Hypercompe trinitatis (Lepidoptera, Erebidae, Arctiinae) and its Caterpillar in Trinidad, W.I.

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ABSTRACT

We document the polyphagous minor pest caterpillar of *Hypercompe trinitatis* (Rothschild) from Trinidad. This is presented in the context of an analysis of the literature and museum specimens to document the history, taxonomy, variability and distribution of this species in Trinidad and Tobago. Notes on identification are provided in comparison with *H. cunigunda* (Stoll), the only other species of the genus known from Trinidad, here newly recorded for the island; images of pinned adults are provided for both. CO1 DNA barcodes were obtained for two Trinidad specimens of *H. trinitatis.* Comparison with sequences in the Barcode of Life Database (BOLD) shows that *H. trinitatis* forms part of a species complex (or perhaps a complex species) which can be referred to as BIN (Barcode Identification Number) BOLD:AAA1342.

Key words: Arctiini, chilli pepper, pak choi, cocoa, *Hypercompe cunigunda*, DNA barcode, BOLD:AAA1342

INTRODUCTION

Hypercompe Hübner (Lepidoptera, Erebidae, Arctiinae, Arctiini), as presently recognized, is a genus of more than 80 species distributed throughout the Americas (Vincent and Laguerre 2014). At least some are polyphagous and regularly recorded feeding on plants of economic importance, but they are not normally pests of any importance. Adults are generally white with small dark markings, and the caterpillars are dark and hairy. Caterpillars of *H. scribonia* (Stoll) are well-known in North America as the 'giant woolly bear' (Hall 2014). The hairy caterpillars of *Hypercompe* species are similar and look as though they may have a stinging or urticating effect on mammalian (including human) skin, but for all Arctiinae this is not the case and they are unlikely to cause more than irritation (dermatitis) at most (Wagner 2009) – unless a person is allergic or sensitized to them.

Rothschild (1910) described *H. trinitatis* as a subspecies of *Ecpantheria icasia* (Cramer) (now *H. icasia*), based on 41 male specimens and one female specimen, all now in the Natural History Museum, London (NHMUK). Subsequently, Watson (1977) established that *Ecpantheria* is a synonym of *Hypercompe*. Then, Watson and Goodger (1986) raised *trinitatis* to species status, but provided no explanation for this action. Vincent and Laguerre (2014) make no change to the status of *H. trinitatis* and treat *H. icasia* as occurring on both the mainland and several Caribbean islands. *Hypercompe trinitatis*, which is an occasional minor polyphagous pest in Trinidad, was the focus of our study.

METHODS

The literature dealing with moths of Trinidad and Tobago was reviewed, evaluated and synthesized for *Hypercompe trinitatis*. This was supplemented by records of museum specimens in the following collections:

MJWC	Research collection of M.J.W. Cock, Dolgellau, UK
NHMUK	The Natural History Museum, London, UK
NMSE	National Museum of Scotland, Edinburgh, UK
OUNHM	Oxford University Natural History Museum, Oxford, UK
UWIZM	The University of the West Indies Zoology Museum, St. Augustine, Trinidad and Tobago.

Twelve caterpillars were found in P.P.'s vegetable garden near San Juan, Trinidad (N 10.646, W 61.439) between September 2016 and May 2017, feeding on various vegetables. Caterpillars were held in clear plastic jars of approximately 1 litre with perforated covers, and a 5 cm layer of moist garden soil (50%) and peat moss (50%) in the bottom of the jar. Fresh leaves of the species on which the caterpillar was collected were added daily while the caterpillar continued to feed, and uneaten leaves removed. Jars were kept under ambient conditions on a table inside a shade house where they were collected, and monitored daily at 07.00h for approximately two months.

