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Short Communication

NEW RECORDS OF COCKROACHES FROM CAVES IN SAMAL ISLAND, PHILIPPINES, WITH NOTES ON THE INVASIVE *PERIPLANETA AMERICANA* (L.) (BLATTODEA: BLATTIDAE)

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ABSTRACT

During a survey of caves in Samal Island, Philippines, two species of cockroaches were collected, namely: *Periplaneta banksi* Hanitsch from Baga Cave, and *P. americana* (L.), from Manan-ao Cave. This is the first record of *P. banksi* in the southern Philippines and *P. americana* inside Philippine caves. The role of human disturbance on the invasion by alien species and consequent displacement of local fauna in cave habitats is discussed.

Keywords: cave cockroaches; cave disturbance; invasive species; *Periplaneta* spp; trogophile; trogloxenes.

INTRODUCTION

Cockroaches (Dictyoptera: Blattodea) are ubiquitous insects found in nearly all types of environments and are common in tropical cave habitats (Roth and Willis, 1960). These highly opportunistic insects are found in several substrates, including different types of guano, and may establish huge populations (Gnaspini, 2005). For instance, Braack (1989) recorded several species in a single cave, with the population of one species reaching 75,000 individuals and of two other species each reaching 40,000–50,000 individuals.

In the Philippines, knowledge of cave cockroaches has gradually increased. Cockroaches have been reported from caves in Pangasinan (Encinares, 2019), Rizal (Bolivar, 1892; Roth, 1988), Polillo Island (Encinares & Lit 2014; Lucañas et al., 2015; Lucañas & Lit, 2016), Siargao Island (Mag-usara & Nuñeza, 2014) and Lanao del Norte (Macud and Nuñeza, 2014; Sobrepeña and Nuñeza, 2014), although Lucañas & Lit (2016) noted that those from Siargao and Lanao del Norte have been most likely misidentified (Table 1).

Here, cockroaches are reported from caves in Samal Island, Davao del Norte, in Mindanao, Philippines. Of the 30 caves in Samal Island surveyed for bat diversity (Quibod et al., 2019), two caves: Baga Cave and Manan-ao Cave are inhabited by cockroaches (Figure 1). Cockroaches were collected and preserved in alcohol. Specimens were pinned and identified based on pertinent literature. All specimens are deposited in the Entomology Section, University of the Philippines Los Baños Museum of Natural History.

Table 1. Summary of cockroaches reported from Philippine Caves.

	Cave	Locality	Cockroach Species	Reference
Luzon	Sto. Rosario Cave	Mabini, Pangasinan	*Nocticola* sp.	Encinares 2019
	Unnamed cave	San Mateo, Rizal	*Nocticola simoni* Bolivar	Bolivar 1892
	Cueva de Tablac	Antipolo, Rizal	*Nocticola caeca* Bolivar	Bolivar 1892
	Unnamed cave	Rodriguez, Rizal	*Nocticola* sp.	Roth 1988
	Bulalon Cave	Burdeos, Quezon	*Hemithyrsocera* sp. *Pycnoscelus striatus* Kirby	Lucañas et al. 2015
			Periplaneta banksi Hanitsch	Lucañas & Lit 2016
	Puting Bato Cave System		*Pycnoscelus striatus Kirby* *Pycnoscelus* sp. *Shelfordina* sp. *Nocticola gonzalezi* Lucanas & Lit	Lucañas & Lit 2016
Mindanao	Buho Cave	General Luna, Siargao	**Calolampra irrorata* (F.) **Polyzosteria limbata* Burmeister **Methana marginalis* Stal **Ellipsidion sp.*	Mag-usara & Nuñeza 2014
	Million-bat Cave	Del Carmen, Siargao	**Polyzosteria limbata* Burmeister	
	Guano Cave	Sta. Monica, Siargao	**Calolampra irrorata* (F.) **Polyzosteria limbata* Burmeister **Ellipsidion sp.*	
	Mighty Cave	Tagoloan, Lanao del Norte	**Blaberus giganteus* (L.) **Laxta granicollis* (Saussure) **Polyzosteria* sp.	Macud & Nuñeza 2014
	Cave 1	Wao, Lanao del Sur	**Eublaberus* sp.	Sobrepeña & Nuñeza 2014

