LIVING WORLD

Journal of The Trinidad and Tobago Field Naturalists' Club

2011

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.

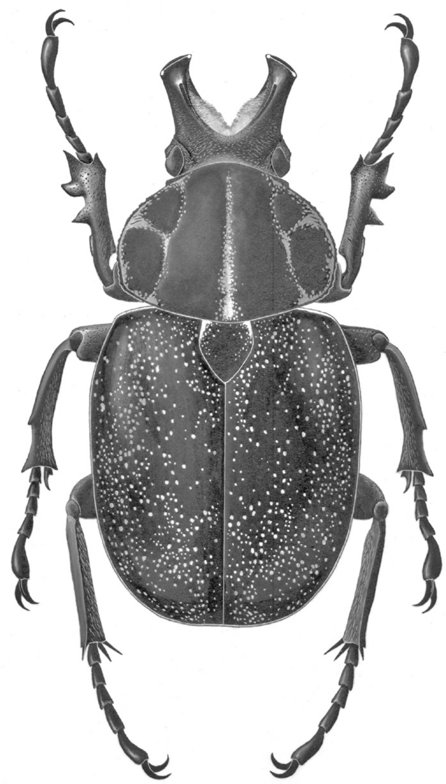
Mission Statement
To foster education and knowledge of natural history and to encourage and promote activities that lead to the appreciation, preservation and conservation of our natural heritage.

Enquiries

All enquiries concerning the Club should be addressed to:
The Honorary Secretary
P.O. Box 642, Port of Spain
Republic of Trinidad and Tobago
E-mail: *admin@ttfnc.org*
Website: *www.ttfnc.org*

LIVING WORLD

Journal of The Trinidad and Tobago
Field Naturalists' Club
2011



Inca clathrata quesneli Boos and Ratcliffe

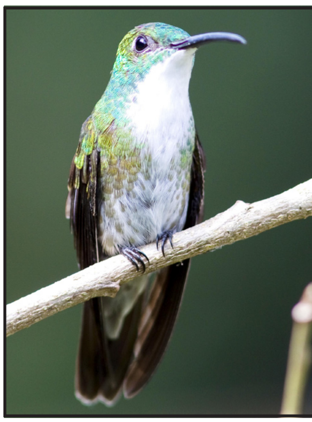
Published June, 2011
Living World is published by The Trinidad and Tobago Field Naturalists' Club

ISSN 1029-3299

ACKNOWLEDGEMENTS

The Management Committee of
The Trinidad and Tobago Field Naturalists' Club acknowledges with thanks
the contributions made to the production of Living World 2011 by our advertisers
and the following sponsor companies:

RUBY TOPAZ CATEGORY
(Contributions of $5,000.00 and above)



WHITE-CHESTED EMERALD CATEGORY
(Contributions of $2,000.00 to $4,999.00)

NEAL & MASSY FOUNDATION

GUARDIAN LIFE LIMITED
LOOKING AFTERLI FE
A MEMBER OF THE GUARDIAN HOLDINGS GROUP

BLUE-CHINNED SAPPHIRE CATEGORY
(Contributions up to $1,999.00)

Dr. Allan Hook

Agostini Limited

Special thanks to Michael E. Tikasingh
for the design and layout of the front and back covers
as well as the Acknowledgements' page.

Editorial

The Living World serves to document studies and observations on the natural history of Trinidad and Tobago and the Caribbean region. We welcome recent developments in the University of the West Indies Zoology Museum at St. Augustine. In our Guest Editorial, Mike Rutherford, the museum curator, announces that the museum is open for business and describes the importance of museum collections to the documentation and study of our biodiversity. Three of the contributions to this issue of Living World refer to specimens lodged in the museum and we would like this to become the norm.

The Living World 2011 includes ten articles describing original research, the regular report of the Trinidad and Tobago Rare Birds Committee (TTRBC), seven Nature Notes and a book review. Our research papers are limited to the animal kingdom but span topics of medical interest, taxonomy, island biogeography and invasive or at least colonising species.

Perry Polar, Matthew Cock and Tamika Seales describe the itching and burning sensation that results from touching the spines of the larvae of the moth *Megalopyge lanata*. Sand flies not only itch but can transmit serious diseases. Elisha Tikasingh provides an account of collections of Phlebotomine sand flies in Trinidad between 1953 and 1977 and the diseases recovered from them. With the close relationship between vector and parasite, the taxonomy and biology of the vector is crucial to understanding and thus managing the diseases.

We are pleased to include part 18 of Matthew Cock's regular account of the Hesperiidae of Trinidad and Tobago. This contribution considers eight genera which, unlike many of the previous groups, are relatively distinctive species.

Several contributions describe the fauna of small islands. Mike Rutherford reports on nine species of land snails inhabiting the Five-Islands Archipelago in the Gulf of Paria and relates this to island size. Stevland Charles *et al.* describe the herpetofauna of small islands off Tobago's north-east coast and include nine new locality records. Further north in the Caribbean, Jo-Anne Sewlal conducted a preliminary survey of St. Lucian spiders and recorded 40 species. Still further north, Courtney and David Bass provide an account of the "Aquatic Invertebrate Community Structure in Water-Filled Bracts of Heliconia flowers on Saba". They recorded 20 taxa of which 17 were previously unrecorded from Saba.

The frog *Eleutherodactylus johnstonei* is an exotic species from Grenada. In the 1978-79 issue of Living World, it was reported that a small population of this frog had become established in Port of Spain. S. A. Manickchan *et al.* provide an update on its distribution 30 years later. In a similar vein myself and others describe the establishment of *Anolis aeneus* (also native to Grenada) for the first time in Tobago and Ryan Mohammed *et al.* describe populations of the Malaysian prawns (introduced for aquaculture), in the river systems along the west coast of Trinidad.

A regular submission to the Living World is the report by the secretary of the Trinidad and Tobago Rare Birds Committee, Martyn Kenefick. This 8th report covers 72 sightings reported in 2010 which includes one new locality record for Trinidad and one for Tobago.

This year we have seven Nature Notes including three notes on lepidoptera, two on arachnids and one each on a mollusc and a snake. Scott Alston-Smith and Matthew Cock describe the mass movement of a Lycaenid butterfly previously unrecorded from Trinidad. Matt Kelly photographed a species of hummingbird hawkmoth in Tobago which was previously unrecorded from the island. Charles De Gannes provides a food plant record of a Nymphalid moth.

Victor Townsend and others describe a novel oviposition site by a harvestman and Chris Starr and Jo-Anne Sewlal record a species of social spider new to Great Inagua, Bahamas. Mike Rutherford recovered viable land snail eggs from a bird pellet. Finally, Stephen Smith and others describe the behaviour of one of the endemic snakes of Tobago and provide us with our cover photograph.

This year we have one book review. Judith Gobin reviews the *Wetlands of Trinidad and Tobago* by Rahanna Juman.

GLW

Cover Photograph

The snake *Erythrolamprus ocellatus* (Peters 1868) is endemic to Tobago. This specimen was collected at Runnemede and photographed by Stephen L.S. Smith. See Nature Note on page 36.

Guest Editorial: University of the West Indies Zoology Museum

This issue of Living World has presented me with a timely opportunity to let it be known that The University of the West Indies Zoology Museum (UWIZM) is open and ready for business. UWIZM is a place where members of the public can bring zoological specimens for help with identification and researchers can come and study any of the approximately 30,000 specimens. Tours are available for groups from pre-school to secondary school and for the general public as well.

UWIZM has its origins in the collections made for the Imperial College of Tropical Agriculture in the 1920s. Insect pests make up the bulk of the early specimens but as teaching needs changed and as new staff members came and went, the collections grew to include other animal phyla. The most significant collections are the beetles, moths and butterflies, social insects, freshwater fish, freshwater crustaceans, reptiles, stony corals and molluscs. Over the decades the specimens were looked after by a variety of lecturers and technicians but it wasn't until last year, when I started, that the museum had its first full-time curator.

There are two rooms that make up the museum: the Land Arthropod Room with all the insects, arachnids and myriapods and the Zoology Room with the wet and dried specimens from all the other animal groups including vertebrates, molluscs, corals and crustaceans. As space is at a premium, they are more like stores that happen to be available for visits rather than fully fledged museum displays. However, there are plans for a dedicated multidisciplinary museum on the UWI St. Augustine campus, combining all of the university's collections in one place.

The main task right now is to catalogue all the specimens and make the information available in an online database. As well as the UWIZM, there are collections held by other organisations in Trinidad and Tobago and on the other UWI campuses and it is my hope that they can be added to the database as well. This would provide a single place for accessing information on natural history specimens for the country and the region.

Looking through the back issues of Living World there are many occasions when museums are mentioned as places to go and examine old specimens relevant to a current study or somewhere to lodge new specimens once a study is completed. When I looked at the museums the vast majority are either from the U.S.A. or the U.K., which is not surprising as these two countries are home to the biggest biological collections in the world.

There have been a few mentions of UWIZM over the years but not nearly as many as I first hoped. The majority comes from one of the journal's most prolific authors, Matthew Cock, whose many papers on the skipper butterflies of Trinidad often mentioned specimens from the Sir Norman Lamont collection. Other mentions include John Michalski, who left a collection of dragonflies and damselflies from his 1987-88 article, and Peter Bacon who, as far back as 1975, was leaving his specimens in the museum. Not surprising as he was a student and eventually head of the department of Life Sciences where the museum is based.

These voucher specimens are a crucial part of the scientific method which is based on the principle that the results of a study should be repeatable and verifiable. It can be a problem if there is no specimen to examine and on occasion it has been found that the species that has been studied is not the same as the one named in the paper. Voucher specimens are the only reliable way of confirming the identity of a species in a study and as such their preservation and accessibility is of much importance. They need to be stored in a research museum that is committed to their long-term care and preservation and the data that goes with them needs to be made available to future researchers.

Unfortunately there are many occasions when specimens are not lodged with a museum quite often because they were never collected in the first place. It is not just the responsibility of the researchers to deposit their specimens but also the journals in which their studies are published need to encourage them to do so. This means that the specimens will be adequately looked after and the papers in the journals are more likely to stand up to investigation and will thus prove more valuable in the long-term.

I hope that in the future any researchers working in Trinidad and Tobago will consider it a necessary part of their study to deposit voucher specimens with all the relevant data at UWIZM. Specimens will be accessioned, catalogued, photographed and the data made available online.

For further details about UWIZM please go to http://sta.uwi.edu/fsa/lifesciences/zoology.asp

Mike Rutherford
UWIZM Curator
Mike.Rutherford@sta.uwi.edu

Painful Encounters with Caterpillars of *Megalopyge lanata* (Stoll), (Lepidoptera: Megalopygidae) in Tobago, Trinidad and Tobago, West Indies

Perry Polar[1], **Matthew J.W. Cock**[2] and **Tamika L. Seales**[3]

1. The University of the West Indies, St. Augustine, Trinidad and Tobago.
perrypolar@gmail.com

2. CABI Europe - Switzerland, Rue des Grillons 1, CH-2800 Delémont, Switzerland.
m.cock@cabi.org

3. Division of Agriculture, Marine Affairs, Marketing and Environment,
Tobago House of Assembly, Trinidad and Tobago.
tseales99@gmail.com

Corresponding author: Perry Polar

ABSTRACT

Shinney is a colloquial term used to describe a hairy caterpillar in Trinidad and Tobago. There have been at least four instances in 2010 in which people were envenomated by shinneys in the Bon Accord region of Tobago. We have identified the species as *Megalopyge lanata* (Stoll) (Megalopygidae), which has been reported in the literature from Trinidad, but only noted in unpublished data from Tobago. The moths are likely to be originating from the mangroves around the Bon Accord Lagoon, which is a protected area (Ramsar site) and have repeatedly appeared on tropical almond trees at the Pigeon Point Beach Facility and hence are a concern to the local tourism industry. We discuss the current management practices and appropriate future actions that should be both effective and environmentally sensitive.

Key words: Erucism, moth, Pigeon Point, shinney, *Terminalia catappa*.

INTRODUCTION

The Dictionary of the English/Creole of Trinidad and Tobago describes a shinney, shinney worm, shinney makak, or chenille as any caterpillar covered with hairs, which are stiff and very irritating (Winer 2009). Shinneys are found in several families of Lepidoptera, but are especially prevalent in the Megalopygidae.

Most Lepidoptera are harmless to humans. The irritating effect caused by certain adult moths is called lepidopterism while encounters with the immature stages are called erucism (Wirtz 1984). Caterpillars which introduce venom through the offensive use of poisonous setae are known as *phanerotoxic* while those which produce volatile or repellent emanations released onto the integument or projected through an emission tube are known as *cryptotoxic* (Wirtz 1984). The setae on these caterpillars act as a defence mechanism against natural predators and human contact is often accidental (Cardoso and Junior 2005).

Several Lepidoptera families have species with caterpillars possessing urticating properties including: Arctiidae, Bombycidae, Limacididae, Eupterotidae, Lymantriidae, Megalopygidae, Noctuidae, Notodontidae and Saturniidae (Wirtz 1984). However, the phenomenon is mainly associated with three families of moths: Megalopygidae, Saturniidae and Arctiidae (Cardoso and Junior 2005). The most important genera of the Megalopygidae family in this respect are *Podalia* and *Megalopyge* (Cardoso and Junior 2005). Setae in caterpillars of the Megalopygidae are thin and plentiful often over the whole body. This usually allows them to be distinguished from the Saturniidae, which have setae, based on scoli, looking like small pine trees (Cardoso and Junior 2005; Cock 2008, 2009; Polar *et al*. 2010). In most cases symptoms are intense pain and local edema (fluid accumulation below skin) and erythema (redness of skin) which are not proportional to the observed pain (Cardoso and Junior 2005).

OBSERVATIONS

Occurrence of shinneys and moths

Adults, pupae and larvae were observed on several occasions in 2009 and 2010 on many of the tropical almond trees (*Terminalia catappa*, Combretaceae) at the Pigeon Point Beach Facility area, a popular tourist destination, and in the mangrove surrounding the facility. The moths were described as 3-4 inches wide with round tipped wings, brown with a fleshy abdomen and they laid eggs on a range of surfaces about the facility.

The first reported sighting recorded by the Tobago House of Assembly was in September 2009 (pupae). Other sightings occurred on October 2009 (pupae), December 2009 (moths), March 2010 (caterpillars), September 2010 (final instar caterpillars and pupa) and October 2010 (adults). This indicates a fairly regular reoccurrence of moths.

Description of envenomations

We have described the symptoms of envenomations to assist in diagnosis where the causative agent has not been identified. On 13 January 2010, James, a local male Caucasian, 33 years of age, 1.94 meters tall and approximately 95 kg was walking barefooted in the mangrove between the Bon Accord slipway and Pigeon Point in Tobago when he stood on an ivory coloured, hairy shinney and was stung on the arch of his left foot. He immediately began to experience symptoms of burning in the area of the sting, gradually getting more intense over 45 minutes. He felt the toxin travel up the lymphatic system of his left leg to the nodes in the groin and later a red line appeared up the leg. Within an hour and a half of being stung, his left foot was swollen and he was limping. He was treated at the Calder Hall Medical Center where doctors were not familiar with what had stung him. He was given a cortisone injection for the pain and a five-day course of broad spectrum antibiotics for possible infection. He also took a five-day course of high dosage antihistamines. His symptoms persisted for three days, especially the effect of the toxin in the upper thigh, but he made a full recovery.

James reported that another male, Simon (Caucasian from St. Lucia, in his 20s, very fit) was also stung when he leaned back against a chair on which a similar shinney was walking. Simon also experienced immediate and quite severe pain along the lymphatic system, travelling into the armpit and arm. Simon self-administered painkillers and what he believed to be an anti-inflammatory herbal treatment but did not go to hospital.

A local biologist, RJ, also described having a painful encounter with a shinney in the Bon Accord area in April 2010. She recounted that she was in pain for one night while on painkillers and antihistamines. RJ reported that she had never encountered the particular organism and has been working in the Bon Accord Lagoon since 1996. She also reported that a fisherwoman was admitted to the hospital as a result of an encounter with a shinney.

Anecdotal evidence from Pigeon Point indicates that these shinneys are known to local residents with one person remembering their existence over thirty years ago. Accounts are vague and effects have also been described as "scratching of the skin". It is not possible to say whether the effects of the envenomations were different or simply reflected the response or tolerance of the individuals. Regardless, the species is of public health importance and a greater understanding of the organism is required.

Identification and previous encounters

Photographs of the shinneys (Figs. 1A, 1B) were identified by MJWC as *Megalopyge lanata* (Stoll) (Megalopygidae). Provisional identification was made from Merian (1705, plate 19) and Sepp (1830, plate 12), and confirmed from Janzen and Hallwachs (2010) which includes photographs of caterpillars from Costa Rica. Unlike most Megalopygidae, in *M. lanata* the setae are in dorsolateral and lateral clumps on each segment of the thorax and abdomen of the caterpillar, and thus superficially more similar to the Saturniidae. A reared female moth was photographed and provisionally confirmed as *M. lanata*, but it was in too poor condition to make a definitive identification. Accordingly, photographs of an adult male and female (Figs. 1C, 1D) from previous collections in Trinidad are provided. Photos of eggs (Fig. 1E) and cocoons (Figs. 1F, 1G) at Pigeon Point are also provided.

Megalopyge lanata is known from previous collections in Trinidad. It was reported from Trinidad by Kaye and Lamont (1927) based on pupae collected on *Andira inermis* (Fabaceae), and caterpillars collected on *Tecoma* sp. (Bignoniaceae) at Pointe Baleine, Gasparee (Gaspar Grande), a small offshore island between Trinidad and Venezuela. Lamont's specimens from *A. inermis* have not been located, but a reared male and female from Gasparee are in the National Museums of Scotland, and there is a similar specimen in the Lamont collection at The University of the West Indies, St. Augustine, which confirm Kaye and Lamont's identification. MJWC (unpublished data) also has records from Fyzabad (R.M. Farmborough), Palmiste (N. Lamont), Pointe à Pierre (R.M. Farmborough), Curepe/St. Augustine (F.D. Bennett, R.E. Cruttwell, D.J. Stradling, M.J.W. Cock), Morne Bleu Textel Installation (M.J.W. Cock). Laurence (2000) refers to this species as "flannelworm or hairy caterpillar".

