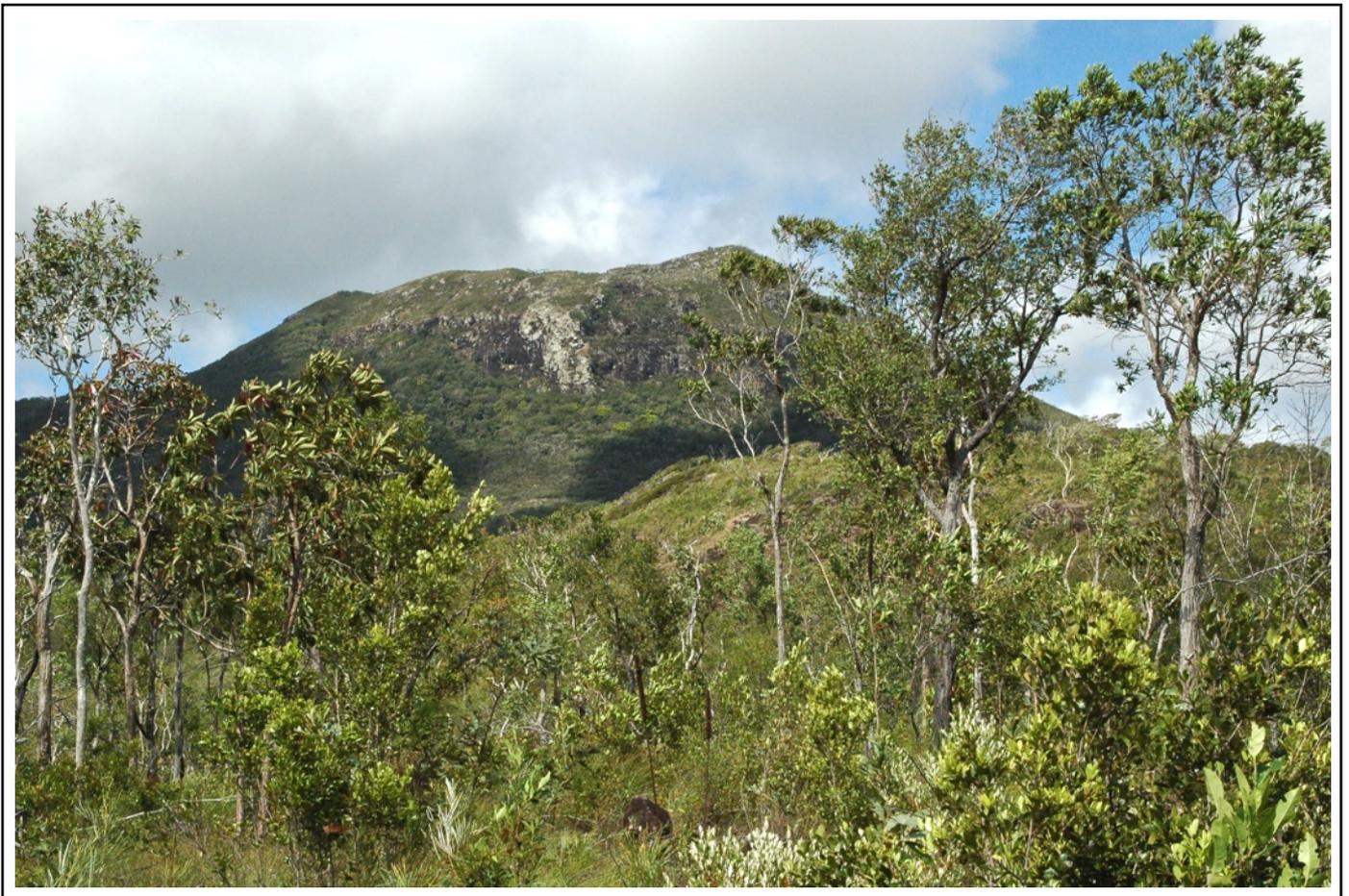


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Northeastern Australia record of *Nanophyllum pygmaeum* Redtenbacher, 1906, now recognized as a new species, *Nanophyllum australianum* n. sp. (Phasmida, Phylliidae)

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Phasmida ; new species ;
Phylliidae ; Australia ;
Nanophyllum ; New Guinea ;
pygmaeum ; walking leaf ;
australianum ; geographic isolation.

