae): museum rediscovery of a relict species from Samoa

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Abstract

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Bryanites graeffii sp. n. is described from Samoa based on a single male specimen collected between 1862–1870 that was recently discovered in the Muséum national d’Histoire naturelle, Paris. Cladistic analysis based on 127 morphological characters from 49 exemplars of the carabid beetle tribe Platynini in the Austral-Pacific region, places the new species as adelphotaxon to *Bryanites samoensis* Valentine, type species of the genus *Bryanites* Valentine, 1987. *Bryanites* comprises, along with *Vitagonum* Moore, 1998 of Fiji and *Ctenognathus* Fairmaire, 1843 of New Zealand, a clade that diverged early in the evolutionary history of Pacific platynine Carabidae. *Bryanites graeffii* exhibits very large body size among taxa of Platynini—16.2 mm standardized body length—with the genus characterized by vestigial flight wings and metathoracic apomorphies that are associated with flight-wing loss. Along with *Blackburnia* Sharp, 1878 of Hawaii, the origins of *Bryanites*, *Vitagonum*, and *Ctenognathus* are hypothesized to date to the Miocene, with their radiations beginning long before the origins of the geographically widespread, flight-capable species of *Metacolpodes* Jeannel, 1948 that colonized numerous island systems across the western Pacific. Given the numerous platynine taxa collected by extensive biotic surveys of Samoa during the first quarter of the 20th Century, the absence of any specimens of *B. graeffii* since the initial collection of the unique holotype prior to 1871 suggests that this species may be extinct. Such extirpation of large platynine carabid beetles has also been documented for Hawaii, where the time of extinction of seven *Blackburnia* species represented only by subfossil fragments coincides with the time of human colonization and attendant introduction of the Pacific rat, *Rattus exulans* (Peale).

Introduction

It is undeniable that natural history museums represent invaluable and irreplaceable archives of biological diversity on Earth. Firstly these institutions serve as repositories for many millions of studied and described specimens: i.e. type specimens and associated subsequent collections of named species. Secondly museums also hold uncounted, unstudied specimens that have been collected and processed, but never adequately examined or understood by a taxonomic specialist. Predictably, examination of unidentified material collected long ago can produce surprising results, especially when the historical museum specimens represent the only evidence we have for existence of that particular species. For example, two Samoan species of flying fox, genus

Pteropus Brisson, 1762 (Chiroptera: Pteropodidae), are known only from museum specimens collected between 1839 and 1856 (Helgen et al. 2009). In this contribution, a Samoan carabid beetle specimen collected prior to 1871, and subsequently deposited in the Paris Natural History Museum, is shown to represent the only specimen known of a new species. Moreover, the genus to which the new species is assigned is known previously only from two species based on two specimens collected in 1924 (Valentine 1987). That the new species is being described only now, over 140 years after its collection from nature, attests to the contextual information that is required to interpret biodiversity, for it is not the simple naming of organisms that occupies systematists, but more importantly, the organized naming and placing in context of all organisms. A scientific

name presented in isolation from any detailed taxonomic framework is nearly useless, being suspect as a natural entity, devoid of biological context provided by knowledge of its sister group (Hennig 1966), and at best representing a single datum indexing a gross estimate of biodiversity.

The specimen described in this contribution is a member of the carabid beetle tribe Platynini belonging to the genus *Bryanites* Valentine, 1987 (Valentine 1987). This genus was previously known only from specimens collected by E. H. Bryan, Jr., 23-v-1924, at Sala'ilua, Savai'i Island, Samoa. Though the holotype specimens of *Bryanites samoensis* Valentine and *B. barri* Valentine are assignable to the Platynini, they are aberrant representatives of that tribe. In contrast to many platynine carabid beetles, which as the name suggests are flattened dorsally, the bodies of *Bryanites* beetles are fusiform with a broad pronotum, their bodies convex dorsally. The two *Bryanites* spp. also exhibit patterns of setation on the elytra and pronotum unusual among platynine taxa. H. E. Andrewes, formerly at the Natural History Museum, London and a worldwide authority on Carabidae, placed determination labels on both specimens subsequently described by Valentine that read “? Pterostichini gen. nov.” He did this presumably because the specimens appear superficially like the larger-bodied, more robust beetles of that tribe, though their lack of a critical diagnostic feature of most Pterostichini—i.e. an externally visible plica, or fold, along the apical elytral margin—fits members of the tribe Platynini. Andrewes' tentative, incorrect guess as to tribal membership is also understandable because the two *Bryanites* beetles appear nothing like the other Samoan species of Platynini that he had previously described (Andrewes 1927).

This paper first traces the provenance of the newly described Samoan beetle specimen from its collection in nature to the present day. We cannot be certain why the specimen avoided description until now. But the documented timing of expeditions and subsequent taxonomic publications coupled with the temporal connections of the various taxonomists, and how the beetle could have passed from hand to hand, make a strong case for how a large carabid beetle from a tropical island could be ignored for well over a century to be rediscovered within a natural history museum. In order to be certain how best to classify the new species, cladistic analysis using morphological characters is used to phylogenetically place the species. After adding the new species to a little-known clade of Samoan Carabidae, the question regarding the fate of this lineage in nature is investigated, with parallels from the platynine carabid beetle fauna of the Hawaiian Islands suggesting a likely scenario for this species leading from the 19th to the 21st Century.

Materials and methods

Taxonomic material. Specimens treated in this contribution were borrowed from the Muséum national d'Histoire naturelle, Paris (MNHN), Mdm. Hélène Perrin and Dr.

Thierry Deuve curators, and the B. P. Bishop Museum, Honolulu (BPBM), James Boone collection manager. Placement of the new species within the context of platynine phylogeny (Suppl. material 1) utilized an updated version of the character matrix previously presented in Liebherr (2005), with that paper citing institutional sources that provided specimens for initial matrix development. Taxa included in the analysis are distributed in the southwest Pacific region, including Australia and Asia, northeastward through Melanesia and Polynesia to the Hawaiian Islands.

