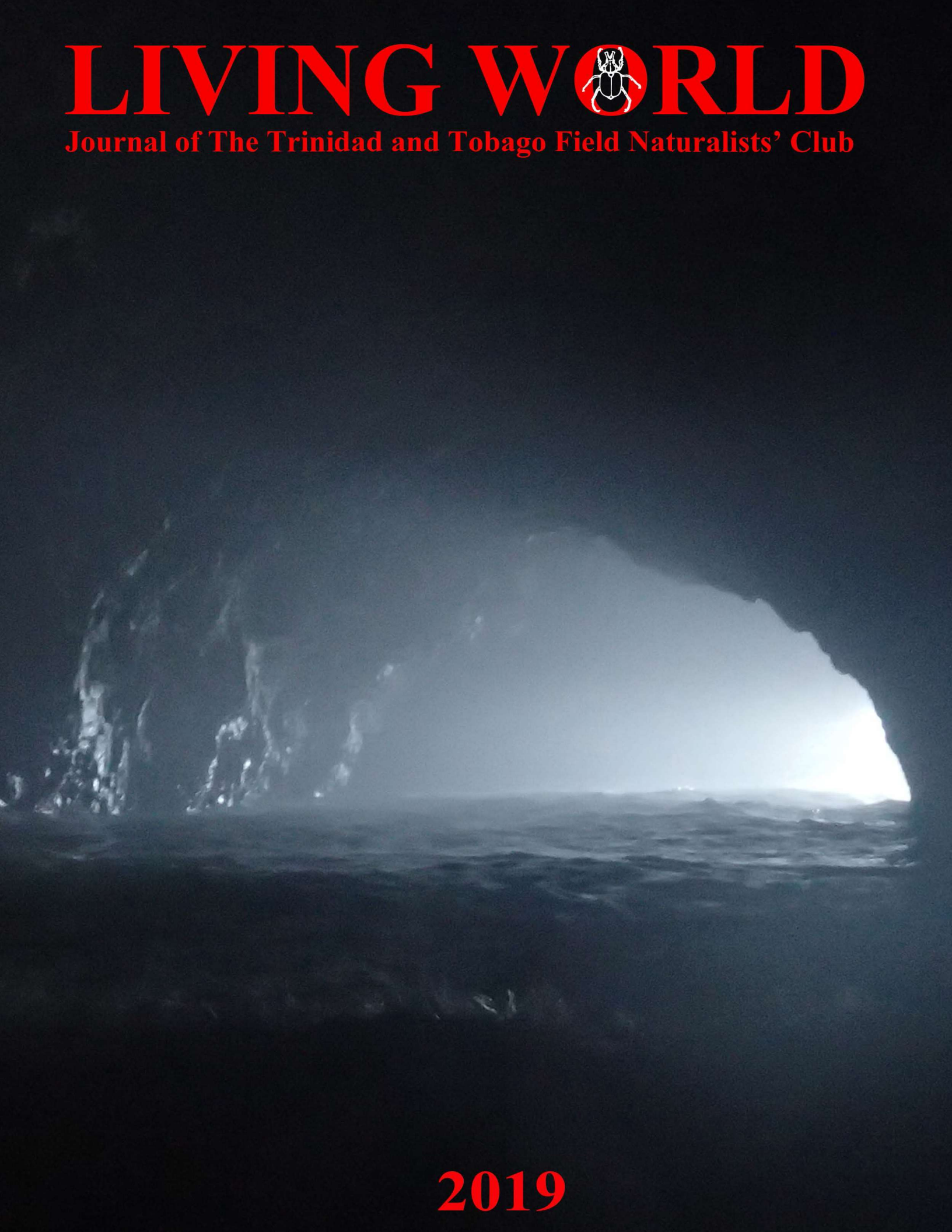
LIVING WORLD

Journal of The Trinidad and Tobago Field Naturalists' Club



2019

THE TRINIDAD AND TOBAGO FIELD NATURALISTS' CLUB

The Trinidad and Tobago Field Naturalists' Club was founded on 10 July, 1891. Its name was incorporated by an Act of Parliament (Act 17 of 1991). The objects of the Club are to bring together persons interested in the study of natural history, the diffusion of knowledge thereof and the conservation of nature.
Monthly meetings are held at St. Mary's College on the second Thursday of every month except December.
Membership is open to all persons of at least fifteen years of age who subscribe to the objects of the Club.

Mission Statement
To foster education and knowledge of natural history and to encourage and promote activities that lead to the appreciation, preservation and conservation of our natural heritage.

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Editorial

The 2019 issue of Living World includes four Research Papers, an unprecedented 12 Nature Notes, our annual report from the Trinidad and Tobago Bird Status and Distribution Committee and one book review.

Arneaud and Duncan start off with a list of mycorrhizal species associated with the Moriche Palms. Mycorrhizal associations are an important and sometimes overlooked component of forest ecology; particularly so for a species which is itself may be argued is a foundation species within the ecosystems it inhabits. An update of the populations of Oilbirds in Trinidad is presented by Mike Rutherford. This is a very timely update and it is encouraging that the Oilbird populations appear to be thriving. Not only were we experiencing a dispersal from the popular cave at the Asa Wright Nature Centre during 2019, but re-establishing the precise locations of the caves and determining the most parsimonious fit between our current caves with those that Snow worked on in the 1950s, provides a platform for future censuses. Matthew Cock provides an account of the three species of Donkey's eyes, *Junonia* spp. In Trinidad and Tobago. While all field naturalists, even the most unexposed, are familiar with the Donkey's-eye butterfly, many of us failed to realise that there were more than one species! Matthew, together with Perry Polar, Mike Rutherford, Giovanni Cafá and, Alan Buddie give us an account of the *Hypercompe trinitatis* and its caterpillar in Trinidad.

The Nature Notes continue to represent a cross section of fauna. In this issue we have four notes from Tobago. Lanya Fanovich, Aljoscha Wothke and Ryan Mohammed describe the distribution of the invasive brittlestar *Ophiothela mirabilis* in coral reefs in Tobago- an account which is particularly useful in understanding the eventual integration of the exotic species into the reef community. Ryan Mohammed, Zolani Frank and Lanya Fanovich provide two new location records for freshwater turtles in Tobago and consider their status. Rakesh Bhukal and Kerresha Khan document the first records of the scorpion of *Chactas raymondhansi*, in Tobago. Finally an update the species list of Bats in Tobago, with the addition of Geoffroy's Hairy-Legged Bat, *Anoura geoffroyi*, is provided by Luke Rostant, Ralph Eshelman, Gary Morgan and Geoffrey Gomes.

In Trinidad Luke Rostant captured a Pawi chick in a camera trap, giving an insight into the early life of this Trinidad endemic. We have three notes relating to lepidoptera, Mike Rutherford describes the Life History of the saturnid moth *Citheronia hamifera,* Matthew Cock helps with the field-identification of the Caligo butterflies; and Matthew, together with Scott Alston-Smith describe the hesperiid butterfly *Oxynthes corusca* and its caterpillar. Jo-Ann Sewlal adds a new family of spiders to the Trinidad and Tobago list on the basis of recent taxonomic work. Bob Thomas and Elsa Thomas describe frog *Pristimantis urichi* being eaten by a killifish, or Jumping Guabine, *Rivulus hartii.* Renoir Auguste, Rainer Deo and Zakariyya Ali present additional site records in Trinidad of the rare Gibba Turtle *Mesoclemmys gibba*.

The report of the Trinidad and Tobago Bird Status and Distribution Committee by Martyn Kenefick records two new species for Tobago, Plumbeous Kite and Band-Rumped Swift, and provides photographic evidence for two species, which if accepted by the South America Classification Committee of the American Ornithologists' Union would become the first accepted records for South America.

Ryam Mohammed brings the LW 2019 issue to a close with a review of the book *Life Along the Seashore of Trinidad and Tobago* by Lorie Lee Lum and Julian Duncan.

Cover Photograph

The Oilbird Cave on Huevos island is currently home to 200 Oilbirds. This photograph was taken by Mike Rutherford while treading water and conducting an Oilbird Census in September 2019. See research article on page 7.

A Preliminary Checklist of Endomycorrhizal Fungi Associated with *Mauritia flexuosa* L.f. (Arecaceae-Calamoideae) in Trinidad, W.I.

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ABSTRACT

Endomycorrhizal fungi associated with the palm *Mauritia flexuosa* L. f. (Arecaceae-Calamoideae) were observed *in situ* and *ex situ* on the island of Trinidad, West Indies. Root endophytes varied between stage classes (seedling–adult) and amongst palms from different locations and individual species of endophyte were associated with more than one palm species. This suggests that palms with associated endophyte communities may have a greater chance of survival in stressful environments. Further studies on the relative abundance of endophytes and host specificity are warranted as different levels of endomycorrhizal associations and adaptations are expected.

Key words: Arborescent palms, Aripo Savanna Environmentally Sensitive Area, Endophytes, Fungus, Symbiosis.

INTRODUCTION

Mauritia flexuosa is one of the most common and widespread palms in the neotropics and plays a significant role in the economies of neotropical countries of South America (Virapongse *et al.* 2017). Trinidad represents the northern limit of the range of distribution for *M. flexuosa* (Comeau *et al.* 2003). Although these palms have been thoroughly studied (socioeconomic importance, livelihood, ecology, conservation, management, and sustainability (Virapongse *et al.* 2017), few records on root-endophyte associations with *M. flexuosa* can be found (Koolen *et al.* 2012, Koolen *et al.* 2013).

Endophytes or endophytic fungi are known to exist in every plant species found thus far on the planet (Arnold *et al.* 2001), however, there is not much information on their associations with individual plant species. Furthermore, little is known of endophyte associations in tropical trees (Asita *et al.* 2018, Schroeder *et al.* 2018), especially palms (Froehlich and Petrini 2000). At present, there is no checklist of endomycorrhizal fungi associated with *M. flexuosa*; leaf-endophytic fungi associations have been documented in palms (Rodrigues 1994, Froehlich and Petrini 2000, Arnold *et al.* 2001), but vaguely described for *M. flexuosa* (Delgado *et al.* 2007, Vasquez *et al.* 2008, Alvarez-Loayza *et al.* 2011).

Root endophytes represent a group of understudied microorganisms (Faeth and Fagan 2002) and can be defined as inconspicuous microbial organisms or endosymbionts adapted to mutualistic associations inside root tissues (Schulz and Boyle 2006, Kurissery *et al.* 2019). In many plant species, root endophytes are known to increase water and nutrient absorption (Kurissery *et al.* 2019), protect against plant pathogens (Faeth and Fagan 2002), and stimulate growth (Schulz and Boyle 2006). Results from this study will provide baseline information relevant to palm conservation and persistence in Trinidad, and by extension, its South American ecological range. This study records a preliminary checklist of endomycorrhizal fungi associated with *M. flexuosa* on the island of Trinidad.

METHODOLOGY

Study site and field collection

This study was conducted primarily in the savanna-forest ecotone landscapes of the Aripo Savanna Environmentally Sensitive Area (ASESA), located in Trinidad, (10°35′30′′ N, 61°12′0′′ W) altitude 45m (Fig.1). The ASESA ecosystem is a series of open treeless areas of grass and sedge marshland within an extensive area of forest. *M. flexuosa* palms are concentrated along the periphery of the savannas and are most abundant along the fire-impacted margins.

All palms sampled were placed in stage classes following Arneaud *et al.* (2017); new seedling (<0.25m), established seedling (0.25–0.5m), older seedling (0.5-1.0m, young juvenile (1–3m), juvenile-1 (3–8m), young adult (8–12m), adult-1 (12–22m), and adult-2 (>22m).

In October 2012, approximately 15 'new seedlings' were taken from the ASESA (Savannas 1 and 3) and transplanted at each of Talparo (along a gully), Tunapuna (in pots), and in a greenhouse in the Department of Life Sciences at the University of the West Indies in St. Augustine (also in pots). From these, only two palms survived in Talparo; the others died either within 15 months or upon reaching 1 metre.

In November 2014, a total of 30 established seedlings were collected from the ASESA (Savannas 1 and 3). From these, 15 were planted adjacent to the new wing of the Life Sciences Building, UWI (impeded soil), and 15 were planted in Tunapuna (well-drained soil). On this occasion, only one seedling survived at the UWI; in Tunapuna all died. In January 2018, several fallen fruit and seeds taken from the ASESA were planted (in a cluster) at the study

site in Tunapuna.

Between September 2017 and April 2018, root cross-sections (taken from aerial and underground roots) from the palms at each location; ranging from seedlings to adults (Table 1, Fig. 1) were observed under a microscope for fungal endomycorrhizal associations. In August 2018, more roots were collected from these palms and further investigated for endomycorrhizal associations. On this occasion, in addition to root samples, fruit samples were collected and cross-sections made, to investigate differences amongst fungal endomycorrhizal species.

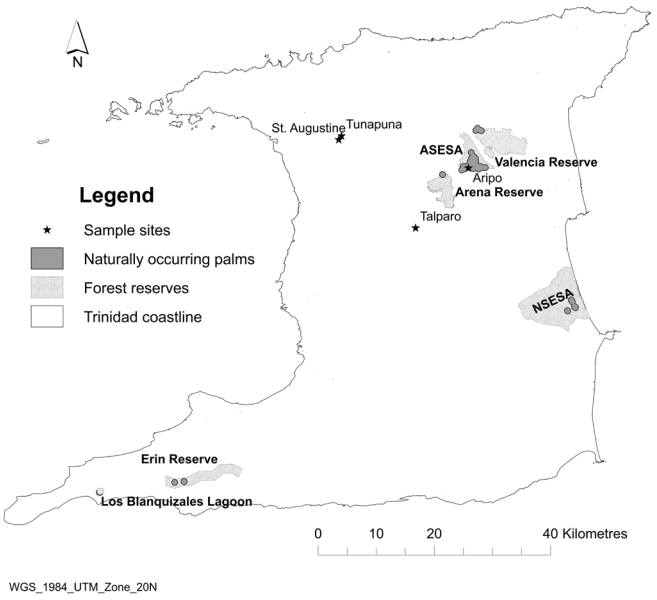

Fig. 1. Locations of naturally and non-naturally occurring *M. flexuosa* palms in Trinidad. ASESA, Aripo Savanna Environmentally Sensitive Area; NSESA, Nariva Swamp Environmentally Sensitive Area.
*Note. *M. flexuosa* palms do not occur in Tobago.

Extraction process

Collected fruit and root samples from the field were placed in sealed bags containing sterile water and immediately transported to the Biotechnology Laboratory (Department of Life Sciences at the UWI, St. Augustine). In the laboratory, samples were surface-sterilised by washing with detergent for one minute, followed by a 30-second rinse using tap water. Samples were then soaked in 95% alcohol for one minute and rinsed with distilled water. Immediately after, samples were placed on sterile potato dextrose agar plates containing rose bengal (50 µg/ml) and streptomycin (100 µg/ml; a broad spectrum aminoglycoside antibiotic) according to the Varma (2012) mycorrhizosphere microorganism screening methodology. Plates were then sealed and incubated at 30°C for 24 hours. Subsequently, samples were wrapped in Ziploc bags, and shipped to Plantwise Diagnostic and Advisory Service, Centre for Agriculture and Bioscience International (CABI) UK for identification. There, culture purity checks were performed, and mixed cultures were subcultured on diagnostic media prior to morphological and molecular analysis.

Morphological and molecular analysis of fungal isolates

For morphological analysis, the colony morphology of the cultures was examined by observing sporulating structures at x400 magnification. Molecular analyses were performed on each sample using nucleic acid as a template. A proprietary formulation (microLYSIS®-PLUS [MLP], Microzone, UK) was subjected to rapid heating and cooling of a thermal cycler to lyse cells and release DNA. Following DNA extraction, polymerase chain reaction (PCR) was employed to amplify copies of the rDNA in vitro. The quality of the PCR product was assessed by gel electrophoresis. The PCR purification step removed unutilised deoxyribonucleotide triphosphated

Table 1. Collection of *M. flexuosa* fruit and root samples in Trinidad.

Location	Stage class	N	Samples collected[1]	Yr. palms transplanted[2]	No. of palms transplanted	No. of palms surviving
ASESA	Seed	3	$1F_y$, $1F_m$, $1F_d$	—	—	—
ASESA	Juvenile 1	2	$2R_a$, $1R_u$	—	—	—
ASESA	Young adult	1	$1R_a$, $2R_u$	—	—	—
ASESA	Adult 2	2	$2R_a$, $2R_u$	—	—	—
St. Augustine	Older seedling	1	$2R_u$	2014	15	1
Talparo	Young juvenile	1	$2R_a$, $1R_u$	2012	10	2
Tunapuna	New seedling	3	$3R_u$	2018	15	3

1. F_y, Fruit (*young*); F_m, Fruit (*mature*); F_d, Fruit (*degraded*); R_a, Root (*aerial*); R_u, Root (*underground*).
2. transplanted from the Aripo Savanna Environmentally Sensitive Area (ASESA).
Note: R_a samples were collected at -5 to 5cm soil depth, whereas R_u samples were collected at 15 to 20cm soil depth.

(NTPs), primers, polymerase, and other PCR mixture compounds to obtain highly purified DNA templates for sequencing. This procedure also allowed segments of DNA and RNA to be amplified. PCR and sequencing reactions were undertaking using the BigDye® Terminator v3.1 kit from Applied Biosystems. In total three PCRs primer pairs were utilised. ITS sequencing used TW81 and AB28 primer pairs; TEF1f and TEF1r primer pairs were used for partial TEF sequencing; and for the bacterium colony, 16S sequencing was conducted using 27f and 534r primer pairs. The amplicons generated in this study were 449 – 529 bp in length.

All identifications were based on comparisons with the European Molecular Biology Laboratory database via

Table 2. Endomycorrhizal fungi associated with *Mauritia flexuosa* in Trinidad.