The moths of Tobago have not been documented. However, it is known to occur there, as MJWC (unpublished data) has a record from Marden House, near Scarborough, at MV light by R. Forrester, 15.i.1982.

In Trinidad, *M. lanata* is an occasional pest of avocado (*Persea americana*, Lauraceae) (Worth 1967; Laurence 2000) and coffee (*Coffea* spp., Rubiaceae) (Laurence 2000). There are records from other food plants elsewhere in the Neotropics, e.g. *Citrus* spp. (Rutaceae) in Surinam (Sepp 1830), *Byrsonima crassifolia* (Malpighiaceae), *Swietenia macrophylla* (Meliaceae), *Roupala montana* (Proteaceae) and *Rhizophora mangle* (Rhizophoraceae) in Costa Rica (Janzen and Hallwachs 2010), and *Conocarpus erectus* (Combretaceae) and *La-*

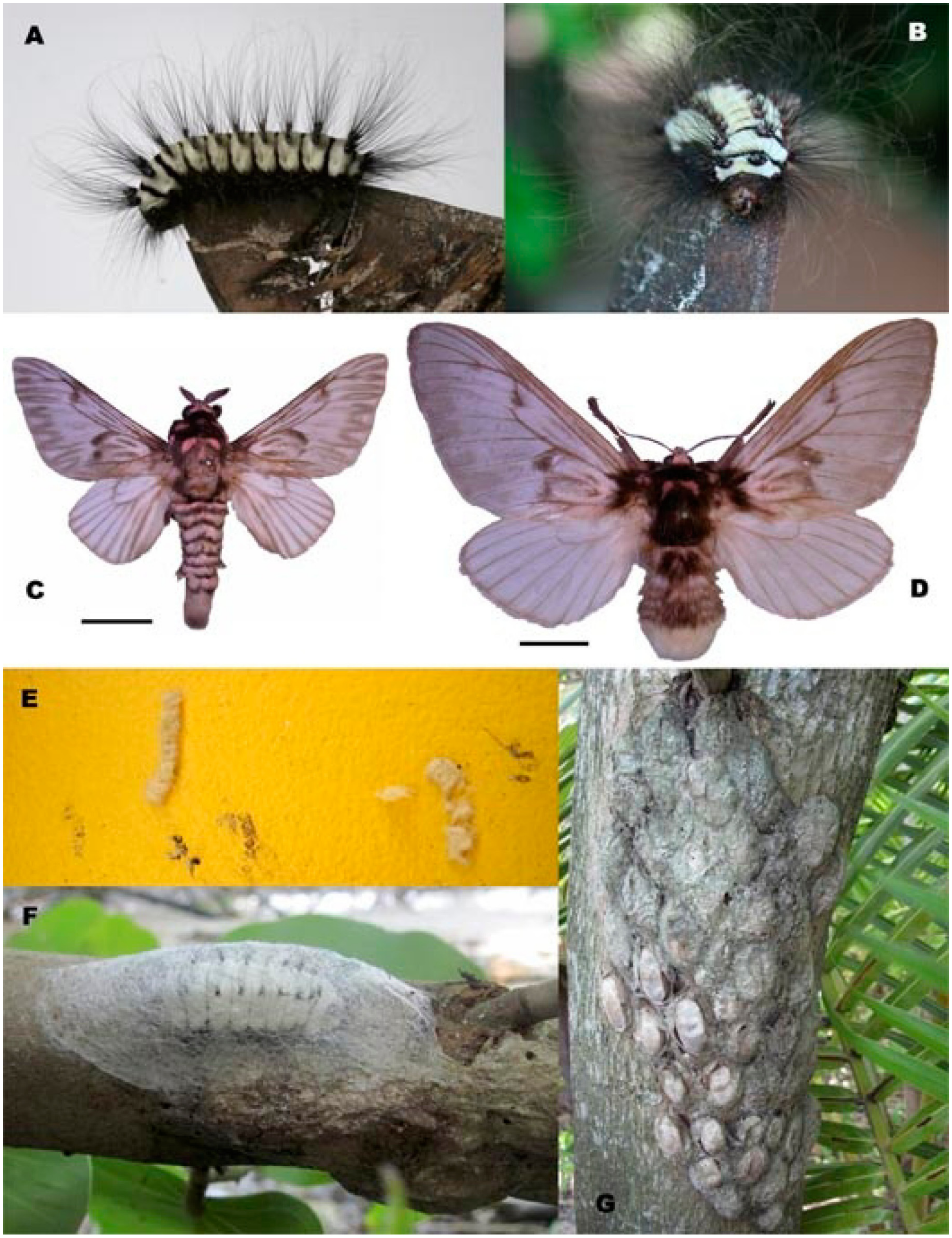


Fig. 1. Biology of *Megalopyge lanata.* **A**, mature caterpillar, lateral view, Pigeon Point, Tobago, 23 January, 2010 (Dawn Glaisher); **B**, mature caterpillar, anterior view, Pigeon Point, Tobago, 3 November, 2010 (Perry Polar); **C**, adult male, captured at light, Morne Bleu Textel Installation, Trinidad, 4 February, 1979, M.J.W. Cock (in collection M.J.W. Cock); **D**, adult female, captured at light, Morne Bleu Textel Installation, Trinidad, 10 November, 1978, M.J.W. Cock (in collection M.J.W. Cock); **E**, two groups of eggs laid on a wall in short rows and covered in setae from the apex of the female abdomen, Pigeon Point, Tobago, 3 November, 2010 (Perry Polar); **F**, caterpillar constructing its cocoon at the edge of a group of cocoons on a branch of tropical almond tree, Pigeon Point, Tobago, 3 November, 2010 (Perry Polar); **G**, a group of cocoons on the trunk of a tropical almond tree (the lower cocoons are abraded, and it can be seen that the inner papery layer is visible, most showing the slit where the adult moth has emerged), Pigeon Point, Tobago, 3 November, 2010 (Perry Polar).

gerstroemia indica (= *speciosa*) (Lythraceae), as well as *T. catappa* in Panama (Aiello 2011). Thus, this is a very polyphagous species. The known food plants and records of adults indicate that although it may be more frequently encountered at the coast, it probably occurs throughout Trinidad and Tobago.

Megalopyge lanata is known to occur widely in the Neotropics and previous encounters have been reported (Cardoso and Junior 2005; Anon 1964). What was almost certainly an encounter with *M. lanata* in Trinidad has been described by Worth (1967) who, along with a colleague, in order to test its toxicity deliberately touched a fat shinney, "whitish in colour, with a coating of sparse long hairs overlying tufts of shorter spines". This resulted in "a tremendous aching" that set in and extended up their arms to the shoulder indicating its venomous nature, and paralleling the observation reported above. Worth (1976) described a community of cocoons of this species at the base of an avocado tree in his garden in Port of Spain, a site that appeared to be used year after year given the tattered remnants of cocoons. In a single cocoon, the "outer spreading, low-lying case was woven loosely" while the interior was more firmly woven "shaped angularly, something like a Brazil nut" but with one end being "virtually unsealed" to allow for the emerging moth to emerge. A survey of the northernmost point at the Pigeon Point area in November 2010 revealed a collection of cocoons (Fig. 1G) at the base of the trunk of a tropical almond tree similar to that described by Worth. Worth (1967) suggested that this pupation site provided camouflage for the cocoons against the rugged bark of the avocado tree. The cocoons may be similarly camouflaged against the bark of tropical almond.

Management Options

The periodic appearance of the shinneys of *M. lanata* at Pigeon Point could pose a problem for the local tourist industry. After the first incident, the trees with shinneys were cordoned off to prevent people coming into contact with them. The shinneys were treated with detergent water, which was ineffective, although this treatment was found effective in killing the caterpillars of *Hylesia metabus* (Cramer) (Saturniidae), another moth with urticating properties in Trinidad (Polar *et al*. 2010). Dipel™, a biological pesticide based on *Bacillus thuringiensis* var. *kurstaki* reduced the number of shinneys; however, since the biological pesticide had to be ingested, the time taken for mortality meant the shinneys continued to pose a risk to people for up to seven days after application. Pestac/Fastac (Alpha-Cypermethrin) acts as a stomach poison and proved more effective because of its neurotoxic effect. This contact pesticide has since been used as a control measure on tropical almond trees when caterpillars are observed at the Pigeon Point Beach Facility. This intervention may be the most practical at this point in the current situation, but may disrupt the action of natural enemies leading to outbreaks of shinneys in the future.

Given that *R. mangle* is plentiful and *C. erectus* is present in the Bon Accord/Buccoo Bay Mangroves (Juman 2010), it is possible that these species may be providing a food source for *M. lanata* from where it makes its way a short distance to the tropical almond trees at the Pigeon Point facility. As the Bon Accord Lagoon is an environmentally sensitive area, spraying of chemical pesticides is not recommended but ecological studies should be conducted, particularly with respect to natural enemies of this species. If monitoring the tropical almond trees at Pigeon Point could detect the very young shinney caterpillars, *Bacillus thuringiensis* could then be applied; it should be more effective on young caterpillars and conserve the local natural enemies.

Sensitization of the Tobago Hotel and Tourism Association is also suggested so they can advise their members who deal with visitors to the island to alert them to the potential dangers of shinneys, and what the caterpillars look like so that they can be avoided if seen. For example, information signs or leaflets could be placed in hotel receptions. The emergency services and hospitals in Tobago should be aware of the species concerned and its potential impacts in the event that emergency treatment is required.

ACKNOWLEDGEMENTS

We would like to thank Ms. Dawn Glaisher for providing photos of caterpillars and an account of James and Simon's encounter as well as Dr. Rahanna Juman for her account. Thank you to Dr. Mark Shaw and Dr. Keith Bland who facilitated MJWC's access to the collection of the National Museums of Scotland and Mr. Raj Mahabir (The University of the West Indies (UWI), St. Augustine) who checked the Lamont collection at UWI for specimens of *M. lanata*.

REFERENCES

Aiello, A. 2011. Annette Aiello. http://striweb.si.edu/aiello/results.php (Last accessed 4 Jan. 2011).

Anon. 1964. Soft look's misleading: Their conduct shocking. *The Panama Canal Spillway*, 27 November 1964: 1, 4. http://ufdc.ufl.edu/UF00094771/00486/1j (Last accessed 27 Jan. 2011).

Cardoso, A. E. C. and **Junior, V. H.** 2005. Accidents caused by lepidopterans (moth larvae and adult): study on the epidemiological, clinical and therapeutic aspects. *Anais Brasileiros de Dermatología,* 80: 573-578.

Cock, M. J. W. 2008. *Automeris metzli* Sallé (Lepidoptera: Saturniidae) in Trinidad, West Indies. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2008: 39-42.

Cock, M. J. W. 2009. *Pseudautomeris* spp. (Lepidoptera: Saturniidae, Hemileucinae) in Trinidad, West Indies. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2009: 32-36.

Janzen, D. H. and **Hallwachs, W.** 2010. Dynamic database for an inventory of the macrocaterpillar fauna, and its food plants and parasitoids, of Area de Conservacion Guanacaste (ACG), northwestern Costa Rica. http://janzen.sas.upenn.edu (Last accessed 31 Jan. 2010).

Juman, R. A. 2010. Wetlands of Trinidad and Tobago. Institute of Marine Affairs, Port of Spain, Trinidad and Tobago: Media & Editorial Projects Ltd. 91p.

Kaye, W. J. and **Lamont, N.** 1927. A catalogue of the Trinidad Lepidoptera: Heterocera (Moths). *Memoirs of the Department of Agriculture, Trinidad and Tobago*, 3: 1-144.

Laurence, G. A. 2000. The insect pests of coffee. *Journal of the Agricultural, Society of Trinidad and Tobago*, 89: 19-20.

Merian, M. S. 1705. Metamorphosis insectorum surinamensium. Valk, Netherlands, Gerardum.

Polar, P., Cock, M. J. W., Fredrickson, C., Hosein, M. and **Krauss, U.** 2010. Invasions of *Hylesia metabus* (Lepidoptera: Saturniidae, Hemileucinae) into Trinidad. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2010: 1-10.

Sepp, J. 1830. Natuurlijke Historie van Surinaamsche Vlinders, naar het leven geteekend. Papillons de Surinam dessinés d'après nature. Volume 1, part 3, pp. 25-32, pls. 9-12. Amsterdam, Netherlands, Jan Christian Sepp en Zoon.

Winer, L. (ed.) 2009. Dictionary of the English/Creole of Trinidad & Tobago. Montreal & Kingston, London – Ithaca: McGill-Queen's University Press. 1072 p.

Wirtz, R. A. 1984. Allergic and toxic reactions to non-stinging arthropods. *Annual Review of Entomology,* 29: 47-69.

Worth, C. B. 1967. A Naturalist in Trinidad. Philadelphia and New York: J.B. Lippincott Company. 291 p.

REVIEWERS 2007 – 2011

The Editorial Committee thanks the following persons who took time off from their busy schedule to review papers over the last five years.

Dr. Paula Cushing
Mr. Hans Boos
Mr. Stevland Charles
Dr. M. J. W. Cock
Dr. Ross G. Cooper
Dr. Roger Downie
Dr. Angela Fields
Dr. Lebert Grierson
Dr. Adrian Hailey
Prof. F. Hayes
Dr. Michele Lee Haynie
Dr. Julian Kenny
Dr. Raymond Manuel
Dr. John Murphy
Dr. Howard Nelson
Dr. Dawn Phillip
Dr. Ricardo Pinto-da-Rocha
Dr. Victor Quesnel
Prof. I. Ramnarine
Mr. Mike Rutherford
Ms. Jo-Anne Sewlal
Dr. William D. Shepard
Dr. Christopher Starr
Dr. Andrew Warren
Prof. D. D. Williams

Dedicated to the memory of Dr. Thomas Henry Gardiner Aitken (1912-2007)

Collections of Phlebotomine Sand Flies (Diptera: Psychodidae), 1953 - 1977 in Trinidad, West Indies

Elisha S. Tikasingh*
Caribbean Epidemiology Centre
Pan American Health Organisation/World Health Organisation
16-18 Jamaica Boulevard, Federation Park,
Port of Spain, Trinidad and Tobago.

*Present address: 12 Newbury Hill, Glencoe, Trinidad and Tobago.
elisha.tikasingh@gmail.com

ABSTRACT
During the period 1953-1977 collections of phlebotomine sand flies in Trinidad yielded 21 species in two genera: one *Brumptomyia* and 20 *Lutzomyia. L. gomezi* was the most commonly collected and most widely distributed species occurring in 20 of the 26 localities surveyed. One species, *L. flaviscutellata,* is a known vector of enzootic rodent leishnaniasis in Trinidad.

Key words: Psychodidae, *Brumptomyia, leopoldoi, Lutzomyia, antunezi, aragaoi, atroclavata, ayrozai, barrettoi, cayennensis, christenseni, dubitans, flaviscutellata, gomezi, lichyi, micropyga, migonei, ovallesi, pilosa, rangeliana, shannoni, sordellii, trinidadensis, walkeri.*

INTRODUCTION

Phlebotomine sand flies, sometimes called "moth flies", have a worldwide distribution. From a medical point of view they include vectors of the parasite *Leishmania,* the etiological agent of leishmaniasis. Two genera are of importance: *Phlebotomus* in the Old World and *Lutzomyia* in the New World. In Trinidad, these sand flies are generally dispersed throughout the island, but nowhere are they particularly abundant. In contrast to their namesakes, the *Culicoides* sand flies or midges (Aitken *et al.* 1975), they are not especially annoying as a human pest. However, Callan (1947) has reported *Lutzomyia trinidadensis* (as *Phlebotomus trinidadensis)* commonly entering buildings during the evening hours to bite humans at the Imperial College of Tropical Agriculture, now The University of the West Indies, St. Augustine.

The literature dealing with Trinidadian phlebotomines is sparse. The earliest records are those of Knab (1913) who described *Lutzomyia atroclavata* (as *Phlebotomus atroclavatus* Knab*)* from Gasparee (Gaspar Grande), an islet off the north-west peninsula of Trinidad, and Newstead's (1922) *Lutzomyia trinidadensis* (as *P. trinidadensis*) although no specific locality was mentioned. Since then there have been brief articles and references to species by Myers (1935), Bequaert (1938), Adamson (1939), Callan (1945), Fairchild and Hertig 1948a, b), Fairchild and Trapido (1950) and Young and Duncan (1994). Tikasingh (1969, 1974, 1975) published papers on leishmaniasis including studies on the vector *Lutzomyia flaviscutellata* (Mangabeira).

The Trinidad Regional Virus Laboratory (TRVL) was established in 1952 to study arthropod-borne viruses (arboviruses) and their vectors (Tikasingh 2000). Aitken *et al.* (1968) described entomological investigations associated with arbovirus studies in the Nariva Swamp (Bush Bush Forest) and reported the collection of 10 species of phlebotomine sand flies, four of which were found to be man biters (*L. amazonensis = ayrozai* (Barretto and Coutinho)*, L. antunezi* (Coutinho)*, L. flaviscutellata* and *L. ovallesi* (Ortiz)). During the course of these investigations covering 16 years (1953-1968), 14,464 phlebotomines were tested for the presence of viruses but none was recovered (Aitken 1960; Aitken *et al.* 1969; TRVL 1968). An additional 11,000 specimens were tested unsuccessfully in 1970 and 1971 (TRVL 1970, 1971). Despite these negative results in Trinidad, many arboviruses have been isolated from *Lutzomyia* spp. in recent years in Brazil and Panama (Young and Arias 1991) and phlebotomines are well-known vectors of viruses elsewhere in the world.