Several taxa were added to complement the previous analysis. *Colpodes kanak* Fauvel (Fauvel 1903) of New Caledonia was added to the analysis based on examination of a female (MNHN) determined by Fauvel in 1906. *Vitagonum apterum* Moore of Fiji was added because it, like *Bryanites*, represents an aberrant, taxonomically isolated platynine lineage in the Pacific (Moore 1998). The male holotype of *Bryanites samoensis* serves to represent the genus in the analysis. The female holotype of *B. barri* Valentine was also studied, and external anatomy of prothorax and elytra is consistent with Valentine's (1987) taxonomic decision placing both species together in the genus. However the type specimen of *B. barri* is heavily damaged. The beetle was extensively disarticulated during description, demonstrated by Valentine's illustrations of an isolated mentum, maxilla, and labium (Valentine 1987: Fig. 3). The resulting disarticulated structures were then mounted on two acetate sheets using Canada balsam as a fixative. Several isolated flecks of mounting medium remain on the sheet without any associated sclerite, suggesting strongly that flexure of the acetate caused the balsam to pop off the acetate. This interpretation explains the absence of the head capsule, mandibles, and antennae from the mounting cards. The female ovipositor is also damaged and the internal reproductive tract not present. Given this destruction of the specimen, 26 characters of the female reproductive tract and 11 characters of the head cannot be scored. Coupling that loss with the inability to score the 21 characters of the male reproductive system from the female holotype leads to at least 58 of the 127 characters necessarily being coded as missing. The poor mounting condition of the remaining sclerites cemented to the specimen cards limits confidence in assessing microsculpture covered by the Balsam, adding further uncertainty to the assessment of character states. This lack of information precludes a precise placement of this taxon in the analysis, at the same time seriously reducing resolution in a strict consensus cladogram when the taxon is included in the analysis. As *B. samoensis* is the type species of *Bryanites*, it was decided to limit the focus of the analysis to the question of where the taxon herein classified as *B. graeffii* fits phylogenetically relative to an array of fully informative exemplar specimens. As we have no evidence to overturn Valentine's (1987) decision to place *B. barri* in *Bryanites*, that decision is allowed to stand.

Laboratory Techniques. Dissection protocols used throughout development of the present character matrix

are detailed in Liebherr (2015: 18–20). An ocular ratio is used to quantify eye size: the maximum width of head across eyes divided by the minimum breadth of frons between eyes. Male genitalia are preserved in polyethylene vials placed on the specimen pin. Standardized body length comprises the sum of three measurements: 1, head length measured from the medioanterior margin of the labrum to the cervical ridge; 2, median pronotal length; and 3, elytral length measured from base of elevated scutellar apex to apex of longer elytron adjacent to the suture.

Character data. The cladistic analysis was based on 127 characters, 26 scored from the female reproductive tract and gonocoxae (i.e. ovipositor), 21 scored from male genitalic structures, and 80 derived from external anatomical structures (Suppl. material 2). Six of the characters are autapomorphic for a single terminal, however these were retained as other taxa could not be scored for these characters, due either to missing female or damaged specimens. Given additional material these characters could become potentially synapomorphous.

Cladistic methods. The character matrix was developed in WinClada (Nixon 2002) (Suppl. material 2), and analyzed by Nona (Goloboff 1999) using the ratchet (Nixon 1999). Results from an initial analysis using 200 iterations of the ratchet were compared to subsequent analyses using 1000 ratchet iterations, and then 10,000 ratchet iterations. After each ratchet run all trees were hard collapsed—i.e. collapsing nodes on trees when they are not supported under all optimizations—and then non-optimum (longer) trees were deleted. The strict consensus was then generated from those remaining hard-collapsed trees. Identical results at the 200, 1000 and 10,000 ratchet levels permitted the conclusion that all most parsimonious trees had been discovered.

Results

Provenance. The specimen rediscovered in the Paris Museum (Fig. 1) bears three labels (Fig. 2). The collector/locality label specifies that the beetle was collected in Samoa by “Dr. Graeffe.” A second label reads “8284”, and a third label notes accession by the Paris Museum. “Dr. Graeffe” is no doubt Eduard Gräffe, or Graeffe, a Swiss zoologist and naturalist who lived in Samoa from 1862–1870 (Graeffe 1917, Clunie and Snow 1986). Graeffe was employed by Johann Cesar VI Godeffroy, a wealthy shipping magnate in Hamburg who founded the Museum Godeffroy. The Museum Godeffroy published a journal, within which Graeffe published treatises on Samoan geography and birds (Graeffe 1873a, 1873b). He also published on the invertebrates including the insects of Fiji (Graeffe 1866). He maintained contact with scientists in Europe, including the ornithologists Otto Finsch and Gustav Hartlaub, to whom he sent a manuscript describing the birds of Tonga (Graeffe 1870). After Graeffe’s return to Hamburg, Leon Fairmaire described new species and redescribed numerous previously described beetle species from Australia, Fiji,

Tonga, and Samoa (Fairmaire 1879a), many deposited in Museum Godeffroy. Fairmaire’s (1879a) paper documents a connection between Graeffe and Fairmaire via the Museum Godeffroy, and supports the transfer of the specimen described herein to Fairmaire, either by loan or by purchase, after 1870 but prior to 1879. Fairmaire described or revised other carabid beetles from Fiji and Tonga (Fairmaire 1878, 1879b, 1881a, 1881b), though no more from Samoa. When his collection passed to the Paris Museum upon his death in 1906, the “MUSEUM PARIS” accession label was placed on the specimens (e.g. Fig. 2), with all of his carabid specimens maintained together in boxes as the “Fairmaire Collection.” When Erwin and Erwin (1971) assessed the condition of the Paris Museum carabid beetle holdings, they cited shelving unit B13, shelves 1–2; “23 boxes of the Fairmaire Collection, misc. carabids in very poor condition with no or poor labels, ‘a mess’! (p. 10).” It is within this set of boxes that the specimen described below was found.