DNA barcoding based on a defined section of the CO1

mitochondrial gene (Hebert *et al.* 2003) provides a tool which may help clarify the status of *H. trinitatis* in future, based on the increasing numbers of publicly available barcodes in BOLD (Barcode of Life Database, http://www.boldsystems.org/) and GenBank (http://www.ncbi.nlm.nih.gov/genbank). Barcode Index Numbers (BINs) have been introduced to provide a permanent numbering system for barcode clusters separated from others by at least 2% base pairs substituted, which in a high percentage of cases correspond to known taxonomic species and can also help flag species complexes or clusters needing taxonomic research (Ratnasingham *et al.* 2013, Miller *et al.* 2016). Using the methods described in Cock *et al.* (2017), we obtained CO1 DNA barcodes for two of three samples of adult *H. trinitatis* collected as caterpillars in Trinidad as reported below. We failed to secure a barcode for the third specimen, despite several attempts using multiple subsamples. The specimens have been deposited in UWIZM and the barcodes in GenBank.

RESULTS

Hypercompe trinitatis (Rothschild, 1910) (Figs. 1, 3-4)

Historical records. Literature records for Trinidad are as follows:

Ecpantheria eridanus (Cramer) var.: Wilson (1894)
Ecpantheria abscondens Oberthür: Kaye (1901)
Ecpantheria icasia trinitatis Rothschild: Rothschild (1910), Kaye and Lamont (1927), Forbes (1922)
Ecpantheria icasia form *trinitatis* Rothschild: Hampson (1920), Seitz (1919)
Ecpantheria muzina Oberthür: Kaye and Lamont (1927), Kirkpatrick (1954), Blest (1964)
Hypercompe trinitatis (Rothschild): Watson and Goodger (1986), Vincent and Laguerre (2014)

Kaye (1901) records *E. abscondens* Oberthür from Trinidad 'in the National Collection' (i.e. NHMUK). *Ecpantheria abscondens* has been considered a synonym of *H. caudata* (Walker), a Mexican species, similar to *H. icasia* (Vincent and Laguerre 2014). Subsequently, Kaye and Lamont (1927) list this record of *E. abscondens* as a synonym of *E. muzina*, which is currently a valid species (*H. muzina*), described from Colombia (Vincent and Laguerre 2014) but previously treated as a synonym of *H. icasia* (Forbes 1922). Since we note that all the *Hypercompe* specimens from Trinidad in NHMUK are *H. trinitatis*, we conclude that this record actually refers to *H. trinitatis* which was not yet described when Kaye (1901) first made his identification. Kaye and Lamont (1927) also recorded *H. trinitatis* from Trinidad (as *Ecpantheria icasia*

