

Scientific Note

Male wing variation in the Cuban cockroach *Byrsotria fumigata* (Guérin-Méneville, 1857) (Blattodea: Blaberidae)

Variación alar en los machos de la cucaracha cubana *Byrsotria fumigata* (Guérin-Méneville, 1857)
(Blattodea: Blaberidae)

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Abstract. *Byrsotria fumigata* (Guérin-Méneville, 1857) is an endemic cockroach from Cuba which presents a remarkable variability in the male wings. This contribution addresses the differences in size and wing shape of males, previously reported on the literature. Brachypterous individuals are illustrated and the wing variation is quantified. The distribution of the species is expanded with two new localities.

Key words: Blaberinae; Blattaria; Cuba; West Indies; wing polymorphism.

Resumen. *Byrsotria fumigata* (Guérin-Méneville, 1857) es una cucaracha endémica de Cuba que presenta una marcada variabilidad en las alas de los machos. En esta contribución se abordan las diferencias en tamaño y forma alar de los machos, previamente reportada en la literatura. Se ilustran individuos braquípteros y se cuantifica la variación alar. La distribución de la especie se amplía con dos nuevas localidades.

Palabras clave: Antillas; Blaberinae; Blattaria; Cuba; polimorfismo alar.

Byrsotria fumigata (Guérin-Méneville, 1857) (Fig. 1) is a blaberid cockroach endemic to the Cuban archipelago. This species has a remarkable variability in the size and shape of male wings, even within the same population. Due to the confusion that this can cause in the taxonomic delimitation, individuals with different wing sizes have been treated as different species in the past, leading to the synonymy of various taxa (see examples in Gutiérrez & Linares 2003). The first mention of male wing polymorphism on *B. fumigata* was made by Rehn (1903), who states that *Byrsotria thunbergii* Stål, 1874 was erected on the basis of brachypterous individuals of *B. fumigata*. Rehn & Hebard (1927) validate this criterion of Rehn (*op. cit.*) and for the first time they illustrate a brachypterous male. Few years later, Roth & Willis (1960) publish photographs of both brachypterous and macropterous males, but only one picture of each wing morph. Gutiérrez & Linares (2003), in the review of the genus *Byrsotria* Stål, 1874, addressed this phenomenon with measurements and scale

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photographs of males with different degrees of wing development. However, they omitted images of males with extreme reduction of the wings (*i.e.*, brachypterous). The present study describes and illustrates brachypterous individuals, in comparison with those previously described by Gutiérrez & Linares (2003), to expand the knowledge on male wing variability in *B. fumigata*. Furthermore, the wing variation is quantified, starting from two groups of individuals from two new locations.