Family/genus/species [Stage] and Location	Identification and description	Reference
(TRICHOCOMACEAE) ***Penicillium Lanata-Divaricata*** [Juvenile 1] ASESA	Using FASTA and BLAST together with CABI fungal database, the ITS sequence showed top matches at >98% identity to members of *Penicillium* section *Lanata-Divaricata* including 100% identity to sequence GU981580 from the type strain of *P. brefeldianum* (CBS 235.81) and 99.4% identity to sequence GU981568 from the type strain of *P. limosum*. Type strains from other members of this group gave slightly lower matches e.g. 98% identity to sequence GU981585 from the type strain of *P. janithellum* (CBS 340.48). From these results, *P. brefeldianum* was the most likely identity for the sample.	Type strains sequences have been published in Diao *et al.* (2018)
(HYPOCREACEAE) ***Trichoderma*** section ***Pachybasium*** clade ***Harzianum*** [Adult 2] ASESA	Internal transcribed spacer results gave >99% matches to many sequences to this section of the *Trichoderma* genus and predominantly to strains of *T. harzianum* DAOM 222136 [JN942884] and closely related species, including 99.6% to *Hypocrea lixii*. The ISTH TrichoKey online tool did not recognise this sequence. The partial TEF sequence gave >99% matches to several sequences assigned to members of the *T. harzianum* clade, including 99.0% match to *T. guizhouense* strain GJS 06-100 (FJ463289). It was not possible to determine a definitive species-level identification for this isolate.	*T. harzianum* strain DAOM 222136 [JN942884] has been cited by Schoch *et al.* (2012), whereas, *T. guizhouense* strain GJS 06-100 (FJ463289) has been cited by Błaszczyk *et al.* (2016).
(HYPOCREACEAE) ***Trichoderma*** [Young juvenile] Talparo	Top matches of >99% were seen to sequences assigned to members of this genus, including 99.4% to *T. gamsii* strain DAOM 231637 (EU280129). The ISTH online identification tool identified this as an 'unidentified Trichoderma species', and as such, it was not possible to determine a definitive species-level identification for this isolate.	*T. gamsii* strain DAOM 231637 (EU280129) has been cited by Hoyos-Carvajal *et al.* (2009).
(NECTRIACEAE) ***Acremonium*** and ***Pleiocarpon*** [Older seedling] St. Augustine	Internal transcribed spacer produced top matches of >95% to members of the family Nectriaceae including members of the genera *Acremonium* and *Pleiocarpon*. Several sequences of unspecified *Acremonium* strains featured in the top results with matches of >98% identity and unspecified Nectriaceae gave matches of 96.4% and 96.6% identity. However, the top match to a fully identified species was only at 95.8% identity to sequence HQ897806 from a reference culture collection strain of *A. macroclavatum* (CBS 123922). A similar match was obtained to 17 strains of *P. strelitziae* e.g. sequence KY304661 and sequence KY304661. However, there was no clear distinction between genera, therefore identification was given to family level.	*A. macroclavatum* strain (CBS 123922) was published by Gräfenhan *et al.* (2011). Seventeen published strains of *P. strelitziae* e.g. sequence KY304661 and sequence KY304661 were published by Aiello *et al.* (2017).
(PLEOSPORACEAE) ***Epicoccum nigrum*** [New seedling] Tunapuna	Internal transcribed spacer sequence obtained from this sample showed top matches at 100% identity to multiple sequences of *E. nigrum*. Best matches included the sequence AJ279448 from reference collection strain CBS 318.83.	*E. nigrum* sequence AJ279448 from reference collection strain CBS 318.83 was published by Shrestha *et al.* (2011).

ASESA, Aripo Savanna Environmentally Sensitive Area; FASTA, Fast-All; BLAST, Basic Local Alignment Search Tool; NCBI, National Centre for Biotechnology Information; ITS, Internal Transcribed Spacer; ISTH, International Subcommission on Trichoderma and Hypocrea.

Table 3. Other endophytes associated with *Mauritia flexuosa* in Trinidad.

FAMILY/genus [Stage] & Location	Identification and description	Reference
NECTRIACEAE ***Gliocephalotrichum*** [Seed] ASESA	Over 98% identity matches (via FASTA, BLAST and NCBI) to multiple sequences from members of the genus *Gliocephalotrichum* including *G. bacillisporum*, *G. longibrachium*, *G. cylindrosporum*, *G. mexicanum*, *G. nephelii*, *G. queenslandicum* and others. The ITS sequence (using BLAST and NCBI) showed top matches at 99% identity to the type strains of *G. longibrachium* (sequence NR 136977) *G. mexicanum* (sequence KF513289) and *G. queenslandicum*. The type strains of *G. cylindrosporum*, *G. simmonsii* and G. *bulbilium* gave slightly lower matches at 98% identity. As there was no clear distinction between species from the ITS sequence result, identification was given to genus level only.	The type strains sequences have been published in Lombard *et al.* (2014).
BURKHOLDERIACEAE ****Burkholderia*** [Young adult] ASESA	Over 99% identity matches (via FASTA, BLAST, NCBI and other database) were made to several species belonging the genus *Burkholderia*, and included the validated type strain sequences of *B. lata* [CP000150 – complete genome study], and the validated type strain of *B. multivorans* [Y18703] which both gave matches of 100%. Sequences derived from type material of *B. cepacia* [ATCC 25416] and *B. vietnamiensis* [LMG 10929] also gave matches of 100% and 99.8% respectively.	Type strains sequences have been published in (Vanlaere *et al.* 2009).

ASESA, Aripo Savanna Environmentally Sensitive Area; FASTA, Fast-All; BLAST, Basic Local Alignment Search Tool; NCBI, National Centre for Biotechnology Information; ISTH, International Subcommission on Trichoderma and Hypocrea.

*soil borne fungi associated with post-harvest spoilage

** rhizobacteria

FASTA (Fast-All) algorithm, European Bioinformatics Institute, National Centre for Biotechnology Information (NCBI), Centre for Agriculture and Bioscience International Fungal Reference Collection - International Mycological Institute (CABI - IMI), Basic Local Alignment Search Tool (BLAST) algorithms, other databases limited to sequences from type material, peer-reviewed published taxonomic descriptions, and matches to sequences published in peer-reviewed literature.

DISCUSSION

The results illustrate important symbiotic relationships between *M. flexuosa* and the following identified endophytes: *A. macroclavatum* (St. Augustine), *P. brefeldianum*, *T. guizhouense* and *T. harzianum* (Aripo Savannas), and *E. nigrum* (Tunapuna). *Trichoderma gamsii* and an unknown species (*Trichoderma* sp.) were also identified in a juvenile palm planted ex situ in Talparo. This suggests that further work should be done to establish the precise relationship between symbiotic microorganisms and *M. flexuosa* palms.

Although we treated samples with rose bengal and streptomycin to kill bacteria, there was still a high concentration of endomycorrhizal bacteria existing in the samples from the ASESA (Savanna 3). This may indicate that *Burkholderia* species exist within the ASESA at high densities in soil and root nodules; may be resistant to streptomycin (Rhodes and Schweizer 2016); or may be insensitive to sodium (Ahn *et al.* 2016). The genus *Burkholderia* includes plant growth rhizobacteria (*B. vietnamiensis*) and pathogens (*B. cepacia*, *B. multivorans* and *B. lata*) capable of both plant and animal diseases (Kirzinger *et al.* 2011).

Different endomycorrhizal fungi were found on fruit and seeds in the ASESA. New seedlings grown in Tunapuna (using seeds from the ASESA) did not share similar endophytes to the other samples. This suggests that endophyte variability within the different stage classes of *M. flexuosa* is high. *Epicoccum nigrum* (found in new seedlings in Tunapuna) is a ubiquitous endomycorrhizal fungus that is known to act as a control for pathogens in sugarcane (Shrestha *et al.* 2011), whereas *Pleiocarpon strelitziae* (found in St. Augustine) is a species recently known for causing basal stem rot (Aiello *et al.* 2017). Seedlings in St. Augustine and Tunapuna are likely to die, since they do not possess any plant-growth stimulating endophytes such as *Trichoderma gamsii* (found in young juvenile palms in Talparo). We speculate that palms with high mycorrhizal fungi and bacteria levels have a greater chance of surviving under stressful conditions. Endophytes, such as *T. guizhouense* and *T. harzianum,* are commercially

used to biologically control plant pathogens (Chaverri and Samuels 2002), whereas *B. vietnamiensis* is known to regulate nitrogen, promote growth, and enhance yields (Van Dommelen and Vanderleyden 2007).

Further studies are required to identify and investigate beneficial endophytes in *M. flexuosa* growing *ex situ*. The identification of host-specific endomycorrhizal associations will have the potential for allowing *M. flexuosa* to be planted closer to indigenous villages that depend on these palms for their livelihoods (Penn 1999, Horn *et al.* 2012.)

CONCLUSION

This study provides a preliminary checklist of endomycorrhizal fungi associated with *M. flexuosa* palms in Trinidad. It also records variability in endophyte species amongst study sites and within the different stage classes of the studied palm.

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An Update on the Population of the Oilbird, *Steatornis caripensis*, in Trinidad, W.I.

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ABSTRACT

The last island wide census of the Oilbird, *Steatornis caripensis,* population of Trinidad was conducted in the late 1950s to early 1960s by David Snow with an estimate of 1,460 individuals. A new census of the known roosts was undertaken between February 2016 and September 2019. Caves were entered and counts were taken by one to three observers. The total number of birds in known colonies was estimated to be 3,320. This shows a more than doubling in population since the last count and suggests that the hunting of Oilbirds may no longer be the threat it once was to the survival of the species in Trinidad.

Key words: Caves

INTRODUCTION

The Oilbirds, *Steatornis caripensis,* of Trinidad have been documented for almost 200 years. Early mentions by writers, including John Latham in 1823 and Charles Kingsley in 1871, were mainly concerned with the description of the bird and their capture for consumption and focused on the colonies in the Bocas Islands. The Oilbird colonies in caves in the Northern Range were first mentioned in the literature by G.P Wall and J.G. Sawkins in a report on the geology of Trinidad in 1860. Many more accounts of visits to some of these caves were written in the following decades including F.W. Urich in 1895 and M.A. Carricker in 1931. These accounts are summarised by Shaw (1993).

The most comprehensive work on the Oilbirds in Trinidad was carried out by David Snow, starting in 1957. He studied all aspects of the Oilbird's life history, focusing mainly on the population at Spring Hill Estate in the Arima Valley, he published two extensive papers (1961 and 1962) detailing everything from general appearance, stance and locomotion to the weights of fruits eaten by the birds. As part of his work he conducted an island wide survey, visiting all the known caves where the birds roosted and estimating the number of birds in each cave (Table 1). The identity and location of three of these caves is still open to debate.

The current survey began when David Oehler, a board member of the Asa Wright Nature Centre (AWNC) and Curator of Ornithology at the Wildlife Conservation Society, New York, instigated a project using GPS tracking tags on Oilbirds. The project's aim was to find out more about where they travel during their foraging forays, specifically the ones roosting in Dunston's Cave, situated within the lands of the AWNC. As the project proceeded it became necessary to visit the other caves to determine whether the birds that had been tagged had changed roosts. Whilst the scanning for tags was underway the opportunity was taken to conduct a count of Oilbirds in each cave. The results of the tagging project are pending publication at the time of writing.

Table 1. "Present Colonies of Oilbirds in Trinidad and Their Populations" (reproduced from Snow, 1962).

Colony	Population
Oropouche cave	200
Aripo caves	
"Main cave"	400
"Small cave"	10
"Middle cave"	140
"Well cave"	80
Arima gorge (Spring Hill cave)	30
La Vache cave	300
Huevos cave	300
Total	**1460**

The routes to the well-known populations - Dunston's Cave, Cumaca Cave and Aripo Main Cave - are familiar to naturalists and hikers. The trails to the lesser-known populations in the Northern Range, Soho Cave and Carricker's Cave, are described in the TTFNC field guide (Comeau, Potter and Roberts, 2006) but they still took more time to locate as fallen trees and overgrown paths meant that several visits were required to find the entrances. The exact locations of the sea caves at La Vache Point and on the island of Huevos were found by direct searching along the coastline as geographic coordinates and the descriptions for both were either vague or not available (Shaw, 2009). The location of the sea cave at Morne Poui was indicated by TTFNC members and confirmed by a local boatman from Blanchisseuse.

METHODS

To survey Oilbirds in Trinidad, all known cave populations (Table 2 and Fig. 1), were visited (some more than once) between February 2016 and September 2019. A handheld GPS unit (Garmin GPSmap 62s) was used to record coordinates of the entrance to each cave, altitude was taken from Google Earth.

Snow (1962) wrote "Direct counting of all the adults is

impossible in most of the caves; instead, it is necessary to count all the nests which appear to be occupied, count all the birds that can be seen perched on nests and ledges, estimate the number of birds flying about, and from these figures assess the number of birds present". We used a similar method and can confirm that accurate counts are very difficult to attain. Upon entering the caves, Oilbirds would react and start to fly around in alarm, therefore before counting began we would wait a period of around five minutes to allow the birds to calm down and return to their nests or roosts, although in the sea caves where conditions were dangerous we did not have the time to wait. A central position was taken up in every chamber where birds were seen and roosting birds were counted from floor to ceiling whilst slowly rotating around. Whilst doing this a bright LED torch was held at the side of the head so that the eye shine of the birds could be seen, this helped on crowded ledges where it was often difficult to discern one bird from the next. When more than one person was present each person made their own count then totals were compared and the larger count used as we thought it was more likely that an observer would miss birds than they would over count. Large fledglings, which are often hard to tell apart from adults, were included in the count but chicks were not. The count was then repeated at least once. In several caves the spot count had to be repeated at various locations as the birds were scattered throughout the chambers. Estimates of flying birds were then made and added to the total. Video footage was also taken in some caves using a camcorder with an infrared light attachment.

Table 2. Geographic coordinates (WGS84) and elevations of visited Oilbird colonies

Colony	Lat. & Long.	Elevation (m)
Cumaca Cave	10.7196°, -61.1754°	152
Soho Cave	10.7181°, -61.2211°	715
Carricker's Cave	10.7144°, -61.2270°	656
Aripo Main Cave	10.7184°, -61.2385°	797
Dunston's Cave	10.7154°, -61.2993°	337
Morne Poui Sea Cave	10.7946°, -61.2659°	sea level
La Vache Sea Cave	10.7770°, -61.4748°	sea level
Huevos Sea Cave	10.7036°, -61.7211°	sea level

RESULTS

Cumaca Cave

Also known as the Oropouche Cave, and referred to as such by Snow, it consists of three main chambers linked by low passages stretching back from the entrance for more than 200 metres (Shaw, 2009). It is an outflow cave with a permanent stream running along the base. I first visited this cave on 28 March 2016 before this census began and made a rough count of over 1000 adults. There were both chicks and eggs present. A second visit took place on 17 March 2017 with Léa Blondel and Jarome Ali. We conducted counts in each of the three main chambers resulting in the following: first chamber 1050, middle chamber 100, deep chamber 250. There were fledglings, eggs and chicks present. In total there were approximately 1400 Oilbirds. A third visit on 26 August 2019 gave the same count.

Soho Cave

This cave consists of a wide sloping entrance in a karst depression leading into large domed chamber with a large mound in the middle, horizontal paths lead to lower down sloping chambers and there is a chimney leading to a "well-like" entrance (Shaw, 2009). I conducted a count on

Fig. 1. Map of northwest Trinidad showing locations of visited Oilbird colonies; Cumaca Cave (1), Soho Cave (2), Carricker's Cave (3), Aripo Main Cave (4), Dunston's Cave (5), Morne Poui Sea Cave (6), La Vache Sea Cave (7), Huevos Sea Cave (8).

8 February 2016 with Elliot Petkovic and Jessica Rozek. There were 60 birds in the main cave, 5 in the lower section and 25 in the chimney at the back of cave for a total count of 90 Oilbirds. A follow up visit on 4 August 2019, accompanied by Mark Charran and Richard Smith, gave a much lower count of no birds in the main cave, 10 in the lower section and 20 in the chimney for a total of 30 Oilbirds.

Carricker's Cave

This cave has a tall mouth leading down a 45° slope to a narrow tunnel and is about 30 metres long. There is an intermittent stream along the base of the cave which only flows after heavy rain and a small side cave with a vertical chamber (Shaw, 2009). Birds roost in the main chamber and in the narrow tunnel. I visited the cave on 13 April 2016 with Andrew Watson, this being our second attempt at locating the cave as a large tree fall had obscured the path to the entrance. We did a rough count of 150 birds, there were several chicks present at the time. A second visit was conducted on 8 February 2017 with Elliot Petkovic and Jessica Rozek. We counted 120 birds in the main chamber, 60 in the lower chamber and approximately 20 flying for a total of 200 Oilbirds. Eggs were seen on several nests. A follow up visit in 4 August 2019 gave a count of 90, we also noted a large treefall over the entrance to the cave which reduced the size of the opening by about 50%.

Aripo Main Cave

This is the largest known cave system in Trinidad at over 860 metres long. It is an inflow cave with an intermittent stream (Shaw, 2009). Oilbirds occupy the main chamber at the entrance, and a smaller chamber deeper inside. A first visit on 10 November 2016 gave a quick count of approximately 350 birds. A second visit on 16 February 2017 with Elliot Petkovic allowed time for a more thorough survey. We counted 280 Oilbirds in the main chamber, 80 in the middle section and 105 in the lowest chamber for a total count of 480 birds. We also observed several nests containing eggs and chicks.

Dunston's Cave

This is the most accessible Oilbird population in Trinidad, located in the grounds of the AWNC, previously known as the Spring Hill Estate. It was called the *Arima gorge* or *Spring Hill cave* by Snow and is actually a narrow gorge with a permanent stream flowing through it and some daylight penetrates throughout (Shaw, 2009). When surveyed for this study on 2 March 2017 the count was 180 Oilbirds. A follow up visit on 23 July 2019, accompanied by AWNC staff and board members, gave a very low count of two birds, the population had abandoned the cave for unknown reasons.

Morne Poui Sea Cave

A small cave in a cleft to the west of a beach at the end of a small cove about 0.8 km west of Cathedral Rock. The cave is approximately 10 metres deep, 17 metres high and 3 to 4 metres wide. This cave was visited on 25 August 2019 during a second period of surveying. A count of 80 Oilbirds was made including fledglings.

La Vache Sea Cave

The entrance is located at the end of a small inlet on the eastern tip of La Vache Point. The cave consists of one large dome shaped cavern approximately 25 metres high in the centre with a smaller cavern at the back. A first attempt to reach the cave was made on 24 September 2016 when Glenn Wilkes, Luke Rostant and I paddled in kayaks from Maracas Beach heading west along the coast, despite searching many inlets around La Vache Point we did not locate the cave and increasing wave height led to us calling off the search. A second attempt was made on 15 July 2017, this time using a pirogue captained by Imran Khan. We approached La Vache Point heading east and finally found the cave by referring to a photograph of the entrance taken by Edward Rooks in the 1980s. I swam in on a high tide at 8:30am and had to tread water whilst conducting the count as there was no area to stand. As I was the only person conducting a count I repeated it three times resulting in an average of 405 roosting and 45 flying birds for a total of 450. However, due to the conditions this total should be taken as a less accurate estimate than the other cave populations. A second visit was made on 21 September 2019 where I was accompanied by Mark Hulme and Zakaryyia Ali. The count was higher at 650 birds roosting and around 40 flying for a total of 690 Oilbirds.

Huevos Sea Cave

The low entrance to the cave is at the end of an inlet on the north side of the northern half of Huevos. There is a single large dome reaching about 30 metres high in the middle with a small beach at the back of the cave. After a first failed attempt to locate the cave, partly due to rough seas making access impossible, a second visit on 21 May 2017 yielded success. Using a pirogue, again captained by Imran Khan, we got as close as safely possible to the entrance and then I swam in to the cave at 0750 h accompanied by Robbery Rennie Jr. and Kevin Mycoo. Standing on the beach I counted approximately 120 roosting birds and 80 flying birds for a total of 200. There were chicks on some nests. A second visit was made on 21 September 2019, also accompanied by Mark Hulme, where we counted 160 roosting and around 40 flying for a total of 200 once again.

DISCUSSION

Cumaca Cave

Previous counts by members of the TTFNC have ranged widely but generally increased over time. In March 1976 Victor Quesnel reported that "The birds occupy only the first chamber. Two independent counts gave 254 and 247 nests, very good agreement given the difficult conditions. There are probably more nests than are visible from the floor so that counting two adults per nest there may well be 550 – 600 adult birds in the cave." (Quesnel, 1976). A few years later in January 1980 Richard ffrench reported "A recent visit… showed that the Oilbirds are thriving… A rough estimate of the numbers was 400." (ffrench, 1980). In 1985 Quesnel again reported on a trip to the cave in April "Most of the group went into the cave with David Rooks where he organised a count of the Oilbird nests. He found [ ], a considerable increase over the approximately 250 nests found on our trip of 7 March 1976. This difference is probably not due to an inaccurate count on the earlier occasion but to genuine increase in number. In 1976 the birds occupied only the first chamber. Now, the birds have established nests in the second chamber as well." (Quesnel, 1985). Unfortunately, the space for the number was left blank on the type written copy of the bulletin! Perhaps it was meant to have been confirmed and filled in by hand later. Finally, in January 2012 Stefanie White wrote "Graham White did a count of the apparently occupied Oilbird nests and came up with a total of 273. This was lower than a previous count in 1991, especially in the first chamber, but is much higher than the original counts conducted by Snow. There was no sign of any recent poaching of the birds and there were a few occupied nests which were within reaching distance and would probably not be there had poachers preceded us."