Cladistic Analysis. Subjecting the taxon-character matrix to Nona (Goloboff 1999) within the WinClada shell (Nixon 2002) resulted in 47 hard-collapsed, multiple equally parsimonious trees (MEPT) of 566 step-length under 200, 1000, or 10,000 iterations of the ratchet (Nixon 1999). These trees were constrained to be fully resolved under all character optimizations; i.e. fast or slow optimization. The strict consensus cladogram of 607 steps (Fig. 3) was rooted so that the species of *Lorostema* Motschulsky, 1865 comprise outgroups to the other Pacific platynine taxa. This decision was based on plesiomorphic presence of two testes in male beetles of *Lorostema* spp. versus the derived monorchid, or single-testis configuration (character 46, Suppl. material 2) in males of species of *Blackburnia* Sharp, 1878, *Notagonum* Darlington, 1952, *Colpodes* W. S. MacLeay, 1825, and *Metacolpodes* Jeannel, 1948 (Will et al. 2005). The cladistic relationships indicate that the newly described species should be combined as *Bryanites graeffii* sp. n. (Fig. 3). The two *Bryanites* examples are members of a clade, under all possible MEPTs, that includes *Vitagonum apterum* Moore of Fiji as adelphotaxon. These two genera are in turn sister group to *Ctenognathus* Fairmaire, 1843 of New Zealand.

Other relationships inherent in the tree are very similar to those discussed in Liebherr (2005, fig. 78), although the inclusion of the two *Bryanites* spp. plus *V. apterum* in this analysis results in the *Ctenognathus* spp. joining with those taxa much closer to the root node the cladogram (Fig. 3). Also, *Notagonum kanak* (Fauvel) comb. n. is placed such that it must be removed from the genus *Colpodes* and newly combined with *Notagonum*.

Taxonomic challenges remain regarding monophyletic classification of species in the genera *Colpodes* and *Notagonum*, and these must be addressed via a more comprehensive and informative phylogenetic analysis, such as those that include DNA-molecular characters (e.g. Maddison 2012). *Colpodes* is certainly polyphyletic. The genus is based on *Colpodes brunneus* (W. S. MacLeay), placed here as sister species to a second Javan species,

C. latus Louwerens (Fig. 3). A third Javan species, *C. brittoni* Louwerens, is also closely related, with beetles of all three species exhibiting exceedingly protruded compound eyes and very broad pronotal lateral margins (Liebherr 1998). Other species combined with *Colpodes* in this analysis—from Fiji and Tahiti (Fig. 3)—must be recombined with different generic names to accommodate the monophyletic taxa *Helluocolpodes* Liebherr, 2005 and *Metacolpodes*. *Notagonum* has been a genus of convenience since Darlington (1952) proposed it. In his words, “It must be admitted that it is hard to draw a line between *Colpodes* in my partly restricted sense and some of the forms which I am including in *Notagonum*, but I am convinced that when *Colpodes* is broken up the various species of *Notagonum* will properly form at least one and perhaps more separate genera (Darlington 1952: 129).”

Taxonomy

Bryanites Valentine, 1987

Type species. *Bryanites samoensis* Valentine (by original designation).

Key to the Adults of *Bryanites* Valentine

1. Beetles of moderate size, standardized body length 11.7–12.5 mm; pronotum quadrisetose both lateral and basal setae present; parascutellar seta present..... 2
- Larger beetles, standardized body length 16.2 mm; pronotum bisetose, only basal seta present both sides; parascutellar seta absent *B. graeffii* sp. n.
2. Third elytral interval with 6 setae along length, the anterior seta associated with the third stria, the trailing five setae associated with the second stria; elytral basal groove meeting lateral elytral depression at right angle; pronotum without any evident laterobasal depressions, at most a slight depression near hind margin (left side of holotype).....
.....*B. samoensis* Valentine
- Third elytral interval with 3 setae along length, the anterior seta associated with the third stria, the posterior two setae associated with the second stria; elytral basal groove meeting lateral elytral depression at acute angle; pronotum with broad, shallow linear laterobasal depressions extended from hind angles toward center of pronotal disc
.....*B. barri* Valentine

Bryanites graeffii sp. n.

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Figs 1, 2, 4

Diagnosis. Besides the very large size of this beetle—standardized body length 16.2 mm—the elytral and pronotal setation are diagnostic. The elytra lack the parascutellar seta and any dorsal elytral setae, though both subapical and apical setae are present in the seventh stria near the rounded sutural apex. The pronotum has only the basal seta present, with this seta’s position $0.14\times$ the median pronotal length anterad a transverse line drawn across the median pronotal base. The pronotal lateral marginal depression is broad and upraised to a smooth, unbeaded margin. The prosternal process is flat between the procoxae, with four to five setae each side approaching the process apex. Cuticular microsculpture

Diagnosis. These beetles can be diagnosed from other Pacific platynine taxa by the much reduced subapical sinuation of the elytra, with the elytral margins straight to convex near the apex (Fig. 1). The pronotum is broadly orbiculate, with the lateral margins convex to only slightly concave anterad the rounded hind angles. The pronotum has the basal seta present and situated anterad the rounded hind angle. The elytra are moderately narrowed basally, with the basal elytral groove meeting the lateral elytral depression at an angle; i.e. the humeri are angulate. The male aedeagus exhibits characters typical of tribe Platynini (Fig. 4): 1, both parameres are rounded apically, or conchoid in shape; 2, the right paramere is smaller than the left, and the aedeagus lies with the right side ventral in repose; 3, the basal bulb is closed and bears a sagittal crest; and 4, the internal sac is tubular and unarmored, with slightly more melanized spicules present apically near the gonopore.

Beetles of all three *Bryanites* species are brachypterous, with the wing rudiments narrow and elongate stenopterous straps, the length of the rudiments more than $4\times$ the rudiment breadth. Beetle size is moderate to large, ranging from 11.7 mm in *B. barri* (measurement of Barr 1987) to 16.2 mm in *B. graeffii*.

is particularly well developed, with the frons and clypeus bearing distinct, upraised isodiametric sculpticells, and the vertex covered with more transverse, though equally well-developed sculpticells. The pronotal and elytral discs are covered with very small transverse sculpticells, the sculpticells’ small size giving the surface a velvety or velour-like reflection.