* Possibly misidentified species

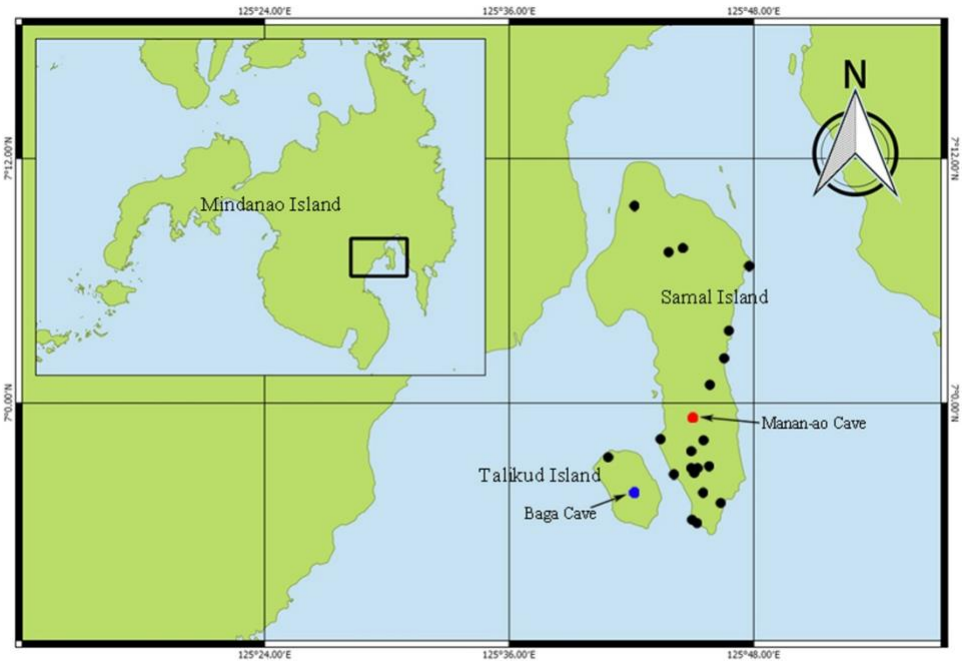

Figure 1. Samal and Talikud Islands, showing location of Manan-ao and Baga Cave. (Inset location of Samal Island in reference to Mindanao, Philippines).

TAXONOMIC ACCOUNT

Order Blattodea
Family Blattidae
Subfamily Blattinae
Genus *Periplaneta* Burmeister 1838

Species *Periplaneta americana* (Linnaeus 1758) (**Figure 2A-D**)

Material examined: 14 ♂, 1 ♀: PHILIPPINES: Mindanao, Samal Island, Manan ao Cave, v.2013, (ARLarona, UPLB MNH BLA-00251 – 00264♂, 00265 ♀)
Brief Diagnosis: This species is distinguished from other *Periplaneta* in the Philippines by its posteriorly recurved cerci in males, and (except *P. banksi*) by the absence of a setose gland on the first abdominal tergite. Its coloration is similar to that of *P. brunnea* Burmeister but differs in the unspecialized first abdominal tergite and recurved cerci.
Distribution: Cosmopolitan; Originating from tropical Africa (Princis, 1966), introduced to the rest of its current distribution primarily through trade and human occupation. Philippines: throughout the country, mainly near past and present human settlements.
Remarks: Troglophilic; invasive species. This species is very common among households and is considered to be one of the most widely distributed species. Interestingly, four of the fifteen collected individuals show a variation of the

compound eye similar to the "lavender" (**Figure 2C, D;** Ross et al., 1964). The other variant, "pearl", has also been observed in a population of *P. americana* from the mine tunnels of Glamorgan, Great Britain (Jefferson, 1958). According to the collector (ARLarona), the individuals from Manan-ao Cave were not as pungent as the usual domiciliary populations of this species.