LOCALITIES

Collections were made between 1953 and 1977 from sites that were generally associated with those where arbovirus field studies were in progress. Chaguaramas was an exception because the United States Naval Station (USNS) occupied the area and collections were made with the assistance of US navy personnel. Elsewhere, most of the collections were in the northern and east-

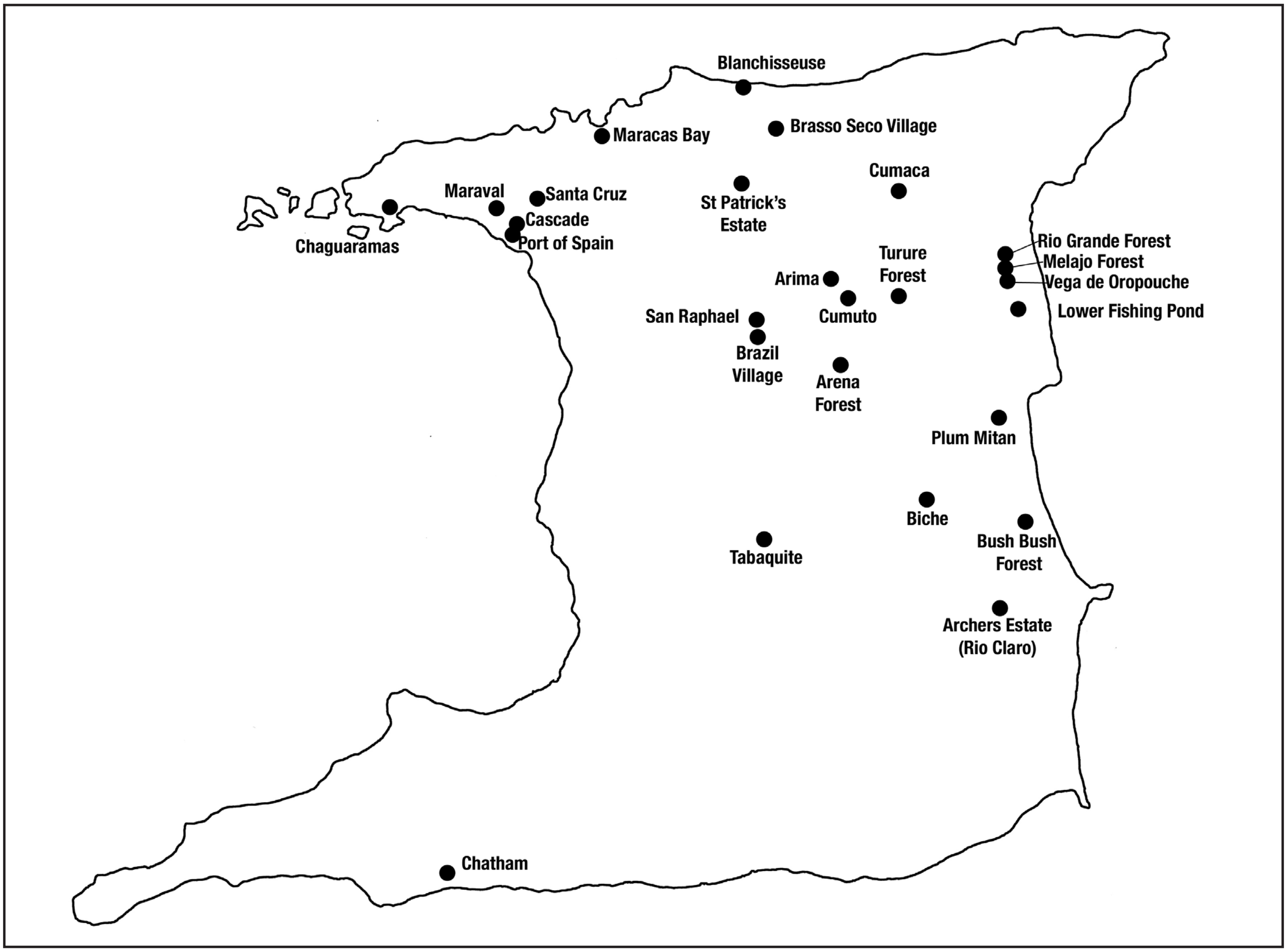


Fig. 1. Collection sites for phlebotomine sand flies in Trinidad, West Indies.

central sections of Trinidad although a single specimen was collected at Chatham in the south-west (Fig. 1). The island was therefore unevenly and selectively surveyed. No studies were conducted in Tobago. Since 1977 there have been no further collections of phlebotomine sand flies by CAREC's staff nor by any other individuals in Trinidad and Tobago.

TECHNIQUES

Sand flies were collected in a variety of ways, utilizing human bait (day and night), hand collection, castor oil-treated traps (Disney 1966), CDC light traps (Sudia and Chamberlain 1962), mouse-baited No. 10 (Worth and Jonkers) and No. 17 traps (Davies 1971), chicken-baited traps (Aitken *et al.* 1968), suction sweepers as well as aspiration from tree buttresses and other natural resting sites. Further, the majority of the collections were made at ground level, but some collections were also made in the forest canopy.

Collections were made by T.H.G. Aitken, E.S. Tikasingh, J.B. Davies, Raymond Martinez, F.S. Blanton and J. Sowa. Identifications were done by G.B. Fairchild (Gorgas Memorial Laboratory and the University of Florida, D.J. Lewis (British Museum) and D.G. Young (University of Florida).

Specimens of collected species have been deposited in the United States National Museum in Washington D.C., the Natural History Museum, London, the University of Florida in Gainesville and at TRVL, now the Caribbean Epidemiology Centre (CAREC).

RESULTS

A list of the sand flies collected with the total number of collections and number of specimens taken from the 26 collecting sites is given in the accompanying table. A detailed list of each collection is lodged at CAREC giving date of each collection, locality, method of collection, collector, determiner and where each specimen was deposited.

Table 1. Phlebotomine sand flies collected by localities from Trinidad, West Indies.

Species	Locality	No. of Collections	No. of Specimens Collected
Brumptomyia leopoldoi (Rodriguez)	Arena Forest	1	1
	Chaguaramas	19	28
	Total	**20**	**29**
Lutzomyia antunezi (Coutinho)	Arena Forest	17	53
	Bush Bush Forest	21	32
	Cumuto	1	1
	Rio Claro (Archer's Est.)	1	1
	Santa Cruz	1	1
	Tabaquite	7	42
	Turure Forest	4	6
	Vega de Oropouche	2	2
	Wallerfield	2	3
	Total	**56**	**141**
L. aragaoi (Costa Lima)	Arena Forest	2	14
	Chaguaramas	41	99
	Cumuto	2	3
	Port of Spain	1	1
	Santa Cruz	1	1
	Turure Forest	31	64
	Total	**78**	**182**
L. atroclavata (Knab)	Chaguaramas	11	11
	Bush Bush Forest	10	22
	Vega de Oropouche	2	2
	Total	**23**	**35**
L. ayrozai (Barretto and Coutinho)	Arima	2	7
	Bush Bush Forest	1	1
	Chaguaramas	5	16
	Cumuto	1	1
	Melajo Forest	1	1
	Rio Grande Forest	2	2
	Turure Forest	6	8
	Total	**18**	**36**
L. barrettoi (Mangabeira)	Arena Forest	1	4
	Chaguaramas	4	4
	Cumuto	1	12
	Total	**6**	**20**

Species	Locality	No. of Collections	No. of Specimens Collected
L. cayennensis (Floch and Abonnenc)	Chaguaramas	6	9
	Bush Bush Forest	12	15
	No locality specified	1	5
	Total	**19**	**29**
L. christenseni (Young and Duncan)	Arena Forest	1	1
	Turure Forest	1	1
	Total	**2**	**2**
L. dubitans (Sherlock)	Caura	2	5
	Chaguaramas	4	4
	Maraval	1	6
	Turure Forest	2	2
	Vega de Oropouche	1	1
	Total	**10**	**18**
L. flaviscutellata (Mangabeira)	Arena Forest	1	3
	Bush Bush Forest	18	27
	Chaguaramas	8	18
	Cumuto	1	3
	Melajo Forest	1	1
	Rio Grande Forest	4	4
	Turure Forest	16	72
	Vega de Oropouche	3	10
	Total	**52**	**138**
L. gomezi (Nitzulescu)	Arena Forest	23	83
	Arima	2	2
	Biche	1	1
	Brasso Seco	1	1
	Brazil Village	2	6
	Bush Bush Forest	1	1
	Chaguaramas	43	62
	Cumaca	4	31
	Cumuto	1	4
	Fishing Pond	1	30
	Maracas Bay	1	1
	Maraval	1	3
	Port of Spain	1	1
	Rio Claro (Archer's Est.)	6	8
	Rio Grande Forest	1	1
	San Raphael	2	9

Species	Locality	No. of Collections	No. of Specimens Collected
	Santa Cruz	2	5
	Tabaquite	1	1
	Turure Forest	2	2
	Vega de Oropouche	116	228
	Total	**212**	**480**
L. lichyi (Floch and Abonnenc)	Arima Valley (Simla)	1	2
	Cumaca	3	3
	Maraval	1	1
	Total	**5**	**6**
L. micropyga (Mangabeira)	Bush Bush Forest	11	14
L. migonei (Franca)	Bush Bush Forest	3	4
L. ovallesi (Ortiz)	Blanchisseuse	1	8
	Bush Bush Forest	4	5
	Cascade	1	1
	Chaguaramas	11	18
	Maraval	1	2
	Santa Cruz	2	3
	Vega de Oropouche	3	3
	Total	**23**	**40**
L. pilosa (Damasceno and Causey)	Bush Bush Forest	9	14
L. rangeliana (Ortiz)	Bush Bush Forest	3	4
	Turure Forest	1	1
	Vega de Oropouche	27	38
	Total	**31**	**43**
L. shannoni (Dyar)	Bush Bush Forest	4	4
L. sordellii (Shannon and Del Ponte)	Bush Bush Forest	5	8
L. trinidadensis (Newstead)	Arena Forest	4	6
	Bush Bush Forest	30	243
	Chaguaramas	12	16
	Chatham	1	1
	Port of Spain	1	1
	Rio Grande Forest	2	2
	Vega de Oropouche	58	82
	Wallerfield	1	1
	Total	**109**	**352**

Species	Locality	No. of Collections	No. of Specimens Collected
L. walkeri (Newstead)	Bush Bush Forest	5	196
	Chaguaramas	1	1
	Vega de Oropouche	1	1
	Total	**7**	**198**
	Grand Total	**703**	**1793**

REMARKS

The present study records the presence in Trinidad of 21 species of phlebotomines of which one species is referred to the genus *Brumptomyia* and the remaining 20 species to the genus *Lutzomyia.*

Brumptomyia leopoldoi

There are 22 species of this genus in Latin America, but only one species was collected in Trinidad. Of the 20 collections of this species, 19 was made by T.H.G. Aitken and all of his collections were made in Chaguaramas between 1955 and 1958 from light trap collections. Young and Duncan (1994) noted that *B. leopoldoi* was commonly found in armadillo burrows.

Lutzomyia antunezi

The 56 collections consisting of 141 specimens of this species came from nine localities, the majority however, coming from Arena Forest, Bush Bush Forest and Tabaquite. This species is anthropophilic, the majority of the specimens was collected when they attempted to bite or when biting humans.

Lutzomyia aragaoi

The 182 specimens collected from 78 collections were all made with light traps from six localities.

Lutzomyia atroclavata

The species was originally described from Gasparee Island as *Phlebotomus atroclavatus* by Knab in 1913. Subsequently, 11 specimens were collected by Aitken using light traps between 1955 and 1958 at Chaguaramas. It is not known to be anthropophilic although specimens were taken off human bait in Bush Bush Forest.

Lutzomyia ayrozai

Collections of this species between 1953 and 1962 were made by Aitken, subsequently all others were made by Tikasingh.

Lutzomyia barrettoi

The 20 specimens taken of this species were all light trap collections.

Lutzomyia cayennensis

Collections of this species were made by a variety of methods: light traps, chicken-baited traps, from chicken houses, hand collections and a tree buttress. All except one were made by Aitken between 1955 and 1963. Five specimens collected by Urich in 1921 are in the Natural History Museum, London. Other specimens of *L. cayennensis* are in the University of Florida.

Lutzomyia christenseni

Only two specimens were collected: a female by Aitken in 1955 in Arena Forest and the other, a male by Tikasingh in 1968 at Turure Forest. Both were collected using light traps.

Lutzomyia dubitans

Of 18 specimens collected, 11 were taken in caves: Caura (5) and Perseverance, Maraval (6).

Lutzomyia flaviscutellata

This is an anthropophilic species and was taken using a variety of methods: human bait, No. 10 traps baited with various rodents, oil trap baited with rodents, chicken trap and natural resting sites such as holes in the ground. The normal resting place of the species is under leaf litter. The species is known to transmit leishmaniasis in rodents (Tikasingh 1969, 1970, 1975).

Lutzomyia gomezi

An anthropophilic species, it was the most commonly collected and was the most widespread in Trinidad. A total of 212 collections (480 specimens) was made in 20 of the 26 localities surveyed. It was collected off human bait, from a horse and a monkey, light traps, chicken-baited traps, oil traps and by aspiration with a suction sweeper near the forest floor.

Lutzomyia lichyi

This is also an anthropophilic species. Five collections were made from Cumaca, Simla (Arima Valley) and Perseverance Cave, Maraval.

Lutzomyia micropyga

Eleven collections were made, all from Bush Bush Forest and all by Aitken between 1962 and 1964.

Lutzomyia migonei

Aitken (1968) made the three collections, all from Bush Bush Forest in 1961. They were all taken from chicken-baited traps.

Lutzomyia ovallesi

Twenty-three collections were made of this anthropophilic species. Of the 40 specimens collected, 10 were taken from caves; 8 from a sea cave in Blanchisseuse by John Davies and two from Perseverance Cave in Maraval.

Lutzomyia pilosa

All nine collections were made by Aitken in Bush Bush Forest in 1961-1962.

Lutzomyia rangeliana

Thirty collections were made by Aitken at Vega de Oropouche and Bush Bush Forest using chicken-baited traps. The one collection made by Tikasingh was with a light trap at Turure Forest.

Lutzomyia shannoni

Four collections were made by Aitken at Bush Bush Forest, 1961-1965.

Lutzomyia sordellii

All specimens of this species were taken from Bush Bush Forest by Tikasingh (four collections) and Aitken (one collection).

Lutzomyia trinidadensis

A total of 352 specimens was collected which was the second largest number of specimens collected. The majority of collections (88 of 109) however, were made at Vega de Oropouche and in Bush Bush Forest. Tesh (1971 *et al.*) noted females feed on cold-blooded vertebrates and Aitken took four females feeding on the gecko *Thecadactylus brevicauda* (Houttuyn) while Tikasingh collected two females feeding on the same species of gecko at Tucker Valley, Chaguaramas. One specimen was collected from a tree buttress at Chatham in 1972, which represents the only sand fly collected from south-western Trinidad.

Lutzomyia walkeri

Aitken collected 197 of the 198 specimens: 196 came from Bush Bush Forest by using chicken-baited traps in 1961 and one came from Vega de Oropouche (La Fortune Estate) in 1959 also from a chicken-baited trap. A single specimen was taken from Chaguaramas in a light trap by Tikasingh.

Records on man-biting activity in Trinidad are associated with eight species: *L. antunezi, ayrozai, flaviscutellata, gomezi, ovallesi, ayrozai, trinidadensis* and *lichyi.* The most widely distributed of the sand flies in Trinidad is *L. gomezi* while five species, *L. micropyga, L. migonei, L. pilosa, L. shannoni* and *L. sordellii* were found at only one locality, Bush Bush Forest, an island in the Nariva Swamp. Ten other species were found in the Bush Bush Forest. Thus, 15 of the 20 *Lutzomyia* species collected came from Bush Bush Forest. Further surveys in the south and southwestern Trinidad might reveal the presence of other species not hitherto collected.

ACKNOWLEDGEMENTS

I thank the dedicated field and laboratory technicians of the TRVL and CAREC particularly Raymond Martinez, Ambrose Guerra, Joseph Ou Hingwan and Raymond Manuel, all of whom worked under the supervision of the late Dr. Thomas H.G. Aitken and the author.

The studies and observations on which this paper is based were conducted with the support and under the auspices of the Governments of Trinidad and Tobago, Jamaica, British Guiana (now Guyana) and the Eastern Caribbean Territories, the Ministry of Overseas Development of the United Kingdom, the Rockefeller Foundation and the Pan American Health Organisation/ World Health Organisation.

REFERENCES

Adamson, A. M. 1939. Observations on biting sand flies (Ceratopogonidae) in Trinidad, B. W. I. *Tropical Agriculture,*16: 79-81.

Aitken, T. H. G. 1960. A survey of Trinidadian arthropods for natural virus infections (August 1953 to December 1958). *Mosquito News,* 20: 1-10.

Aitken, T. H. G., Worth, C. B., Jonkers, A. H., Tikasingh, E. S. and **Downs, W. G.** 1968. Arbovirus studies in Bush Bush Forest, Trinidad, W. I., September 1959 - December 1964. II. Field program and techniques. *American Journal of Tropical Medicine and Hygiene,* 17: 237-252.

Aitken, T. H. G., Spence, L., Jonkers, A. H. and **Downs, W. G.** 1969. A ten-year survey of Trinidadian arthropods for natural virus infections (1953-1963). *Journal of Medical Entomology,* 6: 207-215.

Aitken, T. H. G., Worth, C. B. and **Tikasingh, E. S.** 1968. Arbovirus studies in Bush Bush Forest, Trinidad, W. I., September 1959 - December 1964. III. Entomological studies. *American Journal of Tropical Medicine and Hygiene,* 17: 253-268.

Aitken, T. H. G., Wirth, W. W., Williams, R. W., Davies, J. B. and **Tikasingh, E. S.** 1975. A review of the bloodsucking midges of Trinidad and Tobago, West Indies (Diptera: Ceratopogonidae). *Journal of Entomology (B),* 44: 101-144.

Bequaert, J. 1938. The distribution of *Phlebotomus* in Central and South America. *Carnegie Institute of Washington.* Pub. No. 499: 229-235.

Callan, E. Mc. 1947. A note on *Phlebotomus trinidadensis* Newstead (Dipt.: Psychodidae). *Revista Entomologia* (Rio de Janeiro), 18: 215-218.

Davies, J. B. 1971. A small mosquito trap using animal and carbon dioxide baits. *Mosquito News,* 31: 441-443.

Disney, R. H. L. 1966. A trap for phlebotomine sand flies attracted to rats. *Bulletin of Entomological Research,* 56: 445-451.