Description. Head broad, robust, ocular ratio 1.61; antennae elongate, as long as distance from antennal socket to elytral midlength; scape stout, maximal breadth $0.5\times$ distance from basal constriction to apex; antennomeres 2–3 apparently glabrous, but sparsely covered with very short microsetae, an apical ring of setae on antennomere 3; antennomere 4 apparently glabrous in basal $\frac{1}{4}$ of length, though also with very short microsetae, remainder of antennomere and antennomeres 5–11 pilose with darker



Figure 1. Male holotype, *Bryanites graeffii*, dorsal view.

brunneous, glabrous longitudinal ridge on each anterior and posterior surface; frontal grooves very shallow, ending posteriorly anterad the anterior supraorbital seta; posterior supraorbital setal position behind posterior margin of eye and $3\times$ as far from eye margin as anterior seta; frons and clypeus not demarked by suture, surfaces convex, continuous, only three very shallow transverse wrinkles medially at position of frontoclypeal suture; labral anterior margin straight, only slightly incurved medially; mentum tooth broad, apex flattened medially, mentum setae positioned posterad curved mentum margin each side of midline; submentum with two setae each side. Pronotum broad, maximal width $1.08\times$ median length; lateral margins only slightly incurved anterad rounded hind angles; broadly longitudinal laterobasal depressions joined by well-defined transverse depression anterad basal convexity; median longitudinal impression very finely incised, absent on basal convexity, continuous to beaded front margin; front angles projected anteriorly, their apex tightly rounded; lateral marginal depression of equal breadth from midlength to front angles, about twice as broad in basal half of pronotum; proepisternum smooth, proepimeron very narrow. Elytra flattened overall, sutural intervals upraised at suture in apical half of length; elytral apex evenly rounded; elytral



Figure 2. Specimen labels associated with holotype specimen of *Bryanites graeffii*.

striae finely incised, completely smooth, the intervening intervals nearly flat; humeri narrowed, with elytral basal groove meeting lateral depression at obtuse-angulate juncture, i.e., the humerus; seventh stria with two setae near stria apex; eighth striae with 33–37 lateral elytral setae more or less continuously distributed along elytral length, but with greater intersetal distances near midlength. Legs gracile, elongate; profemur with eight setae along anteroventral margin; mesofemur with 8–11 setae along posteroventral margin; metacoxa bisetose, two lateral setae present anteriorly and posteriorly, median seta absent; metafemur with eight setae along posteroventral margin, three setae on anterodorsal surface near apex from $0.7\text{--}0.8\times$ femoral length; metatarsomeres 1–3 convex dorsally, without evident inner or outer dorsal sulci; metatarsomere 4 lobate apically, length of outer apical lobe $0.4\times$ median tarsomere length, length of inner lobe $0.25\times$ median length; tarsomeres 1–4 with two parallel longitudinal rows of elongate ventrolateral setae each side of a central space, the setae of inner rows each side about half as long as setae of outer rows; metatarsomere 5 apparently with eight ventrolateral setae, equal in length to tarsomere depth, set in two longitudinal rows (several setae broken off). The pronotum and elytra of the type specimen are covered with a varnish-like substance that can be scraped off with diffi-