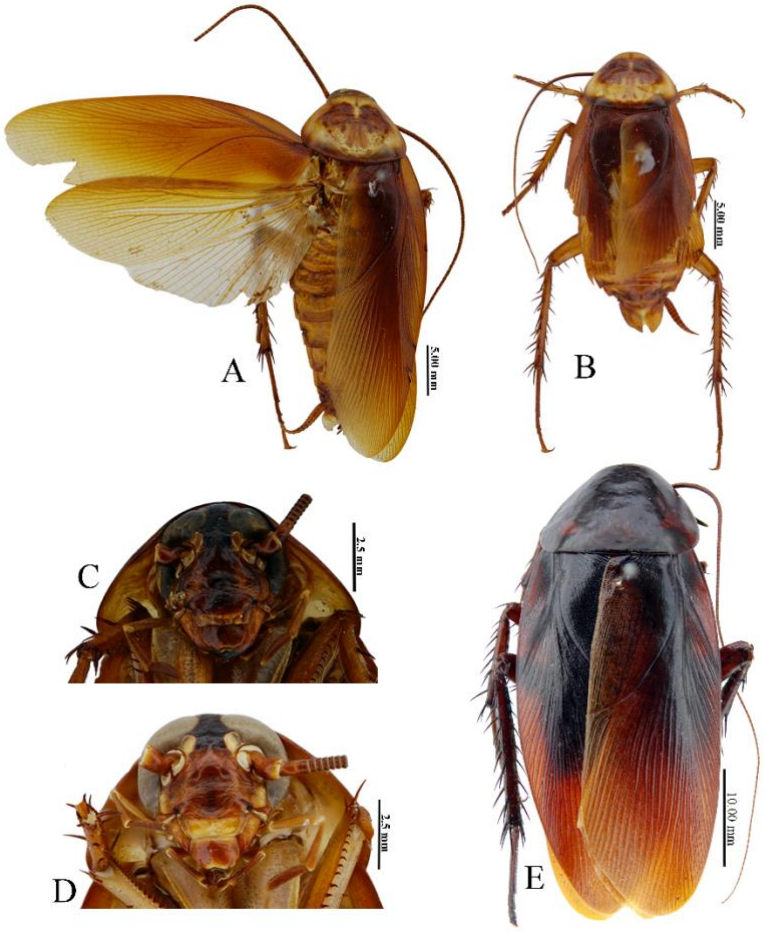

Figure 2.
Cockroaches from caves in Samal and Talikud Islands: *Periplaneta americana* from Manan-ao Cave: **A** Male; **B** female; **C** normal eye variant; **D** eye color variant; **E** *P. banksi* from Baga Cave.

Species *Periplaneta banksi* Hanitsch 1931 (Figure 2E)

Material examined: 1 ♂, 4 ♀: PHILIPPINES: Mindanao, Talikud Island, Baga Cave, v.2013, (PRDBicaldo, UPLB MNH BLA- 00249♂; 00250, 00710-00712 ♀)
Brief Diagnosis: This species is distinguished from other Philippine *Periplaneta* by its large size and (except for *P. americana*) by the absence of a setose gland on the first abdominal tergite. Its coloration is similar to that of *P. malaica* Karny, 1908 but differs in its large size, the unspecialized first abdominal tergite, and the divided subgenital plate, each lobe rounded with minute round projection.

Known Distribution: Philippines: Polillo Island (Lucañas & Lit, 1980).
Remarks: This species was recently redescribed by Lucañas & Lit (2016) from caves in Polillo Island. This is the first report of the species in Mindanao and the second on insular cave systems. Its presence in Baga Cave supports its classification as a troglophile (Lucañas & Lit, 2016).

DISCUSSION

Manan-ao Cave (Figure 3A) is one of the easily accessible caves in Samal Island, because of its proximity to the road and households. It runs a total length of 67.05 m, with only one entrance and a ceiling 26.13 m high. It houses large colonies of fruit bats, *Eonycteris spelaea* and *Rousettus amplexicaudatus*, which rivals those of Monfort Cave (Quibod et al., 2019). Because of those bat colonies, there is a thick layer of guano, supplying food to the cave floor biotic communities.