The latest count is significantly higher than previous ones, this may be due to different counting methods being used but the fact that the birds seem to have expanded into the deeper chambers should also be taken into account. Overall there is a definite trend of increasing numbers over the years in this cave making it the most numerous population in Trinidad.

Soho Cave, Carricker's Cave and "Small cave"

The exact locations of Snow's Aripo "Well cave", "Middle cave" and "Small cave" have been the subject of some debate amongst naturalists in Trinidad. Shaw (2009) suggested that the location of Aripo "Well cave" was now lost and that Carricker's Cave might be "Small cave" and that Soho Cave was a new discovery. I tentatively suggest here that "Well cave" is Soho Cave, "Middle cave" is Carricker's cave and "Small cave" has been relocated but abandoned by Oilbirds.

In Snow's 1962 paper, the Text-Fig. 1 map shows the locations of Oilbird colonies, with the three smaller Aripo caves running in a sloping line from east to west with "Well cave" at the top eastern end, "Middle cave" in the middle (as to be expected!) and "Small cave" at the bottom western end of the line. This matches up roughly with the locations of Soho, Carricker's and a third smaller cave.

Regarding Soho Cave I suggest that between the 1960s and the late 1970s when it was rediscovered, there had been a major collapse of the roof on the south end of what Darlington called the entrance chamber (1995). This exposed an easier entrance which you walk into rather than climb and would have completely changed the look and description of the cave. The sinkhole which leads to this "new" entrance is filled with wild tannia (*Xanthosoma undipes*), a species which takes advantage of gaps in rainforest (Kerbs, 2015), rather than mature trees as found in the area immediately surrounding the sinkhole. This lends credence to the idea that the forest floor collapsed at this sinkhole causing the trees to fall and the tannia to take over.

Carricker wrote of his visit "the first cave… proved to be a huge well-like affair, some sixty feet deep and twenty-five feet across, and with the top bridged over with solid rock, leaving a small opening on either side. One of these was sheer-walled to the bottom, but the other offered a precarious descent for about thirty feet, but from there a sheer drop. A pyramid of rock rose from the centre of the floor to a height of about thirty feet." (Carricker, 1931). In Soho Cave, Darlington's 1995 description of "a vertical shaft opens to the forest floor by a hole only about 1m wide… The shaft is 20.7 m deep, getting wider with depth…" corresponds well with Carricker's. The main chamber (Darlington's entrance chamber) is dominated by a large pointed mound of rock which could easily be described as a pyramid again matching Carricker's account. I am convinced that Carricker's first cave and Soho Cave are the same and when Snow goes and describes "Well cave" as a dry limestone cave with top entrance, and presumably named it "Well cave" after Carricker's description, I think that he must also be referring to the same cave. The dramatic change to the cave may explain why, when Darlington spoke to Snow describing the "newly discovered" Soho Cave, he said it was not his Well Cave (Darlington, 1995).

Previous counts for Soho Cave include a trip in March 1990 "estimated the number of Oilbirds to be 70 pairs." (Comeau, 1991) and in February 1993 it was reported that "The Oilbird population in Soho Cave is estimated at more than 90 individuals of which we were able to count 40." (Jaggernauth, 1993). Snow counted 80 birds for "Well cave" whereas this survey gave a total of 90 birds for Soho

Cave, which matches very well lending further weight to my suggestion.

The evidence for "Middle cave" being Carricker's Cave is not as comprehensive and is largely based on the location of this cave, between Soho Cave and the lower down "Small Cave". Unfortunately, Snow did not include a description of the cave in his 1962 paper, seemingly mistakenly, as he did describe all the other caves to some degree. Snow's count of 140 and my count of 200 for this colony are quite similar giving this cave the third largest population in the Northern Range. The population here appears to have stayed fairly constant over the years possibly indicating that the cave has avoided much disturbance and that all possibly nesting sites have been taken.

I am sure that the bounteous resources found in Soho and Carricker's Caves would have been well known to hunters in the past and that visitors such as Carricker and Snow would have been guided to these caves when they asked the locals.

The location of Snow's Aripo "Small cave" could not be confirmed from any literature sources or local knowledge. However, extensive searching of the possible area (based on the map Text-Fig. 1 in Snow, 1962) resulted in the discovery on 16 February 2017 of a small gorge like cave approximately 0.6 km WSW of Carricker's Cave (at 10.7122°, -61.2324°, altitude 580m). The cave has a small triangular entrance roughly 2m high leading into a narrow gorge with several gaps in the ceiling letting in light; Snow describes his cave as "Small limestone cave with dry floor; nests in subdued light" which corresponds quite well with this cave. There were no Oilbirds present but several ledges looked like they could have been suitable for roosting. If this is indeed "Small cave" it is possible that this population was wiped out by over collecting as this cave was the closest of the Aripo caves to human habitation and easier to access than the others in the area. At the time of the visit a large plastic pipe irrigation system was observed passing by only a few metres from the cave entrance, which suggests people would have been well aware of this population. The possible loss of the population at Aripo "Small cave" is not too significant given Snow's count of only ten birds. Further exploration should still be undertaken in the Aripo area to ascertain if another location could be the missing cave and a full description of this cave needs to be undertaken.

Dunston's Cave

Not surprisingly, given its accessibility, this is the most surveyed Oilbird population in Trinidad and over the years counts, undertaken by members of the Trinidad and Tobago Field Naturalists' Club in the past and more recently by staff of the AWNC, have varied from 25 to 203 (Lambie, 2010). The sudden drop in population in mid-2019 could be due to many factors, no obvious signs of disturbance or change to the cave structure were seen. One possible explanation is that the birds moved to a new area to take advantage of an abundance of fruiting trees or left the area because of a lack of fruiting trees, however this requires further investigation.

Morne Poui Sea Cave

This cave was not known to Snow. The first mention of it in the literature was by Quesnel (1979b) who wrote "David Rooks and a small party were recently shown a cave near Paria [the cave is approximately 1 km west of Paria Beach] which houses a large and previously unreported colony of Oilbirds…" and asked for help in confirming its existence. Ten years later, on the return boat journey after a TTFNC trip to Grand Tacaribe beach, several members of the club visited the cave and described "a thriving colony of 20 to 25 pairs of oil birds" (Acham, 1988). The increase to 80 Oilbirds bodes well and suggests that the cave is a secure roosting site.

La Vache Sea Cave

There are no records of any counts conducted after Snow. A visit was made by members of the TTFNC in November 1980 but they only confirmed the presence of Oilbirds and did not conduct a count (Boos, 2017). The increase in population since the 1960s is quite significant and is likely due to a decrease in harvesting of birds. The relative inaccessibility of this cave and its large size will hopefully mean it is a secure site for years to come but the former factor also works against it being an easy site to monitor regularly.

Huevos Sea Cave

This is the last surviving population in the Bocas Islands and a count of 200 birds is significantly less than Snow's count of 300. Perhaps it is still occasionally targeted by hunters but further investigation, perhaps subtle questioning of fishermen, could find out if this is the case.

Over the years several attempts have been made by members of the TTFNC to find the Huevos Sea Cave but they were unsuccessful (see Quesnel, 1979a; Kelly, 2012) so there are no further counts available between the 1960s and present day to help ascertain if the lower count now is the result of a long term downward trend or just a seasonal change.

The final count for all caves surveyed is presented in Table 3. The highest population count taken during the survey period for each cave was used. The current names of the caves are used with Snow's names in parentheses for comparison.

Snow estimated that there were 1,460 birds in Trinidad in the late 1950s to early 60s. This count puts the total at around 3,320, which is encouraging for a species that used to be heavily persecuted.

One of the factors that should be considered in the overall population is that it may be limited by the availability of suitable roosting sites with each cave having a carrying capacity. In the case of Dunston's Cave, the birds only increased in number when artificial nesting ledges were added in the 1960s (Lambie, 2010). The expansion of birds into the deeper chambers of Cumaca Cave as documented over the years could suggest that some caves have not reached their full capacity and as changes happen to caves from roof collapses and the opening of new sinkholes more roosting sites may become available in the future.

Other Caves Visited

Several other caves were visited during this project to check for signs of Oilbirds but none were expected and no birds were seen. These included Sanderson's Cave, Aripo Cave 2 and 3 (at the time of surveying the entrance of Cave 2 was blocked by an infill of river bed gravel caused by major flooding), Devil's Hole Cave, Colado Cave, Caura Cave, Gasparee Cave and Precipice Cave on Gaspar Grande, an unnamed sea cave on the south side of Point Gourde and L'Anse Paua sea cave (for details of locations of these caves see Shaw 2009).

Other Possible Colonies

There are quite likely to be other small populations of Oilbirds scattered throughout the Northern Range but none were confirmed as part of this study. One possible cave, roughly 3 km southwest of Grande Riviere, was mentioned to me by Joshua Spiers who was conducting unrelated studies in the area but due to time constraints this site was not visited as part of this study. It is also possible that further populations are to be found in sea caves along the north coast but as seen in our searching access to parts of the coastline is difficult and it is very likely that small caves could remain undocumented.

Table 3. Present known colonies of Oilbirds and their populations between February 2016 and September 2019.

Colony	Population
Cumaca Cave (Oropouche Cave)	1400
Aripo Main Cave	480
Carricker's Cave (possibly "Middle cave")	200
Soho Cave (possibly "Well cave")	90
Dunston's Cave (Arima Gorge)	180
La Vache Sea Cave	690
Morne Poui Sea Cave	80
Huevos Sea Cave	200
Total	**3320**

Journalist Heather-Dawn Herrera, in an article in the Trinidad Express on 6 June 2013, documented a trip to El Chiquero Cavern to observe an Oilbird roost. According to the writer the precise location of the cave is kept secret by the family of the original discoverers but it is surmised that the cave is located somewhere in the El Chiquero Forest to the north of the Cumaca Cave. A count of approximately 200-plus birds is mentioned at the end of the article.

Confirmation of these colonies exact locations and numbers are needed to facilitate long term monitoring of the total Trinidad Oilbird population and to help safeguard against these colonies disappearing without our knowledge.

Snow also acknowledged that there could be unrecorded populations of Oilbirds in caves, sinkholes and gorges hidden in the Northern Range but it is likely that these populations would be small numbering in the tens rather than hundreds. Part of the reasoning for this is that the economic value of the Oilbird in past times meant that all large populations were likely to have been previously discovered.

Conclusion

I would estimate that with these unconfirmed populations and with the high likelihood that at any time a certain percentage of each cave population is out foraging and roosting in the forests, that an overall population for Trinidad of more than 3,500 birds is not unrealistic. Snow wrote "I think it unlikely that the estimated total of 1,460 is out by more than 500 either way" (1962) and I agree that a fairly large range of variance could be included in future population estimates. However, to minimise this I suggest that future surveys should ideally have multiple teams visiting all the caves on the same day to get a more accurate 'snapshot' count and take into account the possibility of birds moving temporarily from one cave to another.

As long as the Oilbird stays off the menu the population would seem to be in good condition for the future. However, major threats could still materialise, the most likely being loss of forest habitat in which the birds feed and increased quarrying of limestone sites as the lower down more accessible sites are depleted. Increasing local awareness, as already conducted by the AWNC, and their important role in the environment as agents of seed dispersal and as a keystone species of tropical rainforest (Roca, 1994) should lead to the birds becoming another iconic Trinidad species.

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Donkey's Eyes, *Junonia* spp. (Lepidoptera, Nymphalidae), in Trinidad and Tobago

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ABSTRACT

There are two common species of J*unonia* in Trinidad and Tobago, which have been confused together under the local name 'donkey's eye': *J. zonalis* C. Felder and R. Felder and *J. genoveva genoveva* (Cramer). There is also a local, mangrove-feeding species, *J. litoralis* Brévignon, found in Trinidad but not reported from Tobago. Characters are presented to facilitate identification of adults in the field and from images.

Key words: *Junonia zonalis, Junonia genoveva, Junonia litoralis, Ruellia tuberosa, Avicennia germinans*

INTRODUCTION

Donkey's eye is the common name used in Trinidad and Tobago (Barcant 1970) for two of the three species of *Junonia* (Lepidoptera, Nymphalidae, Nymphalinae) that occur there (Cock 2014). Barcant (1970) treated these two species as a single common species found everywhere in Trinidad and Tobago. However, there are two common species of *Junonia* in Trinidad and Tobago, which had been confused together as the donkey's eye: *J. zonalis* C. Felder and R. Felder and *J. genoveva genoveva* (Cramer). There is also local, mangrove-feeding species, *J. litoralis* Brévignon, found in Trinidad, but not reported from Tobago (Cock 2014, 2017). At least three more species of the complex are found in the Guianas (Brévignon and Brévignon 2012), but these have not been reported from Trinidad or Tobago. Further information on the history and nomenclature of the three species can be found in Cock (2014), together with an explanation of why these names are used for the Trinidad and Tobago fauna.

The molecular genetics of *Junonia* is the subject of ongoing research (e.g. Lalonde *et al.* 2018 and papers cited therein), which is slowly unravelling the complexities found in different geographical areas. DNA barcodes show two main lineages, but do not segregate the recognised species (Brévignon and Brévignon 2012, Lalonde *et al.* 2018), although ongoing research looking at genomes will throw more light on this (C. Brévignon, pers. comm. 2019). Based on recent research, it can be anticipated that the three morphological species in Trinidad are likely to be divided by their food plants, and other aspects of their ecology such as habitat preference, phenology, courtship, but that hybridisation will also occur (Gemmell *et al.* 2014). The names applied to the Trinidad and Tobago species may well be changed in this process as this complex group becomes better understood.

Because the two common species of donkey's eye are amongst the most frequently photographed species in Trinidad and Tobago, this note sets out how to distinguish them, with attention to the characters that are visible in images of the living adults. Suggestions for further research are also mentioned.

RESULTS

The caterpillars of *J. litoralis* are known to feed on black mangrove *Avicennia germinans* (L.) L. (Acanthaceae) (Brévignon and Brévignon 2012), and so far this species has only been found at Caroni Swamp south to Couva in Trinidad, although it can be expected to occur in other areas of mangrove swamp. Observations away from mangrove swamps are unlikely to be this species, but could be either of the other two species.

One of the clearest diagnostic features is the **colour of the underside of the antenna club**, which is pale in *J. zonalis* and distally dark in *J. g. genoveva* and *J. litoralis* (Brévignon and Brévignon 2012). This is not completely clear-cut; I have examined the 10-11 segmented antennal clubs of all Trinidad and Tobago specimens to hand using a binocular microscope (Fig. 1) and come to the following conclusions. My single male specimen of *J. litoralis* has the club dark brown, except the basal two segments are pale ventrally (Fig. 1A). Specimens of *J. zonalis* have the club dark above and creamy white or pale brown below, and in both sexes the distal 3-4 segments may be pale brown ventrally (Figs. 1B-D). Specimens of *J. g. genoveva* have the club dark blackish-brown ventrally, dark brown at the apex, but the basal 2-3 segments of the club may be pale ventrally (Fig. 1E-F), and with scattered white scales extending on the outside edge to about the middle of the club. However, the colour of the ventral side of the antennal club will rarely be visible in images of living adults (none of the live images included here (Figs. 15-23) show this character), so markings of the dorsal and ventral wing surfaces must be used to identify these.

Pinned specimens of all three species are shown life size as Figs. 2-14 (specimens collected by the author and in the author's collection except as indicated), and their separation with both the dorsal and ventral surface visible together is relatively straightforward. In images

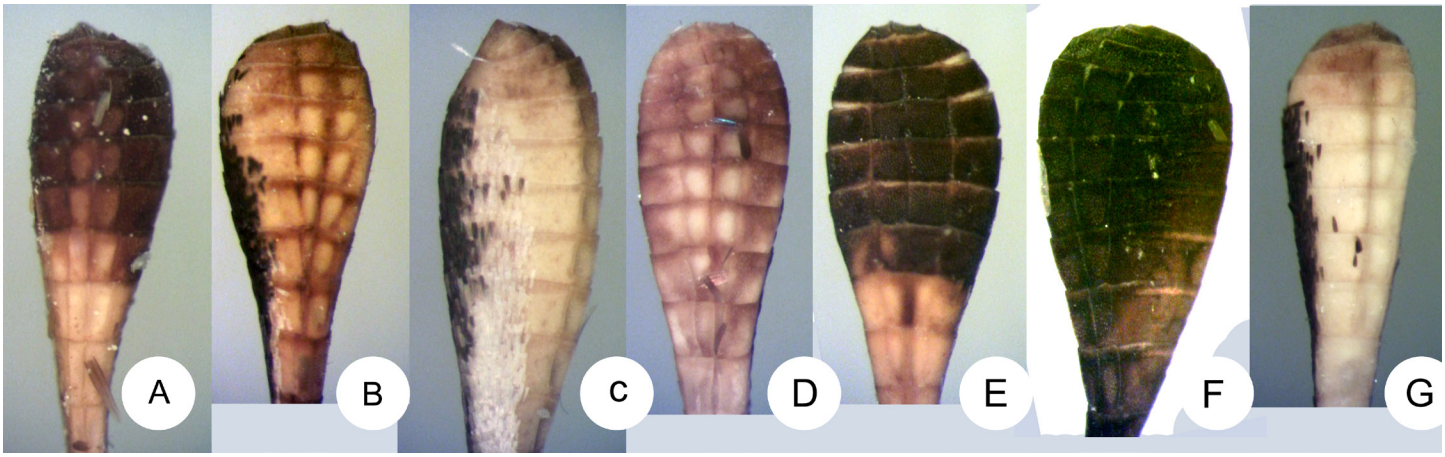

Fig. 1. Details of antennal club of pinned specimens of *Junonia* spp., ventral view except **C** in lateral view. **A**, *J. litoralis* male (Fig. 2); **B**, *J. zonalis* male (Fig. 5); **C**, *J. zonalis* male (Fig. 6); **D**, *J. zonalis* female (Fig. 7); **E**, *J. g. genoveva* male (Fig. 11); **F**, *J. g. genoveva* female (Fig. 14); **G**, *J. zonalis* female possible hybrid (Fig. 9).