Abstract. – A new species of nano-leaf insect, *Nanophyllum australianum* Cumming, Le Tirant, and Teemsma, n. sp. (Phasmida, Phylliidae), is described from a single male specimen from Queensland, Australia. This single Australian record was originally considered as a range expansion for *Nanophyllum pygmaeum* Redtenbacher, 1906 (Rentz, 1988). Reexamination of this specimen as well as the intraspecies variation within other *Nanophyllum* specimens revealed this Australian record as morphologically distinct and geographically isolated. With this species now distinguished from *N. pygmaeum* and additional specimens within the genus examined, a more comprehensive key to species is included.

ZooBank : <http://zoobank.org/81EE671D-8C89-4D08-B306-76B20DF9949C>

Introduction

The genus *Nanophyllum* since its original description in 1906 by Redtenbacher remained rather elusive and poorly described for nearly a century. That is however until the second species was described, *Nanophyllum adisi* Zompro and Grösser, 2003 followed by several additional species over the last few years, all from the island of New Guinea (Figure 1). The only confirmed *Nanophyllum* specimen to be collected outside of New Guinea was collected as a nymph during the 1986 Australian National Insect Collection expedition to the Iron Range in northeast Queensland, Australia by D.C.F. Rentz (Rentz, 1988). The single nymph collected was fortunately brought back to Canberra and reared by Rentz to adulthood, a very wise move on his part as immature phylliids are nearly impossible to identify to any taxonomic level. An example of this is illustrated with the specimen collected by Monteith in 1976 as a nymph and preserved at the time. This specimen (Figure 2) has several morphological features that strongly suggest it is an additional *Nanophyllum australianum* n. sp. specimen. However, the significant morphological change that nymphs undergo as they molt to adulthood, as noted by Rentz (1988), illustrates that it is unwise to make a species level determination based on an immature specimen. It is because of this uncertainty that the authors refrained from designating this nymph as a paratype to *Nanophyllum australianum* n. sp.

The holotype specimen of *Nanophyllum australianum* n. sp. was originally identified as *Nanophyllum pygmaeum* Redtenbacher, 1906 based on the original description and figures (Rentz, 1988). Excluding one work, since Rentz's original identification this record has gone unchallenged in several publications (Brock and Hasenpusch, 2009, Grösser, 2008). Brock and Hasenpusch 2003 hypothesized this Australian *Nanophyllum* to be a separate species; however, no taxonomic act was performed at that time. This is not surprising as at the time of Rentz discovering this specimen nothing was known about *Nanophyllum* intraspecies variation and only the

type species *N. pygmaeum* was known to exist. Reexamination of this Australian record compared to the photograph of the *N. pygmaeum* holotype taken by Paul Brock (Phasmid Species File Online 2018) as well as the intraspecies variation within other *Nanophyllum* species revealed that the Australian specimen falls significantly outside the range of intraspecies variation and instead represents a unique species.

Materials and Methods

The holotype specimen was loaned to the Montreal Insectarium (Stephane Le Tirant, collection manager) by the Australian National Insect Collection, CSIRO. The photos were taken by René Limoges of the Montreal Insectarium using a Nikon D810 DSLR camera with Nikon Micro-Nikkor 200 mm f/4 lens on Manfrotto 454 micrometric positioning sliding plate. Lighting was provided by two Nikon SB-25 flash units with a Cameron Digital diffusion photo box. Adobe Photoshop Elements 13 was used as post processing software. Measurements of the holotype were made to the nearest 0.1 mm using digital calipers. After morphological examinations and photos were completed, the specimen was returned and is deposited in the Australian National Insect Collection, under ANIC Database No. 15 000074.