Unfortunately, also due to its proximity to human settlements, the cave is very prone to anthropogenic disturbances primarily uncontrolled entry and bat hunting. Human activities such as creating fires for bat hunting inside the cave have caused much damage not only to the vertebrates but also to the arthropods and other fauna inhabiting the cave system (Quibod et al., 2019). It had also allowed the entry and eventual colonization of the domiciliary American cockroach, *P. americana* (Linnaeus, 1758).

P. americana, also called the common house cockroach, is one of the most widespread species due to anthropogenic introductions through trade and transport (Rehn, 1945). It was originally described as *Blatta americana* and is hypothesized to be Ethiopian or Afrotropical in origin (Becalloni, 2014).

In the Philippines, it was first recorded by Bruner (1915) and was probably introduced during the early American colonization. Earlier accounts of insects and other arthropods, e.g., Casto de Elera (1895), did not include this species. Although it is abundant in and around human settlements, *P. americana* has not been previously recorded in Philippine caves. As with most cockroaches, *P. americana* is well adapted to dark and humid environments primarily due to its wide habitat tolerance range, lack of specialized feeding habits, and adaptability to low food supply (Culver, 1982). Despite that, they are classified as trogloxenes since they are more associated with urban environments. They are also considered gregarious, and were observed to have high preference to their habitat as long as there are enough resources for growth and reproduction (Bell and Adiyodi, 1982; Lihoreau et al., 2012). With abundant food sources in Manan-ao Cave, it occurs at high population density (Figure 3B), typical in caves with high guano concentration (Darlington, 1995). Adults and last instar nymphs cover the walls (Figure 3C) while early instar nymphs were present on the floor and lower crevices. Roth and Willis (1960) likened such to a sewer system harboring a dense population of *P. americana* in Minnesota.

Unlike its relative *P. australasiae* (Fabricius), the American cockroach is rarely found outside urban environments. Despite that, both were found on Batu Caves and Dark Cave in Malaysia and have been considered an ecological problem (Price and Steiner, 1999; Yussof, 1997). It had also been reported in a cave in Shimoni East Africa (Chopard, 1936), Vengurla in India (Abdulali, 1942), Madagascar (Chopard,1945), Grot van Hato in Netherlands, and Leamington Cave in Bermuda (Roth, 1988). It had also followed man in mining tunnels of Great Britain (Lucas, 1925; Jefferson, 1958), India (Chandler, 1926), and Sumatra (Hanitsch, 1929), where they feed primarily on human feces.

Outside caves, *P. americana* has been noted to outcompete and caused the local extinction of phalangopsine cricket, *Nesitathra philipensis* in Norfolk Island (Rentz, 1988). *P. americana* had also been reported from several caves in Malaysia and Thailand and were noted to have caused the declining population of *Pycnoscelus striatus* (Kirby) in Batu Cave, Malaysia (Price, 2004). It may have that it has displaced the native cave cockroach, like *P. banksi* Hanitsch which is present in Baga Cave of the nearby Talikud Island (Figure 1), and phalangopsine crickets. During the collection in Manan-ao Cave, no other cockroach species were seen or observed.

In comparison to Baga Cave, Manan-ao Cave is relatively shorter but with a higher ceiling, less diverse but more abundant in terms of bat population, although both are highly disturbed (Quibod et al., 2019). Despite that, *P. banksi* is still present in Baga Cave while *P. americana* is absent. Perhaps the length of Baga Cave, its distance from the nearest human settlements, and the presence of areas with relatively low oxygen (Quibod et al., 2019) have limited the invasion of the American cockroach in the cave, keeping *P. banksi* with less competition. Similarly, smaller and elongate forest fragments, especially those with high anthropogenic disturbance, are more easily invaded by exotic species than larger fragments (Laurence et al., 1997; Pellens and Grandcolas, 2002).

Overall, the encroachment of humans into natural ecosystems and habitats comes with it, intentionally or accidentally, invasive alien species, which confounds the direct damage and other disturbances brought about by humans. In terms of monitoring, the presence of invasive species should also be included in assessing the status of caves and other subterranean habitats.