Figs. 2-3. *Junonia litoralis*. **2**, male, Trinidad, Caroni Swamp, track to west from Cacandee Sluice, 26.iii.2003, M.J.W. Cock. **3**, female, Trinidad, Caroni Swamp, ix.2004, S. Alston-Smith (S. Alston-Smith collection).

of live specimens, only one wing surface is available, so characters that work for just the ventral surface or just the dorsal surface are needed. ***Junonia litoralis*** is usually larger than the other two species, although these *Junonia* spp. can vary in size (e.g. compare Figs. 12-14). In ventral view, the hindwing of *J. litoralis* is relatively uniformly dark brown in the male (Fig. 2), paler in the female (Figs. 3, 24), with the eye spots greatly reduced; that of *J. zonalis* is also rather uniform and an intermediate chestnut-brown in the male (Figs. 4-6, 17), paler and less uniform in the female (Figs. 7-8, 20); while that of *J. g. genoveva* is relatively pale (Figs. 10-14, 23). In dorsal view, the male of *J. litoralis* (Fig. 2) is a much darker species than *J. zonalis* (Figs. 4-6, 15, 16), the outer ring basal to the main forewing eyespot is always sullied brown, not clear orange, and the submarginal orange band of the hindwing is reduced or absent. The subapical band of the *J. litoralis* specimen illustrated (Fig. 2) is almost white, but this is not the case in the only other Trinidad specimen that I have seen which has this band distinctly tinted orange-brown, so should not be relied on as a diagnostic character. The dorsal view of female *J. litoralis* (Figs. 3, 24) could be confused with female *J. zonalis* (Figs. 7-9, 18, 19) and female *J. g. genoveva* (Figs. 12-14, 22), but the orange

colouring is duller (like *J. zonalis*), the hindwing submarginal band is broader (like *J. g. genoveva*) and the forewing pale subapical band is narrower. Fig. 9 shows a female (from the tiny patch of mangrove at the neck of the Point Gourde peninsula) identified as *J. zonalis* due to the pale club ventrally (Fig. 1F) and wing shape, but otherwise resembling *J. litoralis*; it might be a hybrid between the two.

Junonia zonalis is intermediate in dorsal view (Figs. 4-9, 15, 16, 18, 19) – normally darker than *J. g. genoveva* (Figs. 10-14, 21, 22) but lighter than male *J. litoralis* (Fig. 2), and comparable to female *J. litoralis* (Fig. 3): the discal hindwing and basal forewing often have a grey tone to them; the outer ring basal to the main forewing eyespot is usually at least slightly sullied brown in the male, but may be sullied or clear orange in the female; and the submarginal

Figs. 4-6. Male *Junonia zonalis.* **4**, Trinidad, Maracas Valley, 28.xii.1981, M.J.W. Cock. **5**, Trinidad, Cat's Hill, 16.vi.2013, J. Morrall. **6**, Trinidad, Cat's Hill, 16.vi.2013, J. Morrall (note missing hindwing spot).

Figs. 7-9. Female *Junonia zonalis.* **7**, Trinidad, near Centeno, 10.vi.1978, M.J.W. Cock. **8**, Trinidad, Cat's Hill, 16.vi.2013, J. Morrall. **9**, possible *J. zonalis* x *J. litoralis* hybrid, Trinidad, Point Gourde, 22.iii.2003, M.J.W. and P.J.A. Cock.

band of the hindwing is narrow or reduced, dull orange when present. ***Junonia g. genoveva*** (Figs. 10-14, 21, 22) is usually paler than *J. zonalis* (Figs. 4-8, 15, 16, 18, 19), and the dorsal surface does not have a grey tone. The outer ring basal to the main forewing eyespot is only rarely slightly sullied brown and is normally clear orange; this character should only be considered in combination with the other diagnostic characters discussed here. The submarginal band of the hindwing is always bright orange and relatively broad. In addition to these characters (summarised in Table 1) it can be seen that the three species and two sexes have slightly different wing shapes (Figs. 2-14), although this may be difficult to judge in images of living adults. Most images of living adults can be identified from the relevant characters for the dorsal or ventral view, but some females are likely to be difficult to allocate between *J. zonalis* and *J. g. genoveva* on the one hand and between *J. zonalis* and *J. litoralis* on the other.

Fig. 10-11. Male *Junonia genoveva.* **10**, Tobago, Crown Point, 12.ix.1982, M.J.W. Cock. **11**, Trinidad, Point Gourde, 11.vi.2013, M.J.W. Cock.

Fig. 12-14. Female *Junonia genoveva.* **12**, Tobago, Crown Point, 12.ix.1982, M.J.W. Cock. **13**, Tobago, Crown Point, 9.i.1982, M.J.W. Cock. **14**, Trinidad, Point Gourde, 11vi.2013, J. Morrall.

DISCUSSION

Although *J. zonalis* and *J. g. genoveva* both seem to be common in Trinidad and Tobago, little is known about their relative distribution, flight times, seasonal variation, behaviour, food plants, early stages etc. and studies on these aspects would be worthwhile. I have the impression that *J. zonalis* is generally more common and widespread, and is usually the species found in gardens, whereas *J. g. genoveva* is more common in drier areas, particularly in Tobago, but this needs critical evaluation.

As noted above, *Junonia litoralis* is known to feed on black mangrove in French Guiana (Brévignon and Brévignon 2012) and caterpillars have also been observed on mangrove in Trinidad (S. Alston-Smith pers. comm.). Although *J. litoralis* has not been reported from Tobago, and the extent of mangrove there is very limited – a little over 200 ha compared to more than 9,000 ha in Trinidad (Junan and Ramsewek 2013) – it would be worth checking

Fig. 15. *Junonia zonalis* male, undated, Trinidad, Curepe, M.J.W. Cock. The submarginal orange band of the hindwing is almost absent, and the outer ring basal to the main forewing eyespot is brown.

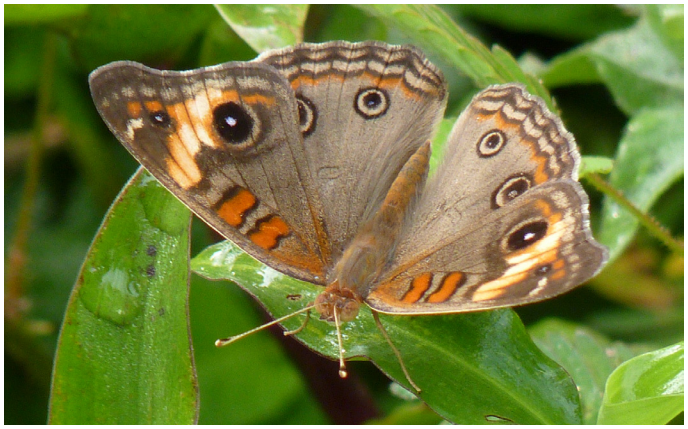

Fig. 16. *Junonia zonalis* male, 18 April 2010, Trinidad, Cat's Hill, K. Sookdeo. The submarginal dull orange band of the hindwing is narrow, and the outer ring basal to the main forewing eyespot is grey-brown.

Fig. 17. *Junonia zonalis* male, 14 September 2016, Trinidad, Fishing Pond, K. Mahabir. The relatively uniform, chestnut brown colouring of the ventral hindwing is typical of the male of *J. zonalis* (cf. Figs. 4-6).

Fig. 18. *Junonia zonalis* female, 29 January 2010, South Oropouche, T.P. Maharaj. The submarginal band of the hindwing is dull orange and narrow, and the outer ring basal to the main forewing eyespot is pale grey-brown.

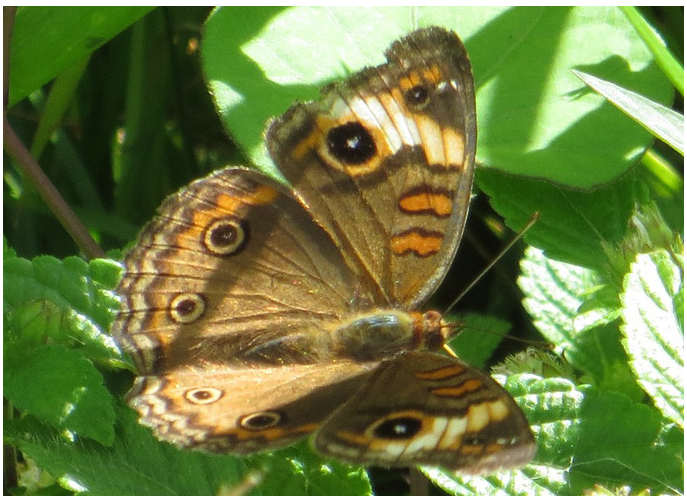

Fig. 19. *Junonia zonalis* female, Trinidad, Four Roads to Carmichael, 3 January 2015, Mike G. Rutherford (cropped from https://www.inaturalist.org/observations/11317932; Creative Commons License CC-BY-NC). The submarginal orange band of the hindwing is narrow and dull orange, and the outer ring basal to the main forewing eyespot is sullied brown.

Fig. 20. *Junonia zonalis* female, 14 September 2016, Trinidad, Fishing Pond, K. Mahabir. The brown colouring of the ventral hindwing is paler than in the male of *J. zonalis* (Figs. 4-6), but not as pale and uniform as that of the female of *J. g. genoveva* (Figs. 12-14).

Fig. 21. *Junonia genoveva genoveva* male, Trinidad, 18 March 2007, South Oropouche, T.P. Maharaj. The hindwing submarginal band is broad and orange, and the outer ring basal to the main forewing eyespot is sullied brown.

Fig. 22. *Junonia genoveva genoveva* female, 19 June 2010, Trinidad, K. Sookdeo. The hindwing submarginal band is broad and bright orange, and the outer ring basal to the main forewing eyespot is slightly sullied brown.

Fig. 23. *Junonia genoveva genoveva* mating pair, Trinidad, Aripo Savannah, 14 October 2011, M.J.W. Cock. The pale ventral colouring is obvious. Note the female (above) carries the male (below).

Fig. 24. *Junonia litoralis* female, 19 July 2019, Orange Valley, Couva, Davis Gunn (cropped from https://www.inaturalist.org/observations/36174162; Creative Commons License CC-BY-NC). The overall colouring is dull and dark, hindwing submarginal band is medium-broad and dull orange, the outer ring basal to the main forewing eyespot is sullied brown, and the forewing subapical band is narrow and sullied.

the larger areas of mangrove at the west end of Tobago for this species. Based on the observations of Brévignon and Brévignon (2012), it can be expected that *J. g. genoveva* feeds on *Hyptis atrorubens* Poit. and other Lamiaceae. The food plant of *J. zonalis* is not clearly known, but F.C. Urich (in Beccaloni *et al.* 2008) reared either *J. g. genoveva* or more likely *J. zonalis* from *Ruellia tuberosa*

Table 1. Overview comparison of the Trinidad and Tobago *Junonia* spp. These characters will need to be considered alongside the figures, as several are based on relative differences. They should be locally evaluated before applying them to populations of these species from other countries.

Character	Distribution	Ventral antennal club	Outer pale ring basal to the main forewing eyespot	Sex	Ventral hindwing colouring	Subapical forewing pale band	Overall dorsal colouring	Orange submarginal band, dorsal hindwing*
J. litoralis	Mangrove swamp, Trinidad only	Dark brown, except the basal two segments are pale	Always sullied brown	male	Rather uniformly dark brown	Narrow; may be white	Dark; noticeably more than other species	Narrow; dull orange, sullied dark brown
				female	Rather uniformly brown	Narrow	Dull	Medium; dull orange
J. zonalis	Disturbed areas, Trinidad and Tobago	Creamy white or pale brown; the distal 3-4 segments may be pale brown ventrally	Usually sullied brown	male	Rather uniformly intermediate chestnut-brown	Broad	Dull, sometimes with a green tinge to hindwing	Narrow, occasionally more or less absent; dull orange
				female	Paler than male and more contrasting markings	Broad, sometime reduced	Dull, sometimes with a green tinge to hindwing	Narrow to medium width; dull orange
J. genoveva	Disturbed areas, Trinidad and Tobago	Dark blackish-brown, dark brown at the apex, but the basal 2-3 segments may be pale	Usually clear orange	male	Relatively uniform pale brown	Broad	Bright	Medium width; bright orange
				female	Contrasting pale brown markings	Broad, some-time reduced	Bright	Broad; bright orange

* The extent to which the bands are perceived as dull or bright orange is at least partially a function of the width of the band (a broader band appears brighter orange), and this may need to be taken into consideration.

L. (Acanthaceae) in Trinidad. The species of this group are recorded from a variety of other families across the Neotropics including Asteraceae (Asterales), Lentibulariaceae, Orobanchaceae, Plantaginaceae, and Verbenaceae (Lamiales) (Beccaloni *et al.* 2008, Brévignon and Brévignon 2012). Hence the food plants accepted by *Junonia* spp. in Trinidad and Tobago need investigation and documentation.

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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*

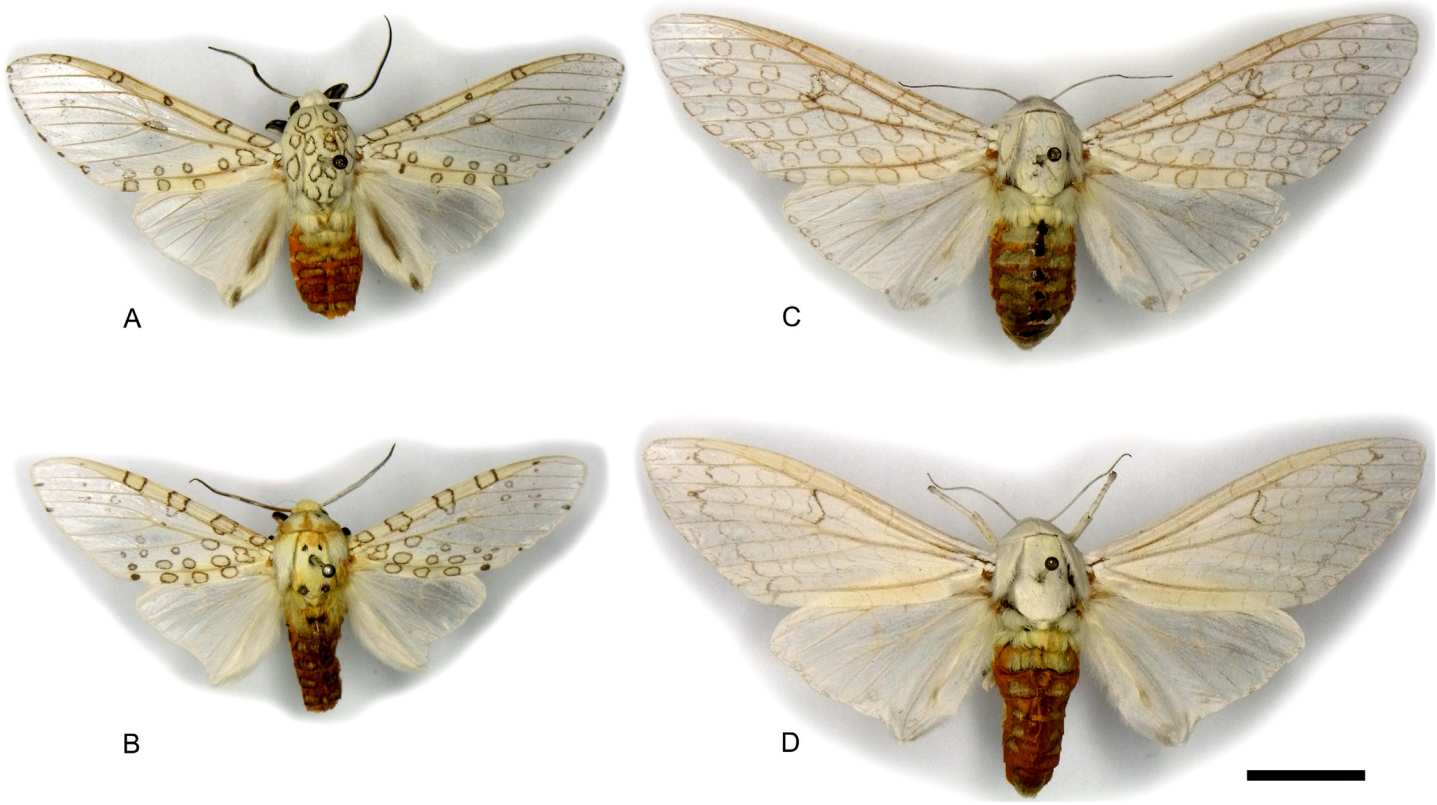

Fig. 1. Pinned adults of *Hypercompe trinitatis* from Trinidad (in MJWC). **A**, ♂, Curepe, MV Trap, 31 May 1979; **B**, ♂, Curepe, MV Trap, 9 February 1980; **C**, ♀, Curepe, MV Trap, 9 November 1978; **D**, ♀, Morne Bleu Textel Installation, at light, 13 September 1978. Scale bar 10 mm; approximately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

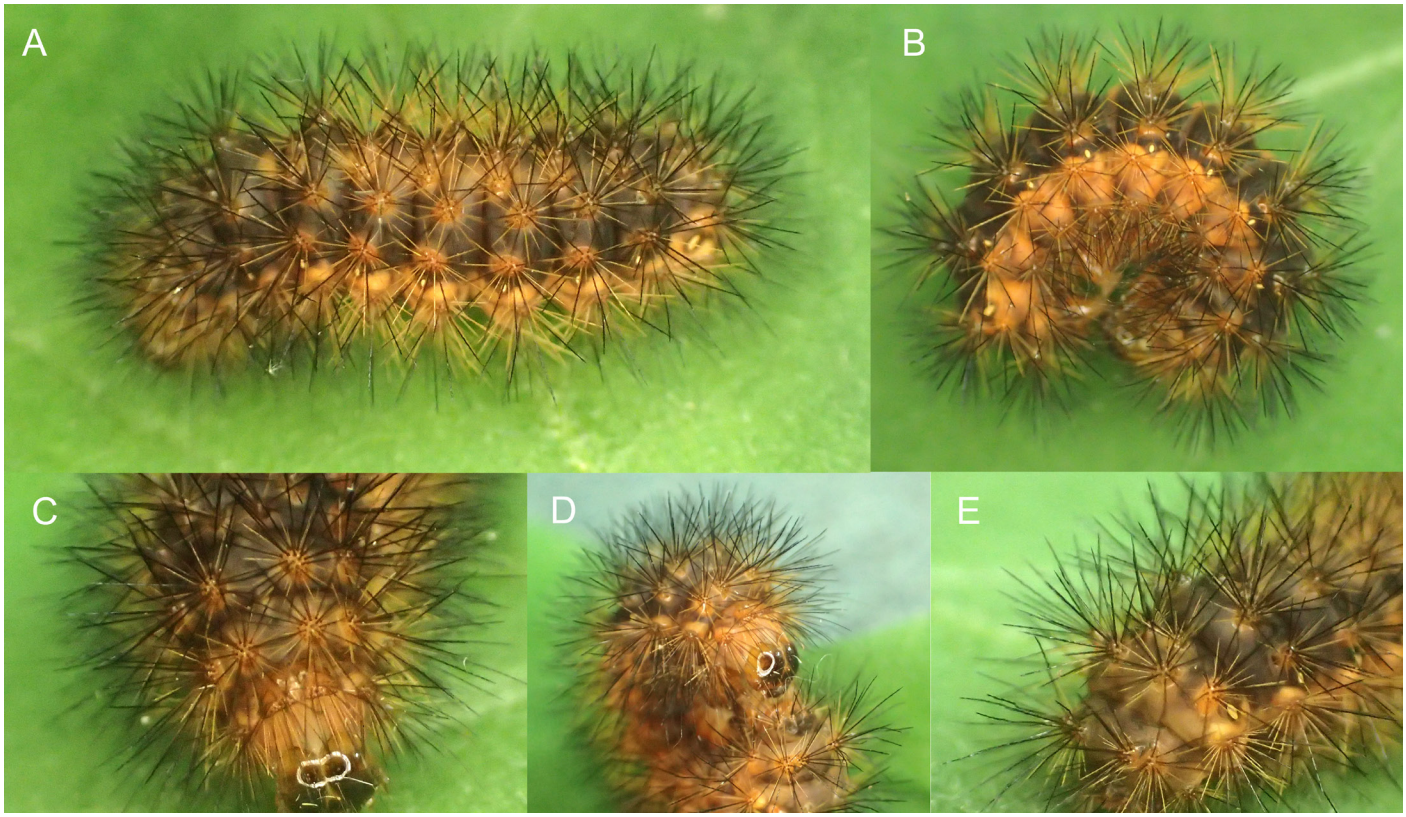

Fig. 4. Mature brown caterpillar of *Hypercompe trinitatis*, collected on eggplant, Mt. Lambert, San Juan, Trinidad, 23 November 2016, specimen C (UWIZM.2017.52.2). **A**, dorsal view; **B**, lateral view; **C**, **D**, anterodorsolateral view, head and anterior region; **E**, lateral view, head and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

Insights into the Reproductive Ecology of the Critically Endangered Trinidad Piping-Guan, *Pipile pipile* Revealed Through Camera Trapping

The Trinidad Piping-Guan (or Pawi), *Pipile pipile*, (family Cracidae) is a species endemic to the island of Trinidad (Hayes *et al.* 2009). It plays an important role in large seed dispersal, and is important economically for ecotourism (Naranjit 2012). The species is classified as critically endangered by the International Union for the Conservation of Nature's Red List (Birdlife International 2018), with estimates of the population being between 77 and 231 individuals (Hayes *et al.* 2009). Though the species is protected under the Conservation of Wildlife Act in Trinidad and Tobago (Chapter 67:01), and is also designated as an Environmentally Sensitive Species, habitat destruction and illegal hunting may continue to adversely affect the species, as well as efforts to conserve the remaining population and aid in the species' recovery (Nelson *et al.* 2011).