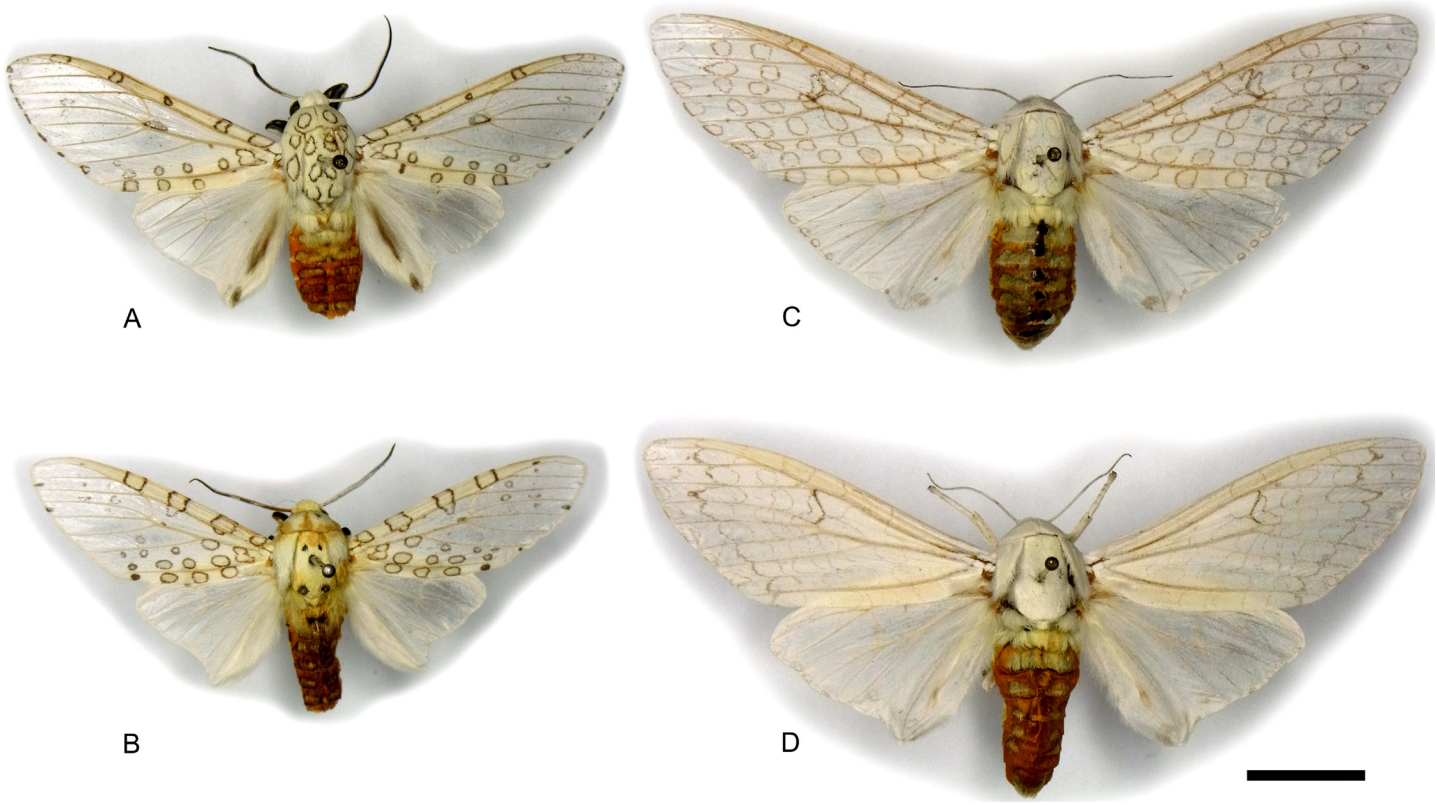

Fig. 1. Pinned adults of *Hypercompe trinitatis* from Trinidad (in MJWC). **A**, ♂, Curepe, MV Trap, 31 May 1979; **B**, ♂, Curepe, MV Trap, 9 February 1980; **C**, ♀, Curepe, MV Trap, 9 November 1978; **D**, ♀, Morne Bleu Textel Installation, at light, 13 September 1978. Scale bar 10 mm; approximately 1.3 x life size.

trinitatis) listing specimens from Tacarigua, Guaico and Palmiste, all collected by Sir Norman Lamont.

Kirkpatrick (1954) recorded *H. muzina* (as *E. muzina*) once in his study on cacao pests in Trinidad. For the same reasons as above, we believe this name was applied to what is currently known as *H. trinitatis*. This publication, or a specimen from it deposited in the NHMUK, is assumed to be the origin of a record of cacao as a food plant for *H. muzina* in Trinidad in the HOSTS database (Robinson *et al.* 2018).

There is a female specimen in UWIZM reared by R.G. Donald in 1945, from a larva feeding on '*Cordia*'. Most likely, this would have been the common black sage, *Varronia curassavica* (= *Cordia curassavica*, = *Cordia macrostachya*) the natural enemies of which were studied by Donald (1945).

Adult variability.

Hypercompe trinitatis is sexually dimorphic and variable (Fig. 1). The males (Fig. 1A-B) have much of the wing surfaces apart from the costa and dorsum variably transparent. Under a binocular microscope, it can be seen that the wings of fresh specimens are sparsely covered with scales that do not cover the surface and are themselves rather transparent. These are readily lost and most are missing in older specimens. The black markings of the wings are variable in their intensity and their exact arrangement, and they are lost with the scales of older specimens. The black circles on the thorax may be reduced to a few small spots. M.J.W.C. dissected several male forms and found no differences in the male genitalia. The female is larger, lacks dark markings on the thorax and retains its wing scales much more than the males do. The dark wing markings of females vary from hardly evident (Fig. 1D) to fully visible (Fig. 1C). This sexual dimorphism and the variability of markings have led to *Hypercompe* species being described more than once by the early workers (examples in Vincent and Laguerre 2014).

Identification.