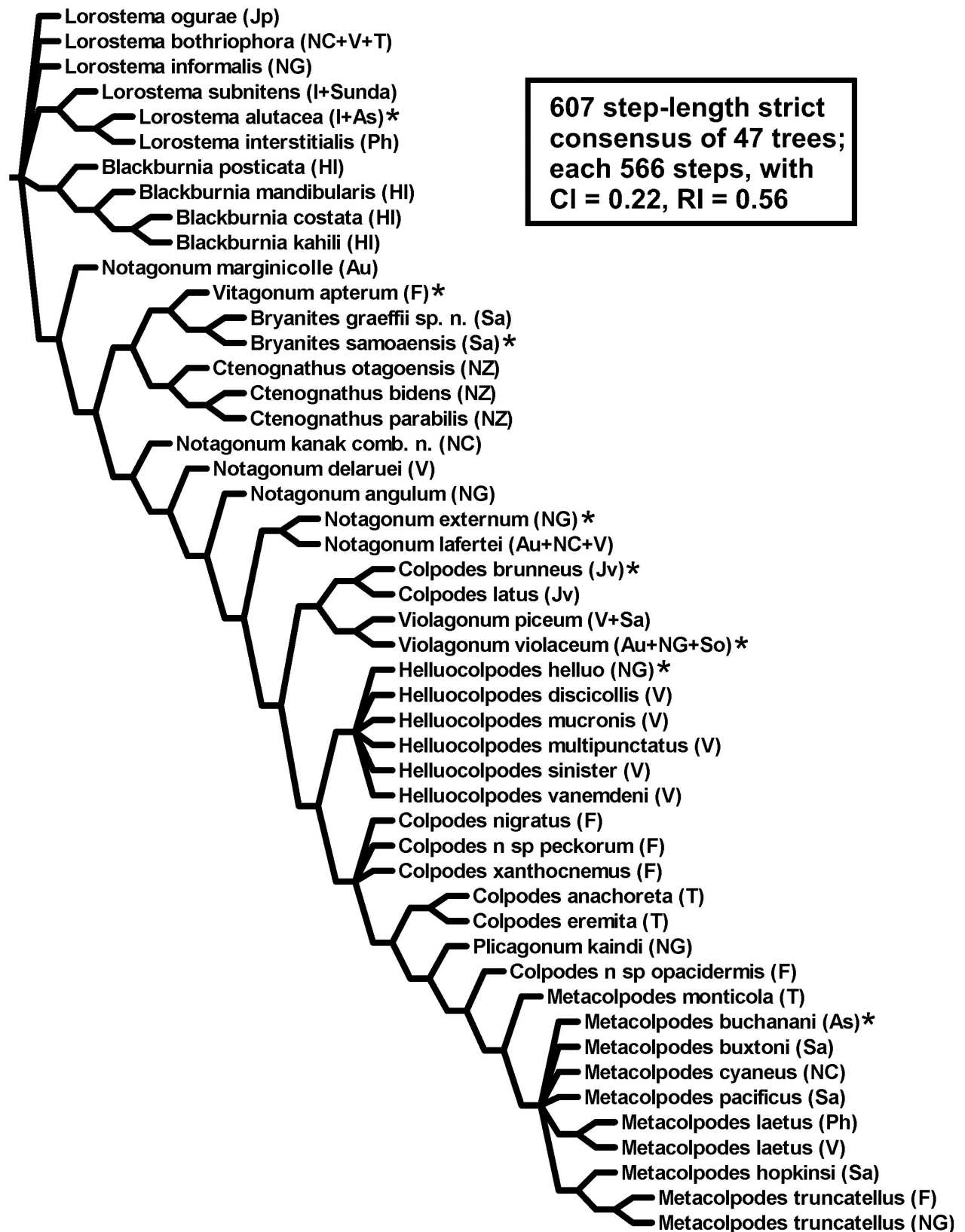


Figure 3. Strict consensus cladogram of 49 taxa of Pacific platynine carabid beetles. Type species, where included, indicated by asterisks. See text for further explanation of cladistic analysis. Distributional areas of species include: As, Asia; Au, Australia; F, Fiji; HI, Hawaiian Islands; I, India including Sri Lanka; Jp, Japan; Jv, Java; NC, New Caledonia; NG, New Guinea; NZ, New Zealand; Ph, Philippine Islands; R, Rapa; Sa, Samoa; So, Solomon Islands; Sunda, Sunda Islands; T, Tahiti and Society Islands; V, Vanuatu.

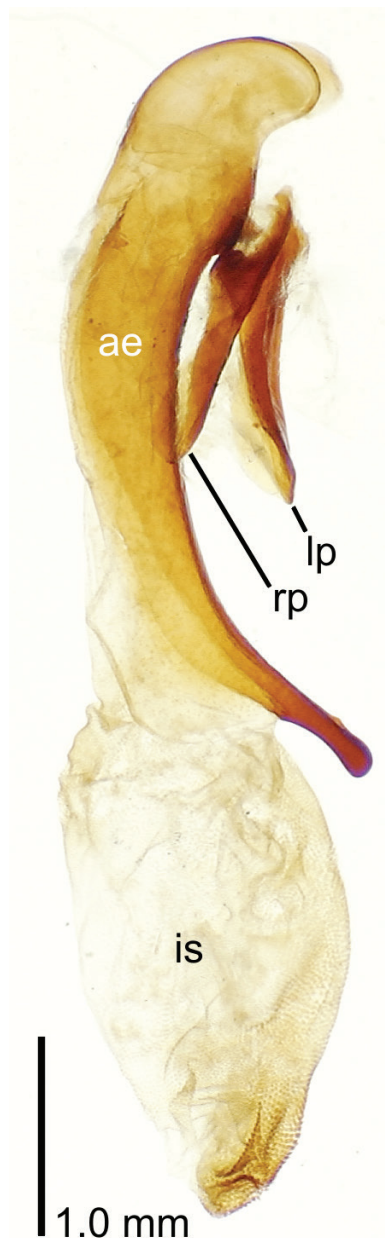


Figure 4. Male aedeagus, internal sac everted, of *Bryanites graeffii* male holotype, right lateral view. Abbreviations include: ae, aedeagal median lobe; is, internal sac; lp, left paramere; rp, right paramere.

culty (Fig. 1). The head, ventral surface, legs, and elytral lateral marginal depression are not so covered, suggesting that this coating is associated with the specimen in life, not an artifact of preservation.

Male genitalia. Aedeagal median lobe elongate, evenly narrowed from midlength to apex extended 4.0× its dorsoventral breadth beyond the apex of the ostial opening (Fig. 4); aedeagal tip slightly expanded, apical surface of tip tightly rounded; right paramere slightly shorter and narrower than left; aedeagal internal sac fusiform (flattened under cover slip), with a field of more heavily sclerotized spicules distributed apically near gonopore.

Type. Holotype male (MNHN): Dr Graeffe / Samoa // 8284 // MUSEUM PARIS / Samoa / Collection Léon Fairmaire / 1906 // HOLOTYPE / Bryanites / graeffii / J.K. Liebherr 2016 (black-margined red label). The type locality is designated as the mountains near Apia, Upolu island, based on Graeffe (1917); his autobiography notes his residing at Apia during his tenure in Samoa. He visited other islands in the Fijian and Tongan archipelagos, but did not mention any visits within Samoa to the islands of Savai'i or Tutuila. Moreover, the following passage for the year 1869, after he had published his popular book describing a trip to Viti Levu (Graeffe 1868), suggests the time period during which he could have collected the specimen here described as *Bryanites graeffii*: “Es wurde nun wieder tüchtig geforscht und zog ich fast täglich mit meinem Gewehr in die Waldungen des Apiaberges, Vögel und grosse Fledermäuse, *Pteropus samoensis* Peale erlegend, Insekten und Landschnecken, sowie Pflanzen sammelnd (Graeffe 1917: 31) [It was now again time for me to diligently conduct research, going almost daily with my rifle into the woods of the Apia mountains to gather birds and big bats, *Pteropus samoensis* Peale, insects and snails, as well as plants].” A collection made in 1869 would have had to wait only a year before Graeffe left Samoa to return to Hamburg, allowing safe preservation of a specimen held in the humid tropical Pacific. In an ironic coincidence, Apia is also the type locality of the extinct flying fox, *Pteropus allenorum* Helgen, Helgen and Wilson, 2009 (Mammalia: Chiroptera), known from a unique holotype collected in 1856 that was recently rediscovered in the Academy of Natural Sciences of Philadelphia (Helgen et al. 2009).