A major constraint has been a general lack of knowledge on the species itself (Nelson *et al.*2011, Alexander 2002). Studies have concentrated on feeding and behavioural ecology (Alexander 2002; Hayes *et al.* 2009; Naranjit 2012), with limited information on their reproduction. Naranjit (2012) confirmed a protracted breeding season and that nesting appears to be low to the ground, with 2-3 cream-coloured eggs being produced. Three 2-3 day old chicks were also observed following an adult along the ground in February of 2007 (Naranjit, 2012).

Here, I add to the observation of parents accompanying chicks on the ground. During the National Wildlife Survey component of the National Restoration, Carbon Sequestration, Wildlife, and Livelihoods Project initiated by the Environmental Management Authority, an adult Pawi with chick were pictured by one of the Reconyx HC600 cameras deployed in the proposed Matura National Park (Fig. 1). The picture was taken on 24 March 2017 at 5:13pm. In the first picture the adult bird was seen walking on the ground up a hill with the chick about half a metre behind. Before the birds go out of frame the chick is very close to the adult, taking shelter under the tail feathers. These individuals were in primary forest at an elevation of about 325m above sea level, between the Grande Riviere and Zagaya Rivers. It would appear that this habitat is suitable for their reproduction, and that, like other cracid species, there is significant parental care and investment of young chicks (Delacour and Amadon 2004). The photo capture reveals that adults and young spend some time on the ground, perhaps engaging in foraging. That nests have been observed close to the ground may facilitate fledging young's access to the ground, where they at least spend some of their time before returning to trees. This may also leave them more vulnerable to predation, and these insights provide valuable information which can be used to further the conservation and recovery of this critically endangered species.

Fig. 1. Adult Pawi and chick pictured in the Matura National Park, 24 March 2017.

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Report on Sightings of the Potential Invasive Species *Ophiothela mirabilis* (Echinodermata: Ophiuroidea) in Tobago, W.I.

Ophiuroids (brittle stars) are evolutionarily adapted to thrive in marine habitats. Their high species diversity, generalist nature, ability to reproduce asexually and sexually and to employ anti-predator mechanisms, make them ideal invaders (Beatty 2015).

The identified epizoic brittle star *Ophiothela cf. mirabilis* (Verrill, 1867) originated in the eastern Pacific where it densely inhabits its hosts (Araújo *et al.* (2018). While several epizoic ophiuroids demonstrates host octocoral-specificity (Mosher and Watling, 2009), *O. mirabilis* is a seemingly opportunistic generalist. They inhabit several host species including sponges, gorgonians, zoanthids, bryozoans, hydrozoans and long-spined sea urchins (*Diadema antillarum* Philippi, 1845) (Hendler and Brugneaux 2013, Mantelatto *et al.* 2016). Using fissiparity, they are able to densely colonise its host with clones of itself, while broken limb fragments may be transported by currents to a new host (Hendler and Brugneaux 2013).

The first observation of *O. mirabilis* in the Atlantic was in 2000 in Brazil off Ilha do Pai, Rio de Janeiro and was further reported in St. Vincent, French Guiana and Tobago (Hendler *et al.* 2012, Hendler and Brugneaux 2013, Mantelatto *et al.* 2016, Lawley *et al.* 2018). Tobago's first documented confirmation of its presence was in 2013 at Store Bay, Goat Island and Little Tobago (Fig.1), possibly introduced through coastal currents or marine vessels (Hendler and Brugneaux 2013). While there has been no further publication of their presence in the wider Caribbean, it is possible they have dispersed to other islands.

Observations of the yellow-orange morphotype of *O. mirabilis* as documented by Araújo *et al.* (2018) were recorded during Reef Check belt transect and roving underwater turtle surveys from July 2016 to January 2018. Fig. 2). A total of 111 dives were performed across 19 sites in Tobago at depths ranging between 8 to 18 m (Fig. 1)..

Specimens were collected and identified using Humann, DeLoach and Wilk (2013) and Granja-Fernández *et al*. (2014), whilst Hendler (1995) was used to validate the identification against other regional species. Host species identification were confirmed using Humann, DeLoach and Wilk (2013) and Sánchez and Wirshing (2005). All species names verified with WoRMS (2018). *O. mirabilis* specimens were submitted to and accessioned at The University of the West Indies Zoology Museum (Accession number UWIZM.2019.5).

Ophiothela mirabilis was found at 15 of the 19 survey sites and detected during 22 of 111 dives during survey period. The species was undetected at sites 10, 12, 16 and 18 (Fig. 1, Table 1). They most commonly inhabited sea whips spp. (at eight sites, 53% of all sites) followed by the octocoral *Antillogorgia bipinnata* (Verrill, 1864) (at five sites, 33% of all sites). In Site 1, *O. mirabilis* showed

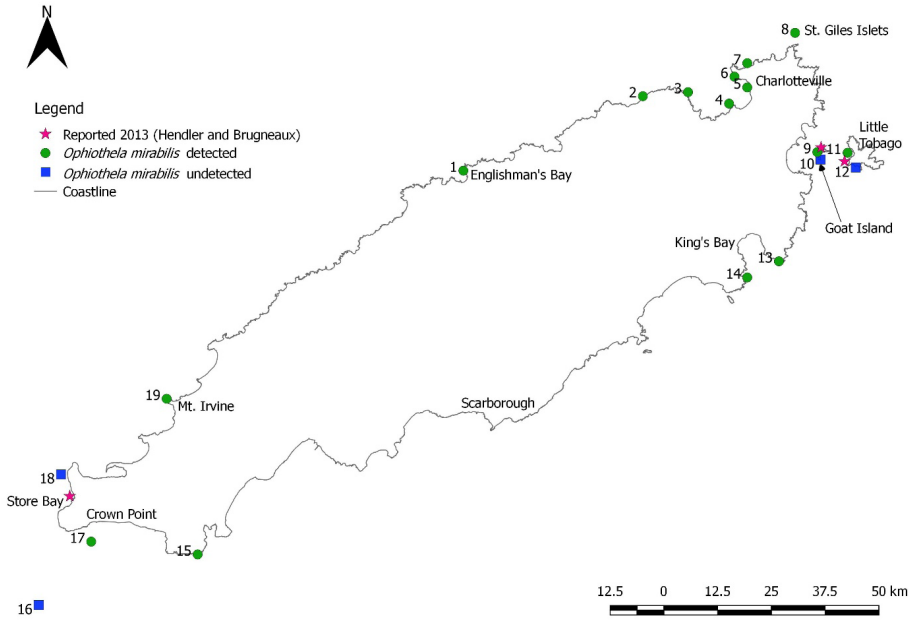

Fig. 1. Survey sites and *O. mirabilis* occurrence in Tobago, including the sites reported in Hendler and Brugneaux, 2013.

Fig. 2. *Ophiothela mirabilis* (yellow-orange) on host sea plume, *Muriceopsis flavida.*

Table 1. Observed host species of *Ophiothela mirabilis* at 19 survey sites in Tobago from July 2016 to January 2018.

General host	Host species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Sea whips and sea plumes	*Antillogorgia acerosa*					x								x						
	Antillogorgia bipinnata		x		x	x	x	x												
	Eunicea tourneforti					x														
	Muriceopsis flavida	x																		
	Plexaura homomalla	x																		
	Pseudoplexaura flagellosa														x					
	Pterogorgia citrina													x						
	Sea whip spp.	x		x		x				x		x				x		x		x
Sea fans	*Gorgonia flabellum*	x												x						
	Gorgonia sp.						x							x		x		x		
	Gorgonia ventalina	x												x						
Fire coral	*Millepora alcicornis*				x		x		x						x					
	Millepora spp.									x		x								
	Total host species richness*	4	1	1	2	3	3	1	1	2	0	2	0	4	2	2	0	2	0	1

*Includes all hosts identified to species but excludes *Gorgonia* sp., *Millepora* sp. and Sea whip spp. These three are only included in the total host species richness count when they were the lone host organism type at the survey site.

the greatest host diversity by populating at least five species (all octocorals). For most sites, the species was found mostly inhabiting just one host structure. However, at Englishman's Bay (Site 1) there was an increase from one host structure during July 2017 to six, represented by four host species in December 2017. *Ophiothela mirabilis* was previously undetected at Flying Reef (Site 17) from May 2017 to July 2017, but there was a first occurrence in August 2017 on 12 colonies of sea whips (10 unidentified).

Ophiothela mirabilis was found inhabiting on octocorals (sea whips and sea fans) and fire corals (*Millepora* spp.). Additionally, they were also observed on the Branching vase sponge (*Callyspongia vaginalis*) and Red cushion sea stars (*Oreaster reticulatus*) (pers. obs. prior to data collection). At sites 10, 12, 16 and 18, the potential hosts were present, but uninfested. Despite the literature indicating that *O. mirabilis* are generalists (e.g. Hendler and Brugneaux 2013), from the data, there seems to be a stronger preference for the octocorals and fire corals identified. There is no clear pattern of dispersal for Tobago.

Research is slowly expanding to better understand *O. mirabilis*, such as its host preference and host selection mechanism (Ribeiro *et al.* 2009, Mantelatto *et al.* 2016). Notwithstanding, knowledge gaps in its sexual reproductive and larval dispersal behaviour, feeding habits, and environmental requirements and interactions, underscores the need to bolster research effort (Hendler, 2013). As with all potential alien invasive species, there is an inherent need to discern the impacts of *O. mirabilis* to native epizoic symbionts, its hosts and ultimately the reef environment particularly as it pertains to already existing stressors. With the information presented here, we now have a baseline to support future monitoring and research into *Ophiothela mirabilis* in Tobago.

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A New Species of Bat, Geoffroy's Hairy-Legged Bat, *Anoura geoffroyi*, Recorded for Tobago, W.I. and Updated Species List

In this short note, we update the list of existing bat species found in Tobago, as well as those believed to be extinct on the island. We also highlight the capture of a new record, Geoffroy's Hairy-legged Bat, *Anoura geoffroyi* in Tobago. Of the over 1300 species of bat found throughout the world, 68 species are recorded in Trinidad, and 24 recorded in Tobago by Gomes and Reid (2015). A new species of *Myotis*, Sir David Attenborough's Myotis, *Myotis attenboroughi* was reported in 2017 for Tobago (Moratelli *et al.* 2017) which replaces *Myotis nigricans*. Three species cited in Gomes and Reid (2015) are locally extinct on Tobago – *Pteronotus parnelli, Pternotus personatus,* and *Natalus tumidirostris.* Since this publication, fossil evidence from Robinson Crusoe Cave, Amblypygid Cave, and Effigy Cave have revealed an additional seven species of locally extinct or extirpated bat species from Tobago. Gomes and Reid (2015) cite *A. geoffroyi* in Trinidad, and this is considered to be the most comprehensive and contemporary review of the bats of Trinidad and Tobago. Recent captures reveal this species' presence in Tobago. The first record (to our knowledge) of *A. geoffroyi* was during the 2015 Bioblitz in Charlotteville. This specimen was captured and released on the compound of the Man-O-War Bay Cottages on 23 October 2015. The University of Glasgow Tobago Expedition captured one individual in Dead Bay on 1 August 2016, and again captured one individual in the Main Ridge Forest Reserve along the Blue Copper Trail on 20 July 2018. The Diploma/MSc in Biodiversity Conservation and Sustainable Development in the Caribbean field practicum also captured an individual at the same location (Blue Copper Trail) on 8 May 2018. Having four records of the species in Tobago in just three years, the species would appear to be well established, though a roost has not yet been identified. The inclusion of an additional nectarivore in Tobago is a welcome discovery. Table 1 presents an updated list of the species reported for the island of Tobago, both locally extinct/extirpated as well as existing, their family and subfamily, their feeding guild, and the reference where the species is reported. Today, there are 22 species existing in Tobago, with an additional 10 species locally extinct/extirpated.

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Table 1. List of existing and locally extinct/extirpated species of bat found on the island of Tobago, their feeding guild, and reference.

Family/Subfamily	**Species**	**Feeding Guild***	**Reference**	**Existing**	**Locally Extinct**
Emballonuridae	*Peropteryx trinitatis*	SFIns	Gomes and Reid 2015	X	
	Saccopteryx leptura	SFIns	Gomes and Reid 2015	X	
Phyllostomidae					
Micronycterinae	*Lampronycteris bracyotis*	SFIns	This publication		X
	Micronycteris megalotis	SFIns	Gomes and Reid 2015	X	
Phyllostominae	*Phyllostomus hastatus*	O	Gomes and Reid 2015	X	
	Trachops cirrhosus	C	This publication		X
Glossophaginae	*Anoura geoffreyi*	N	This publication	X	
	Glossophaga longirostris	N	Gomes and Reid 2015	X	
Carollinae	*Carollia perspicillata*	F	Gomes and Reid 2015	X	
Stenodermatinae	*Artibeus cinereus*	F	Gomes and Reid 2015	X	
	Artibeus jamaicensis	F	Gomes and Reid 2015	X	
	Artibeus lituratus	F	Gomes and Reid 2015	X	
	Centurio senex	F	Gomes and Reid 2015	X	
	Chiroderma trinitatum	F	Gomes and Reid 2015	X	
	Chiroderma villossum	F	Gomes and Reid 2015	X	
	Sturina lilium	F	Gomes and Reid 2015	X	
	Vampyrodes carracioli	F	Gomes and Reid 2015	X	
Mormoopidae					
	Mormoops megalophylla	FFIns	This publication		X
	Pteronotus davyi	FFIns	This publication		X
	Pteronotus fuscus	FFIns	This publication		X
	Pteronotus gymnotus	FFIns	This publication		X
	Pteronotus parnelli	FFIns	Gomes and Reid 2015		X
	Pteronotus personatus	FFIns	Gomes and Reid 2015		X
	Pteronotus rubiginosus	FFIns	This publication		X
Noctilionidae					
	Noctolio leporinus	P	Gomes and Reid 2015	X	
Natalidae					
	Natalus tumidorostris	SFIns	Gomes and Reid 2015		X
Molossidae					
	Molossus molossus	FFIns	Gomes and Reid 2015	X	
	Tadarida brasiliensis	FFIns	Gomes and Reid 2015	X	
Vespertilionidae					
	Eptisicus brasiliensis	SFIns	Gomes and Reid 2015	X	
	Lassiurus blossevillii	SFIns	Gomes and Reid 2015	X	
	Myotis attenboroughi	SFIns	Moratelli *et al.* 2017	X	
	Rhogeessa io	SFIns	Gomes and Reid 2015	X	

*F = Frugivore; N = Nectarivore; P = Piscivore; FFIns = Fast flying insectivore;
SFIns = Slow flying insectivore; O = Omnivore; C = Carnivore

Terrestrial and Freshwater Turtles of Tobago, W.I. and Report of a Potential Alien Invasive Species

Within the last decade, there has been growing attention toward the herpetofauna of Tobago. The checklist for Tobago is continually expanding as numerous cryptic species are documented, as reviewed by Murphy and Downie (2012), most notably lizards, snakes and frogs (for example new *Leptophis* sp. (Murphy *et al.* 2013)). Despite this, terrestrial and freshwater turtles are seemingly understudied possibly owing to their rarity on the island. This is in stark contrast to their marine counterparts who are more prevalent and are ranked higher on the International Union for Conservation of Nature listings, thereby receiving more recognition. Here, we reviewed the Emydidae (pond and river turtles) and the accounts of Testudinidae families (Tortoises).

In Emydidae family, a single species, *Rhinoclemmys punctularia punctularia* (Galap or Galup) has been documented in Tobago historically (Hardy, 1982 in Murphy, 1997)), based on two specimens. Hardy (1982) noted an apparent waif caught in a fisherman's net at Bloody Bay and an additional specimen in a river near Hillsborough Dam. Hardy (1982) also quoted Poyntz's (1683, 1695) account of a freshwater aquatic species present on the island. However, Murphy et al (2018) suggested that emydids could be absent from the island.

Now, we add to this narrative two recent sightings of freshwater turtles in Tobago, presumably *R. punctularia punctularia*. In June 2014, one specimen was observed in a pond near Parlatuvier's Top River Fall (UTM 20P 756831E, 1250038N) in north east, Tobago. A second sub-adult with a carapace length of 12.0cm was caught in November 2013 at a tributary of the Bacolet River, on the outskirts of Scarborough (UTM 20P 748344E, 1238221N) south west, Tobago. Several wildlife tour operators (e.g. R. Corbin) and hunters recall witnessing them in the valley drainages of Mason Hall. In Trinidad, this species is relatively common in waterways with high turbidity and low visibility (Mohammed et al 2010). In Tobago, similar habitats are limited as most rivers are clear water systems due to the island's dendritic drainage, short water catchments and limestone geology, which is comparable to the northern range drainage where this species is absent. This can account for the species' rarity in Tobago. There are however, several individuals being kept as pets in Tobago, with some originating from Trinidad (e.g. three specimens housed in Speyside of which at least one is a breeding female). Additionally, Corbin Local Wildlife Park (CLWP) located south of Mason Hall has two individuals which were captured within the area. The occurrence of *R. punctularia punctularia* in Tobago could therefore be due to both native breeding populations as well as introduced individuals from the pet shop trade.

A second member of the Emydidae family is now reported in Tobago; however, this species has the potential to be invasive. An exotic Red-eared slider (*Trachemys scripta elegans*) was collected in July 2017 among debris on the beach in Speyside (UTM 20P 769196E, 1258397N) by Z. Frank (of Frank's Tours). It seemed to be a sub-adult with a carapace length of 14.0cm and in healthy condition. This species which is native to North America (Cadi and Joly, 2004), was first recorded in the wild in Trinidad by Mohammed *et al.* (2010) and its range has since expanded within the island (Mohammed *et al.* 2017). *T. scripta elegans* is noted as a niche competitor among the native freshwater turtles in Trinidad (Mohammed *et al.* 2010).