Fairchild, G. B. and **Hertig, M.** 1948a. Notes on the *Phlebotomus* of Panama (Diptera: Psychodidae). III. *P. cruciatus* Coq., *trinidadensis* Newst. and *gomezi* Nitz. *Annals of the Entomological Society of America,* 41: 247-257.

Fairchild, G. B. and **Hertig, M.** 1948b. Notes on the *Phlebotomus* of Panama (Diptera: Psychodidae) IV. *P. atroclavatus* Knab, *P. cayennensis* Floch and Abonnenc, *P. chiapensis* Dampf and some related forms from the West Indies and Mexico. *Annals of the Entomological Society of America,* 41: 455-467.

Fairchild, G. B. and **Trapido, H.** 1950. The West Indian species of *Phlebotomus* (Diptera: Psychodidae). *Annals of the Entomological Society of America,* 43: 405-417.

Knab, F. 1913. A new American *Phlebotomus*. *Insecutor Inscitiae Menstruus,* 1:135-137.

Myers, J. G. 1935. The sandfly pest *(Culicoides)*. *Tropical Agriculture*, 12: 71-73.

Newstead, R. 1922. A new species of *Phlebotomus* from Trinidad. *Annals of Tropical Medicine and Parasitology,* 16: 47-50.

Sudia, W. D. and **Chamberlain, R. W.** 1962. Battery operated light trap, an improved model. *Mosquito News,* 22: 126-129.

Tesh, R. B., Chaniotis, B. N., Aronson, M. D. and **Johnson, K. M.** 1971. Natural host preferences of Panamanian sand flies as determined by precipitin tests. *American Journal of Tropical Medicine and Hygiene,* 20: 150-156.

Tikasingh, E. S. 1969. Leishmaniasis in Trinidad. A preliminary report. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* 63: 411.

Tikasingh, E. S. 1970. Enzootic rodent leishmaniasis in Trinidad, West Indies. *Bulletin of the Pan American Health Organisation,* 8: 232-242.

Tikasingh, E. S. 1975. Observations on *Lutzomyia flaviscutellata* (Mang.) (Diptera: Psychodidae), a vector of enzootic leishmaniasis in Trinidad, W. I. *Journal of Medical Entomology,* 12: 228-232.

Tikasingh, E. S. 2000. The Hunt for Caribbean Viruses: A History of the Trinidad Regional Virus Laboratory. Port of Spain, Trinidad and Tobago: Caribbean Epidemiology Centre, 156 p.

TRVL (Trinidad Regional Virus Laboratory). 1968, 1970, 1971. Annual Reports.

Young, D. G. and **Arias, J. R.** 1991. Phlebotomine sand flies in the Americas. *PAHO Technical Paper,* 33: 1-26.

Young, D. G. and **Duncan, M. A.** 1994. Guide to the identification and geographic distribution of *Lutzomyia* sand flies in Mexico, the West Indies, Central and South America (Diptera: Psychodidae). *Memoirs of the American Entomological Institute,* 54: 1-881.

The Skipper Butterflies (Hesperiidae) of Trinidad
Part 18, Hesperiinae, Moncini: Eight Genera of Relatively Distinctive Species: *Callimormus*, *Eutocus*, *Artines*, *Flaccilla*, *Phanes*, *Monca*, *Vehilius* and *Parphorus*

Matthew J. W. Cock
c/o CABI Europe - Switzerland, Rue des Grillons 1, CH-2800 Delémont, Switzerland.
m.cock@cabi.org

ABSTRACT
Trinidad and Tobago skipper butterflies (Hesperiidae) of the tribe Moncini (genera *Callimormus*, *Eutocus*, *Artines*, *Flaccilla*, *Phanes*, *Monca*, *Vehilius* and *Parphorus*) are treated and the adults illustrated. Details are given of the taxonomy, history, identification and biology of the 19 Trinidad species in these genera. Of these, three species occur in Tobago, and *C. juventus* Scudder is reported from Tobago but not Trinidad. *Vehilius celeus celeus* (Mabille) is a new record for Trinidad. The single record of *P. decora* (Herrich-Schäffer) from Tobago is shown to be based on a misidentified specimen of *C. juventus*. Partial life histories of *F. aecas* (Stoll), *V. s. stictomenes* (Butler), *P. s. storax* (Mabille) and *P. decora* are described and illustrated for *F. aecas* and *P. storax*. *Monca crispinus* (Plötz) **stat. rev.** is recognised as a valid species, not a subspecies of *M. telata* (Herrich-Schäffer).

Key words: Trinidad, Tobago, Hesperiidae, *Callimormus*, *Eutocus*, *Artines*, *Flaccilla*, *Phanes*, *Monca*, *Vehilius*, *Parphorus*, life history, food plant.

INTRODUCTION

This paper is the third in my series on Trinidad Hesperiidae to deal with members of the tribe Moncini, subfamily Hesperiinae. Cock (2010) gave a general introduction to this tribe, and Cock (2009) dealt with the genera *Vettius*, *Turesis*, *Thoon*, *Justinia*, *Eutychide*, *Onophas*, *Naevolus*. As explained in Cock (2010), this part covers the distinctive, relatively easily identified species of Moncini not already covered. Part 19 will cover the brown species with pale spots and part 20 the plain brown species.

In this part I have included reference to the original description of all the Trinidad species treated. Up until now this has not been practical because I had not been able to check the original literature, and it was not useful to quote since almost none was available in Trinidad and Tobago. Today, virtually all these are available through the internet, thanks to the efforts of groups such as the Biodiversity Heritage Library, Goettingen University and the Smithsonian Institution.

With *Living World* moving to full colour production, it no longer seems necessary to include a colour description of the adult butterflies, as has been my practice hitherto. Equally, it is not necessary to include references to published illustrations, unless they add to those which I provide. However, I do include references to published illustrations of the male and female genitalia when they are available.

In this paper, all specimens illustrated are in the author's collection unless indicated otherwise. Similarly, any specimens referred to without attributing a collector or collection, were collected by the author and are in either the author's collection or the collection of CABI, Curepe, Trinidad. Other conventions and abbreviations follow earlier parts of this series (Cock 2010 and earlier papers). Plant names have been checked against Tropicos (2010). The museum abbreviations are given in the acknowledgements at the end of the paper.

Species with veins of UNH and apex UNF pale or yellow

In this paper, nine of the eleven Trinidad species characterised by pale or yellow veins on the UNH and apical area of the UNF are treated: *Callimormus alsimo* (Möschler), *C. juventus* Scudder, *Eutocus vetulus vetulus* (Mabille), *Vehilius stictomenes stictomenes* (Butler), *V. celeus celeus* (Mabille), *V. vetula* (Mabille), *V. seriatus seriatus* (Mabille), *Parphorus storax storax* (Mabille) and *P. decora* (Herrich-Schäffer). Two similar species, *Saturnus saturnus saturnus* (Fabricius) and female *S. reticulata reticulata* (Plötz), were treated in Cock (2006). Several other species which have the UNH veins only slightly paler than the ground colour will be treated in the next part in this series.

Of these 11 species, *C. alsimo*, *P. storax*, *P. decora* and *S. saturnus* have no spots in the spaces between the veins, UNH. *Callimormus alsimo* (Figs. 1-2) has only a trace of discal spots F and is darker than the other species. *Parphorus storax* is smaller, and although the female has no spots F (Fig. 45), the male does, at least UPF (Fig. 44); the yellow veins are more heavily marked than in *C. alsimo* and more extensive UNF. *Parphorus decora* and *S. saturnus* both have yellow spots F, but *S. saturnus* has a spot in space 1B UNF (Cock 2006, Figs. 1-2), which *P. decora* does not have (Figs. 50-51); the yellow veins on the UNS of *P. decora* are also more heavily marked.

The remaining species, *C. juventus*, *E. vetulus*, *V. stictomenes*, *V. celeus*, *V. seriatus*, *V. vetula*, and female *S. reticulata*, have spots in the spaces between the veins UNH. In *E. vetulus* these spots are pale blueish, not white or yellow. In *C. juventus*, *V. vetula* and *V. seriatus* the UNS has a strong purple sheen. In *C. juventus* (Figs. 3-4) and *V. vetula* (Fig. 31) the spots are small; the former has yellow spots F, but the latter doesn't. *Vehilius seriatus* is distinctive because the pale yellow spots (some in spaces, some on veins) are connected to the margin by a pale yellow line (Figs. 32-33).

The remaining three species do not have a purple sheen UNS. *Saturnus reticulata* is larger (Cock 2006, Fig. 8), the spots UNH are short streaks and the veins are weakly yellow. *Vehilius celeus* and *V. stictomenes* both have long streaks in the spaces UNH, those of *V. celeus* yellower and those of *V. stictomenes* whiter; UPH, the spots are stronger in *V. celeus* (Fig. 30), which also has spots in spaces 4 and 5 F which are not present in *V. stictomenes* (Figs. 24-25).

Callimormus Scudder 1872

A genus of about nine species, which Evans (1955) characterises by the antennae just over half as long as the costa, shaft usually chequered yellow, yellow under base of club, club slender, obtuse at thickest point to long apiculus, tip pointed; nudum of ten segments entirely on apiculus; palpi cylindrical: third segment long, slender, acicular (Figs. 1, 7); mid tibiae generally with a few long spines; small species: F 10-12 mm; wings rounded: H vein lA = vein 8; male UPF with brands: typically against cell between veins 2 and 3, and under vein 2; typically with yellow discal spots UPF and UNH with yellow veins; the genitalia indicate a compact genus.

Vehilius spp. (below) are similar in appearance, but *Callimormus* spp. are quite easy to distinguish by the relatively long, slender third segment of the palpi.

J2/2 *Callimormus alsimo* (Möschler 1883)

Figs. 1-2.

Möschler (1883) described and illustrated this species from Surinam. Godman (1901 in Godman 1899-1901, plate 103, Figs. 32-33) illustrates the UNS and male genitalia as *C. filata* (Plötz), which is a synonym (Evans 1955; Mielke 2004); Burns (1990) reproduces the figure of the male genitalia. Evans (1955) lists specimens from Panama to south Brazil, but the only place from which there is a long series in the NHM is Trinidad (22♂, 6♀). Kaye (1914, 1921, no. 439) records this species from Trinidad as *C. filata* based on a specimen from St. Ann's Valley collected by G.E. Tryhane.

Identification is discussed above with other species with UNH and apex UNF veins pale or yellow.

Fig. 1. Adult ♂ *Callimormus alsimo,* Morne Catherine, 24.iii.1982. Scale bar = 1cm.

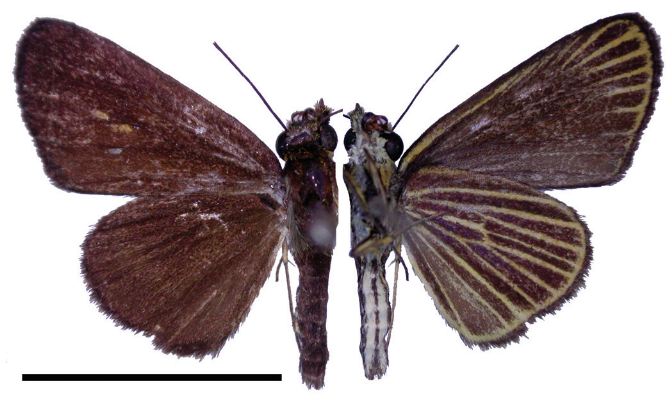


Fig. 2. Adult ♀ *Callimormus alsimo,* Morne Catherine, 31.iii.1982. Scale bar = 1cm.

I have records of 38 specimens from Trinidad which show that this species is found primarily in the Northern Range, from Morne Catherine to Guanapo Valley, at altitudes from near sea level to about 1,600 ft. (490 m) in San Miguel Valley behind Mt. St. Benedict (♂ 29.vii.1978). Just one record from the south of the island (Parrylands, ♀ 13.ii.1980) shows that although it may be found, it is not common. Most records are from the dry season, January to March.

The life history and food plants have not been reported (Mielke 2005; Beccaloni *et al*. 2008).

J2/6 *Callimormus juventus* Scudder 1872

Figs. 3-4.

Scudder (1872) described *C. juventus* from Panama, and placed it in his new genus *Callimormus*; his female type can be seen at Harvard College (2010). Godman (1901 in Godman 1899-1901, plate 103, Figs. 28-31) illustrates the UPS, UNS, venation and male genitalia;

Burns (1990) reproduces the figure of the male genitalia. Hayward (1950, plate xiii.11) also illustrates the male genitalia. It is found from Mexico to Argentina, including Venezuela and Surinam (Evans 1955), but although it has been recorded from Tobago, it is not known from Trinidad (as yet). It would seem worthwhile to keep an eye out for this species in the north-west of Trinidad and on the Bocas Islands.

Fig. 3. Adult ♂ *Callimormus juventus*, Speyside, Tobago, ii.1922, A. Hall; specimen in BM.

Fig. 4. Adult ♂ *Callimormus juventus*, Tobago, W.G. Sheldon bequest; specimen in NHM. Scale bar = 1cm.

Sheldon (1936) records this species from Tobago as "*C. juventa* Latr." based on an A. Hall specimen from Speyside. This could be either the specimen in the BM, shown as Fig. 3, or that in the NHM, both collected by A. Hall, Speyside, ii.1932. W.G. Sheldon subsequently captured specimens himself (♂ and ♀ now in the NHM), but did not publish this. One of Sheldon's specimens was misidentified by Evans (1955) as *Parphorus decora* (see under that species below).

Janzen and Hallwachs (2010) have reared this species from grasses four times, but the only grass species identified is *Acroceras zizanioides*. They also illustrate the final instar caterpillar.

J2/7 *Callimormus corades* (C. Felder [1863])
Figs. 5-7.

This species is reported from Colombia, Brazil (type locality "Rio", i.e. Rio de Janeiro) and Argentina (Evans 1955), as well as Surinam (Williams and Bell 1931; Dinther 1960; De Jong 1983). The illustrations of the adult and male genitalia by Godman (1901 in Godman 1899-1901, plate 103, Fig. 37) are of *C. saturnus* (Herrich-Schäffer) (Evans 1955; Mielke 2005). Bell (1941a) illustrates the male genitalia of *C. igarapus* Bell, which is a synonym of *C. corades* (Mielke 2004), and Hayward (1950, plate xiii.9) also illustrates the male genitalia.

Hence, although Crowfoot (1893) and Kaye (1914, 1921, no. 440) recorded this species from Trinidad, I assume that these records follow Godman (1901 in Godman 1899-1901) and actually refer to the common *C. saturnus* (below). Similarly, Longstaff's (1908, 1912) and Sheldon's (1936) records of *C. corades* from Tobago are considered to refer to *C. saturnus*.

Fig. 5. Adult ♂ *Callimormus corades*, Debe, 28.viii.1982. Scale bar = 1cm.

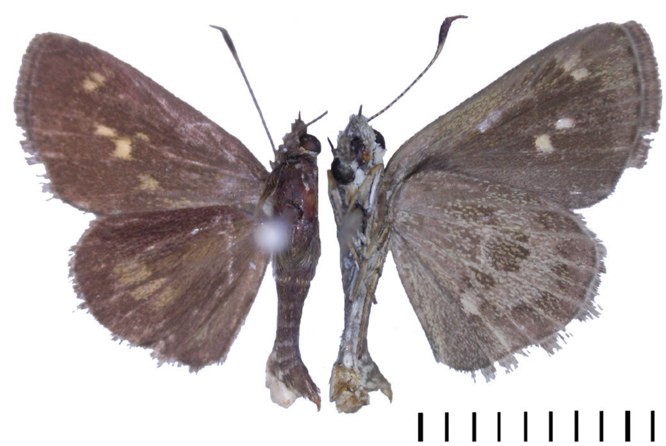


Fig. 6. Adult ♀ *Callimormus corades*, Arena Forest Reserve, forest track, 23.iii.1982. Scale in mm.

Fig. 7. *Callimormus corades*, South Oropouche, Mon Desir, 16.xii.2009 (photo, Tarran P. Maharaj).

In spite of the early misidentifications of *C. corades* from Trinidad, it is a true Trinidad species which I now correctly record from the island for the first time: Arena Forest Reserve (♂,♀ 23.iii.1980, MJWC), Debe (♂ 28.viii.1982, MJWC), South Oropouche, Mon Desir, 16.xii.2009 (photo, T.P. Maharaj, Fig. 7). S. Alston-Smith (pers. comm. 2011) has a further four specimens, all from the south of the island.

This small species can be recognised by its grey tone UNS, the faint, pale discal band UNH, pale veins near the margin UNH, and the diffuse yellow spots UPH. It might be confused with *C. saturnus* which is browner, and does not have pale veins UNH. *Vehilius inca* (Scudder) is superficially similar, but the UPF spots are white, not yellow, and there is no UNH discal band.

This is an uncommon species in Trinidad, although easily overlooked. It is difficult to generalise about habitats, but it seems to be associated with roadsides in secondary forest areas.

Dinther (1960) lists several Hesperiidae, including *C. corades*, that feed on rice in Surinam, but do not cause economic damage. This record is repeated by Remillet (1998), which is the source of its inclusion in Beccaloni *et al*. (2008).

J2/8 *Callimormus saturnus* (Herrich-Schäffer 1869 in Herrich-Schäffer 1867-1871)

Figs. 8-10.

This common and widespread species is reported from Mexico to Paraguay, and was described from Venezuela (Evans 1955; Scott 1986). The illustrations of the adult and male genitalia by Godman (1901 in Godman 1899-1901, plate 103, Fig. 37) as *C. corades* are actually of *C. saturnus* (Evans 1955; Mielke 2005).

As indicated under the last species, Trinidad records of *C. saturnus* incorrectly use the name *C. corades*. Crowfoot (1893) first recorded this species from Trinidad (as *Pamphila corades*), and Kaye (1914, 1921, no. 440) included it based on a G.E. Tryhane specimen from St. Ann's Valley. There are no specimens of *C. corades* from Trinidad in the NHM, but many specimens of *C. saturnus*, including 8♂ and 5♀ from St. Anns' [sic] Valley.

There are no specimens of *C. corades* or *C. saturnus* from Tobago in the NHM, but there is a female *C. saturnus* from Speyside (ii.1932, A. Hall) in BM (misidentified as *Cymaenes tripunctus* (Herrich-Schäffer)), which is in line with Sheldon's (1936) comment regarding *C. corades*: "Speyside, not uncommon around hotel (A.H. and W.G.S.)".

