Cockroaches (Insecta, Blattodea) from caves of Polillo Island (Philippines), with description of a new species

Cristian C. Lucañas¹, Ireneo L. Lit, Jr.¹,²

¹ Entomology Section, Museum of Natural History (MNH), University of the Philippines Los Baños (UPLB), College, Laguna ² Environmental Biology Division, Institute of Biological Sciences (IBS), College of Arts and Sciences (CAS) UPLB

Corresponding author: Cristian C. Lucañas (cclucas@up.edu.ph)

Academic editor: O. Moldovan | Received 11 July 2016 | Accepted 9 September 2016 | Published 28 September 2016

Citation: Lucañas CC, Lit IL Jr. (2016) Cockroaches (Insecta, Blattodea) from caves of Polillo Island (Philippines), with description of a new species. Subterranean Biology 19: 51–64. doi: 10.3897/subtbiol.19.9804

Abstract

Cockroaches collected during a protracted series of fieldwork in several limestone caves in Polillo Island, Philippines were taxonomically studied. A new species of *Nocticola* (Nocticolidae), *N. gonzalezii* Lucañas & Lit, sp. n., is described. The male of *Periplaneta banksii* Hanitsch (Blattidae) is described for the first time. Altogether, the present cave cockroach fauna of the island consists of six species.

Keywords

Blaberidae, Blattidae, Burdeos, cave cockroaches, Ectobiidae, Nocticolidae, troglobiont

Introduction

Cockroaches are well represented in cave ecosystems. They are classified as: trogloxene, troglophile, guanobody or troglobiont depending on their specialization or adaptation to the cave environment (Chopard 1936, Roth and Willis 1960). Juberthie (2000) estimated that there are at least 31 species of troglobiont or obligate cavernicolous cockroaches worldwide but additional species are still waiting to be described.

Unfortunately, very few studies have been conducted regarding the diversity of Philippine cockroaches, maybe because the group includes species that are considered
household pests. Thus, limited information is available on the country’s fauna, especially in cave ecosystems. In recent years, the increasing interest in cave studies in the country has provided an opportunity to study the diversity of cockroaches in Philippine limestone caves.

The first documented troglobiont cockroaches in the Philippines were species of Nocticolidae from Rizal Province (Bolivar 1982), a few kilometers to the east of what is now Metro Manila. These were: *Nocticola simoni* Bolívar, 1892 (from a cave in San Mateo town), and *Nocticola caeca* Bolívar, 1892 (from Cueva de Talbac, in what is now Antipolo City). Roth (1988) also noted an unidentified *Nocticola* nymph from a cave in Montalban town (now called Rodriguez), also in Rizal Province, deposited in the Natural History Museum, Geneva, Switzerland.

Unfortunately, due to the limited knowledge on Philippine cockroach diversity, many species have often been misidentified. Encinares and Lit (2014) listed species found in caves in Polillo, including what they initially identified as Cryptocercidae sp. and Blattidae spp. 1, 2, 3 and 4. Lucañas et al. (2015) later clarified their identities to be *Pycnoscelus striatus* (Kirby, 1903) and *Hemithyrsocera* sp.

Mag-usara and Nuñeza (2014) reported *Polyzosteria limbata* Burmeister, 1838, *Calolampra irrorata* (Fabricius, 1775), *Methana marginalis* (Saussure, 1864) and *Ellipsidion* sp. from several caves in Siargao, Surigao del Norte. Although, we were not able to examine the specimens, it is likely that those cockroaches have been misidentified as the mentioned species are all restricted to Australia. Similarly, *Polyzosteria* and *Euablaberus* sp. have been reported from a cave in Lanao del Norte (Macud and Nuñeza 2014, Sobrepeña and Nuñeza 2014), which are known only from Australia and the neotropics, respectively.

Other than those, there have been very few studies regarding the diversity of cockroaches in caves. This paper provides a list of cockroaches collected from several caves in Polillo Island, Quezon Province in the Philippines.