Instead, Tobago's high aquatic species biomass, particularly its *Macrobrachium* sp. could be at risk of falling prey to this voracious generalist predator as documented in other countries (Leberer, 2003). *T. scripta elegans* has been reported previously in Turks and Caicos Island (Reynolds and Niemiler, 2010), Puerto Rico and Hispaniola, to Guadeloupe and Martinique (Henderson and Powell 2009) though, it seems to still be absent in Barbados (Fields and Horrocks, 2011). We can infer this species can adapt to life on small island states. The species are becoming increasingly popular in the local pet trade in Trinidad and Tobago within the last decade, which could be its potential source of introduction. *Chrysemys picta dorsalis* (Southern painted turtle) also native to North America, has also been observed in the pet trade in Tobago, but not yet in the wild.

Native Testudinidae families (tortoises) have not been confirmed for Tobago. Some publications (Murphy, 1997; Boos and Quesnel 1994) suggested that *Geochelone carbonaria* (Red-footed tortoise) could potentially be an introduced species into Trinidad and only *Geochelone denticulata* (Yellow-footed tortoise or Morocoy) is considered native, although it is suspected they were introduced by early Amerindian colonisers. Distribution data documents *Geochelone* sp. throughout the Lesser Antilles except Barbados and Sombrero (part of the British territory of Anguilla), though there is no conclusive evidence discerning whether their distribution is a result of natural dispersal or introduction (Censky and Kaiser 1999)

A shell of *Geochelone* sp. is documented for Tobago here, and currently housed at a private collection in Tobago. The animal was captured from the wild in 1952 but no locality information is known. Hardy (1982) remarked that several elderly citizens of Tobago recognised the word 'Morocoy' during discussions in 1979. They indicated the species was fairly abundant and

occurred in Speyside's forests. Additionally, Hardy (1982) noted captive populations of both *G. carbonaria* and *G. denticulata* were released in Speyside forest, leading to several shells being found. Specimens were caught in other parts of Tobago near rural villages but without proper documentation. Poyntz's accounts (1683, 1695) confirms the presence of a terrestrial turtle species on the island but without a detailed description. Considering no recent additional specimens have been documented by biologists, tour guides or forestry personnel on field surveys and communications with hunters have not yielded a positive account, it is possible that the *Geochelone* sp. is extinct in the wild in Tobago. There are nonetheless some persons keeping these tortoises as pets or at wildlife parks (eg. CLWP, specimens originating from Trinidad).

To conclude, monitoring and control on hunting pressures would support the survival of our native freshwater species, but we should be mindful of the increasing threat of aquatic alien invasive species. It is imperative that pet owners be responsible in their care, as our national regulation does not address the issues of management of invasive species since we now see *Trachemys scripta elegans* spreading in Trinidad. If these individuals are detected in the wild, the authors and Forestry Officials should be contacted. Also, if the animal is retrieved in Tobago, it can be taken to CLWP where they will be offered sanctuary without threatening Tobago's native species. Lastly, we see due to lack of managed hunting and suitable habitat, the morrocoy, *Geochelone* sp is now extinct in Tobago and we should do the needful to ensure our native *Rhinoclemmys* does not follow the same fate.

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Notes on the Life History of *Citheronia hamifera* Rothschild, 1907 (Lepidoptera, Saturniidae)

On 4 July 2016 a large ornate caterpillar was found on the northern slope of Flagstaff Hill, Speyside, Tobago (11.3302°, -60.5388°). When first observed the larva was crawling across the leaf litter on the forest floor (Fig. 1). Due to the large size and turgid look of the caterpillar it was thought that it had possibly finished feeding and was searching for a place to pupate, and so it was collected to be raised in captivity. The larva was kept in a small plastic tub containing soil and covered with a mesh lid. On 10 July it developed into a pupa which was partially buried in the soil, the exuviae (cast skin) was deposited next to the pupa. There was no cocoon formation. A female imago emerged on 31 July giving a pupation duration of 21 days. Photographs of the imago (Fig. 2) were sent to Matthew Cock and identified as *Citheronia hamifera* Rothschild, 1907 (Lepidoptera: Saturniidae).

Adults of this family have vestigial mouthparts therefore don't feed and only tend to live for a week or so in order to mate and lay eggs (Tuskes, Tuttle *et al.* 1996). Because this specimen was in an enclosed space she did not find a mate but did deposit a cluster of eggs on the side of the tank, unfortunately these were not preserved or described further.

The genus *Citheronia* is widespread throughout the Americas (Tuskes, Tuttle *et al.* 1996) with 21 species having been reported, the majority in the neotropics (Lemaire 1988). *Citheronia hamifera* was originally described from Trinidad and Guyana. It is the same species that Kaye and Lamont (1927) recorded from Trinidad as *C. mexicana* Grote and Robinson. *C. hamifera* has been previously reported from Tobago, some of the most recent records were four specimens collected by J. Ingraham in 2009 around Englishman's Bay (Cock 2017).

When the caterpillar was found there were a variety of plant species nearby but none could be directly connected with the caterpillar, i.e. no obvious signs of nibbled leaves were seen. *Citheronia* are known to be polyphagous and feed on a wide variety of plants (Tuskes, Tuttle *et al.* 1996). The habitat in this area is a mix of young secondary forest and lowland rain forest dominated by crappo - cabbage palm (Helmer, Ruzycki *et al.* 2012).

Fig. 1. Final instar caterpillar of *Citheronia hamifera.*

Fig. 2. Preserved *Citheronia hamifera* female.

The adult specimen along with the pupa case and the shed skin of the last larva instar were added to the University of the West Indies Zoology Museum collection under the accession number UWIZM.2016.33.16.

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Field-identification of the *Caligo* Butterflies (Nymphalidae, Brassolinae) of Trinidad and Tobago

Three species of *Caligo* are found in Trinidad: *C. brasiliensis minor* Kaye (forest mort bleu), *C. teucer insulanus* Stichel (cocoa mort bleu), and *C. illioneus illioneus* (Cramer) (cane mort bleu) (Barcant 1970, Cock 2014). The first two are also found in Tobago (Cock 2017). Together with the morpho, *Morpho helenor insularis* Fruhstorfer (Nymphalidae, Satyrinae), they are the largest Trinidad and Tobago butterflies, with a wing length of 6-8 cm. *Caligo* spp. are easily recognised by the large eye spots on the ventral hindwing, which have been likened to the eyes of owls, frogs and lizards (Stradling 1976, Quesnel and Stradling 2012).

Caligo brasiliensis and *C. teucer* are conspicuous members of the forest fauna, while the latter is associated with area where sugar cane is found, including housing. Hence they are frequent subjects for photography by naturalists (e.g. https://www.inaturalist.org). In life, these butterflies always rest with their wings closed and only the ventral wing surface visible. Although Barcant (1970) provides guidance for their identification based on characters of the dorsal surface, identification based on the ventral surface alone has not been documented. This note is intended to fill that gap and enable all three species to be identified in the field and from photographs of butterflies at rest.

The total impression of the ventral hindwing and the definition of the lizard head (i.e. the discal band incorporating the eye spots) are useful, particularly when making field observations. In *C. brasiliensis* the overall impression is lighter in colour, more evenly striated and the lizard head is scarcely defined. These characters alone will normally suffice to recognise *C. brasiliensis*. The other two species are similar, but *C. teucer* is generally slightly darker and the brown lizard head is less well defined, whereas the brown lizard head of *C. illioneus* is more uniform and clearly defined.

There are diagnostic details that can be used, particularly with images. Fig 1. shows ventral views of males and females of the three species, with arrows to indicate selected diagnostic features. Although *C. illioneus* is smaller than the other two species, and males are smaller than females, these are all shown the same size, since relative size will not be a useful diagnostic in the field or in images. The following features are indicated:

1. The inner submarginal line of the forewing is irregular in *C. brasiliensis* and *C. teucer*, but is a regular series of arcs in *C. illioneus*.
2. There is a pale discal line, immediately beyond the dark discal line in *C. teucer* and *C. illioneus*, but not *C. brasiliensis*. This line is usually stronger and straighter in *C. illioneus*.
3. The area central to the costal eye spot is scarcely different from the rest of the hindwing in *C. brasiliensis*, slightly darker in *C. teucer* and brown in *C. illioneus*, uniform with the rest of the discal band.
4. The dark inner submarginal band of the hindwing is more sharply and strongly defined in *C. teucer* and *C. illioneus*.
5. A pale elongate patch is evident in the discal band of *C. teucer* and *C. illioneus*.

Using these characters, most field images of adults can be readily identified (Figs. 2-4), and I hope this guidance will be of value to naturalists and photographers in Trinidad and Tobago. I have not attempted to evaluate these characters for mainland populations of *Caligo* spp., although they may provide a useful starting point.

Guppy (1904) illustrated the early stages of. *C. illioneus illioneus* on sugar cane in Trinidad, but the other two species, which feed on banana (*Musa* spp. Musaceae) and related species such as *Heliconia* spp. (Heliconiaceae) in Trinidad (Barcant 1970, J.O. Boos pers. comm., F.C. Urich pers. comm.) have not been documented. This would be a useful addition to our knowledge of Trinidad butterflies.

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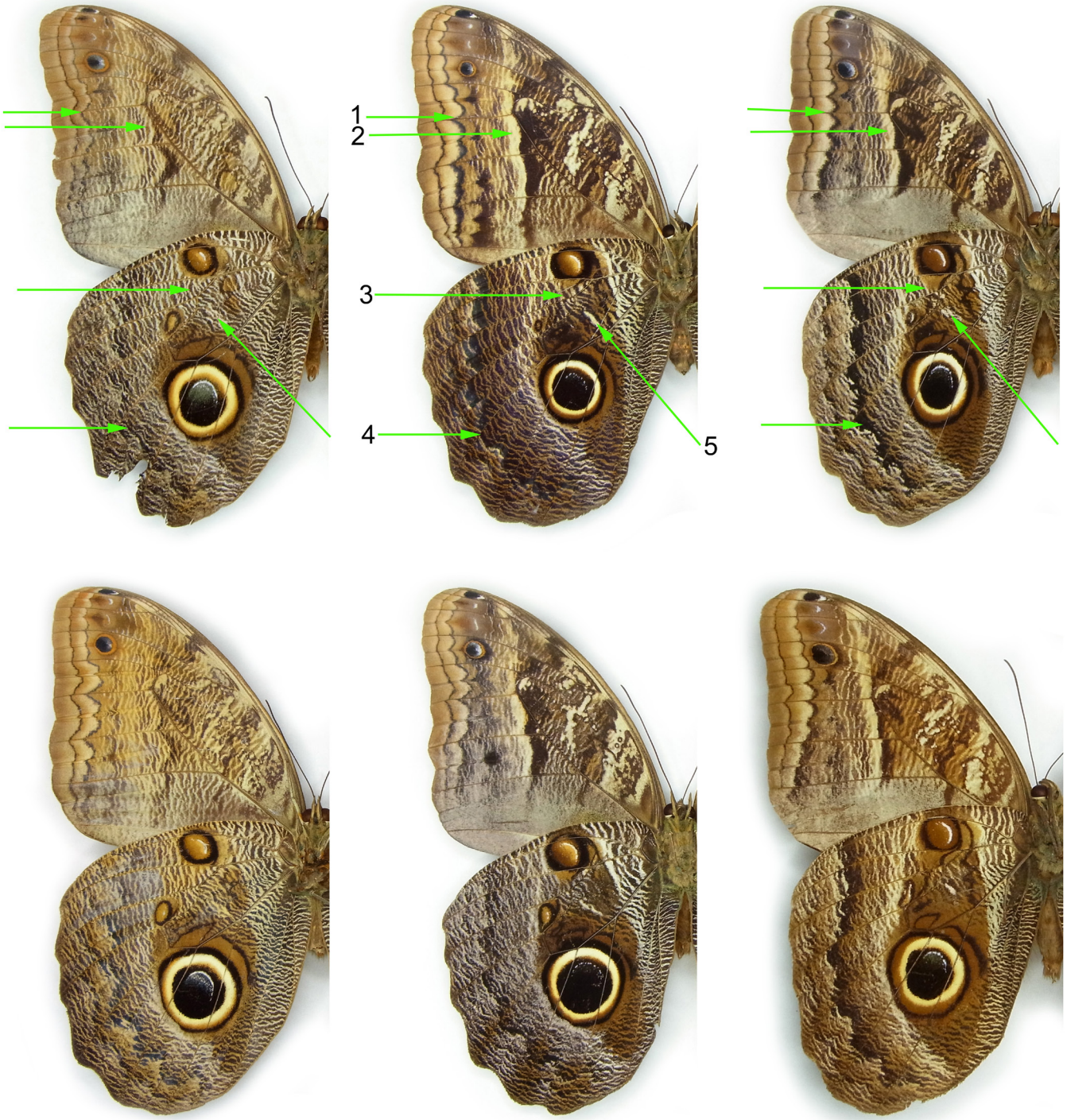

Fig. 1. Ventral view *Caligo* spp. of Trinidad and Tobago. From left to right *C. brasiliensis minor*, *C. teucer insulanus*, and *C. illioneus illioneus*; upper row males, lower row females. All specimens from Trinidad. Not to scale. See text regarding numbered diagnostic features.

Fig. 2. *Caligo brasiliensis minor*, Asa Wright Nature Centre,17 December 2018 (N. Norman, https://www.inaturalist.org/ observations/19262347, Creative Commons Licence CC-BY-NC).

Fig. 3. *Caligo teucer insulanus*, Mt. Tabor, 11 December 2011, (M.G. Rutherford, https://www.inaturalist.org/observations/9952092, Creative Commons Licence CC-BY-NC, flipped horizontally).

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I thank the photographers, Nancy Norman, Mike Rutherford and Kris Sookdeo, for sharing their photographs of living *Caligo* spp., directly or through iNaturalist, and Keith Willmott for helpful comments.

Fig. 4. *Caligo illioneus illioneus*, Rousillac, 10.vii.2010 (K. Sookdeo).

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Pristimantis urichi (Urich's Litter Frog) as Prey for the Killifish, *Rivulus hartii* (Jumping Guabine)

Experience in the Neotropics confirms that small frogs may be assumed to be prey for many predators, but direct observations of predation events are generally limited and in the present case, under night-time conditions, very rare. During an evening nature observation walk along the entrance roadway to the Asa Wright Nature Centre, 7.4 miles on the Arima-Blanchisseuse Road in the Arima Valley, Trinidad, West Indies (ca. 10 43'9.38"N 61 17'50.45"W), vocalizing males of the endangered frog *Pristimantis urichi* were abundant. These small "tink" frogs were found calling as they perched on leaves of plants growing on nearly vertical banks. They were occasionally seen moving across the road, otherwise they are known to move among the leaves on the forest floor or steep banks (Murphy, 1997).

During rainy periods, water typically pools or streams down gutters along the edges of the road. A common denizen of these pools is the killifish *Rivulus hartii*, which enters these ephemeral habitats from local streams. This fish is known to move overland on wet nights, regularly colonizing temporary pools and seepages. (Gibb *et al.*, 2011).

On 11 October 2017, at 20:30 hours, an adult *R. hartii* was observed in a water-filled, leaf-lined roadside gutter with an adult *P. urichi* in its mouth (Fig. 1). The frog's body was intact (Fig. 2), allowing easy identification and suggesting predation rather than scavenging; its legs were shredded and the animal appeared dead. The feeding behavior was observed for 10 minutes, when it was interrupted for identification and examination of the extent of the consumption (Fig. 2). A thorough survey of the roadside gutters yielded no further instances of frog predation by the fish.

Killifish can be abundant in the nearby headwater streams of the Arima River, inviting speculation as to their role in affecting or regulating populations of these and other stream-dwelling frogs, such as *Mannophryne*

Fig. 1. *Rivulus hartii* preying on a *Pristimantis urichi*.

Fig. 2. *P. urichi* after removal from the mouth of the *R. hartii*.

trinitatis (family Dendrobatidae), a species of similar size and habitat as *P. urichi*. Downie *et al.* (2001), have shown that males of *M. trinitatis* carry their tadpoles on their backs while searching for a pool in which to deposit them. The male will avoid pools containing *R. hartii*, a predator of tadpoles. Such inherited behaviour is fascinating and immediately raises the question of whether similar avoidance behaviours may also exist in *P. urichi*.

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First Record of *Chactas raymondhansi* Francke & Boos, 1986, in Tobago, W.I.

The scorpion fauna of Trinidad and Tobago currently comprises ten species following the reinstatement of *Microtityus starri* Lourenço and Huber, 1999, by Armas and Teruel, 2014. These species belong to two families: Chactidae Pocock, 1893, and Buthidae C.L. Koch, 1837, and five genera: *Ananteris* Thorell 1891, *Microtityus* Kjellesvig-Waering, 1966, *Tityus* Koch, 1836, *Broteochactas* Pocock, 1893, and *Chactas* Gervais, 1844. All of these genera except *Chactas* were previously recorded from Tobago. *Chactas* is for the most part a neotropical genus, as its members occur almost exclusively from Central to South America (Lourenço 1991; Teruel and Cozijin 2011), with a single species, *Chactas raymondhansi* Francke and Boos, 1986*,* being found in Trinidad. No other records for this genus are reported for the rest of the Caribbean with most being found in Colombia and Venezuela (González-Sponga 1996; Lourenço 1997). This note details the first records of *C. raymondhansi* for the island of Tobago.

Chactas raymondhansi was previously thought to be endemic to Trinidad and had only been found in cloud forest at the summits of the highest mountains in the Northern Range: Cerro Del Aripo (990 m), Mt. El Tucuche (980 m) and Morne Bleu (800 m) (Prendini 2001). As such, because of its restricted range, it can be considered to be micro-endemic and rare. As with most chactid scorpions, its venom is not considered toxic to vertebrates (Goyffon 1978), but its robust body and the fact that it is the largest scorpion known on the island (Francke and Boos 1986) would nonetheless make it a formidable predator to invertebrate prey. As for its microhabitat, *C. raymondhansi* was originally described as being bromeliad-dwelling, as the first specimens that were collected came from the bases of the bromeliad, *Glomeropitcairnia erectiflora* Mez. However, as stated by Prendini (2001) this designation is nothing more than an artefact of diurnal collecting methods, which target bromeliads as a convenient place to search. Prendini's statement is further supported by field observations of the specimens that are recorded in this paper.

During a nocturnal scorpion survey conducted in the Main Ridge Forest. Reserve, Tobago on 12 March, 2017, 3 specimens of *C. raymondhansi* were collected on trees approximately 2.5 metres above ground level along the Gilpin Trial. The microhabitat where they were collected is consistent with what was previously reported for this species as they are generally regarded as arboreal, having only been collected no less than 1m above ground level. Arboreal scorpions can typically be found under tree bark, in tree holes and crevices, in epiphytes, and at the bases of leaves. The first specimen that was observed and subsequently collected was a female (carapace length: 9 mm), that was seen running under ultraviolet light (395 nm) along the root mass of a tree that was hanging overhead on the steep side of the mountain ridge at UTM 761177E, 1248462N. Upon being approached, the scorpion retreated into a cavity in the middle of the root mass of the tree which was mostly out of contact with soil. The root mass was subsequently taken apart and the specimen collected. The second and third specimens were collected in a follow-up trip on 28 May 2017. The second specimen was a male (carapace length: 7 mm) collected at UTM 761059E, 1248603N, and the third specimen was a female (carapace length: 9 mm) collected at 761005E, 1248701N (Fig 1.).