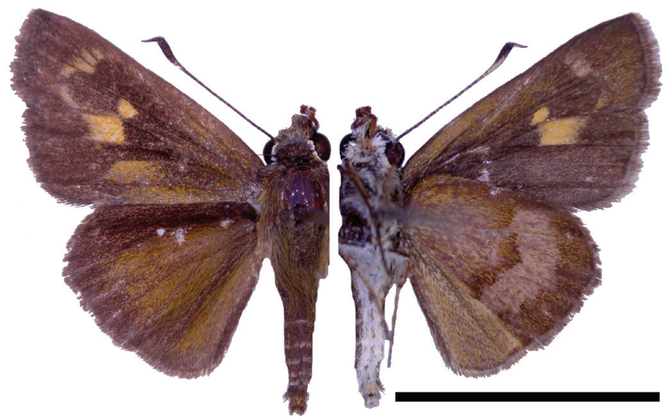


Fig. 8. Adult ♂ *Callimormus saturnus*, Maracas Valley, Ortinola Estate, 18.i.1982. Scale bar = 1cm.

Fig. 9. Adult ♀ *Callimormus saturnus*, Mt. St. Benedict, 15.i.1988. Scale bar = 1cm.

This common small species can be recognised by the yellow spots UPF, and especially the distinct pale brown discal band UNH. The large quadrate yellow spot in space 2 UPF, especially in males, can also be helpful.

This is a common species in Trinidad – I have 74 records from throughout the island from sea level to 2,300

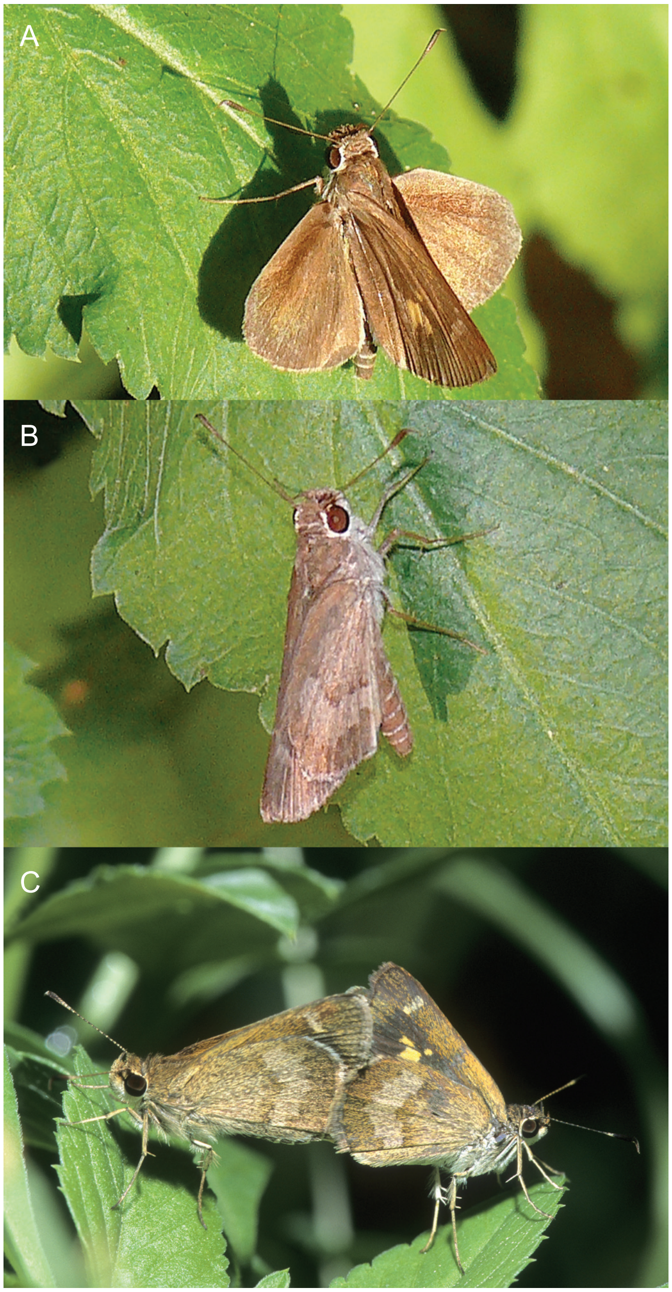


Fig. 10. Adults of *Callimormus saturnus*. **A**, basking, South Oropouche, Mon Desir, 7.ii.2010 (photo, Tarran P. Maharaj); **B**, same individual as A, under side (photo, Tarran P. Maharaj); **C**, mating pair, in secondary rainforest on top of Mt. St. Benedict during the 2nd week of July 2002 (photo, Bryan Reynolds, www.botwf.org).

ft. (700 m, Morne Bleu Textel, ♂ 16.i.1988), primarily in disturbed situations such as roadsides. It is also present on Chacachacare Island (Rusts Bay, ♂ 15.i.1980) (Cock 1981) and widespread in Tobago (Crown Point, Bloody Bay, Speyside, Charlotteville-Speyside Ridge).

Janzen and Hallwachs (2010) have reared this species ten times from five different grasses, of which *Panicum trichoides* and *Paspalum notatum* are the only ones recorded more than once. They do not illustrate the early stages.

***Eutocus* Godman 1900 in Godman 1899-1901**

This genus of seven species is similar to *Callimormus* (Evans 1955) with an angled brand over the origin of vein 2, but no brand below that vein; mid tibiae smooth; mostly small, male F 10-12 mm; inconspicuous or no markings UPF. The male genitalia are not of the *Callimormus* type and vary a good deal with the species, so probably more than one genus is involved.

J3/1 *Eutocus facilis* (Plötz)

I defer treatment of this small plain brown species until a later part of this series, so that the plain brown species can be treated together.

J3/4 *Eutocus vetulus vetulus* (Mabille 1883)
Figs. 11-12.

Evans (1955), and hence Cock (1982), treated this taxon as *vinda* Evans 1955, a subspecies of *E. matildae* (Hayward). However, Evans (1955) had misidentified *vetulus* Mabille as a species of *Vehilius* (see *V. seriatus* below), and Mielke and Casagrande (2002) established that *vetulus* Mabille 1883 (as opposed to *vetulus* Mabille 1878) is actually a senior synonym of *vinda* Evans. Hence, *Eutocus vetulus vetulus* is the nominate subspecies described from Brazil and found from Panama to east Bolivia, including Trinidad (Evans 1955) and Suriname (De Jong 1983), and *matildae* is now a subspecies of *E. vetulus*.

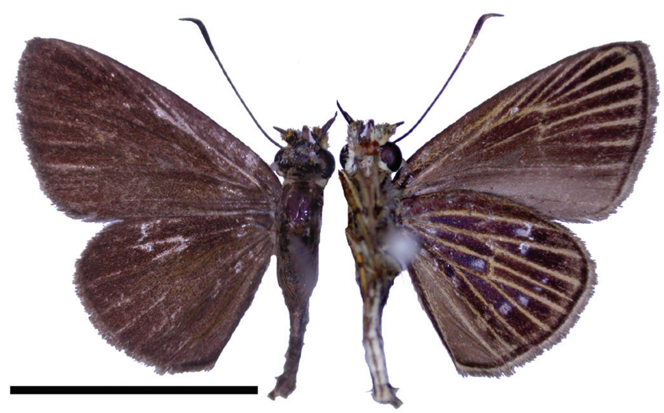


Fig. 11. Adult ♂ *Eutocus vetulus vetulus*, Arena Forest Reserve, 23.iii.1980. Scale bar = 1cm.

The genitalia do not seem to have been illustrated for this subspecies (Mielke 2005). Evans (1955) includes a diagram of the male genitalia of ssp. *matildae*, and Hayward (1950, plate xi.7) also shows this species, although

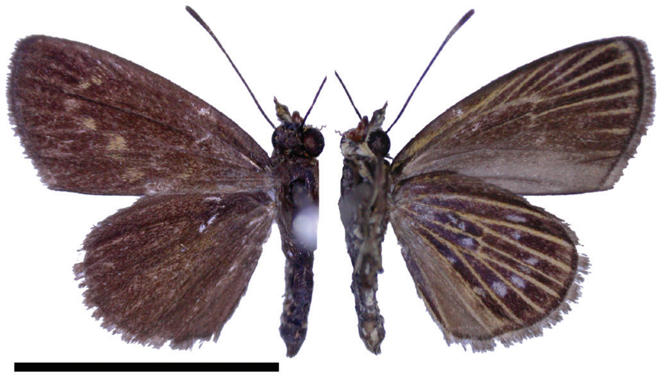


Fig. 12. Adult ♀ *Eutocus vetulus vetulus*, Upper Guanapo Valley, 23.i.1988. Scale bar = 1cm.

the two illustrations do not obviously belong to the same species.

This species is easily separated from other species with UNH and apex UNF veins pale or yellow, by the blue tone to the spots in UNH spaces.

Although Evans lists just one female from Trinidad in the NHM, there are two, one collected by W.J. Kaye from "Trinidad" (1906-10), and the other by F. Birch from Caparo, probably in the first decade of the twentieth century. I have three more records: Arena Forest Reserve (♂ 23.iii.1980), Brasso (♀ 11.x.1993) and Upper Guanapo Valley (♀ 23.i.1988), and S. Alston-Smith (pers. comm. 2011) has two more from Chatham (in forest, ♂ viii.2006), and Moruga East (in bamboo near the bridge on the old road for Moruga Bouffe, ♂ xii.2006). Thus, this species is widespread at low altitudes, normally in forest situations.

There seem to be no records of the life history or food plants (Mielke 2005; Beccaloni *et al*. 2008).

Artines Godman 1901 in Godman 1899-1901

Godman established this genus with *aepitus* (Geyer) as the type species, but the species which he treated as *aepitus* was actually *A. aquilina* (Plötz), so that is the type species for the genus, not *aepitus*. There are at least seven species in this genus, but only one from Trinidad, which is easily recognised.

J12/1 *Artines aepitus* (Geyer [1832] in Hübner [1832]-[1833])

Fig. 13.

This species was incorrectly said to be from Java when it was described (Geyer [1832]), but it actually occurs from Panama to Brazil (Evans 1955). Godman (1901 in Godman 1899-1901) did not know *aepitus*, and described this species anew as *A. atizies* Godman, from Panama, Venezuela, Trinidad, Guyana (holotype) and Brazil. Godman (1901 in Godman 1899-1901, plate 103, Figs. 49-50) illustrates the UNS and male genitalia as *A. atizies*.

Hence, it was under the name *A. atizies* that Kaye (1904) included this species in his first catalogue based on "Two specimens in St. Ann's Valley in July 1898 (W. J. Kaye)" and adds that it "is very conspicuous on the wing and flies in damp, dark places". Later, he states that it is "fairly frequent, and not at all rare" (Kaye 1921, no. 441). The latter comment is reflected in the NHM collection which contains 39 males and 19 females of this species from Trinidad, but no more than ten each from any other location (Evans 1955).

The sexes are similar and the male has no brand UPF. The UNH markings should not be confused with any other Trinidad species, although the two *Phanes* spp. (below) have similar colouring UNH.

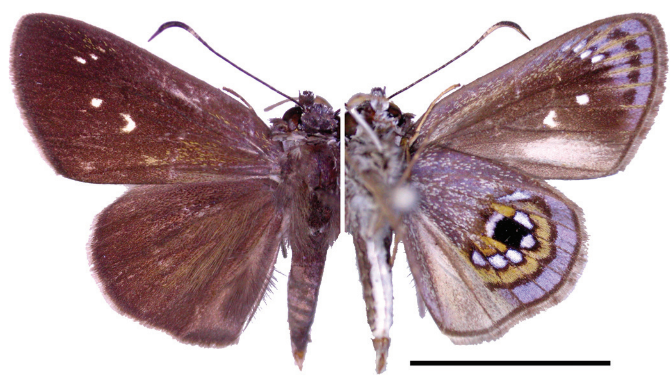


Fig. 13. Adult ♂ *Artines aepitus*, Mt. Tabor, 1,200 ft. (365 m), 27.xii.1979. Scale bar = 1cm.

Of the 67 records from Trinidad that I have of this species, 13 have no locality beyond Trinidad, and the great majority of the remainder are from the foothills of the Northern Range, from Morne Catherine to Arima Valley. The highest elevation of which I have a record is 1500 ft. (Morne Catherine, ♂ 28.i.1980). The only records from outside the Northern Range are from Spanish Farm, Las Lomas (♀ 31.viii.1980; ♀ 17.xii.1980) and Caparo (♂, 4♀ in NHM). At this time I have no records from the Central Range or the south of the island. The collection localities all seem to be forested areas, with no records from open or suburban areas.

Neither Mielke (2005) nor Beccaloni *et al*. (2008) list any records of the life history or food plants.

Flaccilla Godman 1901 in Godman 1899-1901

Godman (1901 in Godman 1899-1901) established the monotypic genus *Flaccilla* for the distinctive species *aecas* (Stoll). Hemming (1939) considered *Flaccilla* a homonym and introduced *Aecas* Hemming to replace it, and this is the genus used by Evans (1955) and Cock (1982). However, Hemming (1967) reinstated *Flaccilla*, sinking *Aecas* as a synonym, so that *Flaccilla* is used again for this species (Mielke 2004).

J13 *Flaccilla aecas* (Stoll 1781 in Cramer 1780-1782)
Figs. 14-18.

This species was described from Surinam (Stoll 1781) and occurs from Guatemala to south Brazil (Evans 1955). Kaye (1914) mis-spelt the genus as *Flacilla* when he added *F. aecas* to the Trinidad list, and as *Flacilia* in his catalogue (Kaye 1921, no. 433).

Godman (1901 in Godman 1899-1901, plate 102, Figs. 39-40) illustrates the male forewing venation and genitalia. The male UPF has long, narrow brands, against the cell between veins 2 and 3, over and under vein 2 and over vein 1. Otherwise the sexes are similar. The purple-blue iridescence UNS should distinguish this species from any others in Trinidad.

I have 34 records of this species from Trinidad. Although most records are from the Northern Range, from Morne Catherine to Morne Bleu, there are also records from central and south Trinidad. The localities are mostly at lower altitudes, but several were taken above 2,000 ft. (610 m), one at 2,500 ft. (760 m), between Morne Bleu and the Textel Installation (♀ 6.ii.1981). Most records are from forested areas, including disturbed forests (e.g., Wallerfield, ♀ 29.ii.1980), but one male was captured in the mercury vapour light trap in my garden in Curepe (11.ii.1980). It flies throughout the year, although more captures have been made between September and March.

Steinhauser (1975) reports rearing this species on "bamboo" in Colombia. I have found final or penultimate instar caterpillars of *F. aecas* on *Bambusa vulgaris* on at least three occasions (93/5, Mt. St. Benedict, 11.x.1993; 94/46, Rio Claro-Guayaguayare, between milestones 4½ and 5½, 1.x.1994; 95/46, Point Gourde, 8.x.1995), but the last was parasitized, and neither of the first two emerged

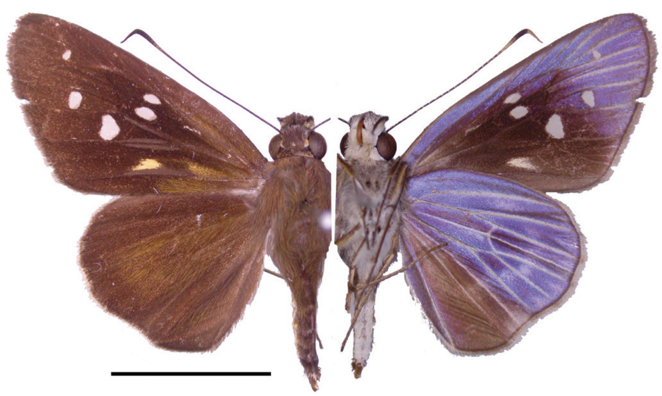


Fig. 14. Adult ♂ *Flaccilla aecas*, Curepe, MVL trap, 11.ii.1980. Scale bar = 1cm.

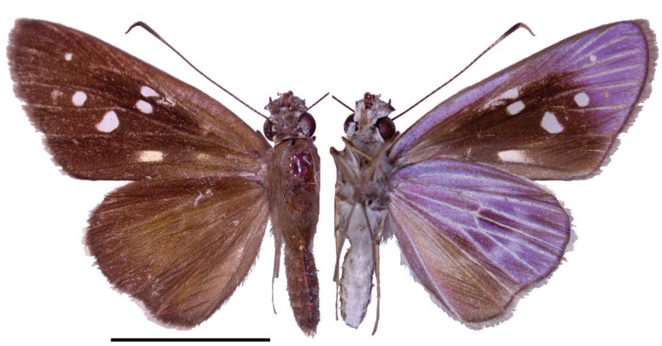


Fig. 15. Adult ♀ *Flaccilla aecas*, St. Ann's Ridge, 30.i.1979. Scale bar = 1cm.