Etymology. The species epithet honors Dr. Eduard Graeffe, zoologist and naturalist from Zurich, Switzerland who collected the type specimen while working in Samoa from 1862–1870 (Clunie & Snow 1986). The species epithet is formed from Gräffe converted to Latin iconography, and without the terminal letter. This formation is consistent with several other honorific epithets for Eduard Gräffe; e.g. *Epeira graeffii* Keyserling (Arachnida: Araneidae), now combined with *Phonographa* Simon, 1894, *Lamelidoris graeffii* Bergh (Nudibranchia: Dorididae), and *Pachycephala pectoralis graeffii* Hartlaub (Aves: Pachycephalidae).

Nomenclatural note

Based upon the results of the cladistic analysis, *Colpodes kanak* Fauvel is newly combined with the genus *Notagonum* Darlington: *Notagonum kanak* (Fauvel) comb. n. (Suppl. material 1). This taxonomic decision is based on *N. kanak* exhibiting the following character states that place it within the *Notagonum* grade (Fig. 5, Suppl. material 2): 1, frons with evident isodiametric microsculpture that is visible through the surface reflection; 2, pronotal basal bead visible laterally but effaced at midline; 3, pronotal laterobasal depressions smooth, not punctate; 4, pronotal disc with evident transverse mi-



Figure 5. *Notagonum kanak* female (MNHN), label data: Ncalédonie / ile d. Pins / f. Faustien // MUSEUM PARIS / Ex. Coll. M. MAINDRON / Coll. G. BABAU 1930 // Colpodes / kanak / Fauvel dedit 1906 (card mounted, abdomen removed, female genitalia and reproductive tract in vial on pin).

crosculpture; 5, margins of prosternal process rounded on posterior face; 6, short elytral sutural tooth present, subapical tooth absent; 7, metatarsomere 4 with shallow apicomedial ventral invagination and short lateral lobes, the outer, or lateral lobe, less than twice the length of the inner lobe.

Discussion

The results of the cladistic analysis succeed in the goal of placing the new species as a member of a Samoan lineage, *Bryanites*, that exhibits a close biogeographic relationship to the Fijian relict, *Vitagonum* (Moore 1998). This clade, and its sister group *Ctenognathus* of New Zealand, diverged early in the history of Pacific Platynini. Previously, Liebherr (2005) concluded that the Hawaiian genus *Blackburnia* colonized the Hawaiian Island chain long before the origins of the present high islands, and perhaps as long ago as 28 Mya when Kure became the first in a consistently present subaerial chain of islands

generated by the Hawaiian Island volcanic hotspot (Duncan and Clague 1985). In the Samoan Island chain, the Alexa Bank seamount is hypothesized to have originated as a subaerial island 22 Ma (McDougall 2010), setting the earliest date possible for colonization of the Samoan Islands hotspot volcanic chain by a *Bryanites* ancestor. Subaerial origin of the Fijian archipelago is dated to a similar time—22–25 Ma (Gill and McDougall 1973, Whelan et al. 1985)—establishing a maximal time of origin for the ancestor of *Vitagonum*. And volcanism along the Kermadec-Lau-Tonga Ridge system would have enhanced colonization prospects for the ancestor of New Zealand *Ctenognathus* 10–15 Mya. Thus all area relationships among the early diverging Pacific platynine lineages, including *Bryanites*, occupy continental areas or island chains available for colonization in the Miocene. This supports Valentine's (1987) hypothesis that *Bryanites* is a relict Samoan lineage.

The question of whether any or all of the *Bryanites* species are extinct is necessarily open ended. Nevertheless, examination of the circumstances of their collections taken within the context of other biological surveys of Samoa paint a grim picture as to the possibility of their continued existence in nature. The single specimen of *Bryanites graeffii* was collected prior to 1871 by a naturalist principally interested in birds and marine invertebrates (Graeffe 1917). Nonetheless, we know that he collected insects during his trips to Fiji (Graeffe 1868), and during 1869 near Apia (Graeffe 1917). But only the one specimen of *B. graeffii* described herein is known to have passed to Leon Fairmaire for eventual deposition in the Paris Museum. The British Museum survey of 1924–1925 (Kami and Miller 1998), summarized for Carabidae by Andrewes (1927), led to description of five other platynine carabids—*Colpodes buxtoni* Andrewes, *C. pacificus* Andrewes, *C. hopkinsi* Andrewes, *C. piceus* Andrewes, and *C. anomalus* Andrewes, the first three of which are now assigned to *Metacolpodes* (Fig. 3, Suppl. material 1; Liebherr 2005). Andrewes (1927) also examined previously collected taxonomic material, including that from 1905 collections for the Vienna Museum (Rechinger 1914) and 1912–1913 collections for the Berlin Museum (Friedrichs 1914).

The Bishop Museum's Whitney South Seas Expedition of 1924, including E. H. Bryan, Jr. as entomologist, also visited Samoa (Evenhuis 2007). Bryan's field notes for 23 May 1924—the date labeled on the two specimens later described as *Bryanites* (Valentine 1987)—included: "Put away large quantity of specimens collected yesterday (Evenhuis 2007: 125)." Some of those "yesterday's" specimens were collected when he "Dug several things from partly rotten bank [*sic bark*] of large tree: centipedes, termites, sowbugs, tree cricket and moderately large slender fuscous Carabid (Evenhuis 2007: 125)." Given that the description of a "moderately large slender fuscous Carabid" on Samoa can only fit a *Bryanites* beetle, it appears that *Bryanites*, either the *B. barri* or *B. samoensis* individual that Bryan collected, was associ-