In Trinidad, *H. trinitatis* might only be confused with *H. cunigunda* (Stoll) (Fig. 2), an uncommon species found in forested areas of Trinidad but not previously reported (M.J.W. Cock unpublished). Males of *H. cunigunda* have been collected on three occasions attracted to mercury vapour lights in lowland forest: Parrylands, 13 November 1980, 25 July 1981; Simla, Arima Valley, 22 July 1981 (specimens in MJWC and UWIZM). Compared with *H. trinitatis*, the adults have a more pronounced lobe at the hindwing tornus, and are more heavily (albeit variably) marked dorsally on the forewing and dorsum of the hindwing, and the abdomen is dark dorsally, with variably apparent longitudinal bands (these are not evident in Fig. 2).

Distribution in Trinidad and Tobago.

We have examined specimens of *H. trinitatis* from diverse habitats throughout Trinidad, up to 700 m in the Northern Range: Arima, Arima Valley (St. Patrick's Estate), Caparo, Curepe, Guaico, Morne Bleu Textel Installation, Palmiste, Penal, Point Fortin, Port of Spain (Belmont), near Sangre Grande, St. Augustine (specimens in MJWC, NHMUK, NMSE, OUNHM, UWIZM). It is more commonly collected in disturbed areas than in forested areas. It has also been reported from Tobago without locality (Cock 2017).

Biology observations in Trinidad.

Kirkpatrick's (1954) publication on the insect pests of cocoa in Trinidad is obscure and difficult to obtain, so we reproduce this paragraph verbatim here, as it also provides a satisfactory description of what we found.

'*Larva about 50 mm. in length, black, with three pairs of verrucae [scoli]: on prothorax, four pairs on meso- and metathorax, and six pairs on each abdominal segment- three pairs above the spiracle and three below. The dorsal verrucae [scoli] are black, the subdorsal ones dark brown*

Fig. 2. Pinned adult males of *Hypercompe cunigunda* from Trinidad (in MJWC). **A**, Arima Valley, Simla, MV light, 22 July 1981; **B**, Parrylands oilfield, MV light, 25 July 1981 (dissected). Scale bar 10 mm; approximately 1.3 x life size.

and the sub-spiracular ones reddish. In the earlier instars all the verrucae [scoli] are red. Each verruca [scolus] bears numerous shortly pubescent hairs, about half as long as the diameter of the body, mainly black, but many of them reddish at the base. Pupa in a thin cocoon among leaves. Larval period about five weeks, pupa 16 days. This species has only once been observed on cacao, at I.C.T.A. [Imperial College of Tropical Agriculture, St. Augustine, Trinidad and Tobago] in November, 1952, when considerable numbers were defoliating small experimental cacao plants grown under artificial shade. It has also been seen on various weeds and cacao is probably not a normal host plant.'

P.P. collected and reared several caterpillars of *H. trinitatis* feeding on leaves of the following vegetables and herbs: chilli pepper (*Capsicum annuum* L. unknown variety, Solanaceae), eggplant (*Solanum melongena* L., Solanaceae), basil (*Ocimum basilicum* L., Lamiaceae), pak choi (*Brassica rapa* subsp. *chinensis* (L.) Hanelt, Brassicaceae), local spinach (*Amaranthus* sp. Amaranthaceae), but only examples from chilli pepper and pak choi were successfully reared through to adults (Table 1). The caterpillars were photographed and two individuals are shown here as Figs. 3 and 4. The caterpillar shown in Fig. 3 matches Kirkpatrick's (1954) description, while that shown in Fig. 4 is distinctly paler and browner, and lacks the red scoli.

DNA barcodes.

We obtained identical barcodes from two of the three

Table 1. Details of caterpillars of *Hypercompe trinitatis* collected and reared in this study.

Collection Ref.	Collection date	Food plant	Caterpillar photographed	Adult emerged
B	26 September 2016	Chilli pepper	-	3 November
C	10 November 2016	Chilli pepper	23 November	20 December
H	22 January 2017	Pak choi	24 January	13 February

Fig. 3. Mature dark caterpillar of *Hypercompe trinitatis*, collected on pak choi, Mt. Lambert, San Juan, Trinidad, 24 January 2017, specimen H (UWIZM.2017.52.3). **A**, lateral view; **B**, lateral view, head and anterior region; **C**, anterior view of head and anterior region; **D**, anterolateral view of head and anterior region.