Photographs of the nymph in the Queensland Museum collection (#PS2319) were taken by Geoff Thompson on a Dun Inc. BK-Plus imaging system with Dynalite studio flash, on a Canon 5DS, MP-E65mm 1-5x f2.8 Macro lens at 2.5X, modified and exported with Capture One Pro, focus stacked with Zerene Stacker software, before further processing with Photoshop CS6-extended. The photograph of the *N. pygmaeum* specimen from the Wollaston Expedition was taken by the Natural History Museum United Kingdom (NHMUK) staff, and were used under the license CC0-1.0 (NHMUK, 2018).

No additional specimens of *Nanophyllum* collected in Australia could be located by the authors to review or include as paratype

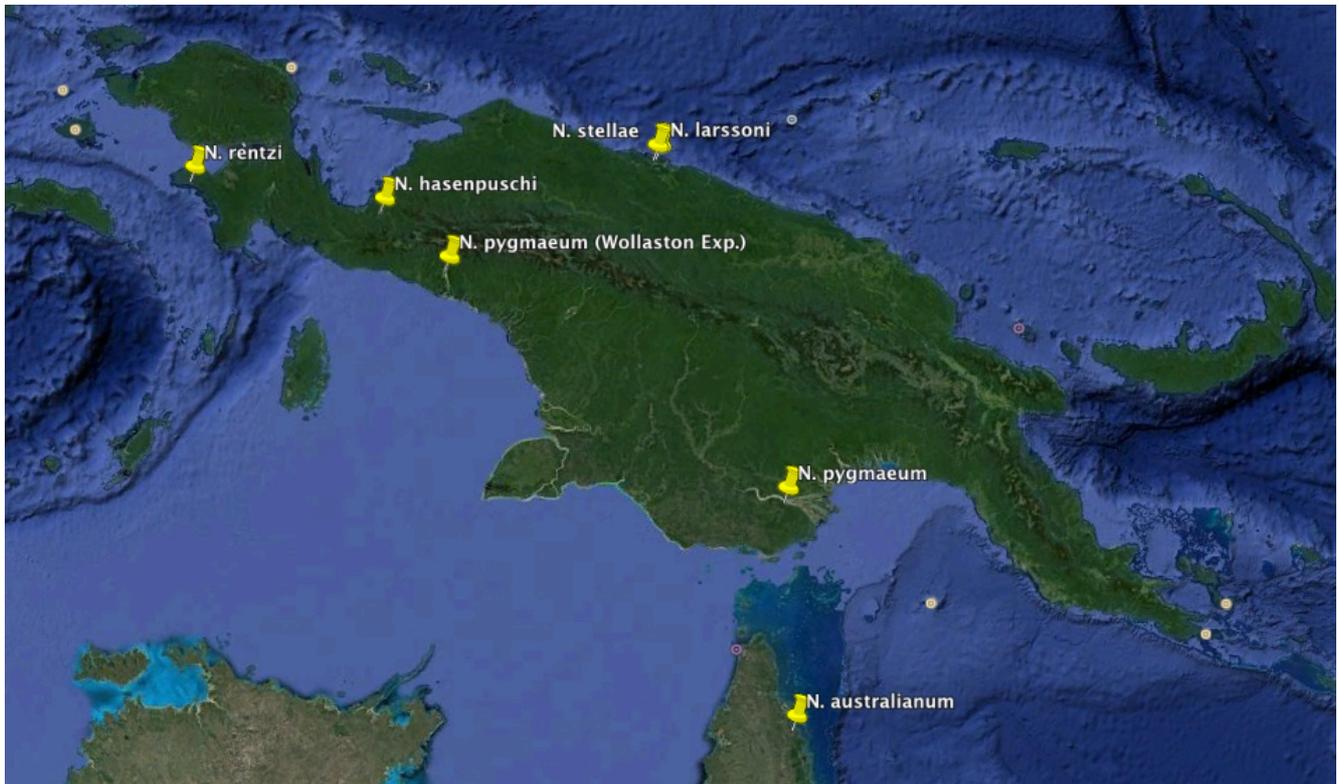


Fig. 1. - Distribution map for mappable *Nanophyllium* records. All marked specimens represent the holotype localities except for the record of *N. pygmaeum* from the Wollaston Expedition collected along the Utakwa River (Figure 4). (Google Earth: Image Landsat/ Copernicus: Data SIO, NOAA, U.S. Navy, NGA, GEBCO: Image date December 13th, 2015, Accessed July 10th, 2018).

material, despite examination of several hundred specimens from many institutions around the world with notable Phylliidae collections.