ated with a downed log covered with rotten bark. Bryan described the situation within which he was collecting at that camp as “Two large *Ac[h]atinella [sic]* landshells on Orange tree in banana patch at about 2200'. [Met] Mr. Beck and returned to hut. Mosquitoes not bad, but rats after our provisions. Very good collecting at this elevation (Evenhuis 2007: 125).” Being a field biologist based on Oahu, Bryan no doubt mistook a native Samoan *Samoana* or *Eua* land snail (Pilsbry 1909–1910, Cowie 1992) for the precinctive Oahu genus *Achatinella*, but his sighting of native land snails in proximity to rats in 1924 suggests that the native elements did not have long to exist at the site given the presence of invasive rats. There is both indirect and direct evidence that rats prey on native brachypterous carabid beetles. Deposits in Makauwahi Cave on Kauai include abundant subfossil fragments of extinct, brachypterous *Blackburnia* carabid beetles in stratigraphic layers deposited prior to human colonization and the associated introduction of the Pacific rat, *Rattus exulans* (Peale) (Liebherr and Porch 2015). Subfossil fragments of those presently extinct taxa are absent from the stratigraphic column in deposits laid down from shortly after the time of human colonization up to the present. More directly, stomach contents of alien black rats (*Rattus rattus* L.) have been shown to include fragments of a native Hawaiian *Blackburnia* beetle species, as well as native katydids, weevils and spiders (Shiels et al. 2013). The presence of predatory, climbing, night active rats is uniformly deleterious to native communities on tropical islands (Harper and Bunbury 2015), with Samoa not a likely exception to this rule.

Given these various lines of data, it seems unlikely that *Bryanites* beetles currently exist in nature. Only through the perspicuous collecting by E. H. Bryan, Jr. and the passing of his two specimens to J. Manson Valentine could the first two species of this genus be described (Valentine 1987). The subsequent discovery of a single additional specimen collected over 140 years ago that traveled a circuitous route from Samoa, to the Museum Godeffroy, to the Paris Museum adds another entry point to study of the *Bryanites* radiation. Are we better for knowing about this evolutionary story even after all known players have likely left the scene? To the degree that the hotspot volcanic chain of Samoa supported a very unique radiation of platynine Carabidae, as did Hawaii, we have learned that the *Blackburnia* radiation of Hawaii had an analog in Samoa, with Samoan species inhabiting the islands of Savai'i and Upolu. We have characterized a large-bodied, distinctive species that may turn up in Samoan subfossil deposits, much like the large-bodied subfossil *Blackburnia* spp. of Kauai (Liebherr and Porch 2015). And should these or any other *Bryanites* beetles have survived forest conversion, and the plagues of rats and other invasive species so that they may be collected during a future biological survey, that sample will be connected to specimens held in two other biodiversity hotspots on Earth.

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References

- Andrewes HE (1927) Coleoptera, Carabidae. In: Andrewes HE, Austen EE (Eds) *Insects of Samoa and other Samoan Terrestrial Arthropoda*, Part 4(1). Trustees of the British Museum, London, 14 pp.
- Clunies F, Snow PA (1986) Notes to accompany English translation of “Travels in the interior of the island Vitilevu” by Eduard Graeffe. *Domodomo* 4: 130–140.
- Cowie RH (1992) Evolution and extinction of Partulidae, endemic Pacific Island land snails. *Philosophical Transactions of the Royal Society of London B* 335: 167–191. <https://doi.org/10.1098/rstb.1992.0017>
- Darlington PJ Jr (1952) The carabid beetles of New Guinea part 2. the Agonini. *Bulletin of the Museum of Comparative Zoology* 107: 89–252. [4 pls]
- Duncan RA, Clague DA (1985) Pacific plate motion recorded by linear volcanic chains. In: Nairn AEM, Stehli FG, Uyeda S (Eds) *The Ocean Basins and Margins*. Plenum Press, New York, 89–121. https://doi.org/10.1007/978-1-4613-2351-8_3
- Erwin TL, Erwin JL (1971) A guide to the ground beetle collection in the Muséum National d'Histoire Naturelle, Paris (Coleoptera: Carabidae). Smithsonian Institution Duplicating Unit, Washington, D.C., 22 pp. http://entomology.si.edu/StaffPages/Erwin/T's%20updated%20pub%20PDFs%2010Jan2014/015_1971_GroundBeetleCollection_ParisMuseum.pdf
- Evenhuis NL (compiler) (2007) Field Notes of E.H. Bryan, Jr. on the Whitney South Seas Expedition (February–November 1924). Bishop Museum Technical Report 37: 1–334.
- Fairmaire L (1878) Diagnoses de Coléoptères des îles Viti, Samoa, Tonga, etc. *Petites Nouvelles Entomologiques* 2(210): 286.
- Fairmaire L (1879a) Descriptions de Coléoptères nouveaux ou peu connus du Musée Godeffroy. *Journal des Muséum Godeffroy* 14: 80–114.
- Fairmaire L (1879b) Diagnoses de Coléoptères Australiens et Polynésiens. *Le Naturaliste* 1(9): 70.
- Fairmaire L (1881a) Diagnoses de Coléoptères de la Mélanésie. *Le Naturaliste* 3(43): 348–349.
- Fairmaire L (1881b) Essai sur les Coléoptères des îles Viti (Fidji). *Annales de la Société Entomologique de France* (ser. 6) 1: 243–318.