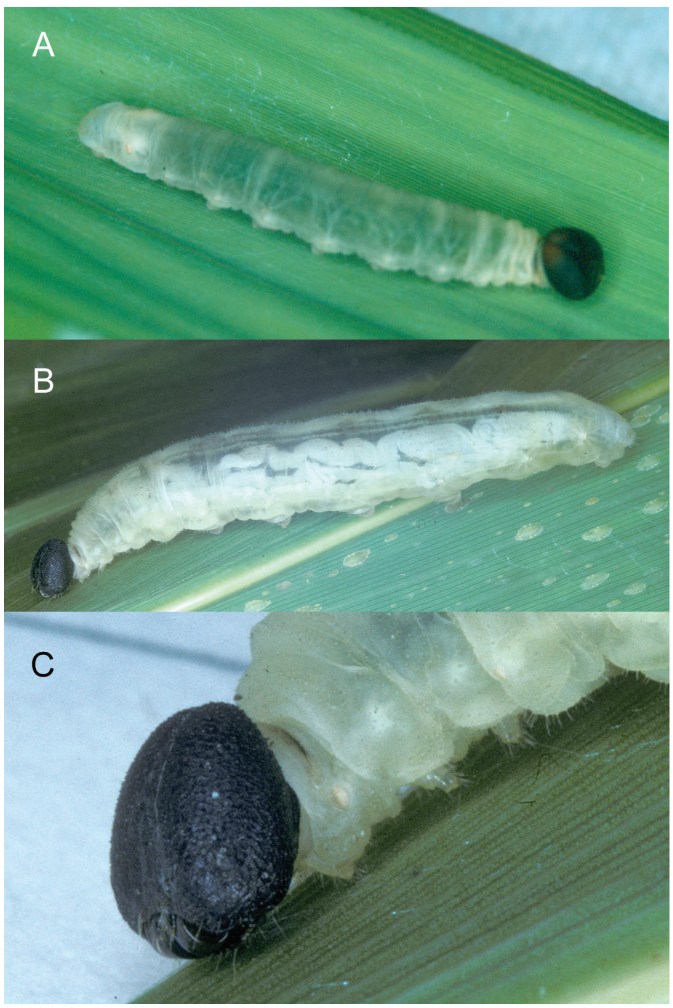


Fig. 16. Instar 5 caterpillars of *Flaccilla aecas* collected on *Bambusa vulgaris*. **A**, collected 1.x.1994 as instar 5, Rio Claro-Guayaguayare, between milestones 4½ and 5½, photo 4.x.94, pupated 1.x.1994, Ref. 94/46; **B**, collected 8.x.1995 as instar 5, Point Gourde, photo 8.x.1995, pupated 14.x.1995, 29 mm, Ref. 95/46; **C**, close up of anterior portion, anterolateral view, details as B.

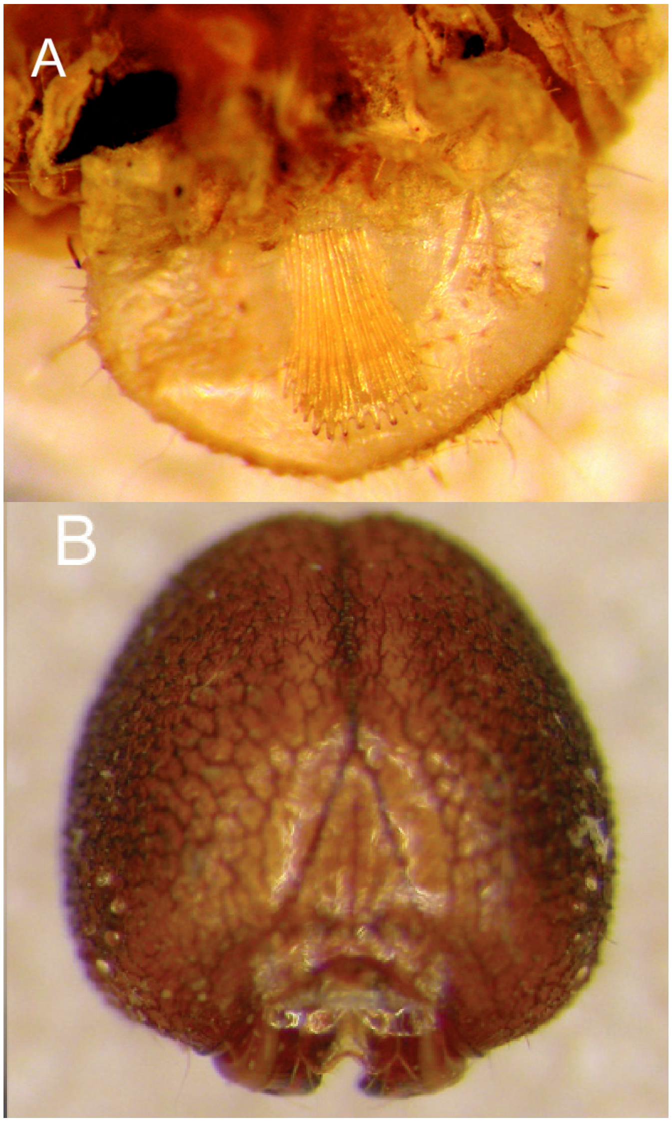


Fig. 17. Details of caterpillars of *Flaccilla aecas* collected 11.x.1993 on *Bambusa vulgaris*, Mt. St. Benedict, Ref. 93/5. **A**, anal comb and anal plate of cast instar 5 skin, ventral view; **B**, head capsule of instar 4, frontal view.

properly. I have also observed a female flying around *B. vulgaris* showing what appeared to be oviposition behaviour (Arima-Blanchisseuse Road, milestone 9¾, 1600 h, 17.i.2004). Since *B. vulgaris* is exotic, presumably *F. aecas* also feeds on one or more indigenous bamboos.

The later leaf shelters are made by folding over the distal part of a leaf along the midrib, and feeding basally to this from both leaf margins to the midrib, leaving the midrib bare for up to 7 cm. The bared midrib bends, so that the distal portion with the shelter is pendulous. The caterpillar may also feed on the leaf distal to the shelter, and for the pupal chamber, the edges of the leaf forming the shelter are eaten to make a narrower, tighter shelter. Shelter 94/46 contained a near mature caterpillar and was made on a 34 cm leaf; the basal leaf for 11.5 cm on one side and 14.5 cm on the other was intact, the midrib was then bare by feeding for 7 cm, and the shelter beyond this was 12.5 cm long.

An instar 4 caterpillar had the head rounded triangular (i.e. wider nearer the base than the apex – cf. Fig. 17B), rugose, dark brown. The final instar caterpillar (95/46) grows to 30 mm or more; head rounded triangular, slightly indent at vertex; rugose; matt black, dark brown below apices each side of epicranial suture and at the base of the clypeus. T1 with a very narrow, dark, dorsal plate, pale at dorsum. Body matt translucent dark dull green; dorsal vessel visible as a double pale line; convoluted white fat bodies obvious, at least in some individuals. Spiracles pale, inconspicuous; legs concolorous.

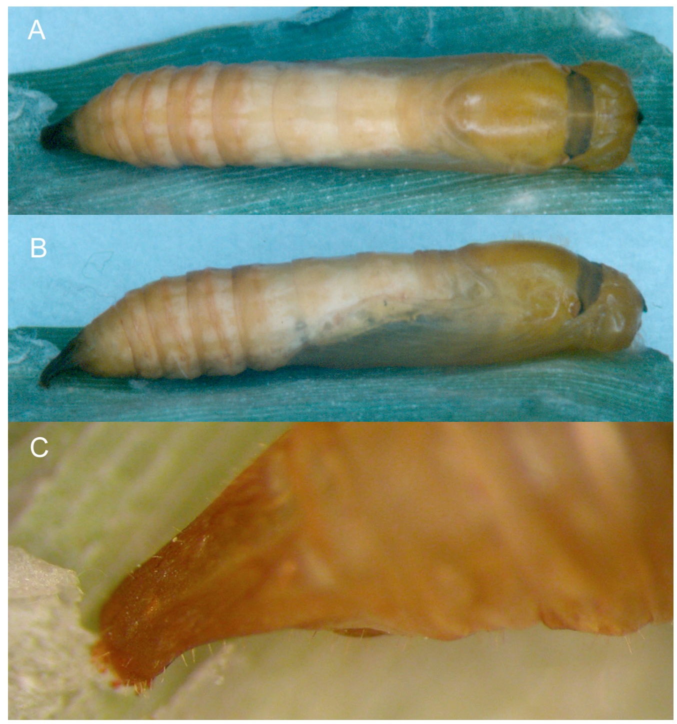


Fig. 18. Pupa of *Flaccilla aecas*, collected 11.x.1993 as caterpillar on *Bambusa vulgaris*, Mt. St. Benedict, 15 mm, Ref. 93/5. **A**, dorsal view; **B**, lateral view; **C**, dorsolateral view of cremaster.

The pupa (Fig. 18) is slender, 15 mm long; the frontal projection is a short, downward-directed, dark protuberance; ventrally, between eyes, two small bumps; proboscis sheath extends 3-4 mm beyond wing cases; pupa light brown, paler on abdomen; spiracle T1 slightly darker; a broad, blackish line across collar between spiracles T1; other spiracles concolorous.

There are three emerged pupae and one parasitized pupa from Moss' collection over this name in the NHM. The three emerged pupae match the pupa described here, but the parasitized one has a strong frontal spike and is clearly a different species. By implication, the ichneumonid adult associated with this material is from the parasitized pupa, and so would be incorrectly associated with *F. aecas*.

I obtained a tachinid from the pupa of one field collected caterpillar (Point Gourde, 8.x.1995, 95/46). A single tachinid larva came out of the pupa three days after formation, formed a puparium, but failed to emerge.

Phanes **Godman 1901 in Godman 1899-1901**

Godman (1901 in Godman 1899-1901) originally proposed the genus *Phanes* as *Phanis*, but when that was shown to be a homonym, he amended it to *Phanes* (Godman 1901 in Godman 1899-1901, supplement, p. 741). Nevertheless, this change has been overlooked by some authors and *Phanis* appears in the literature. *Phanes* was established for *justinianus* Latreille, incorrectly considered to be synonymous with *aletes* (Geyer) at that time. The true *justinianus* is also a Trinidad species, now placed in the genus *Justinia* Evans (Evans 1955; Mielke 2004; Cock 2009).

Males have a small sagittate brand over the origin vein 2 UPF. Evans (1955) treats seven species in this genus of which two occur in Trinidad and are distinctive and easily recognised.

J23/1 *Phanes aletes* (Geyer [1832] in Hübner [1832]-[1833])
Fig. 19.

Phanes aletes is found from Mexico to south Brazil (Evans 1955). Godman (1900 in Godman 1899-1901, plate 99, Figs. 24-27) illustrates the UPS, UNS and male venation and genitalia as *P. justinianus*. According to Evans (1955), Hayward's (1950, plate ix.13) illustration of the male genitalia is actually of *P. almoda* (Hewitson) (see below under *P. almoda*).

Kaye (1904, 1921, no. 405) recorded this species from Trinidad as "*Phanis justinianus*" referring to "a single specimen in July 1898 (W.J. Kaye)", and citing *aletes* as a synonym, leaving no doubt as to the species intended.

Apart from the male brand, the sexes are similar and distinguished from *P. almoda* by the larger yellow patch mid UNH.

Although I have 24 records of this species, I would consider it to be only an occasional species in Trinidad, perhaps collected more frequently because of its distinctively coloured UNS. Most records are from the Northern Range, from St. Ann's (many old records) to Arima Valley, mostly below 1,000 ft. (300 m). Apart from one record from Spanish Farm, Las Lomas (♂ 13.xi.1981), I have no records from central and south Trinidad. It is a forest species that flies throughout the year.

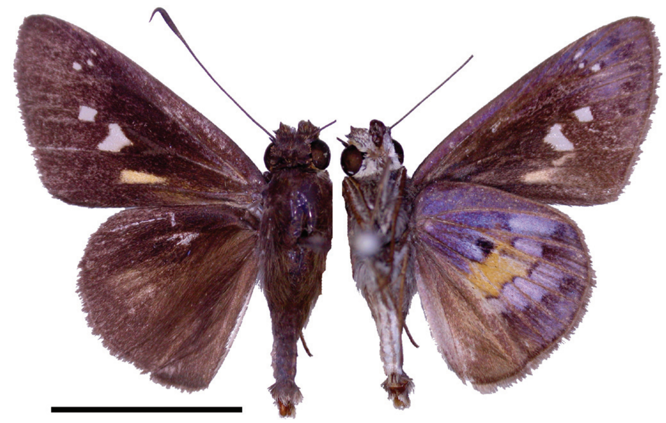


Fig. 19. Adult ♂ *Phanes aletes*, San Miguel Valley, old cacao estate, 17.x.1979. Scale bar = 1cm.

Moss (1949) reared this skipper "from *Carex* and various grasses", but he did not illustrate the early stages and there are none from his collection in the NHM. Janzen and Hallwachs (2010) include six rearing records from four grass species; three of these were from *Lasiacis ruscifolia*. They do not illustrate the early stages.

J23/2 *Phanes almoda* (Hewitson 1866)
Fig. 20.

This species is found from Trinidad and the Guyanas to Peru and south Brazil (Evans 1955). Kaye (1904, 1921, no. 406) writes: "A single specimen taken with the previous species [i.e. *P. aletes*] (W.J. Kaye). These two species may prove to be one variable one. More material is necessary or life histories are wanted to decide." In this, Kaye is incorrect as the two are separate valid species, even though the life histories are not yet known.

As for *P. aletes*, the sexes are similar apart from the male brand. In the Trinidad fauna, the two *Phanes* spp. might only be confused with each other, and the small

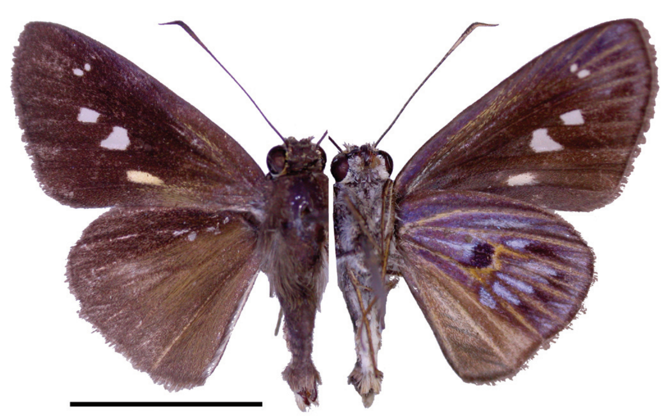


Fig. 20. Adult ♂ *Phanes almoda*, Point Gourde, 16.x.1993. Scale bar = 1cm.

yellow patch mid UNH distinguishes *P. almoda*. Williams and Bell (1931, Fig. 26) illustrate the male genitalia, which are similar to those of *P. aletes* as illustrated by Godman (1900 in Godman 1899-1901) as *justinianus*. Hayward's (1950, plate ix.13) figure of the male genitalia of *P. aletes* is actually *P. almoda* according to Evans (1955), but this only fits if the valve shown by Hayward is the left valve (looking from above with head to the front) exterior view, rather than the right valve interior view. The male genitalia that Hayward (1950) illustrates as *P. almoda* do not seem to be of this species.

All except one of the 22 records of this species that I have are from the forested foothills of the Northern Range, from Point Gourde to Maracas Valley. S. Alston-Smith (pers. comm. 2011) has a specimen from Caltoo Trace, Nariva Swamp. In my experience this is an uncommon species – I personally only caught two males.

The life history and food plants have not been reported (Mielke 2005; Beccaloni *et al*. 2008).

***Monca* Evans 1955**

Evans (1955) established this genus for four small skippers characterised by the presence F of an apical spot in space 9 and a spot mid-costa in space 10 (more obvious UNF), and by a broad central and discal pale area UNH. There are no secondary sexual characters.

J25/1 *Monca telata telata* (Herrich-Schäffer 1869 in Herrich-Schäffer 1867-1871)

Figs. 21-23.

The nominate subspecies is found in northern South America from Colombia to the Guyanas and the Amazon; a second subspecies, *crispinus* Plötz is found in Central America, and a third, *penda* Evans in Bolivia (Evans 1955; Mielke 2004). Subspecies *crispinus* is the senior synonym for the Central American subspecies of *M. telata* hitherto known as *M. telata tyrtaeus* (Plötz) (Mielke and Casagrande 2002; Mielke 2004). Recently, several authors and websites have treated *crispinus* as a valid species, but I have not traced a publication to formally establish this. The two taxa occur sympatrically in the Tikal National Park area of Guatemala (Austin *et al*. 1996) and in Belize (A.D. Warren, pers. comm. 2011), a strong indication that they are separate species that do not interbreed. Bell's (1941b) treatment of the two taxa, showing the radical differences in the male genitalia, particularly the claspers, indicates that the two should be treated as separate species: *M. crispinus* **stat. rev.** and *M. telata*. Evans (1955) compares the male genitalia of ssp. *penda* with those of ssp. *telata* noting that there are differences, although not as striking as those between sspp. *crispinus* and *telata*. Hence, I consider *penda* should continue to be treated as a subspecies of *telata* pending further study. In addition to the male genitalia illustrations in Bell (1941b), Hayward (1950, plate xi.3) illustrates the male genitalia, whereas Godman (1901 in Godman 1899-

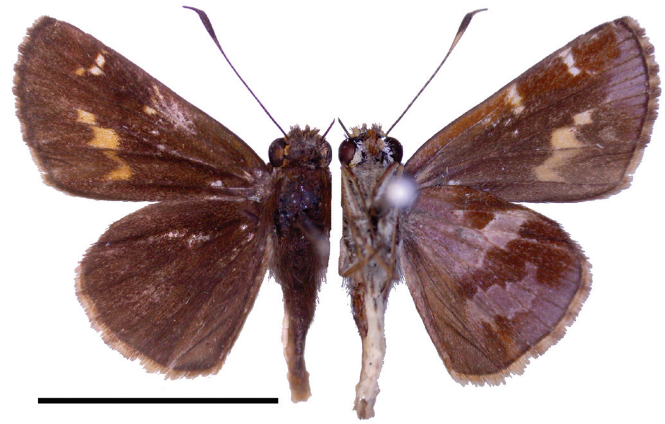


Fig. 21. Adult ♂ *Monca telata telata*, Point Gourde, 16.x.1993. Scale bar = 1cm.

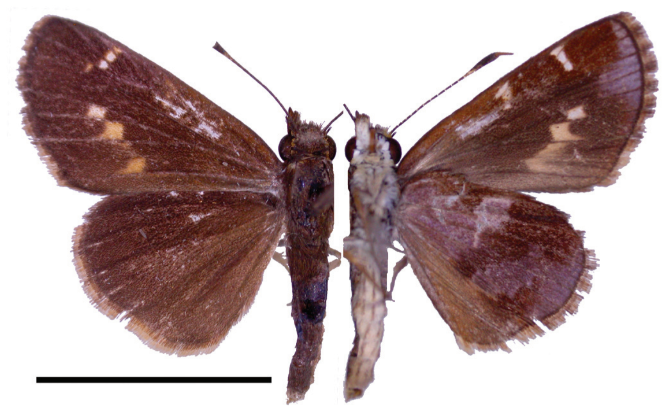


Fig. 22. Adult ♀ *Monca telata telata*, Curepe, at *Bidens* flowers, 9.xi.1980. Scale bar = 1cm.