Description

Nanophyllium australianum Cumming, Le Tirant & Teemsma n. sp. (Fig. 3)

ZooBank : <http://zoobank.org/2FA4651D-95A2-46A5-AB3B-74DCB2C479AC>

Holotype, ♂: AUSTRALIA: 12.44S 143.14E, 3km ENE. of Mt.Tozer, nr, Iron Range Nat. Park, Qld, 28 June-4 July 1986, D.C.F.Rentz. Stop I-3, rainforest. Collected as nymph, matured 25.XII.86, Died 9.I.87. ANIC Database No. 15 000074. Deposited in the Australian National Insect Collection type collection.

Differentiation. – With the interior lobe of the profemora distinctly angled, the mesolpleurae with spination throughout, and the mesofemora interior lobe marked with notable serration and greatly reduced at the distal and proximal ends, this new species falls within the pygmaeum species-group (Cumming, 2017). This endemic Australian species is easily distinguished from all other *Nanophyllium* by the exterior lobe of the profemora which is greatly reduced, no wider than the shaft of the profemora. This notable morphological difference from all other *Nanophyllium* species as well as the notable geographic isolation from other known species warrants full species status. As with all other species of *Nanophyllium*, the female sex is currently unknown in *Nanophyllium australianum* n. sp. and it is hoped that by recognizing this species as endemic to Australia that the female will one day be located and recognized as significant.

Coloration. – Antennae uniformly brown, only slightly darker than the brown found throughout the remainder of the body. The majority of the dorsal aspect throughout the body is brown

except for; the metathorax which is straw yellow, and a strip of green coloration along each side of the central body cavity. Alae and tegmina of a similar uniform brown coloration to that found throughout the dorsal surface. Throughout the ventral surface the coloration is lighter than that found on the dorsal surface. Ventral of head through thorax straw yellow to pale green, with a majority of the abdomen also pale green, with only the margins of segments II-V brown. Legs are of a similar brown to that found on the dorsal surface of the body. Coloration description is based upon the dried specimen, which appears to have maintained the original coloration rather well when compared to color photographs of the specimen while alive (Brock and Hasenpusch, 2009).

Morphology

Head. – *Capsule* as long as wide, with a vertex that is flat, lacking granulation, but with a rough appearing texture. – *Posteriomedian tubercle* is broad and does not appear to split into two distinct tubercles as are clearly present in other congeners. Three well-developed ocelli are situated between the compound eyes, which are ovular and distinctly protruding from the head capsule. – *Antennae* longer than outstretched forelegs, with 22 segments (including the scapus and pedicellus) with segments III-XX covered in straight bristle like setae each longer than the segment is wide. – *Scapus* and *pedicellus* almost completely lacking setae, only three to four short setae are detectable. – *Terminal two antennal segments* lack setae longer than the segments are wide, instead they have a dense covering in stout setae.

Thorax. – *Pronotum* slightly wider than long, with lateral margins that first slightly diverge, continue for about half of the length parallel, then converge to a slightly curved posterior. Pronotum surface flat but textured like the surface of the head. Surface lacks granulation but has a clear furrow along the sagittal plane and slight furrows originating in the center at the sagittal plane and angled slightly toward the anterior. – *Mesopraescutum* wider than long, with distinctly converging margins. All surfaces smooth, lacking granulation or spination, including the slightly raised sagittal plane and the lateral margins. – *Mesopleurae* slightly diverge toward the posterior with a distinct downward crease in the center separating the mesopleurae into anterior and posterior halves. The anterior half has the most notable