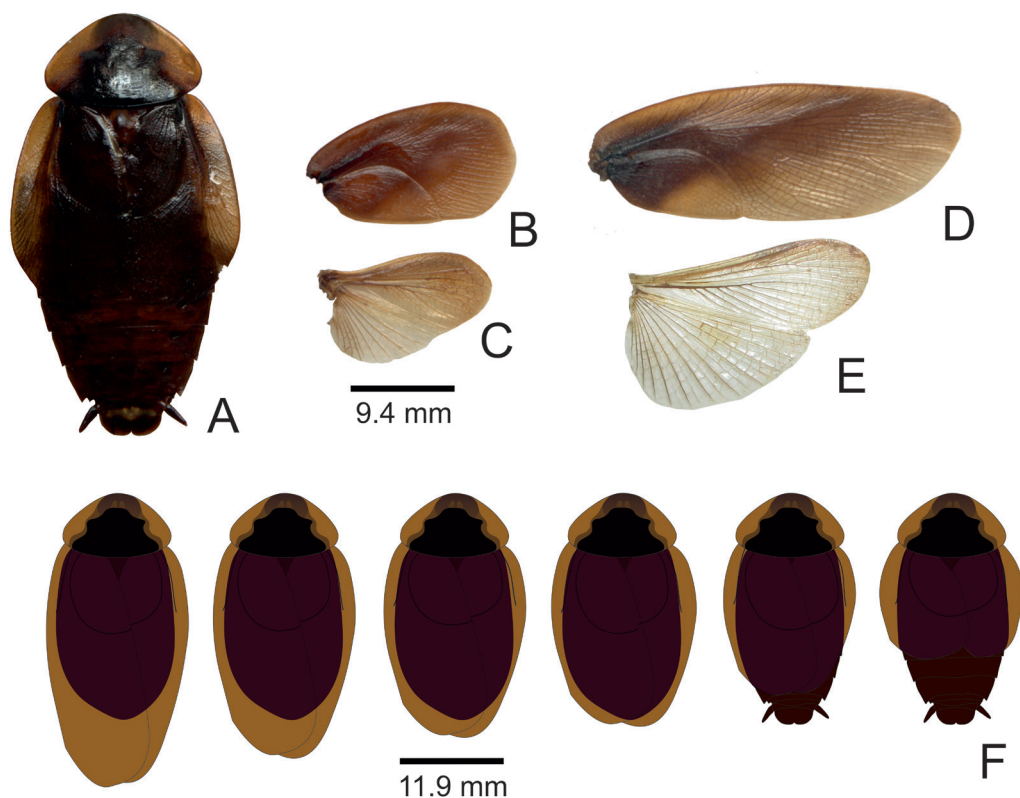


Figure 1. Differences in wing shape and size in males of *Byrsotria fumigata*. (A) dorsal view of a brachypterous individual, with its right tegmen (B) and membranous wing (C) detailed in dorsal view. For comparison, same detail views of the right tegmen (D) and membranous wing (E) of a macropterous individual are included. (F) continuous variation in tegmina, modified from Gutiérrez & Linares (2003). / 1. Diferencias en la forma y tamaño de las alas de los machos de *Byrsotria fumigata*. (A) vista dorsal de un individuo braquíptero, con el detalle de su tegmina (B) y ala membranosa (C) derechas en vista dorsal. Para comparación, se incluyen las mismas vistas en detalle de la tegmina (D) y ala membranosa (E) derecha de un individuo macróptero. (F) variación continua en las tegminas, modificado de Gutiérrez & Linares (2003).

Material examined. Corresponds to 24 individuals from two **new localities** for the species: 6♂♂: CUBA, Mayabeque Province, Jaruco Municipality, Boca de Jaruco, El Vaho Cave, 23°09'58" N / 81°59'43" W / 30 masl, April/2015, leg. R. Núñez (FBUH). 18♂♂: Escaleras de Jaruco, Aguirre Cave, 23°02'38" N / 82°03'42" W / 79 masl, 11/May/2019, leg. S. Yong & R. Teruel (SY).

All samples were collected manually, preserved in ethanol 80% and deposited at Facultad de Biología, Universidad de La Habana, Havana, Cuba (FBUH) and private collection of Sheyla Yong, Havana, Cuba (SYC). The identity of all samples was obtained

using the key for *Byrsotria* males, presented by Gutiérrez & Linares (2003). From dorsal photographs of the right tegmen and the entire body of each individual were measured the follow structures: Tegmen Length (TL), from tip to base; Tegmen Width (TW), measured at widest section; and Total Body Length (TBL), from the apex of the pronotum to the end of the abdomen, excluding cerci. Descriptive statistics were applied to these measures, where mean, minimum, maximum and standard deviation were obtained. For detailed study, the wings were dissected and mounted between two microscope slides sealed with wax.

Males of *B. fumigata* have a wide variability in the size and shape of the wings (Fig. 1F). The exposed wings (tegmina) may or may not exceed the posterior end of the abdomen, depending on the TL and TBL. The tegmina of brachypterous individuals have a more oval shape (Fig. 1B), different from the sub-elliptical of macropterous (Fig. 1D). Similarly, the membranous wings are more rounded in brachypterous individuals than in macropterous (Figs. 1C, 1E). With the series of individuals examined we found evidences of a continuum in tegmina sizes that goes from the anterior end of the V-tergite to the posterior end of the VIII-tergite.

The mean TL for the individuals studied is 27.43 mm (min-max: 18.30–36.50 mm), the mean TW is 13.51 mm (min-max: 11.00–17.40 mm) and the mean TBL 35.45 mm (min-max: 31.70–39.80 mm) (Table 1). Of the measures analyzed, the one with the highest variability was the TL (SD = 0.52 mm), which showed the great variability in the wing size amongst specimens from the same population. The means and maximums of the variables measured (TL, TW and TBL) exceeded those previously obtained by Gutiérrez & Linares (2003), so the upper limits of these are herein expanded to include those found in the present study.