Fig. 23. Adult *Monca telata telata*, Point Gourde, 16.x.1993.

1901, plate 101.15) illustrates the male genitalia of *M. crispinus* as *Megistias telata*.

"Two specimens from the Maraval Valley (C.W. Ellacombe)" are the basis of the inclusion of this species in Kaye's (1904) first Trinidad catalogue under the name *Megistias telata*. This treatment is repeated in Kaye (1921, no. 423), although in the meantime, Longstaff (1912) had recorded a capture in April 1907 on the Ariapeta [sic] Road (Ariapita Road, Port of Spain). Sheldon (1936) records this species from Tobago based on a W.J. Kaye specimen from Bacolet.

The pale central and discal areas UNH give this species a distinctive appearance, which is apparent in the field (Fig. 23). This is not a very common species in Trinidad, although the 12 records I have show that it is widespread at low to medium altitudes in forested areas including secondary forest. S. Alston-Smith (pers. comm. 2011) has a further seven specimens from similar locations. Of the three Tobago specimens I have seen, only one has a locality. My record of a female from Crown Point (16.v.1981) suggests that it is also found in open disturbed habitats.

As for many of the species treated here, the life history and food plants have not been reported (Mielke 2005; Beccaloni *et al*. 2008). However there are records for the Central American species. McGuire and Rickard (1974) records *Paspalum* spp. as "local" food plants of "*Monca telata tyrtaeus*" (i.e. *M. crispinus*) in their checklist of the butterflies of Bentsen-Rio Grande State Valley Park, Texas. Scott (1986) gives the same food plant. In Costa Rica, Janzen and Hallwachs (2010) have reared "*Monca tyrtaeus*" (i.e. *M. crispinus*) a dozen times from five species of grass, including *Oryza latifolia*.

Vehilius Godman 1900 in Godman 1899-1901

Evans (1955) considers this genus structurally the same as *Cymaenes* (to be treated in part 19), i.e. antennae rather > half costa; club ¼ shaft; nudum 3/8; palpi slender, third segment short, conical, protruding; mid tibiae with a few spines; no secondary sexual characters. It differs in that the veins UNH and apex UNF are more or less pale.

J28/1 *Vehilius stictomenes stictomenes* (Butler 1877)

Figs. 24-27.

Vehilius stictomenes is a common species found from Mexico to Paraguay; subspecies *stictomenes* (TL Obydos, Amazons) is found throughout most of South America, whereas ssp. *illudens* Mabille replaces it in Central America, and a third subspecies, *madra* Evans is restricted to western Ecuador (Evans 1955). Godman (1900 in Godman 1899-1901, plate 100, Figs. 47-49) illustrates the UPS, UNS and male genitalia as *V. venosus* (Plötz), which is a synonym (Evans 1955; Mielke 2004), and this accounts for the use of the name *venosus* in some of the Trinidad literature.

For *V. stictomenes*, Kaye (1904, 1921, no. 419) wrote "One specimen in June 1898 (W.J. Kaye). Doubtless a common species." He duplicated this record when he reported the synonym *V. venosus*, citing a specimen captured by G.B. Longstaff in Maraval in April 1907 (Kaye 1914, Kaye 1921, no. 421), although the actual record is of a pair captured 19.xii.1906 (Longstaff 1912).

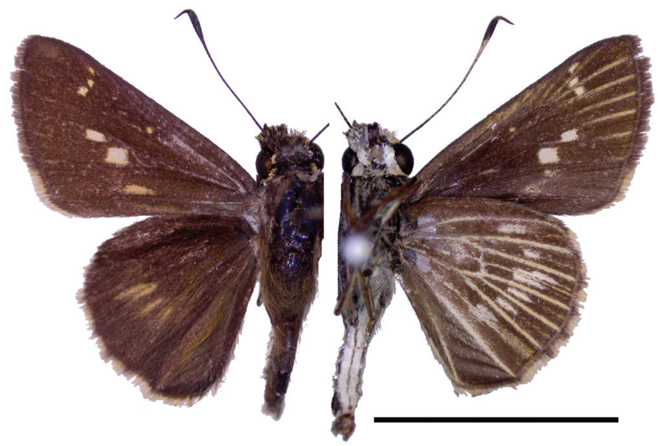


Fig. 24. Adult ♂ *Vehilius stictomenes stictomenes*, Arima-Blanchisseuse Road, milestone 9¾, Textel Road, 8.x.1994. Scale bar = 1cm.

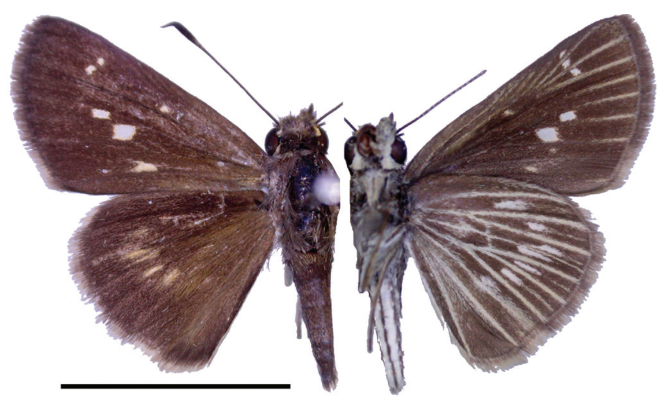


Fig. 25. Adult ♀ *Vehilius stictomenes stictomenes*, Inniss Field, 17.v.1999. Scale bar = 1cm.

There is a single male from Tobago in the NHM captured 1-4.ii.1931, at Old Grange Tower by Capt. A.K. Totton, which was included in the listings in Evans (1955).

Identification is discussed above with other species with UNH and apex UNF veins pale or yellow.

This species is common and widespread in Trinidad. I have 61 records from forest edges and roadsides in both the north and south of the island, ranging up to 2,000 ft. (610 m) at the top of the Arima Valley. Captures are throughout the year, but October and January to March have the highest numbers of captures.

Fig. 26. Adult *Vehilius stictomenes stictomenes*, South Oropouche, Mon Desir, 9.ii.2010; photo, Tarran P. Maharaj.

Fig. 27. Adult *Vehilius stictomenes stictomenes*, South Oropouche, Mon Desir, 6.ii.2010; photo, Tarran P. Maharaj.

This species has been reported as bred from grasses (Moss 1949). Beccaloni *et al*. (2008) also include personal communications of records of *Paspalum notatum* in Brazil (A. Freitas) and *P. virgatum* in Trinidad (M.J.W. Cock). I collected a caterpillar on this grass at Macoya Gardens, 21.i.1982. It pupated 26.i.1982 and a male emerged 3.ii.1982. The caterpillar head was rounded; scattered pale, inconspicuous hairs; colour pale brown with darker bands speckled with pale, along the epicranial and adfrontal sutures, parallel and close to epicranial suture, laterally from vertex to stemmata, and on the ventral half of the lateral posterior margin; a dark spot in centre of face on frons; frontal sutures narrowly brown; faint brown line down middle of frons; black surrounding stemmata. The pupa measured 20 mm; stout frontal spike; proboscis extending to end of wings; green, paler below; abdomen with darker dorsal line and pair of yellow subdorsal lines each side. The emerged pupa was translucent and fragile, and collapsed after the butterfly emerged.

J28/2 *Vehilius inca* (Scudder 1872)
Figs. 28-29.

Like the last species, *V. inca* is common, found from Mexico to Paraguay, but unlike the last, no subspecies are recognised (Evans 1955; Mielke 2004). Godman (1900 in Godman 1899-1901, plate 101, Figs. 6-7) describes as new and illustrates the UNS and male genitalia of *Megistias labdacus* Godman, which is a synonym of *V. inca* (Evans 1955; Mielke 2004). Hayward (1950, plate xi.2) also illustrates the male genitalia as *Lerodea labdacus*, but his figure of the male genitalia of *Lerodea mocoreta* Hayward (plate xii.4) are of different species, in spite of *mocoreta* being treated as a synonym of *V. inca* by Mielke (2004). Hayward (plate x.4) also illustrates the male genitalia of *Vehilius stictomenes simplex* Jörgensen, a synonym of *V. inca* according to Evans (1955) and Mielke (2004), but the genitalia illustrated are clearly similar to *V. stictomenes* and not to *V. inca*. If Hayward (1950) has correctly associated the genitalia with *V. simplex*, then it is a synonym or subspecies of *V. stictomenes*.

Fig. 28. Adult ♂ *Vehilius inca*, Arima-Blanchisseuse Road, milestone 9¾, Textel Road, 5.x.1979. Scale bar = 1cm.

Kaye (1904) described a new species, *Vehilius subplanus*, from Trinidad taken "In June 1898". It is a synonym of *V. inca* (Evans 1955; Mielke 2004) and the type is in MGCL (A.D. Warren, pers. comm.). This information is repeated in Kaye (1921, no. 420). Kaye duplicated this record when he added *Megistias labdacus* to the Trinidad list based on a G.E. Tryhane specimen from St. Ann's Valley (Kaye 1914, 1921, no. 422).

This is a rather undistinguished small skipper. The white spots UPF variably from space 1B to 7, and plain UNH without a discal band, although sometimes with slightly pale veins, should serve to distinguish it from other small species.

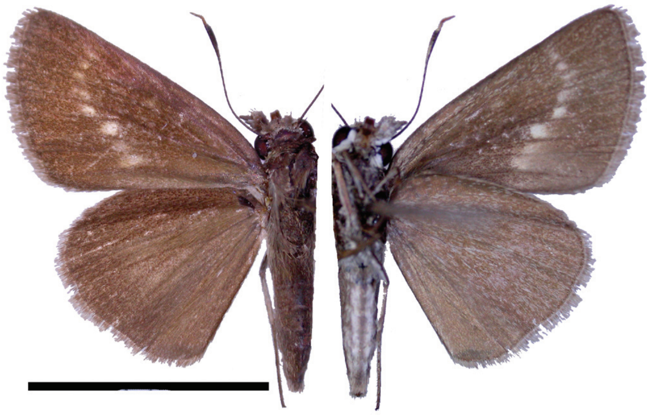


Fig. 29. Adult ♀ *Vehilius inca*, Piarco, 21.ix.1982. Scale bar = 1cm.

Although this species is not as common as the last, I have 31 records showing it to be equally widespread and occurring in similar habitats. Again captures are throughout the year, but with peak captures in October and January to March.

This skipper is a grass feeder – from a caterpillar collected on "grass" in Mexico, Kendall (1976) reared a specimen on *Panicum maximum*.

J28/4 *Vehilius celeus celeus* (Mabille 1891)
Fig. 30.

This species was described from Pará, Brazil (Mabille 1891; Mielke and Casagrande 2002), but misidentified by Evans (1955). Thus, Mielke and Casagrande (2002) examined the type of *V. celeus* and showed that it is the same as the species treated by Evans (1955) as *V. almoneus* Schaus. There are two further subspecies found in southern Brazil (Mielke 2004, 2005), which were described after Evans (1955) completed his work. Evans (1955) lists specimens of "*V. almoneus*" from the Guyanas, Amazon (Manaus and Belem (Pará)) and Bolivia (Santa Cruz), so the records from Bolivia may well refer to one of the new subspecies. This is a new island record from Trinidad, based on captures by Scott Alston-Smith on roadside flowers in Grande Ravine.

The identification of the different species with UNH and apex UNF veins pale or yellow is discussed above – the spots in spaces 4 and 5 F, and UPH markings make

Fig. 30. Adult ♀ *Vehilius celeus*, Trinidad, S. Alston-Smith. Scale bar = 1cm.

this species distinctive. Lindsey (1925) illustrates the male genitalia.

Dinther (1960) lists this species is a minor pest of rice in Suriname and includes a drawing of an adult which confirms that he has applied the name correctly. Remillet (1988) repeats this information and is in turn cited by Beccaloni *et al*. (2008).

J28/6 *Vehilius vetula* (Mabille 1878)
Fig. 31.

Vehilius vetula (Mabille 1878) – not to be confused with *Eutocus vetulus* (Mabille 1883), which Evans misidentified as a species of *Vehilius* (see *V. seriatus* below) – was described from Pará (Belem) Brazil, and is found from Panama to the Amazon. Cock (1982) added this species to the Trinidad list based on a single female taken in the Parrylands Oilfield (26.iii.1980; Fig. 31). More recently, S. Alston-Smith (pers. comm. 2011) has captured five specimens: three from Inniss Field (xii.2006, i.2007) and two from Rock River Road (ii.2007), all taken on roadside flowers in the early morning, 0700-0800 h.

Fig. 31. Adult ♀ *Vehilius vetula*, Parrylands, 26.iii.1980. Scale in mm.

Williams and Bell (1931) illustrate the male genitalia of *forbesi* Williams and Bell, a synonym that they described from Guyana. De Jong (1983) also illustrates the male genitalia of a Suriname specimen.

The life history and food plants have not been reported (Mielke 2005; Beccaloni *et al*. 2008).

J28/7 *Vehilius seriatus seriatus* (Mabille 1891)
Figs. 32-34.

Mielke and Casagrande (2002) established that *vetulus* Mabille 1883 (as opposed to *vetula* Mabille 1878 above) was misidentified by Evans (1955). Accordingly, the senior name for the species which Evans (1955) treated as *vetulus* Mabille 1883 is *seriatus* Mabille 1891 (and the subspecies that Evans treated as *vetulus* Mabille 1883, represented by one female from Nicaragua in the NHM is apparently left without a name). *Vehilius seriatus* is uncommon, the nominate subspecies known from Colombia, Venezuela (Evans 1955) and Surinam (De Jong 1983), with a second subspecies, *danius* (Bell 1941a) from south Brazil (Evans 1955; Mielke 2004).

Fig. 32. Adult ♂ *Vehilius seriatus seriatus*, Morne Bleu Textel Installation, 20.i.1981. Scale bar = 1cm.

The male genitalia of ssp. *seriatus* do not seem to have been illustrated, although by implication they are similar to those of the other subspecies in Evans (1955). Evans (1955) includes a diagram of his "ssp. *vetulus*", and Bell (1941a) illustrates the male genitalia of ssp. *danius* from Santa Catharina, Brazil.

Material of this species in the NHM is limited; there are only eight specimens of ssp. *seriatus* from Colombia and Venezuela. Trinidad material has the UNS pale veins and dashes in the spaces quite a lot more pronounced that the NHM specimens. The identity of the Trinidad material merits further study if the type of *seriatus* can be located for comparison. The most likely collection to house the type is the Muséum National d'Histoire Naturelle, Paris, but it could not be located there (J. Pierre, pers. comm. 2010). I illustrate here the male genitalia of a Trinidad specimen. The lateral view is similar to that of ssp. *danius* (Bell 1941a, Fig. 8). The uncus is more deeply divided than indicated in Evans' (1955) diagram of his "*vetulus* Mabille 1883".

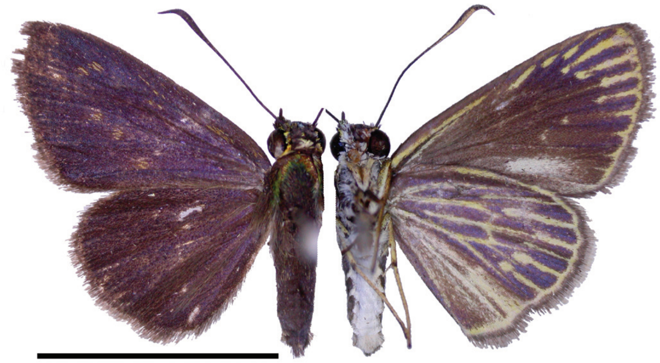


Fig. 33. Adult ♀ *Vehilius seriatus seriatus*, Arima-Blanchisseuse Road, milestone 9¾, 27.xi.1980. Scale bar = 1cm.

The strong pale yellow spots UNH and the lines connecting them to the margin make this species distinctive compared to other species with UNH and apex UNF veins pale or yellow, as discussed above.

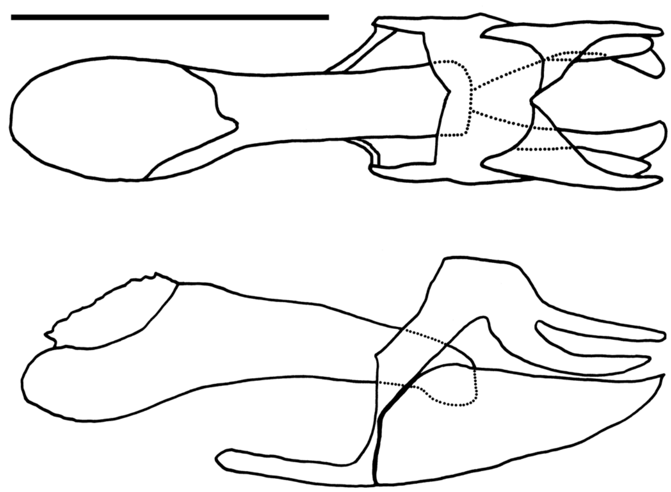


Fig. 34. Male genitalia of *Vehilius seriatus seriatus*, Morne Bleu Textel Installation, 20.i.1981 (Fig. 32); above, dorsal view; below, lateral view. Scale bar = 1mm.

This species is localised on the higher parts of the Northern Range and apart from one capture at 1,600 ft. (490 m) in San Miguel Valley behind Mt. St. Benedict (♂ 29.vii.1978), my dozen captures are from the ridges around the Arima Valley (Las Lapas Trace, Andrew's Trace, Lalaja Ridge, and the ridge from the Textel Installation to Morne Bleu.

The life history and food plants have not been reported (Mielke 2005; Beccaloni *et al*. 2008).

***Remella* Hemming 1939**

This genus was first established as *Perimeles* Godman for the species *remus* (Fabricius). It was an unavailable homonym and so was replaced by Hemming (1939) with *Remella*. Evans (1955) treated *Remella* as a synonym of *Moeris* Godman in which he placed a dozen species. However, Burns (1990) divided the genus based on the male genitalia and resurrected the genus *Remella* for *remus*, the type species of the genus. Mielke (2004) added four species to the genus to make five altogether, of which two similar species occur in Trinidad.