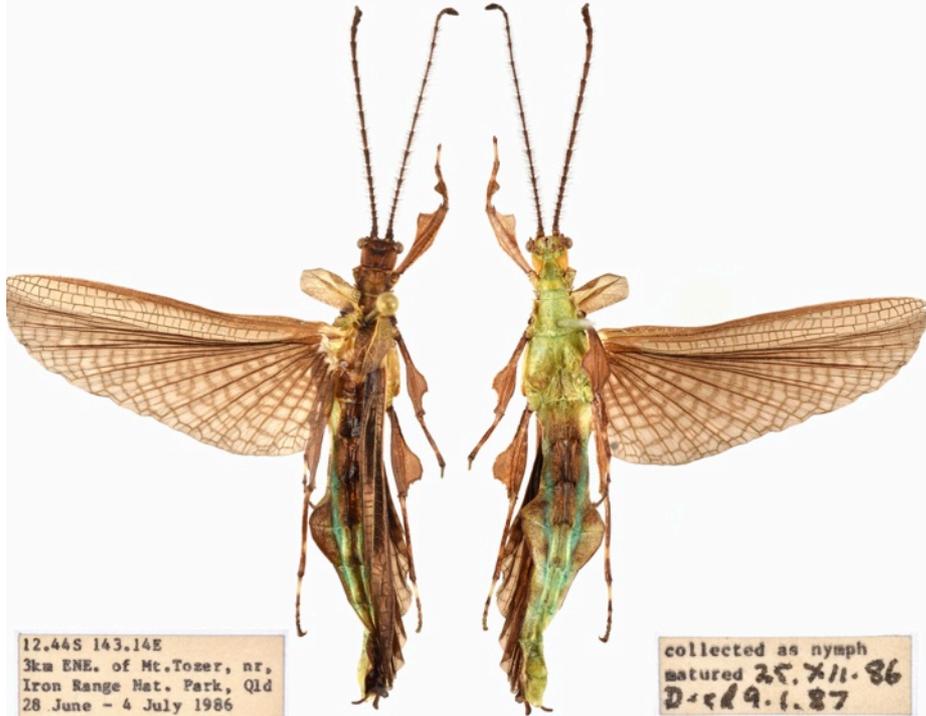


Gordon's Mine Area,
Iron Range, N.Qld.
12-19.ii.1976
G.B.Monteith
Rainforest

Photog.Spm
PS2319

Nanophyllium
pygmaeum Redten.

Fig. 2. - Phylliid nymph collected by Geoff Monteith in 1976 and the collection labels.



12.44S 143.14E
3km ENE. of Mt.Toser, nr,
Iron Range Nat. Park, Qld
28 June - 4 July 1986
D.C.F.Rentz. Stop I-3
rainforest

collected as nymph
matured 25.XII.86
D-589.1.87

ANIC Database No.
15 000074



Fig. 3. - Holotype *Nanophyllium australianum* n. sp. and data labels.



Brit. Mus.
1922-96.

NHMK 012497238

Nanophyllium pygma
-eum
Redtenbacher 1906
Det. P.Brock 2002

Dutch New Guinea:
Utakwa River.
ix. 1912-iii. 1913.
A.F.R. Wollaston.

Fig. 4. - Notable *Nanophyllium pygmaeum* male collected on the Wollaston Expedition adding a range expansion for the species outside of Papua New Guinea, on to the Indonesian half of the island. (Copyright: NHMUK, 2018).

features, including the largest spine on the anterior rim, followed by a node, two less prominent spines, and near the crease an additional node. The posterior half of the mesopleurae is only marked with one to two small spines near the crease, the remainder of the mesopleurae lacks nodes and spines. Surface of mesopleurae smooth, with the notable furrow angled towards the anterior. Entire ventral aspect of thorax smooth, no granulation or a notable texture. – *Tegmina* (length 4.1 mm, maximum width 2.1 mm) only reaching three quarters of the way through the metathorax.

Alae. – Well developed in a long oval fan configuration (length 20.1 mm), with the exposed area of the folded alae not notably sclerotized.

Abdomen. – Abdominal segments II-III with approximately parallel margins, IV diverging and the widest segment, V-VII distinctly then gradually converging, VIII approximately parallel, IX-X converging to a slightly curved apex. The margin of tergite X has three to four distinct nubby teeth on each side of the sagittal plane. – *Poculum* starts a third of the way through abdominal segment VIII and ends in a broad rounded apex with a distinct single row of thin black setae. *Poculum* reaches about halfway through segment X. – *Cercus* long, with slightly cupped margins, and with dense, stout setae covering all surfaces. – *Vomer* broad and long nearly reaching the apex of segment X.