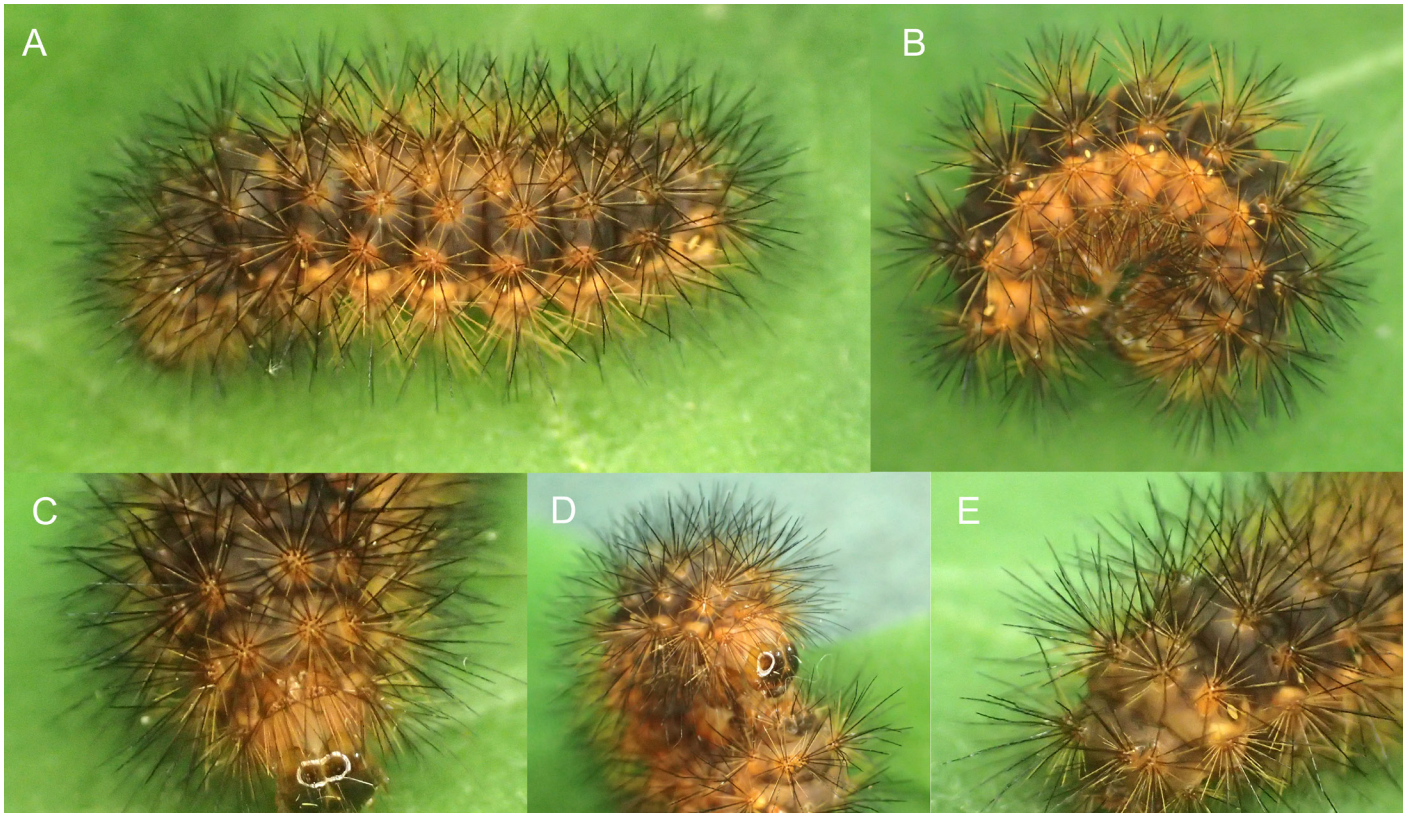

Fig. 4. Mature brown caterpillar of *Hypercompe trinitatis*, collected on eggplant, Mt. Lambert, San Juan, Trinidad, 23 November 2016, specimen C (UWIZM.2017.52.2). **A**, dorsal view; **B**, lateral view; **C**, **D**, anterodorsolateral view, head and anterior region; **E**, lateral view, head and anterior region.