Both of these specimens, just like the first, were observed at approximately 2.5 metres above ground level with use of UV flashlights. Each were observed to be motionless in a "sit and wait" position, which is the typical hunting position for these opportunistic predators (Fig 2). The first specimen retreated into a cavity on the trunk of the tree when an attempt was made to collect it. The cavity was subsequently cut open and the scorpion was collected and placed into a collecting jar. The second scorpion was observed overhead on the exposed root mass of a tree on the steep side of the mountain ridge. It quickly retreated into a cavity of a root when an attempt was made to collect it but the root cavity was subsequently cut open and the scorpion retrieved. All three specimens were euthanised and subsequently examined by the lead author under a dissecting microscope for confirmation of identity. The diagnostic features that characterise *C. raymondhansi* as described by Francke and Boos (1986) were observed. For verification, photomicrographs were taken and sent to Dr Oscar F. Francke of the National Autonomous University of Mexico, the species authority for *C. raymondhansi*, who confirmed the identifications. The first specimen to be collected was deposited in the University of the West Indies Zoology Museum, St. Augustine campus, Trinidad and numbered UWIZM.2019.8, while the two specimens were kept for genetic studies.

With the addition of this new record there are now seven scorpion species known to inhabit Tobago. These are as follows: from Buthidae: *Ananteris cussinii* Borelli, 1910; *Microtityus rickyi* Kjellesvig-Waering, 1966; *Microtityus starri* Lourenço and Huber, 1999; *Tityus trinitatis* Pocock, 1897; and from Chactidae: *Broteochactas laui* Kjellesvig-Waering, 1966; *Broteochactas nitidus* Pocock, 1893; *Chactas raymondhansi* Francke and Boos, 1986. All, with the exception of *A. cussinii,* are endemic to Trinidad and Tobago which sets Tobago at an astounding 87% level of endemism for Trinidad and Tobago's scorpions. As to why this species wasn't previously recorded, this could simply be the result of limited survey effort being conducted

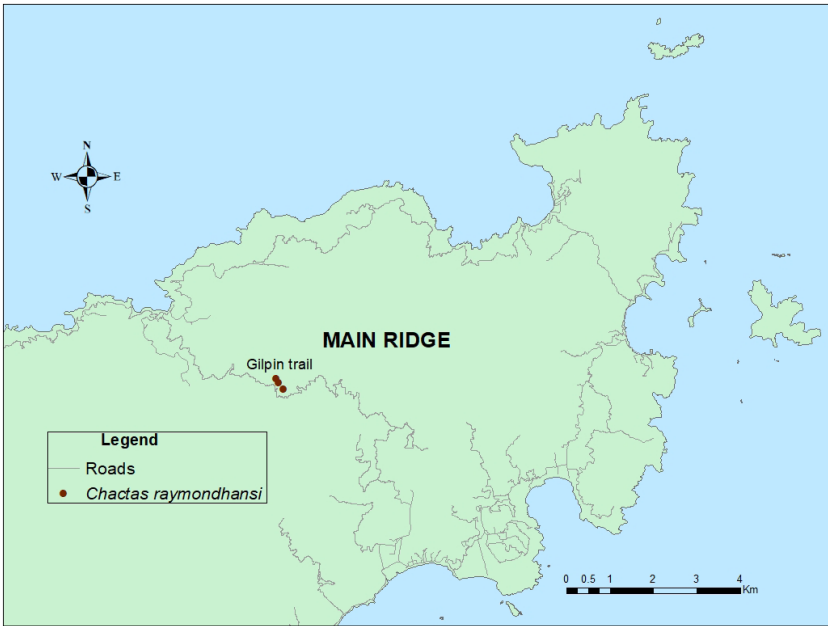

Fig. 1. Locations of *C. raymondhansi* in North-East Tobago.

Fig. 2. First specimen of *Chactas raymondhansi* Francke & Boos, 1986 collected in Tobago. (Sex: female; Carapace length: 9 mm).

in Tobago coupled with the general rarity of this species, making it unlikely to be encountered in its habitat.

It would be worthwhile to make a return trip to the Main Ridge Forest Reserve to conduct a more extensive survey for these scorpions in an attempt to estimate population size and distribution. In addition, more detailed field observations can be made to contribute to our knowledge of the ecology of this species, an area of its biology that is understudied as is the case with many species of scorpion.

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Two Additional Site Records of the Elusive Gibba Turtle *Mesoclemmys gibba* (Schweigger 1812) fromTrinidad, W.I.

The gibba turtle *Mesoclemmys gibba* (Schweigger 1812) is a freshwater turtle species found on the Caribbean island of Trinidad, and across South America (Murphy *et al.* 2018). This nocturnal omnivorous turtle can be found near pools of water or rivers in forests. The literature reports this species on Trinidad in the north east part of the island in the Sangre Grande Regional Corporation, central Trinidad, and in the south west peninsular (Mohammed *et al.* 2010; Murphy *et al.* 2018). Among the known native freshwater turtle species on the island, it is considered the most elusive, with very few sightings and published records. Indeed, Murphy (1997) Mohammed *et al.* (2010) and Mohammed *et al.* (2014) conducted extensive searches over three decades (1980s -2000s) and relied on anecdotal evidence, and literature or museum records to infer its distribution. Freshwater turtles are among the most threatened groups of animals globally (Böhm *et al.* 2013) and information about their distribution can be used towards improved conservation measures. We therefore report two additional site records of the gibba turtle in Trinidad.

On 2 August 2019, at approximately 20:00h we saw a *Mesoclemmys gibba* (Fig. 1.) on the side of a dirt road in Moruga, Trinidad. There was forest on either side of the road and the area there is known to flood during heavy rains. We estimated the carapace length at 15cm (+/- 2cm). After observing and photographing the turtle, we placed it in the vegetation on the side of the road. The closest published records of this species are from Bush Bush Wildlife Sanctuary (Mohammed *et al.* 2014) and Penal district (Mohammed *et al.* 2010); both more than 30km distance which suggests a wide distribution of the species on the island (Fig. 2.). In addition to the Moruga sighting, one of us (RJA) observed two adults (one female and one male) on December 6 2018 at approximately 19:30h in the Sangre Grande Regional Corporation, near to the sighting reported in Murphy (1997). Both individuals were seen in a pool of water with closed canopy within secondary forest. Upon revisiting the same area in February 2019, the pool had dried and no turtles were seen. The gibba turtle is predominantly aquatic and likely moved on to another water body or was hidden under the mud which perhaps is a consequence of limited sightings.

Murphy (1997) described the distribution of the gibba turtle as disjunctive and relied on a limited number of literature records to which two are added here, from the previous reported sites. Thus, these additional observational records of the gibba turtle at Moruga and Sangre Grande on Trinidad suggest that the species may be more widespread across the island than previously reported (Mohammed *et al.* 2010). Indeed, we postulate that the gibba turtle may be distributed across the southern part of the island, as far south east as Guayaguayare, with similar to suitable habitat as that at Moruga. With sparse number of observed records on this freshwater turtle species in Trinidad, we hope further published records of this elusive turtle can be reported in the future more regularly to help guide measures to conserve the species and its habitat.

Fig. 1. Photographs of Gibba Turtle *Mesoclemmys gibba* from Moruga, Trinidad.

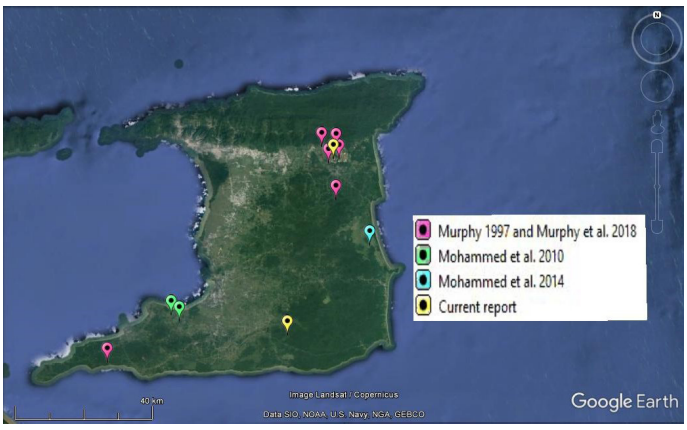

Figure 2. Distributional records of Gibba Turtle *Mesoclemmys gibba* on Trinidad.

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Additional spider family for Trinidad and Tobago, Filistatidae

Currently 53 families of spiders of the infraorders Araneomorphae and Mygalomorphae are confirmed to be found in Trinidad and Tobago (Sewlal and Cutler 2003, Cutler 2005, Sewlal and Alayón 2007, Sewlal 2009, Sewlal 2010, Sewlal 2013). Magalhaes and Ramírez (2019) gives the latest reference and characteristics of the family Filistatidae (Araneomorphae), bringing the total number of families recorded from Trinidad and Tobago to 54.

The record for this family consists of a single adult female *Kukulcania hibernalis* (Hentz, 1842) collected by C. Seiderman in the Arima Valley: [N10.61719°, W61.27437°], in June 1983. An immature specimen was also collected by N. Nieves on 16 February 1959 during a team drive to Diego Martín [N10.37572°, W61.23356°]. Both specimens are housed at the American Museum of Natural History.

ACKNOWLEDGEMENTS

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Oxynthes corusca (Herrich-Schäffer) (Lepidoptera, Hesperiidae), an Overlooked Butterfly Record from Trinidad, W.I., with Notes on the Caterpillar

Evans (1955) records a female of *Oxynthes corusca* (Herrich-Schäffer, 1869) (Hesperiidae, Hesperiinae, Hesperiini) from Trinidad in The Natural History Museum, London (NHMUK). However, this record has been overlooked since then (e.g. Cock 2014b) until now, when more recent specimens were located and identified. SAS had an old male specimen in his collection from Andrew's Trace (July 1992), and recently sent images to MJWC to identify. By coincidence, soon after this MJWC found and spread a papered male specimen from amongst material collected by Julius Boos in the Parrylands oilfield in February 1980 (Fig. 1). MJWC dissected this specimen, identified it from Evans (1955) and confirmed the identification from Warren *et al.* (2017). We have not examined the female specimen in the NHMUK.

Oxynthes corusca is similar to *Niconiades* spp. known from Trinidad (Cock 2003) in wing shape, the white discal line on the ventral hindwing, the arrangement of spots of the forewing and the male brands (above and below vein 2 near base and above vein 1). The most obvious difference is that *O. corusca* has no hyaline spots on the hindwing, which all Trinidad *Niconiades* spp. have. Further illustrations can be seen at Warren *et al.*'s (2017) website *Illustrated Lists of American Butterflies (North and South America)*.

Fig. 1. Male *Oxynthes corusca*, Parrylands oilfield, February 1980 (J.O. Boos) [Coll. MJWC]. Scale bar = 1 cm.

In Costa Rica, the caterpillars feed on various Poaceae, but especially *Olyra latifolia* L. (Janzen and Hallwachs 2018). The pupa is brown and densely covered with a loose white flocculence of powder and fibres (Janzen and Hallwachs 2018). The final instar caterpillars in Costa Rica illustrated by Janzen and Hallwachs (2018) match one from Trinidad documented below that MJWC found but failed to rear (MJWC 04/34), except that in Costa Rica the frons and adfrontals are white rather than yellow.

Specimen MJWC 04/34 was collected on *Olyra latifolia* (herbarium sample MJWC 0305) in a shady clearing in the forest of Inniss Field, 16 January 2004, and although the caterpillar moulted to what was almost certainly the final shelter, it died before pupating. The leaf shelter was made from the apex of a leaf and was 85mm long; both sides of the leaf were rolled upwards and joined; the mid-rib at the base of the shelter was flexed and the leaf shelter dangled from this point; the caterpillar rested head upwards with its round head blocking the entrance to the leaf shelter; feeding was basal to the shelter, from both sides of the leaf lamina.

What is here interpreted as the final instar (Fig. 2) measured 19 mm when newly moulted, but poor food quality at this stage suggests it may have been undersized. Head almost round in anterior view, 3.5 mm wide x 3.8 mm high, anteriorly flattened in profile; posterior margin broadly dark brown, darker ventrally; from vertex laterally to stemmata a broad, light brown band with diffuse margins; face brown on epicranium and clypeus, frons and adfrontals pale yellow, strongly contrasting with rest of face; the adfrontal sutures narrowly dark and the adjacent epicranium slightly paler than the rest of the brown epicranium; inconspicuous short, pale, erect setae. Pronotum brown, divided at dorsum. Body dull translucent green; red-brown tinge on T2–T3 and A7–A9; anal plate rounded posteriorly, with broad brown border; spiracles pale brown; legs and prolegs coloured as body, but a little paler. The penultimate instar (Fig. 3) was similar to the final instar, but the head was 2.9 mm wide x 2.9 mm high; darker; the lateral areas of the head not as pale; the frons and adfrontals were more contrasting; pronotum black.

Fig. 2. Final instar of *Oxynthes corusca* collected on *Ultra latifolia*, 16 January 2004, Inniss Field; moulted to final instar 29 January; photographed 6 February; died, 20mm, MJWC 04/34. Above, head and anterior segments; below, anal segments.

Fig. 3. Head and anterior segments of the penultimate instar of *Oxynthes corusca* collected on *Olyra latifolia*, 16 January 2004, Inniss Field, 22mm, MJWC 04/34.

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Predation by a Boa Constrictor (*Boa constrictor*) on a Great Kiskadee (*Pitangus sulphuratus*) in Trinidad, W.I.

The Boa Constrictor (*Boa constrictor*) is a large, heavy-bodied snake inhabiting a diversity of habitats throughout most of South America. It is a dietary generalist, foraging on a wide variety of prey including shrimp, fish, lizards, birds and mammals (e.g., Sironi *et al.* 2000, Quick *et al.* 2005, Pizzatto *et al.* 2009, Sanches *et al.* 2018). In Trinidad its natural diet is poorly documented, with few prey identified to species (see reviews by Murphy 1997, Boos 2001), including two species of birds (Hayes 2002). In this note we document a Boa Constrictor preying on a Great Kiskadee (*Pitangus sulphuratus*).

At about 8:00 am on 27 January 2014, RLG observed a Great Kiskadee captured by a Boa Constrictor that was hidden within a metal pipe (Fig. 1) on the campus of Caribbean Union College Secondary School in Maracas Valley, Trinidad. The approximately 10 cm wide pipe extended several m above the ground and leaned at an angle of approximately 60°. The approximately 2 m long boa had climbed the pipe and sought shelter within it, and ambushed the kiskadee as it perched or attempted to perch on the pipe. The kiskadee appeared to be grasped by its abdomen, with a single coil of the snake wrapped around its midbody, underneath its wings (Fig. 1). The captured kiskadee struggled for more than a minute, remaining silent the entire time despite its head being free, until it grew still, but the snake, apparently alarmed by the approaching crowd of humans attracted to the commotion, released the bird, which flew away while the boa retreated into the pole.

The Great Kiskadee is a highly aggressive and vocal species that vigorously defends itself and its nest from potential predators (Brush and Fitzpatrick 2002), including snakes (Smith 1977, Skutch 1979, Jones and Saporito 2016). Thus, its silence during this predation attempt appears unusual. The only previously published report of a Boa Constrictor preying on a Great Kiskadee occurred in Brazil, while a kiskadee was foraging on fruits of a *Cecropia pachystachya* tree (Rocha Santos *et al.* 2014), but there was no mention of whether vocalization occurred during capture. Högstedt (1983) hypothesized that the primary function of fear screams in captured birds was to attract the attention of secondary predators who might attempt to steal the prey (kleptoparasitism), potentially allowing the victim to escape. Because potential kleptoparasites are more likely to use vision to detect captured prey in open habitats and to use hearing to detect captured prey in closed habitats, Högstedt (1983) predicted that fear screams were more likely to be given by captured birds in closed habitats. Högstedt (1983) tested his prediction by comparing the frequency of fear screams given by birds removed from mist nets in different habitats, and found strong supporting evidence for his hypothesis. Because the Great Kiskadee typically inhabits open habitats (Brush and Fitzpatrick 2002), its silence while gripped by a Boa Constrictor is consistent with Högstedt's (1983)

Fig. 1. Boa Constrictor preying on a Great Kiskadee at Maracas Valley, Trinidad, 27 January 2014. Photo by Renis L. Gabriel.

hypothesis, although emitting fear screams likely would have been more effective in attracting the humans who interfered during the predation attempt.

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Sixteenth Report of the Trinidad and Tobago Birds Status and Distribution Committee Records Submitted During 2018

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The Trinidad and Tobago Rare Birds Committee was established in 1995 to assess, document and archive the occurrence of rare or unusual birds in Trinidad and Tobago and thus provide reliable long-term monitoring of our rarer species. Now re-named the Birds Status and Distribution Committee, we have assessed all records submitted during 2018. In all 107 records were adjudged, representing 54 different species. These included a first documented account for South America and two new species for Tobago. As in previous years, we wish to commend the quality of photographic submissions by so many observers.

Of the submissions assessed, in only 12 cases did the Committee find the identification inconclusive.

Records presented below follow the revised nomenclature and taxonomic order of the South American Classification Committee (SACC) as at December 2018.

The Committee comprises the following members: Martyn Kenefick (Secretary), Faraaz Abdool, Geoffrey Gomes, Nigel Lallsingh, Bill Murphy, Kris Sookdeo and Graham White. Again, there are instances where we have benefited from supporting international expert knowledge to assist us with certain identification issues. We wish to acknowledge the valuable assistance provided by Bill Clark and Scott Weisenthal during 2018

Archived records including photographic submissions number 1,476 at the end of 2018. Previous reports of this Committee were prepared by Hayes and White, (2000); White and Hayes (2002) and Kenefick (2005, 2007,2008,2009,2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018).

The list of species considered by the TTBSDC (TTRBC), together with the Official List of the Birds of Trinidad and Tobago and details of all accepted records by the Committee can be accessed, from our website at http://rbc.ttfnc.org. We urge finders to document and report their sightings to us.

All recorded sightings summarized below occurred in 2018 unless otherwise stated

Records accepted

A **White-faced Whistling-Duck, *Dendrocygna viduata*** was found in flooded farmland at Aranguez on 24 July (JF). This is the only photographic record for 2018 although we are aware of an undocumented flock within the Caroni Rice Project during September.

An eclipsed- plumaged drake **Northern Shoveler, *Spatula clypeata*** was found at the Canaan sewage ponds, Tobago on 4 December. (MKe). This is just the fourth documented sighting of this North American migrant in the last 18 years, all being found between late October – early February.

An immature/female plumaged **Lesser Scaup, *Aythya affinis*** found on 30 November at Lowlands, Tobago, remained and was photographed until 10 December at least (GW, MKe). This migrant duck has been documented in six of the last 10 years, all sightings between 16 November – 15 February.

A flock of **American Flamingos, *Phoenicopterus ruber*** , first documented on 31 January and seen throughout the year feeding in the Caroni Swamp, peaked at a magnificent 163 birds by the end of June (many obs).

Two **Dark-billed Cuckoos, *Coccyzus melacoryphus*** were found adjacent to the Caroni Rice Project on 12 July (JF) (Fig.1.) with one still present until 15 September at least. This was in almost the exact location where up to three birds were regularly seen during August 2017 (see Kenefick 2018). What was likely to be a different individual was found along Baboonia Trace on 15 July (RA).

A **Band-rumped Swift, *Chaetura spinicaudus*** was photographed hawking low over the swimming pool at Cuffie River Nature Retreat, Tobago on 14 June.(AB) Whilst a common resident in Trinidad hill forest, this is the first documented record for Tobago.

Fig. 1. dark-billed Cuckoo, Caroni Rice project, July 2018. Photo Jerome Foster.

For the fourth year in a row, since first being found in 2015, **Amethyst Woodstars, *Calliphlox amethystinahas*** were photographed in Trinidad during 2018 with sightings of an adult male undergoing a complete moult at Yerette from 28 April – 7 July at least (TF) (Fig. 2) and possibly two different individuals feeding on vervain at the Asa Wright Nature Centre between 22 May and 14 June. (MR, CS).