Legs. – *Profemora interior lobe* triangular in approximately a right angle with three stout, evenly spaced teeth. – *Profemora exterior lobe* greatly reduced, but reaches end to end in a gentle arc only as wide as the profemoral shaft, and marked only with stout setae which are mostly evenly spaced. – *Protibiae exterior lobe* only a slight bulge on the proximal half, only slightly detectable when compared to the clearly defined interior lobe on the proximal half in an obtuse smooth triangle slightly wider than the protibiae shaft. – *Mesofemora exterior lobe* gently arcing end to end with the widest point just distal to the midpoint and at its widest as wide as the mesofemoral shaft. – *Mesofemora interior lobe* reduced at the distal and proximal ends with a distinct lobe slightly situated more towards the distal end of the

mesofemora marked with two distinct teeth, one near the distal end and one near the top of the arc. – *Interior lobe of metafemora* wide and concentrated just distal to the center with distal and proximal ends reduced, distal half of the lobe with three distinct teeth. – *Exterior lobe of metafemora* gently arcing end to end without teeth, thinner than the metafemoral shaft. – *Mesotibiae* with a small rounded triangular lobe on the exterior near the center, interior of mesotibiae lacking lobes. – *Metatibiae* simple, lacking lobes.

Measurements of holotype [mm]

- length of body (including cerci and head, excluding antennae): 27.1
- length/width of head: 2.0/2.0
- antennae: 13.5
- pronotum: 1.5
- mesonotum: 1.6
- length/width of tegmina: 4.1/2.1
- length/width of alae: 20.1/8.2
- greatest width of abdomen: 5.2
- profemora: 4.4
- mesofemora: 4.6
- metafemora: 5.0
- protibiae: 3.4
- mesotibiae: 3.9
- metatibiae: 4.9.

Distribution. – The genus *Nanophyllium* has been recorded from throughout the island of New Guinea and from the single confirmed record from Queensland Australia (Figure 1). All data points mapped in figure 1 represent the holotype specimen except for a notable *Nanophyllium pygmaeum* from the Natural History Museum, United Kingdom collection, collected in 1912-1913 on the Wollaston Expedition in present day Irian Jaya. This confirmed record of *Nanophyllium pygmaeum* from the Indonesian side of

Key to species-groups and known males of the genus *Nanophyllium* Redtenbacher, 1906

1. Mesopleurae with a single, anterior spine present, the remainder lacks spination; profemoral interior lobe rounded without a sharp angle; mesofemoral interior lobe a large rounded triangle, reaching from end to end and without prominent spination; metafemoral interior lobe of a similar width to the exterior lobe: *stellae* species-group **2.**
 - Mesopleurae with distinct spination from end to end; profemoral interior lobe with a sharp angle giving the profemora a boxy appearance; mesofemoral interior lobe reduced at each end creating an overall angular shape with prominent spination present; metafemoral interior lobe notably wider than the exterior lobe: *pygmaeum* species-group **3.**
2. Exterior profemoral lobe smoothly rounded with an obtuse angle; abdominal segments V-VII with straight, converging lateral margins giving the abdomen a spade-shaped appearance *N. stellae* Cumming, 2016
 - Exterior profemoral lobe slightly recurved creating an overall acute angle; segments V-VII each with margins that expand and then contract creating a scalloped edge *N. larssoni* Cumming, 2017
3. Exterior profemora lobe distinct, wider than the width of the profemoral shaft **4.**
 - Exterior lobe of profemora greatly reduced, not wider than the width of the profemoral shaft *N. australianum* Cumming, Le Tirant, and Teemsma, new species
4. Exterior lobe of profemora notably tapered on the distal and proximal ends; the interior lobe of the profemora can be of the same size as the exterior lobe or larger than the exterior lobe **5.**
 - Exterior lobe of profemora only notably tapered on the proximal end, with the distal nearly reaching the end of the profemoral shaft; profemora interior lobe always smaller than the exterior lobe *N. adisi* Zompro & Grösser, 2003
5. Tegmina, head, and thorax brown; alae partially to completely brown **6.**
 - Tegmina/alae transparent; head and thorax pale green *N. rentzi* Brock & Grösser, 2008
6. Alae almost completely brown, or completely brown in color *N. pygmaeum* Redtenbacher, 1906
 - Only the alae margin and sclerotized section brown, interior half of the alae transparent *N. hasenpuschi* Brock & Grösser, 2008

New Guinea adds an additional species to the ever growing number of species found in the country. The only species that could not be accurately included in the distribution map is *Nanophyllum adisi* Zompro & Grösser, 2003 which was unable to be mapped due to vague collection data.