Table 2. Results of barcoding reared *Hypercompe trinitatis*.

Collection ref.	Sample no.	UWIZM Accession number	Barcode obtained	GenBank Accession number
B	MJWC-185	UWIZM.2017.52.1	Yes	MH281950
C	MJWC-186	UWIZM.2017.52.2	No	-
H	MJWC-187	UWIZM.2017.52.3	Yes	MH281951

specimens of *H. trinitatis* that were reared through to adult (Table 2). We found that the two barcodes for *H. trinitatis* cluster with several other haplotypes in the BIN BOLD:AAA1342, which appears to be a complex group of geographically and genetically varied, closely-related taxa, identified as *H. icasia* and several other species. This species complex (or possibly complex species) is badly in need of revision, and beyond our scope here.

DISCUSSION

Caterpillars identified as *H. icasia* (BOLD:AAA1342) documented from Costa Rica by Janzen and Hallwachs (2018) are variable, and may represent more than one species. Some are comparable to the ones we illustrate in Fig. 3; others have the apices of the scoli of abdominal segments 3–6 dull red, sometimes with a reddish lateral line on the same segments; others are almost entirely black. Thus, the variable caterpillars of BOLD:AAA1342 (Costa Rica) and *H. trinitatis* are similar, offering no diagnostic differences or support for their treatment as separate species.

Van Zwalenburg (1916) describes the life history of *E. icasia* (as *H. eridanus* (Cramer)) from Puerto Rico, and Ryckewaert (1998) illustrates a caterpillar from the Lesser Antilles as *H. icasia*. The description and image show a similar morphology to those from Costa Rica and Trinidad, but the head is red, the setae light brown, the apices of the scoli are bright red, and the spiracles yellow, giving a very different appearance. These caterpillars of purported *H. icasia* (Lesser and Greater Antilles) are sufficiently different to support the view that they may represent a different species to *H. trinitatis* and what is treated as *H. icasia* in Central America (Janzen and Hallwachs 2018).

Food plant records from outside Trinidad should be treated with caution until it is clear what *Hypercompe* taxa are actually involved. *Hypercompe icasia* has been

recorded as a minor pest of several crops including citrus in Honduras (Bates 1933), banana in Panama and Costa Rica (Harrison and Stephens 1966), and sweet potato, orange, banana, and vanilla in Puerto Rico (Van Zwalenburg 1916, Plank 1938). These records from Central America are considered representative of BOLD:AAA1342, whereas the Puerto Rican ones may represent a different species, as no CO1 DNA barcodes of this species are available from the Antilles. BOLD:AAA1342 is highly polyphagous having been collected from nearly 40 families of plants in Costa Rica (Janzen and Hallwachs 2018). Indeed, Miller *et al.* (2007) report that their life style, particularly when young, is peripatetic, sampling and feeding on diverse plants. Arctiinae caterpillars showing this behaviour have been characterized as 'specialist generalists' (Singer and Bernays 2009), and in the examples they have studied (not *Hypercompe* spp.) explain this is a strategy '*to acquire particular secondary metabolites from particular plants*' because of the unpredictability of availability of suitable plants from which to obtain these metabolites and '*the caterpillars use these chemicals for the pharmacological properties of defence against parasitoids and, in all likelihood, generalist predators as well*'. In the case of *Hypercompe* species, these sequestered chemicals are probably carried through to the adult stage and similarly used for protection, and perhaps in courtship and mating. Thus we attach no particular significance to the fact that our observations were based on caterpillars found on specific vegetables, as they would probably feed on many plants in a vegetable garden.

The complex BOLD:AAA1342, which includes *H. trinitatis* needs revision, which is beyond our scope here. Hence, until the constituents of this BIN are better resolved, we retain the name *H. trinitatis*, recognizing that although it may well prove to be a valid species, it might also prove to be a subspecies or synonym of *H. muzina* or some other *Hypercompe* species. We also note that with only two barcodes from one site in Trinidad we cannot preclude the possibility that additional cryptic diversity exists amongst *H. trinitatis* within the island, although we consider this unlikely.

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