- Fauvel A (1903) Faune analytique des Coléoptères de la Nouvelle-Calédonie. *Revue d'Entomologie* 22: 203–378.
- Friedrichs R (1914) Über *Adoretus vestitus* Boh. als Schädling im Samoa, und seine fruheren Stande. *Zeitschrift für Wissenschaftliche Insektenbiologie* Berlin 10: 41–47.
- Gill JB, McDougall I (1973) Biostratigraphic and geological significance of Miocene-Pliocene volcanism in Fiji. *Nature* 241: 176–180. <https://doi.org/10.1038/241117a0>
- Goloboff PA (1999) NONA (NO NAME). Published by the author, Tucumán, Argentina. <http://www.softpedia.com/get/Science-CAD/NONA.shtml> [accessed 16-ix-2016]
- Graeffe E (1866) Notizen über die Faune der Viti-Inseln. *Verhandlungen der Kaiserlich-Königliche Zoologisch-Botanische Gesellschaft in Wien* 16: 585–596.
- Graeffe E (1868) Reisen im Innern der Insel Viti-Levu. Zürcher and Furrer, Zürich, 48 pp. [2 pls]
- Graeffe E (1870) Ornithologische Mitteilungen aus Central-Polynesien. *Journal für Ornithologie* 18(108): 401–420. <https://doi.org/10.1007/BF02259500>
- Graeffe E (1873a) Topographie der Schiffer-inseln. *Journal des Museum Godeffroy* 1: 1–32.
- Graeffe E (1873b) Vogelbälge aus Huahine. *Journal des Museum Godeffroy* 1: 48–51.
- Graeffe E (1917) Meine Biographie in meinem 80. Lebensjahre geschrieben. *Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich* 61: 1–39.
- Harper GA, Bunbury N (2015) Invasive rats on tropical islands: their population biology and impacts on native species. *Global Ecology and Conservation* 3: 607–627. <http://creativecommons.org/licenses/by-nc-nd/4.0>
- Helgen KM, Helgen LE, Wilson DE (2009) Pacific flying foxes (Mammalia: Chiroptera): two new species of *Pteropus* from Samoa, probably extinct. *American Museum Novitates* 3646: 1–37.
- Hennig W (1966) *Phylogenetic Systematics*. University of Illinois Press, Urbana, 263 pp.
- Kami KS, Miller SE (1998) Samoan insects and related arthropods: checklist and bibliography. Bishop Museum Technical Report No. 13, 136 pp.
- Liebherr JK (1998) On *Rembus (Colpodes) brunneus* MacLeay (Coleoptera: Carabidae, Platynini): redescription and relationships. *Journal of Natural History* 32: 987–1000. <https://doi.org/10.1080/00222939800770511>
- Liebherr JK (2005) Platynini (Coleoptera: Carabidae) of Vanuatu: Miocene diversification on the Melanesian arc. *Intertribe Systematics* 19: 263–295. <http://dx.doi.org/10.1071/IS04032>
- Liebherr JK (2015) The *Mecyclothorax* beetles (Coleoptera: Carabidae: Moriomorphini) of Haleakalā, Maui: keystone of a hyperdiverse Hawaiian radiation. *ZooKeys* 544: 1–407. <https://doi.org/10.3897/zookeys.544.6074>
- Liebherr JK, Porch N (2015) Reassembling a lost lowland carabid beetle assemblage (Coleoptera) from Kauai, Hawaiian Islands. *Invertebrate Systematics* 29: 191–213. <http://dx.doi.org/10.1071/IS14047>
- Lorenz W (2005) Systematic list of extant ground beetles of the world (Insecta: Coleoptera: “Geadephaga”: Trachypachidae and Carabidae incl. Paussinae, Cicindelinae, Rhysodinae) [2nd edn]. Published by the author, Tutzing, 530 pp.
- McDougall I (2010) Age of volcanism and its migration in the Samoa Islands. *Geological Magazine* 147: 705–717. <https://doi.org/10.1017/S0016756810000038>
- Maddison DR (2012) Phylogeny of *Bembidion* and related ground beetles (Coleoptera: Carabidae: Trechinae: Bembidiini: Bembidiina). *Molecular Phylogenetic & Evolution* 63: 533–576. <http://dx.doi.org/10.1016/j.ympev.2012.01.015>
- Moore BP (1998) A new genus and species of flightless Carabidae (Coleoptera) from Fiji. *Australian Entomologist* 25: 103–106.
- Nixon KC (1999) The parsimony ratchet, a new method for rapid parsimony analysis. *Cladistics* 15: 407–414. <https://doi.org/10.1111/j.1096-0031.1999.tb00277.x>
- Nixon KC (2002) WinClada. Ithaca, NY, Published by the author. <http://www.softpedia.com/get/Science-CAD/WinClada.shtml> [accessed 16-ix-2016]
- Pilsbry HA (1909–1910) *Caecilioides, Glessula* and Partulidae. *Manual of Conchology* (2nd Ser.) 20. Academy of Natural Sciences, Philadelphia, 336 pp. [43 pls]
- Rechinger K (1914) Botanische und zoologische Ergebnisse einer wissenschaftlichen Forschungsreise nach den Samoa-inseln, dem Neuguinea-Archipel und den Salomoninseln von März bis Dezember 1905, v. Teil. *Denkschriften der Kaiserlichen Akademie der Wissenschaften* Wien 89: 443–708.
- Shiels AB, Flores CA, Khamsing A, Krushelnycky PD, Mosher SM, Drake DR (2013) Dietary niche differentiation among three species of invasive rodents (*Rattus rattus*, *R. exulans*, *Mus musculus*). *Biological Invasions* 15: 1037–1048. doi:10.1007/s10530-012-0348-0
- Valentine JM (1987) Some ancient and zoogeographically significant carabid beetles from the South Pacific (Coleoptera: Carabidae), with descriptions of new taxa. *Bishop Museum Occasional Papers* 27: 73–89.
- Whelan PM, Gill JB, Kollman E, Duncan RA, Drake RE (1985) Radiometric dating of magmatic stages in Fiji. In: Scholl DW, Vallier TL (Eds) *Geology and offshore resources of Pacific Island arcs – Tonga Region*. Circum-Pacific Council for Energy and Mineral Resources, Houston, 415–440.
- Will KW, Liebherr JK, Maddison DR, Galián J (2005) Absence asymmetry: the evolution of monorchid beetles (Insecta: Coleoptera: Carabidae). *Journal of Morphology* 264: 75–93. <https://doi.org/10.1002/jmor.10319>

Supplementary material 1

Taxonomic checklist

Authors: James K. Liebherr

Data type: Adobe PDF file

Explanation note: Taxa included in cladistic analysis taxonomically placing *Bryanites graeffii* sp. n. are listed along with their taxonomic authorities.

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Supplementary material 2

Computer file for cladistic analysis

Authors: James K. Liebherr

Data type: Adobe PDF file

Explanation note: The NONA format data file that supports the cladistic analysis of *Bryanites* and Pacific Platynini is provided for export to a plain text editor.

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