At the present, the *stellae* species-group is only known from north of the east/west mountain ranges and has yet to be recorded elsewhere on the island. Whereas, the *pygmaeum* species-group has a broader distribution, with species found throughout New Guinea and with *Nanophyllum australianum* n. sp. from Australia.

It is the author's opinion that *Nanophyllum australianum* n. sp. is likely the sole species of *Nanophyllum* in Australia due to the somewhat restricted range of Phylliidae to only the Northeast coast (see map in Brock and Hasenpusch, 2003). It is also our believe that there are likely several additional species of *Nanophyllum* still to be described from the island of New Guinea due to the significant increase in *Nanophyllum* species recorded from the island in the last two decades.

Etymology. – This species is given the toponym of *australianum* in honor of it being the first and currently only confirmed *Nanophyllum* species recorded from the country.

Notes on Conservation. – The species *Nanophyllum pygmaeum* is currently recognized as “Data Deficient” under the IUCN Red List (Rudolf and Brock, 2017). This listing was likely due in part to the unclarified distribution of the species and the assumed fragmented nature of its range, with the holotype *Nanophyllum pygmaeum* known from southern Papua New Guinea and the Australian record separated from it by the Torres Strait. The Australian population is now recognized as a separate species and as stated by the IUCN, *Nanophyllum australianum* n. sp. occurs in the Iron Range National Park, therefore it is likely protected from human influence (Rudolf and Brock, 2017). The true *Nanophyllum pygmaeum* from southern Papua New Guinea is above noted as having a range that expands westwards to include a record from Irian Jaya, Indonesia and therefore can be found in two countries. The main threat to *Nanophyllum pygmaeum* is likely destruction of habitat from deforestation, but at this time the designation of “Data Deficient” should remain as so few specimens have been recorded, which give only an initial view into the true distribution of the species.

Acknowledgments

Specimen courtesy of the Australian National Insect Collection, CSIRO. The authors thank Youning Su and Cate Lemann at CSIRO for their collaboration with this rare species. René Limoges, entomological technician at the Montreal Insectarium for taking many of the photos for this work, as well as for many professional courtesies. Michael Crisp for the photo of Iron Range which was used on the cover. Geoff Monteith for discussion on his additional nymph collected in 1976, and notes about the region and habitat. Geoff Thompson and the Queensland Museum for the photos of the

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Résumé

Cumming R. T., Le Tirant S. & Teemsma S. N., 2018. – Description de *Nanophyllum australianum* n. sp. sur un exemplaire unique du Nord-Est de l'Australie, préalablement déterminé comme *Nanophyllum pygmaeum* Redtenbacher, 1906 (Phasmida, Phylliidae). *Faunitaxys*, 6(9) : 1 – 5.

Une nouvelle espèce de nano insecte-feuille, *Nanophyllum australianum* n. sp. Cumming, Le Tirant & Teemsma (Phasmida, Phylliidae) est décrite à partir d'un unique spécimen adulte du Queensland (Australie) considéré jusqu'ici comme une extension géographique de *Nanophyllum pygmaeum* Redtenbacher, 1906 (Rentz, 1988). Le réexamen de ce spécimen ainsi que l'étude des variations intraspécifiques des autres *Nanophyllum*, ont révélé que l'espèce australienne est distincte et isolée géographiquement. Une clé des espèces est présentée.

Mots-clés. – Phasmata, Phasmida, Phylliidae, *Nanophyllum*, *pygmaeum*, *australianum*, taxonomie, nouvelle espèce, Australie, Papouasie Nouvelle-Guinée, insecte feuille, isolation géographique.

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