**Materials and methods**

All examined specimens were either pinned (for larger specimens) or preserved in vials of 95% ethyl alcohol, unless otherwise indicated as mounted on slide using Canada Balsam. Slide preparations were made starting with cold maceration by soaking in 10% aqueous Potassium Hydroxide (KOH) solution for 24 hours at ambient room temperature. They were then washed in distilled water to remove unwanted undissolved internal contents, and then run through graded alcohol series and then anhydrous clove oil to remove excess ethanol. Finally, they were mounted on microscope slides using Canada Balsam. The following parameters were measured using a calibration micrometer for pinned specimens and calibrated ocular micrometer for slide mounted specimens:

**TL** (Total length) the length from the tip of the vertex (if exposed) or pronotum up to the tip of the tegmina at rest;
Cockroaches (Insecta, Blattodea) from caves of Polillo Island (Philippines)...

BL (Body length) the length from the tip of the vertex (if exposed) or pronotum up to the tip of the subgenital plate (in case of brachypterous/micropterous/apterous species, total length = body length);

Pn Pronotum length × width along the longest axis;

Tg Tegmina length along the longest axis.

Standard deviations for each measurement were also noted. Terminologies used for male genitalia follow Klass (1977), and Roth (2003) for other characters such as fore femoral armaments (Type A (robust spines terminating to 2–3 terminal spines), B (several proximal spines followed by row of smaller spinules with 2–3 terminal spines) and C (row of piliform spinules with 1–2 terminal spines).

Illustrations were made by tracing printed photomicrographs of clear slide-mounted specimens. The degree of sclerotization and pigmentation was made through line thickness and by stippling. All specimens are deposited in the Entomological Collection of the UPLB-MNH.

Taxonomy

Family Nocticolidae Bolívar, 1892
Genus Nocticola Bolívar, 1892

Nocticola gonzalezi Luкаnas & Lit, sp. n.
http://zoobank.org/7E3D0AEF-1BED-4DC7-89CC-CD534663BB68

Figure 1


Paratypes: 1 male, 1 female, 5 nymphs, same locality as holotype but 10.x.2013: (CC Luкаnas, UPLBMNH BLA-00221, ♀ (slide); -00222, ♂; -00223, nymph (slide); -00224a-d, 4 nymphs), “PARATYPE / Nocticola gonzalezi Luкаnas & Lit [laser printed on blue slide label or handwritten on blue label]”.

Type locality. Philippines: Polillo Island (Quezon Province): Cave 5, Sitio Puting Bato, Barangay Aluyon, Burdeos, on calcite rubble with insectivorous bat guano.


Roth (1988) noted the difficulty in separating nocticolid genera. Although Chopard (1945, 1966), being unable to differentiate Nocticola from Alluaudellina Chopard, 1932 noted the possibility of the two being synonyms, Nocticola differs from the latter by the absence of styles. Aside from Nocticola, only Cardacus Strand, 1928 lacks style in the
family. The former is distinguished from the latter by the absence of ocelli and exposed vertex. Following such dichotomy, this new species is placed under *Nocticola*.

This species can be distinguished from other troglobiotic *Nocticola* by the presence of an accessory hook-like phallomere which was only reported from two epigean species, *N. scytala* Andersen & Kjærandsen and *N. clavata* Andersen & Kjærandsen from Ghana, West Africa (Andersen and Kjærandsen 1995).
This species is similar to *N. simoni* and *N. caeca* in terms of coloration but differs in terms of size, *N. gonzalezi* being smaller. Unfortunately, the male genitalia of *N. simoni* and the male of *N. caeca* was not described by Bolivar (1892) and the location of the type specimens are unknown (Paris 1993).

Many *Nocticola* species are narrow endemics even among caves within a contiguous area (e.g. *N. simoni* was collected from a cave in San Mateo, Rizal Province and *N. caeca* from nearby Antipolo, also in Rizal Province). Considering this, as well as the morphological characteristics and the isolation of Cave 5 in Puting Bato, Burdeos, Polillo Island, we iterate the distinctness of *N. gonzalezi*.

**Description.** Size (mm): ♂, TL: 2.36 ± 0.13 mm; Pn: 0.50 ± 0.10 × 0.93 ± 0.05 mm; Tg: 1.13 ± 0.2. ♀ TL: 2.5 mm; Pn: 0.50 × 0.95 mm.