Table1. Descriptive statistics of the variables length of tegmen, width of tegmen and total length of the body for the studied individuals of *Byrsotria fumigata* (N = 24). Standard deviation (SD), Minimum and Maximum (Min–Max). / Estadísticas descriptivas de las variables longitud de la tegmina, ancho de la tegmina y longitud total del cuerpo en los individuos estudiados de *Byrsotria fumigata* (N = 24). Desviación estándar (SD), Mínimo y Máximo (Min–Max).

Measurements	Mean (mm)	Min–Max (mm)	SD (mm)
Length of tegmen	27.43	18.30–36.50	0.52
Width of tegmen	13.51	11.00–17.40	0.18
Total length of the body	35.45	31.70–39.80	0.25

In this study we collected 3 macropterous against 3 brachypterous individuals from El Vaho Cave, and 6 macropterous against 12 brachypterous individuals from Aguirre Cave. When analyzing the measurements of the samples, separating them by localities, we can observe a tendency to larger sizes in Aguirre Cave than in El Vaho Cave (Table 2). The mean value for each variable was higher in Aguirre Cave (TL: 28.2 mm; TW: 14.2 mm; TBL: 35.6 mm) than in El Vaho Cave (TL: 25.1 mm; TW: 11.5 mm; TBL: 35.0 mm), however, this result may be an artifact resulting from the differences in sample size. A greater representation of each locality would be needed for a more accurate statistical study, which would allow to recognize differences between both populations.

It is common to find wing polymorphism within the same insect population, where both flying and non-flying individuals (*i.e.*, macropterous and brachypterous, respectively) occur together depending on the environmental conditions to which they are exposed (Roff 1984, 1986). It is probable that *B. fumigata* has fixed this wing polymorphism during its evolution, where the macropterous males have greater mobility that allows them

to search for mates, food and flee from predators with greater efficiency, as well as to explore new habitats in search for favorable conditions (Roff & Fairbairn 2007). However, brachypterous males tend to reach adulthood faster and be more fertile than macropterous (Mole & Zera 1993; Tanaka 1993). Future studies of experimental genetics and ecology could help to decipher this phenomenon in *B. fumigata*.

Table 2. Measurements of the variables Tegmen Length (TL), Tegmen Width (TW) and Total Body Length (TBL) for the studied individuals of *Byrsotria fumigata* (N = 24). The wing morph of each individual is also shown. / Mediciones de las variables Longitud de la Tegmina (TL), Ancho de la Tegmina (TW) y Longitud Total del Cuerpo (TBL) en los individuos estudiados de *Byrsotria fumigata* (N = 24). También se muestra el morfo alar de cada individuo.

Localities	TL (mm)	TW (mm)	TBL (mm)	Wing morph
El Vaho Cave	32.8	12.1	39.8	macropterous
El Vaho Cave	22.1	11.3	33.5	brachypterous
El Vaho Cave	20.4	11.3	33.4	brachypterous
El Vaho Cave	29.6	12	33.3	macropterous
El Vaho Cave	18.3	11	38.4	brachypterous
El Vaho Cave	27.2	11.5	31.7	macropterous
Aguirre Cave	24.6	15.6	36.7	brachypterous
Aguirre Cave	22.7	11.8	38.3	brachypterous
Aguirre Cave	35	14.6	39.7	macropterous
Aguirre Cave	26.5	15.7	38.1	brachypterous
Aguirre Cave	25.8	15.3	35.7	brachypterous
Aguirre Cave	34.1	14.5	34.8	macropterous
Aguirre Cave	22.4	11.1	33.3	brachypterous
Aguirre Cave	24.7	14.7	35	brachypterous
Aguirre Cave	26	15.2	34.7	brachypterous
Aguirre Cave	27.5	14.9	36.7	brachypterous
Aguirre Cave	36.5	13.3	38.1	macropterous
Aguirre Cave	34	12	34.2	macropterous
Aguirre Cave	24.6	12.8	34.2	brachypterous
Aguirre Cave	24.7	14.8	32	brachypterous
Aguirre Cave	25.4	14.1	35.2	brachypterous
Aguirre Cave	32.8	13.8	32	macropterous
Aguirre Cave	24.5	13.4	33.4	brachypterous
Aguirre Cave	36.1	17.4	38.6	macropterous

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