Fig. 2. Amethyst Woodstar, Yerette, July 2018. Photo Theo Furguson.

Single **Black-necked Stilts, *Himantopus mexicanus*** were photographed at Lowlands, Tobago on 18 January (MKe, SN) and at the Canaan sewage ponds on 20 November (MKe). Whether both sightings refer to the same individual is unknown. These are the first documented records for Tobago since 2005.

A **Double-striped Thick-Knee, *Burhinus bistriatus*** remained faithful to a small area of the Queens Park Savanna, Port of Spain from 18 July – 1 September at least (Bd'A *et al.*). It is likely to be the same individual which was found in the same unlikely spot in August 2017 (see Kenefick 2018). Additionally, two birds were photographed close to Kernaham settlement on 2 September (ZA). All but two documented sightings of this species in the last 24 years have occurred between 6 July - 2 September.

An immature (probable male) **Ruff, *Calidris pugnax*** was photographed feeding in wet farmland at Aranguez on 20 October (RA). Still a truly rare wanderer, breeding in Europe and wintering in Africa, this is just the third documented record in the last 18 years.

For the eighth year in a row**, Franklin's Gulls, *Leucophaeus pipixcan*** have been found amongst the Laughing Gull high tide roost on the west coast tidal mudflats with a first winter plumaged bird at Brickfield on 1 January (NL) (Fig.3) and an adult in winter plumage on 17 October at Orange Valley (NL).

An **Audubon's Shearwater, *Puffinus lherminieri*** was well documented swimming close inshore at Salybia Bay on 26 November 2017 (LA, MR). This species is normally only seen when nesting on Little Tobago island. It rarely comes in sight of land during daylight hours and had not been found in Trinidad waters for many years.

Fig. 3. Franklins Gull, Brickfiled Mudflats, January 2018. Photo Nigel Lallsingh.

A **Jabiru, *Jabiru mycteria,*** was found feeding in a wet field close to Fishing Pond on 6 July (KM). Sadly it only remained for a few moments and could not be relocated. As is to be expected with austral wanderers, all ten documented sightings in the last 18 years have been between 11 June – 9 September.

An adult **Striated Heron, *Butorides striata*** was photographed at Castara, Tobago on 20 June (AB). Despite its abundance in Trinidad, this is just the second documented Tobago sighting in the last 23 years.

The **Gray Heron, *Ardea cinerea***, first found on the west coast tidal mudflats in 2016 (see Kenefick 2017, 2018) was still present until 27 May at least. (many obs)

Up to two **Little Egrets**, ***Egretta garzetta***, first found in 2016 (see Kenefick 2017, 2018), remained throughout the year on the Trincity River (many obs).

A flock of approximately 500 **Scarlet Ibis, *Eudocimus ruber*** were seen from many locations along the Tobago coastline on 9-10 September. (ES et al) This coincides with vastly increasing numbers taking up residence in Caroni Swamp and may have been a consequence of a major earthquake which had an epicentre in north eastern Venezuela on 21 August.

Single **Snail Kites, *Rostrhamus sociabilis*** were found hunting over Caroni Rice Project on 12 January (JF), Aranguez farmland on 30 March (BJ) and at Pt Fortin on 7 April (CS). Of the 15 documented sightings in the last 20 years, all but four have occurred between January-May.

A **Plumbeous Kite, *Ictinia plumbea*** was photographed gliding NE over Englishman's Bay, Tobago on 5 January. (MKe) Not only is this an exceptionally early date for this visitor from the mainland, it also constitutes the first documented record for Tobago.

A pair of **Great Black Hawks, *Buteogallus urubitinga*** were documented soaring over Gran Couva on 10 January (NL) whilst two more were photographed near Manzanilla on 18 March (KM). Identification of this large raptor

remains a real challenge and its similarity to the regularly seen Common Black Hawk, *Buteogallus anthracinus* may well mask its true status in Trinidad.

The hybrid **White-tailed Hawk, *Geranoaetus albicaudatus* x Savanna Hawk, *Buteogallus meridionalis*** first found on the Caroni Rice Project on 26 July 2017 (see Kenefick 2018) remained until 12 January at least (many observers).

An adult **White-tailed Hawk, *Geranoaetus albicaudatus*** was photographed close to Kernaham village in Nariva swamp on 21 January (KM). This is the fourth time in six years that this species, and likely the same individual, has been recorded in this area.

A **Bat Falcon, *Falco rufigularis*** was photographed perched atop a dead tree overlooking Englishman's Bay, Tobago on 1 December 2017 (LA, NG)(Fig. 4). Whilst widespread yet uncommon in Trinidad, this constitutes just the third documented record for Tobago, and the first for eight years.

Fig. 4. Bat Falcon, Englishman's Bay, December 2017, Photo Luis Arce.

A **White-eyed Parakeet, *Psittacara leucophthalmus*** was photographed feeding in coastal trees at Brickfield on 19 May (CC).

Small-billed Elaenia, *Elaenia parvirostris* in recent years has become an expected austral visitor to Trinidad. During 2018, documented sightings were as follows:- one at the Asa Wright Nature Centre on 4 July (MK, GW); two adjacent to the Caroni Rice Project on 7 July (NL); two at Carlsen Fields on 28 July (JF); one at Orange Grove on 12 August (JF); up to three feeding close to the mangrove at Orange Valley on 27 August (NL) and one along Rahamut Trace on 31 August (JF *et al*.).

A male **Slaty Elaenia, *Elaenia strepera*** was carefully studied in woodland close to Arboretum Road, Chaguaramas on 30 May (Bd'A) (Fig. 5.). This is just the second documented sighting of this austral wanderer in the last 20 years.

A Lesser Elaenia, *Elaenia chiriquensis* was photographed feeding on the border of Caroni Rice Project on 26 July (NL). This remains one of the most challenging resident species to identify in Trinidad. Whilst smaller, its similarity to the Yellow-bellied Elaenia may mask its true status and abundance, as size if often difficult to accurately determine in the field.

Fig. 5. Slaty Elaenia, Chaguaramas, May 2018. Photo Brian D'Abreau.

An immature male **Crested Doradito, *Pseudocolopteryx sclateri*** was found in a wet grassy field along Rahamut trace on 29 August (DH). This sighting was extremely close to the area where three pairs were present in July - September 2010.

An elusive, skulking **White-eyed Vireo, *Vireo griseus*** was photographed close to the Erin Savanna on 9 January, remaining until 12 January at least (NL *et al.*)(Fig.6). This constitutes the first photographed and documented record for South America. No photographs were ever submitted to support the only previous sighting in Tobago in January 1998. The normal wintering range for this species rarely extends further south than northern Nicaragua.

Fig. 6. White-eyed Vireo, Erin Savanna, Janurary 2018. Photo Nigel Lallsingh.

A Black-whiskered Vireo, *Vireo altiloquus* was found on Mt. St. Benedict on 22 September (JF). This species is still very scarce in Trinidad and Tobago despite being a common resident throughout much of the Lesser Antilles.

Three **Cliff Swallows, *Petrochelidon pyrrhonota*** were found hawking insects over Bon Accord sewage ponds, Tobago on 18 November (SMcC, CN) and up to four

birds were watched feeding over Lowlands, Tobago on 10 December (MKe).

Single adult male **Yellow-bellied Seedeaters, *Sporophila nigricollis*** were found in the southern foothills of the Northern range as follows :- farm roads close to Arima on 30 August (MO, BH); Maracas St Joseph on 22 September (FM, AS) and on Mt St Benedict the same date (JF, MH).

An adult male **Scarlet Tanager, *Piranga olivacea*** was photographed in forest close to Brasso Seco on 16 April. Almost all occurrences in Trinidad and Tobago are on north-bound migration; of those, all but one have occurred in April.

An adult male **Rose-breasted Grosbeak, *Pheucticus ludovicianus*** was photographed feeding on the fruit of both Trema and Wild Tobacco at the Asa Wright Nature Centre on 23 April (BR, MK *et al.*), remaining until 29 April at least (Fig. 7). Of the 13 documented records in the last 18 years, 10 have occurred during March-April.

Fig. 7. Rose-breasted Grossbeak, Asa Wright Nature Centre, April 2018. Photo Nancy Walker.

An immature **Cape May Warbler, *Setophaga tigrina*** was carefully studied and photographed at Gran Couva on 18 February (KS). This is just the fifth documented record of this migrant warbler in the last 23 years.

The immature female **Cerulean Warbler, *Setophaga cerulean*** first found on 4 December 2017 (see Kenefick 2018) remained faithful to a large Samaan tree in Gran Couva until 18 March. Amazingly, what is obviously the same bird, now in adult plumage, returned on 25 December,

Fig. 8. Cerulean Warbler, Grand Couva, December 2018. Photo Nigel Lalsingh

remaining to the year end (NL)(Fig. 8.).

Three basic plumaged **Blackburnian Warblers, *Setophaga fusca*** have been documented in 2018. During the first winter period, a probable female was at Gran Couva on 18 February (JF) and a probable male was photographed in the Caura Valley on 27 February (NL). At the end of the year another male was found at Gran Couva on 27 December (NL). This brings to five, the total of sightings in the last three years and may reflect the continuing abundance of Spruce Budworm, a favoured food source, on their breeding grounds.

A **Chestnut-sided Warbler, *Setophaga pensylvanica*** moulting into alternate plumage was photographed at Chaguaramas on 3 March (FO). Once considered to be an exceptionally rare winter visitor from the north, six birds have now been documented in the last eight years; all between 29 December – 6 April.

A flock of at least 50 **Bobolink, *Dolichonyx oryzivorus*** were feeding in weedy fields along Rahamut trace on 14 October (KSo, FA *et al.*). Of the 25 documented sightings of this southbound migrant, all but five have been during October.

A male **Red-winged Blackbird, *Agelaius phoeniceus*** was found in marshes close to Caroni Swamp, and was irregularly reported up until mid 1981 (TM). The sighting was accepted by Richard ffrench and, in accordance with practice at that time was incorporated onto the Official List. Lack of photographic evidence however precluded the record being considered SACC for acceptance onto the South American Checklist. Photographs have now come to light and as such will be assessed by SACC. The photos (Fig. 9) are very poor quality. However they present sufficient detail to convince members of the Committee of

Fig. 9. Red-winged Blackbird, Caroni Swamp 1981. Photographer Tim Manolis.

the identification.

Escaped cage and aviary species

We are aware of a reintroduction project involving **Muscovy Ducks** *Cairina moschata* from Point-à-Pierre Wildfowl Trust. Sightings of this species from the south west peninsula of Trinidad may involve such birds.

Village Weavers, *Ploceus culcullatus* remain in small numbers on Caroni Rice Project; a **Rose-ringed Parakeet**, *Psittacula krameri* was found in Aranguez and **Red-and-Green Macaws**, *Ara chloropterus* continue to be seen at many locations throughout coastal Trinidad.

The provenance of seedeater and seed-finch species continues to be a problem. The Committee has taken a decision that, unless there is supporting evidence to the contrary, all sightings will be considered under this category and that assessment will be based on identification alone.

Additional records

Acceptable records were also received for a further 39 sightings of the following species whose status has been established but whose distribution continues to be monitored by the Committee: **Scaled Dove**, *Columbina squammata* (Fig. 10)*;* **Blue Ground Dove,** *Claravis pretiosa*; **Rufous-necked Wood-Rail**, *Aramides axillaris* (Fig. 11)*;* **Rufescent Tiger-Heron**, *Tigrisoma lineatum* (Fig 12.)*;* **Little Egret,** *Egretta garzetta;* **Glossy Ibis,** *Plegadis falcinellus;* **Black Hawk-Eagle**, *Spizaetus tyrannus;* **Crane Hawk,** *Geranospiza caerulescens;* **Rufous Crab Hawk**, *Buteogallus aequinoctialis;* **Crested Caracara,** *Caracara cheriway;* **Aplomado Falcon,** *Falco femoralis;* **Variegated Flycatcher**, *Empidonomus varius;* **Summer Tanager,** *Piranga rubra.*

Inconclusive records

Submissions of the following species were deemed inconclusive: **White-faced Whistling-Duck,** *Dendrocygna viduata;* **Chapman's Swift,** *Chaetura chapmani;* **Gull-billed Tern,** *Gelochelidon nilotica;* **Hook-billed Kite,** *Chondrohierax uncinatus;* **Great Black Hawk,** *Buteogallus urubitinga;* **Orange-breasted Falcon,** *Falco deiroleucus,* **White-eyed Parakeet,** *Psittacara leucophthalmus;* **Small-billed Elaenia,** *Elaenia parvirostris;* **Lesser Elaenia**, *Elaenia chiriquensis;* **Ruddy-breasted Seedeater**, *Sporophila minuta;* **Yellow-bellied Seedeater,** *Sporophila nigricollis.*

Nomenclature changes

Part of the mission statement of the South American Classification Committee is to create a standard classification, with English names, for the birds of South America. This is subject to constant revision by the proposal system to allow incorporation of new data.

Fig. 10. Scaled Dove, Brickfield, November 2018. Photo Nigel Lallsingh.

Fig. 12. Rufous-necked Wood-Rail, Manzanilla, April 2018. Photo Kamal Mahabir.

Fig. 11. Rufescent Tiger-Heron, Chatham, 12 January 2018. Photo Kamal Mahabir.

The following change was made in 2018: **Gray-cowled Wood-Rail** (*Aramides cajaneus)* formerly Gray-necked Wood-Rail. (Remsen *et al.* 2018)

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Book Review

Life Along the Seashore of Trinidad and Tobago
by Lori M. Lee Lum and E. Julian Duncan

'Life along the Seashore of Trinidad and Tobago' was launched in 2018 as part of the Institute of Marine Affairs' (IMA) 40 years anniversary celebration. I offer the Institute congratulations for opting to celebrate in this manner. The book is jointly authored by Ms. Lori M. Lee Lum of the IMA and Professor Emeritus E. Julian Duncan of the St. Augustine Campus of The University of the West Indies. On the market there is no other publication or literature in circulation that summarises flora and fauna of the Trinidad and Tobago coastline. This book attempts fill that niche.

On first general inspection, the book easily carried and conveniently sized for field use. Despite the unavailability of hard cover versions, it seems to be printed and bound for much use, as I have found, having taken my copy in the field on several occasions. The book has exactly 110 printed pages and is divided into the following major sections (not chapters): Marine Invertebrates (22 pages), Drift Seeds and Fruits (6 pages), Flowering Plants (22 pages), Algae (38 pages), and Solid Waste Pollution (5 pages); there is a bias towards flora.

Delving into the text, the first image is a map of Trinidad and Tobago displaying sample sites from which data was used for compilation of this work. In Trinidad, 14 sites were sampled and six in Tobago for a total of 20 sites. Surprisingly, site distribution was skewed with one site each on the north and south coasts of Trinidad, stark contrast to seven on the east coast. Of the five sample sites on Trinidad's west coast, three are located in the north west peninsula. Similar aggregation of sample sites occurs in Tobago where most are located on the south western region of the island. The furthest northern site is located in Speyside, whilst the entire coastline from there to Mount Irving Bay (on the Caribbean coast) has not been evaluated. Despite this, no justification is made for site selection on either island. Furthermore, a formal definition of the seashore and descriptions of the seashore types are lacking. Considering our coastline (ergo our seashore) consists of mud flats, rocky shores, and sandy beaches it would have been appreciated if the sites were representative of particular habitats.

Proceeding into the first section, 'Marine Invertebrates', one can see fauna spanning multiple taxa but mollusc dominates the section. Despite this, very little information is given on several mollusc species in comparison to other books such as Southeastern and Caribbean Seashores by E.H. Kaplan (1998) or Seashells of the Caribbean by L. Sutty (1990). Additionally, there are several species described as inhabitants of tidal rock pools, which can be justified as a seashore type, but some such as the sea fans and fire coral which are typical reef fauna. Mention is made of one burrowing crab (Atlantic ghost crab) yet the common mole crab which is seasonally abundant on the east coast of Trinidad is missing, along with larger species such as our local blue crab. For these reasons I would say the benthic communities are under-represented. This section would appeal to the general public in its content and layout, but lacks some technical information.

The Marine Invertebrates section is followed by three sections on a wide plethora of flora. This coverage is much appreciated as there is indeed a dearth of information regarding our islands' coastal and nearshore vegetation. At this point, it is very clear that book is authored by two different individuals as the writing style and attention to detail changed. The section on 'Algae' is very detailed, more so than that of sections on 'Flowering Plants' or 'Drift Seeds'. The author focused both on the general morphology and the microscopic structure of these plants. The details regarding the cellular structure can be comparable to work published by Littler and Littler (Caribbean Reef Plants, 2000). However, as the name suggests, the Littlers' book covered a very broad spectrum whilst this book quickly brought the focus to our local seashores. It was also good of the author to highlight new species reportings as well as potential invasive species.

My major concern however, is the omission of vertebrates, considering that the first section describes invertebrates. Sea birds which are one of the most common seashore faunas (for example sand pipers and laughing gulls) and the various nesting marine turtles such as leatherback, green and hawksbill are unmentioned. Lastly, even though invertebrates of the tidal pools are commented on, comments on fish species such as gobies or damselfish are lacking. Fish such as the 'four eyed fish' which are prevalent on both mud flats and sandy shore regions are also excluded. However, the brief on the solid waste pollution issue its impact on vertebrate communities are acknowledged.

Overall the book is well-written in clear and concise language and I have not found a single typographical error. Nonetheless, the aesthetics of some pages were compromised by images in multiple and perceivably

random dimensions, which is an issue throughout the book. Additionally, photographs lack consistent labelling common and scientific name of specimen, location and photo credit. Other publications such as Seashore Life of the Caribbean (Jones and Jones, 2009) have similar content but do not focus on any one particular island as their layout is defined by habitat and the associated fauna. In conclusion, I consider this book to be an asset in my reference collection and would recommend it to any young naturalist ranging from secondary school to the undergraduate tertiary level, particularly botany students. I look forward to the second edition of this book and hope the comments in this review are considered, particularly improvements on the faunal component.

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Notes to Contributors

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References should follow the Name and Year system. Some examples:

1. **Journals:**
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   Larsen, N.J. and **Levesque, A.** 2008. Range expansion of White-winged Dove (*Zenaida asiatica*) in the Lesser Antilles. *Journal of Caribbean Ornithology*, 21: 61-65.
   Quesnel, V., Farrel, T. F., Hilton, A., Hilton, J. and **Zuniaga, L.** 1996. The revegetation of the McClean Monument. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 1995-1996: 9-12.

2. **Books and Monographs:**
   Kenny, J. 2008. The Biological Diversity of Trinidad and Tobago. Maraval, Trinidad and Tobago: Prospect Press. 265 p.

3. **Citation from Books and Monographs with Editors:**
   Collins, C.T. 2002. Notes on the biology of the Band-rumped Swift in Trinidad. p. 138-143. *In* **F.E. Hayes** and **S.A. Temple,** eds. Studies in Trinidad and Tobago's Ornithology Honouring Richard ffrench. St. Augustine, Trinidad and Tobago: Department of Life sciences, University of the West Indies, Occasional Paper No. 11.

4. **Online References:**
   Rutherford, M.G. 2012. Tucker Valley BioBlitz 2012 Summary. *Field Naturalist* 2012(4), p. 6-17 [Online]. Available at http://ttfnc.org/photojournals/2012-4.pdf (Accessed 02 February 2013)

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