**Male.** (Fig. 1A,G). Yellowish brown throughout except for light brown pronotum and tegmina. Vertex of head slightly exposed; eyes reduced but larger than those of female (Fig. 1C); ocelli absent. Pronotum wider than long. Forewing reduced, venation simple indicated by spinules, rounded at apex; hind wing highly reduced, triangular with single vein. Legs very long, forefemur Type C1 (Fig. 1D); mid- and hind femur with apical spines; mid- and hind tibia with several minute spines on outer aspect; hind metatarsi longer than the rest; pulvilli and arolia absent, tarsal claw simple, symmetrical. Abdominal tergal gland absent (*simoni*-species-group (Roth 1988)). Supra-anal plate symmetrical. Style absent. Genitalia as illustrated (Fig. 1E), genital hook (L3) conspicuous, extending well beyond subgenital plate. Accessory hook-like phallomere (L2d) dagger-like.

**Female.** (Fig. 1B,H) Larger than male. Opaque yellow throughout except for lateral thoracic margins. Apterous. Supra-anal plate triangular. Subgenital plate broad basally, valvular.

**Nymphs.** Similar to female. Opaque white. Eyes reduced to 3-4 distinct facets.

**Etymology.** The species is named after Dr. Juan Carlos T. Gonzalez, the current director of the UPLB-MNH, in recognition of his pioneering efforts toward biodiversity documentation and conservation in the Polillos, a group of islands, east of Luzon and politically a part of Quezon Province.

**Distribution.** Philippines: Polillo Island.

**Ecology.** Collected only from a single cave in Burdeos, Polillo Island, Quezon. The cave is deposited with porous calcite rocks and thin guano deposits from periodical roost of insectivorous bats, *Hipposideros coronatus* (Peters, 1871) and *Miniopterus schreibersii* (Kuhl, 1817). The site is relatively dry and rocky compared to the damp and sticky clay that is found throughout the rest of the cave, especially during the rainy season. They are quite fast and usually hide among the holes in the calcite rocks. They are found among and probably serve as prey for nymphs of whipspiders (Arachnida: Amblypygi), whipscorpions (Thelyphonida) and adult short-tailed whipscorpion (Schizomida).

**Conservation status.** Due to the narrow distribution of this species, it is suggested that the species be considered “Vulnerable” and that the cave from which it was collected be protected from further anthropogenic disturbances.

**Remarks.** Because of its morphological characteristics, this species can be classified as a true cave-dweller or troglobiotic.
Family Blattidae Stephens, 1829
Genus *Periplaneta* Burmeister, 1838

*Periplaneta banksii* Hanitsch, 1931


**Diagnosis.** Reddish-brown throughout. Fore femur A2 (Fig. 2C). Tegmina well developed (Fig. 2A). Arolia minute. Tarsal claws simple, symmetrical. Male supra-anal plate symmetrical, deeply divided, each lobe rounded and with minute round projection apically (Fig. 2G). Cerci erect, pointed (Fig. 2G). Genital hook (Fig. 2E: L3) angulate, with minute sub-apical process.

Hanitsch (1931) noted the relatively large size of the species compared to other *Periplaneta* species.

**Description.** Size (mm): ♂ TL: 45.71 ± 2.29; BL: 37.42 ± 3.69; Pn: 11.57 ± 0.79 × 14.86 ± 1.46; Tg: 35.71 ± 2.29; ♀ TL: 48.5 ± 2.01; BL: 41 ± 2.53; Pn: 11.6 ± 0.51 × 15.8 ± 1.03; Tg: 37.7 ± 2.41.


**Female.** Similar to male except that supra-anal plate rounded with deep division. Subgenital plate valvular.

**Distribution.** Philippines, Taiwan

**Ecology.** This is the first record of the species inside caves. The species is abundant and most individuals hid among the crevices of the cave walls. They were found from the twilight to the dark zone. Nymphs and mating pairs were often seen, suggesting that the species can complete their life cycle within the cave. Despite that, *P. banksii* is classified as troglophilic because of the lack of distinct troglobiotic characters and the possibility of the species surviving outside cave conditions.

Both nymphs and adults are possibly preyed upon by whipspiders, *Charon* sp., and huntsman spiders, *Heteropoda* sp.
Figure 2. *Periplaneta banksi* Hanitsch, 1931: A Adult female B head C prothoracic leg D tarsal claws E male genitalia: (L1-3: left phallomere sclerites; L2v: L2 ventral sclerite; R1-3: right phallomere sclerite; vph: ventral phallomere) F L2v close-up G male supra-anal plate H female subgenital plate.