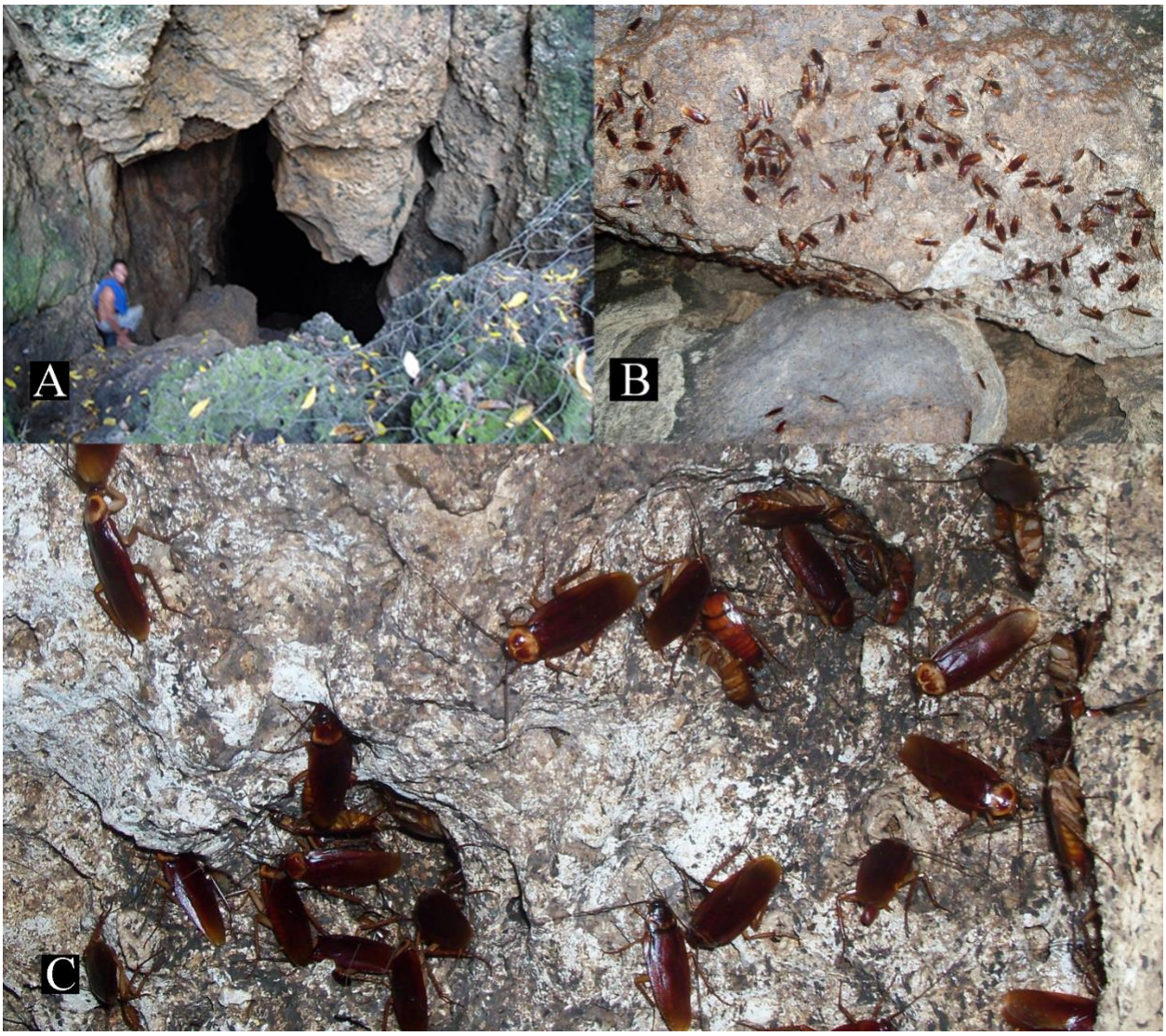

Figure 3. Cockroaches from Manan-ao cave: **A** entrance of Manan-ao Cave; **B** cave walls covered with *Periplaneta americana*; **C** closer view of cave wall, showing last instar nymphs and adult cockroaches

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