Remarks. Hanitsch (1931) described *P. banksi* from a single female specimen from the Philippines without any further details on its collection locality. Asahinai (1980) later described another female specimen from Taiwan. This is the first time the male of this species is described.

The species resembles *P. lata* (Herbst, 1786), but differs primarily by its larger size. Bruinjing (1948) noted the possibility of the two species being synonyms, but a detailed examination of the male genitalia of *P. lata* is needed to confirm this.

Family Blaberidae Saussure, 1864
Subfamily Pycnoscelinae McKittrick, 1964
Genus *Pycnoscelus* Scudder, 1862

*Pycnoscelus striatus* (Kirby, 1903)
Figure 3


Description. Size (mm): ♂ TL: 14.25 ± 1.32; BL: 13.59 ± 1.15; Pn: 4.57 ± 0.42 × 5.91 ± 0.65; Tg: 9.68 ± 1.56; ♀ TL: 21.39 ± 1.91; BL: 17.67 ± 1.97; Pn: 5.97 ± 0.40 × 7.42 ± 0.43; Tg: 16.67 ± 1.91.

Male. Often less than half the size of females. Vertex exposed. Ocelli present. Pronotum rhomboid, almost as long as wide, reddish-brown, densely punctured. Tegmina variable, reaching slightly beyond abdomen or reaching only up to 7th abdominal tergite. Fore femur C₁. Mid- and hind femur unarmed. Pulvilli present on four proximal tarsomeres. Hind metatarsomere slightly longer than succeeding tarsomeres combined. Tarsal claws simple, symmetrical. Arolia minute. Abdominal tergites un-
Cockroaches (Insecta, Blattodea) from caves of Polillo Island (Philippines)...


**Female.** Almost similar to males except larger and robust. Wing size highly variable. Subgenital plate entire.

**Distribution.** Malaysia (Malacca), Indonesia (Sumatra, Kalimantan), Philippines.

**Ecology.** McClure (1965) noted that *P. striatus* reaches very high population density, reaching up to 3000/m² of guano on Batu Caves, Malaysia. Similarly, individuals from Cave 3-4 form dense populations in thick guano from the fruit bat *Rousettus amplexicaudatus* (Geoffroy, 1810), but are also found in small population on dark zone with thin guano from insectivorous bats. They classified as guanobytas as they burrow beneath layers of guano. They are found together with and may serve as prey to *Phologgiellus kwebaburdeos* Barrion-Dupo et al., 2014 (Barrion-Dupo et al. 2014, Rasalan et al. 2015), scutigerid centipedes, *Scutigera* sp. and some whipspiders, *Charon* sp.

**Remarks.** Roth (1998) reported a female specimen collected from bat guano in Manhuyod or Negros. Roth temporarily assigned it as *Pycnoscelus* sp C. due to the absence of a male specimen, but stated that it closely resembles *P. striatus*. The specimen is deposited in the Zoological Institute, Department of Systematics, Lund, Sweden. Several specimens collected from Burdeos have the same interocular width as *Pycnoscelus* sp. C (2.3mm), while some fit with *P. striatus* (1.5-1.7mm). Therefore, it is possible that *Pycnoscelus* sp. C is a variation of *P. striatus*. Additional specimens, particularly from the same collection locality of *Pycnoscelus* sp. C, are needed to confirm this.

The foregoing description of the right style (*i.e.* rounded apically) differs from that of Roth (1998), which he illustrated as acute apically.

*Pycnoscelus* sp. D

**Figure 4A**


**Description.** Size (mm): ♀ TL: 21.5 ± 0.71; BL: 18.5 ± 0.71; Pn: 6.5 ± 0.71 × 8.5 ± 0.71; Tg: 17.5 ± 0.71.

**Male:** Unknown


**Ecology.** The species was collected on thick guano piles of mix bat populations in Cave 2. In contrast with *P. striatus*, the species was present only on the top layer of the guano and does not burrow much even if disturbed.
Figure 4. Other cave cockroaches from Polillo Island, Quezon: A Blaberidae: *Pycnoscelus* sp. D adult female B Ectobiidae: *Shelfordina* sp., adult female C *Hemithysocera* sp., early instar nymph.

Remarks. This species or form is closely similar to *P. striatus* and may prove to be only a variation. For now, it is treated separately because of its darker coloration, robust abdomen, rather convex body, large arolia and the presence of narrow anterolateral band on its pronotum. The absence of a male specimen hinders further identification.

Roth (1998) described unverified species of *Pycnoscelus* and temporarily assigned them as spp. A, B and C. In order to avoid confusion, this specimen is temporarily named as *Pycnoscelus* sp. D.

Family Ectobiidae Brunner von Wattenwyl, 1865
Subfamily Pseudophyllodromiinae (temporary name)
Genus *Shelfordina* Hebard, 1929

*Shelfordina* sp.

Figure 4B

Material examined. 1 female: Philippines: Polillo Island (Quezon Province): Cave 3-4, Sitio Puting Bato, Barangay Aluyon, Burdeos, 01.iii.2013 (CC Lucañas, UPL-BMNH BLA-00533).

Description. Size (mm): TL: 13.50; Pn: 3.00 × 4.00; Tg: 10.00.

Male: Unknown.

Female: Vertex of head slightly exposed. Ocelli minute. Pronotum anteriorly ellipsoidal, wider than long, with brown central maculae, anterior and lateral areas hyaline. Fore femur type A2. Mid femora armed with row of spines on outer aspect. Hind
femora missing from specimen. All tarsomeres with pulvilli, 1-3 spined. Tarsal claws symmetrical with minute dentations. Arolium present. Tegmina well-developed.

**Remarks.** Accidentals. Since only one female specimen was collected and trogloborphic characters are absent, it can be said that its presence in the cave was accidental.

Roth (1990) described *Shelfordina philippensis* from Camarines Sur, but later transferred it to the genus *Margattea* (Roth 1996). Both genera are morphologically similar except for the armature of the fore femora, i.e., type A for *Shelfordina* and B for *Margattea*, and the presence of tergal gland on the eighth abdominal segment in males of *Margattea*.

Subfamily Blattellinae Karny, 1908

Genus *Hemithyrsocera* Saussure, 1893

**Hemithyrsocera sp.**

Figure 4C

**Material examined.** 3 nymphs: Philippines: Polillo Island (Quezon Province): Bulalon Cave, Burdeos (v.2010 JMA Encinares, UPLBMNH BLA-00441-00442, nymphs); Cave 3-4 (v.2011 JMA Encinares, UPLBMNH BLA-00532, nymph).

**Description.** Front femur A2, pulvilli on 4 proximal tarsomeres, tarsal claw simple and symmetric, arolium present. Quite similar to nymphs of *H. silbergliedi* except for the broad lateral white margin of the pronotum and completely black abdomen.

**Remarks.** Accidentals. This species has been previously recorded only from Bulalon Cave (Lucañas et al. 2015) with only a few early instar nymphs collected inside the cave. Even though *H. silbergliedi* (Roth, 1985) is abundant outside the caves, the slight differences in pronotal coloration and the absence of adult specimens hinders further identification.

**Acknowledgements**

The authors would like to express their gratitude to the UPLB-MNH staff for allowing the first author to tag along during their expeditions and for the use of their laboratory equipment and space during the examination of the specimens; Dr. Aimee Lynn B. Dupo for the use of camera that generated high quality images; IBS Cave Ecology Laboratory, also for the use of space and facilities; Mr. John Mark A. Encinares for the information regarding the specimens from Bulalon and Mapanghe caves; Dr. George W. Beccaloni, Dr. Darren J. Mann and Dr. Christine A. Nalepa for sending references otherwise unavailable to us; and lastly, the local government of Burdeos, Quezon for the permission to conduct the study and the Polillo Ecology Wardens for their support during the fieldwork, without which these expeditions will not be possible. Funding for initial fieldwork in Polillo was received from the UPLB Basic Research Project (No. 88-D66-00) of the second author.
References


Chopard L (1932) Un cas de microphthalmie lice a l’atrophie des ailes chez une blatte cavernicole. Societe de entomologique de France., Livre du Centenaire, Paris, 486–496


Kirby WF (1903) Notes on Blattidae, with descriptions of new genera and species in the collection of the British Museum, South Kennigton. The Annals and Magazine of Natural History 7(7): 404–415. doi: 10.1080/00222930308678790


Rasalan JB, Barrion-Dupo ALA, Bicaldo PRD, Sotto MP (2015) Spider assemblages of Puting Bato Cave 3–4 and surrounding karst forest environs, with additional notes on the cave-
dwell