J33/1 *Remella remus* (Fabricius 1798)
Figs. 35-38.

Until quite recently, this species was known as *Moeris remus*, based on Evans' (1955) treatment – e.g. Cock (1982). *Remella remus* was described from French Guiana and is widespread from Mexico to Paraguay.

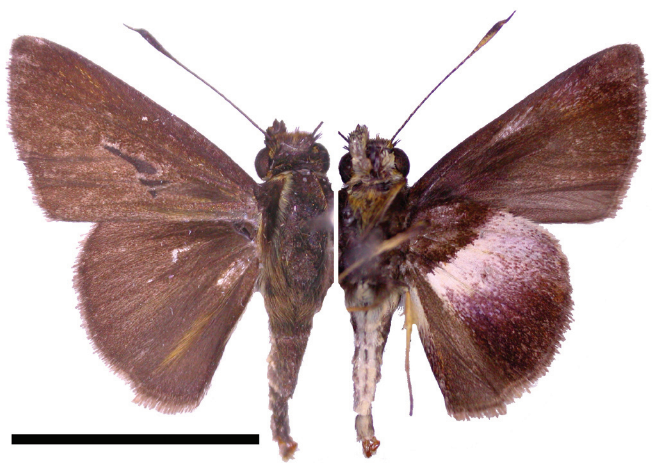


Fig. 35. Adult ♂ *Remella remus*, Arima-Blanchisseuse Road, milestone 8, 8.ix.1979. Scale bar = 1cm.

Fig. 36. Adult ♀ *Remella remus*, lower Morne Catherine, 17.i.1988. Scale bar = 1cm.

Fig. 37. Adult *Remella remus* at *Bidens pilosa* flower, Palo Seco, 7.x.1995.

Fig. 38. Adult ♂ *Remella remus*, Mt. St. Benedict, 2.x.1994.

This species was first recorded from Trinidad by Crowfoot (1893) under the name *Pamphila remus*. Longstaff (1912) adds a record as *Perimeles remus* from Ariapeta [sic] Road, Port of Spain, in April 1907, which Kaye (1914) refers to. Later, Kaye adds that it was "fairly common in the hills round Port of Spain, Nov. 1920 (W.J.K.)" (Kaye 1921, no. 401)

Godman (1900 in Godman 1899-1901, plate 99, Figs. 1-3) illustrates the UNS, male venation and genitalia; Burns (1990) reproduces the figure of the male genitalia. Hayward (1950, plate viii.3) also illustrates the male genitalia.

The two *Remella* spp. found in Trinidad have the UNH reddish purple with a characteristic pale to white band UNH, sharply defined basally but diffuse distally, usually with a dark spot in the band (Figs. 35-36, 39-40). They cannot be mistaken for any other Trinidad species. The males are easily separated as *R. remus* has a strong three part stigma (Fig. 35), whereas *R. vopiscus* (Herrich-Schäffer) has none (Fig. 39). The female of *R. remus* (Fig. 36) is similar to the male of *R. vopiscus*, but the female of *R. vopiscus* (Fig. 40) seems to generally have the white band UNH reduced and sullied, but this may merit further study.

Beebe (1951) includes this species in his treatment of migrating butterflies at Portochuelo Pass, Rancho Grande, northern Venezuela. However, since this is based on a single record of a species that cannot be identified in flight, it is just as likely, if not more likely, to have been local movement by species resident in the vicinity.

Forty records from Trinidad show that this is quite a common species at forest edges and roadsides throughout the island, to at least 2,000 ft. (610 m, Arima-Blanchisseuse Road, Andrew's Trace, ♂ 9.iv.1980). I have noted one capture of a male in the clearing at the summit of Mt. Tabor at 1,860 ft. (565 m) between 0930 and 1030 h, 13.i.2004, and another of a female at *Eupatorium* flowers (Rio Claro-Guayaguayare Road, milestone 4-5, 17.ix.1978). Months of capture are spread through the year, with peaks in February to April and September.

The life history and food plants have not been reported (Mielke 2005; Beccaloni *et al*. 2008).

J33/4 *Remella vopiscus* (Herrich-Schäffer 1869 in Herrich-Schäffer 1867-1871)

Figs. 39-40.

Although Burns (1990) removed *remus* from *Moeris* and placed it in *Remella* (see last species), he did not consider the other species in *Moeris*. Of these, *vopiscus* Herrich-Schäffer is very similar in appearance to *remus* and the genitalia appear congeneric, although *vopiscus* lacks the male brand of *remus* (Evans 1955), and so Mielke (2004) placed *vopiscus* in *Remella*. This species was described from Venezuela and is found from Mexico to the Amazon (Evans 1955). Although Evans (1955) recognised two subspecies, these are now considered separate species (Mielke 2004). Apart from Evans' (1955) diagram, the genitalia do not seem to have been illustrated (Mielke 2005).

Kaye (1921) did not distinguish *R. vopiscus* from *R. remus*, so Evans' (1955) listing of eight males and three females from Trinidad was the first record of this species from the island.

See under *R. remus* (above) for the separation of these two species.

Just 20 records show that this species is less common than the last. Furthermore, although *R. vopiscus* is widespread, all localities are at low altitude and the capture localities suggest that it is more associated with disturbed habitats and suburban situations than the last. The principle months of capture are January and August to November, suggesting that this is not a dry season species. I have noted a male feeding at flowers of *Bidens pilosa* (Curepe, 9.xi.1980) and caught one male in my mercury vapour light trap in Curepe (23-28.xi.1980). I have also observed a male feeding from a bird dropping on a leaf, moistening the dropping with liquid from its anus and then sucking up the resultant liquid (Curepe, 17.viii.1980).

The life history and food plants have not been reported (Mielke 2005; Beccaloni *et al*. 2008).

Fig. 39. Adult ♂ *Remella vopiscus*, Curepe, feeding on bird dropping, 17.viii.1980. Scale bar = 1cm.

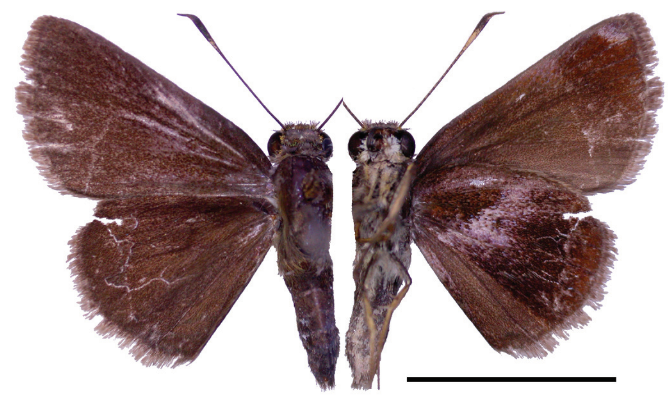


Fig. 40. Adult ♀ *Remella vopiscus*, Point Gourde, 12.vii.1997. Scale bar = 1cm.

Moeris Godman 1900 in Godman 1899-1901

This genus was established by Godman (1900 in Godman 1899-1901) for the species *striga* (Geyer). As stated above under *Remella*, Evans (1955) treated the genus in a broader sense (see also Cock 1982), but following Burns' (1990) reinstatement of *Remella*, now there are only five species in the genus *Moeris* (Mielke 2004) of which one easily recognised species occurs in Trinidad.

[*Moeris stollmeyeri* (Bell)]

Moeris stollmeyeri (species no. 167 in Cock 1982) is now treated as a synonym of *Mnasicles hicetaon* Godman (species no. 148 in Cock 1982). Mielke and Casagrande (2002) established this synonymy based on an examination of the type of *stollmeyeri*. *Mnasicles hicetaon* will be dealt with in part 20 of this series.

J33/10 *Moeris striga strada* Evans 1955

Figs. 41-43.

Moeris striga is found from Mexico to Argentina in four subspecies (Mielke 2004), but subspecies *strada*, which was described from Trinidad, is restricted to Trinidad and Venezuela (Evans 1955). The Central American subspecies is *stroma* Evans, while ssp. *menopis* Schaus occurs in southern South America. Kaye (1904, 1921, no. 412) includes this species as *M. striga*, citing "two ♂ and 1 ♀ in June 1901 (W.J. Kaye)."

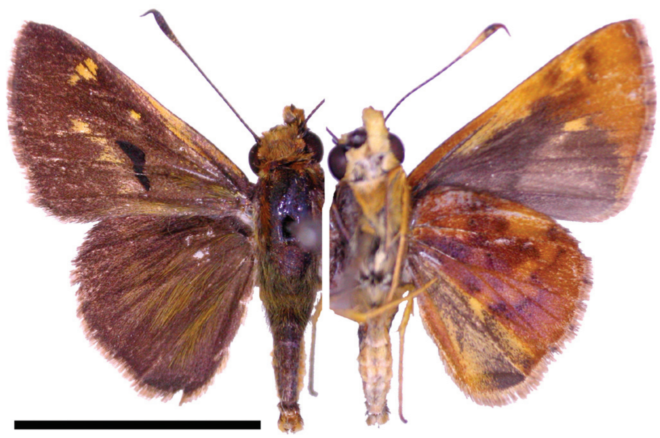


Fig. 41. Adult ♂ *Moeris striga strada*, Trinity Hills, summit of Morne Derrick, 4.iv.1982. Scale bar = 1cm.

The genitalia of ssp. *strada* have not been illustrated (Mielke 2005), although Godman (1900 in Godman 1899-1901, plate 100, Figs. 1-2) illustrates the venation and male genitalia of ssp. *stroma* (as *striga*), and Hayward (1950, plate ix.2) illustrates the male genitalia of ssp. *menopis* (as *Phlebodes silvicultrix* Hayward, a synonym from Argentina).

As Kaye (1904) points out, *M. striga strada* is "easily recognized by the well-marked underside."

This is another quite common species with over 40 records predominantly from the Northern Range, from Point Gourde and Morne Catherine as far east as Lalaja Ridge. The only records from outside the Northern Range are from Wallerfield (♀ 7.iv.1982), Palo Seco (♀ 7.x.1995) and the heights of the Trinity Hills (♂ 4.iv.1982, ♂ 29.xii.1981). At least half the records which include a locality are from ridges or hilltops, suggesting this is typical habitat for this species. Captures are spread through the year, with small peaks in April and September. It also occurs on Chacachacare Island (near summit, ♂ on *Eupatorium* flowers, 7.i.1982) (Cock 1984).

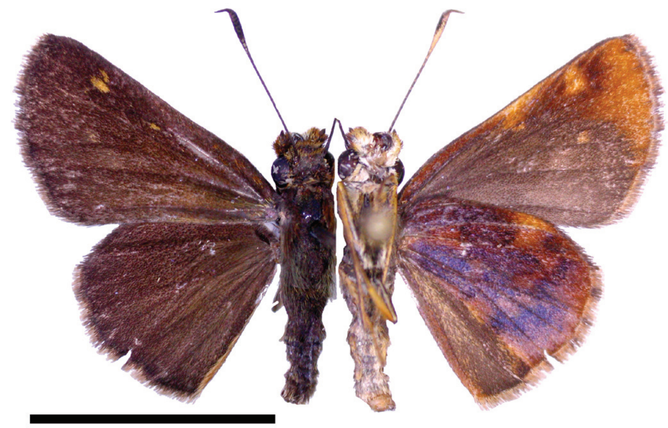


Fig. 42. Adult ♀ *Moeris striga strada*, Palo Seco Oilfield, 7.x.1995. Scale bar = 1cm.

Fig. 43. Adult ♀ *Moeris striga strada*, Palo Seco Oilfield, 7.x.1995.

Although the early stages of ssp. *strada* have not been reported (Mielke 2005; Beccaloni *et al*. 2008), there are observations for ssp. *stroma*. Thus, Steinhauser (1975) reports oviposition on grass in El Salvador, and Janzen and Hallwachs (2010) have reared it in Costa Rica from caterpillars on *Lasiacis procerrima* and *L. sorghoidea*, but do not include pictures of the early stages.

***Parphorus* Godman 1900 in Godman 1899-1901**

Godman established this genus, with *storax* as the type species. Evans (1955) characterises it: "Antennae rather longer than half costa: club ¼ shaft: nudum 3/8. Palpi second segment quadrate, hairy: third short. Mid tibiae with a few spines, which may be short or long or obsolete. F vein 2 mid vein 3 and base. Below, with more or less well-defined pale veins. Male UPF with a brand or stigma."

J34/1 *Parphorus storax storax* (Mabille 1891)
Figs. 44-49.

The nominate subspecies is found from Mexico (Warren 2000) to south Brazil (type locality Panama) (Evans 1955) and Argentina (Hayward 1950), but there is a second subspecies, *sorra* Evans, found in Ecuador and part of Venezuela. In the addenda to Kaye (1914) and in Kaye (1921, no. 425), *P. storax* is recorded from the Botanical Gardens, Jan. 3, 1913 (K. St. A. Rogers).

Godman (1900 in Godman 1899-1901, plate 101, Figs. 22-25) illustrates the UPS, UNS, male venation and genitalia and Hayward (1950 plate x.12) also illustrates the male genitalia. Identification is discussed above with other species with UNH and apex UNF veins pale or yellow. *Parphorus storax* is smaller than the other Trinidad species with these markings.

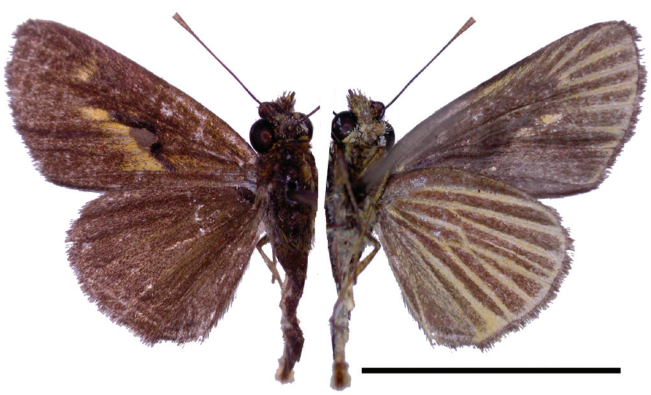


Fig. 44. Adult ♂ *Parphorus storax storax*, Arena Forest, near Parrotts Ride, 8.x.1994. Scale bar = 1cm.

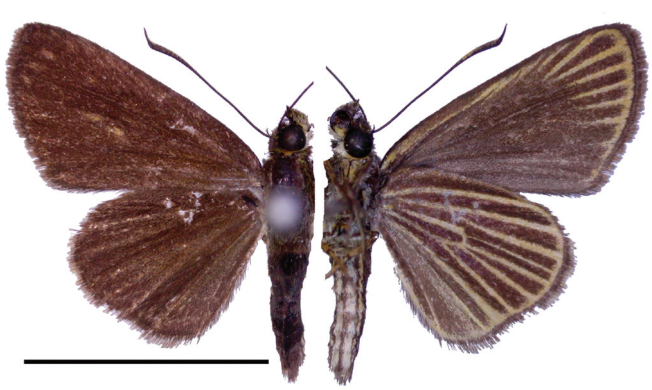


Fig. 45. Adult ♀ *Parphorus storax storax*, Arima-Blanchisseuse Road, Andrew's Trace, 17.ix.1980. Scale bar = 1cm.

This is an occasional species in Trinidad with 20 records available to me. These include some lowland forest sites, but most are from higher forested areas, particularly in the Northern Range, from Morne Catherine to the Upper Guanapo Valley, and up to 2,600 ft. (790 m) on El Tucuche (2♂ 9.i.1980). Males occur in twos and threes in sunlit patches in forest (El Tucuche, 2♂ 9.i.198; Arima-Blanchisseuse Road, Andrew's Trace, 2♂ 17.iii.1982; Mt. Harris, 2♂ 25.iii.2003; Mt. Tamana, summit ridge, 2♂ 13.vii.1997), but it doesn't normally come out of the forest, e.g. to flowers.

I have reared this species from caterpillars on *Olyra latifolia* and *Orthoclada laxa*, as described below. Janzen and Hallwachs (2010) have reared it seven times from four different grasses including *Olyra latifolia*. They illustrate the final instar caterpillar, which is similar to those shown in Fig. 48, but their material has white subdorsal and lateral stripes, and the head has the sutures narrowly dark and the band from vertex to stemmata narrower.

The shelter made by a fifth instar caterpillar on *Orthoclada laxa* (Mt. Harris, 03/228B) was on a leaf 120 mm long; the basal 50 mm were intact; notches were cut from the margin to the midrib at this point, one on each side, the midrib being bared for another 20 mm; the distal part of the leaf was folded along the midrib, with the shelter lid being folded under the other half.

The pupal shelter on *Orthoclada laxa* (Mt. Harris, 03/228A) was on a leaf of 135 mm, of which the basal 35 mm were intact; the leaf was eaten distally to this leaving the midrib bare for 15 mm; distally, the leaf on one side was eaten from the margin to leave a width of about 10

Fig. 46. Leaf shelters of *Parphorus storax storax* on *Olyra latifolia*, Mt. Tabor, 12.i.2004, 04/13. Arrows: 1, first shelter (could be of another species); 2, shelters; 3, feeding damage.

mm which was rolled under the other half to make the pupal shelter.

An instar 4 caterpillar collected on *Olyra latifolia* (Mt. Tabor, 04/13B) had a black head, narrow black plate on T1 and the body dull translucent green (Fig. 47).

Fig. 47. Instar 4 caterpillar of *Parphorus storax storax* collected 12.i.2004 on *Olyra latifolia*, Mt. Tabor, 12.i.2004, 16 mm, Ref. 04/13a.

A week before pupation, the fifth instar caterpillar measured 23 mm (Fig. 48). Head small, rounded, but wider nearer base than apex, slightly indent at vertex; pale green-brown with dense, sharply defined black markings: upper part of epicranial suture (all epicranial suture and upper part of adfrontal sutures in caterpillar on *Olyra latifolia*, Mt. Tabor, 04/13A, Fig. 48C); lower 1/5 of face, extending to the stemmata laterally; a broad stripe from vertex over apices to stemmata, stopping short of black area on ventral part of head. T1 concolorous; a narrow, black, shiny plate on dorsal margin. Body dull dark translucent green; darker dorsal line more apparent on A6-A8; tracheal line visible; gonads in A5 pale brown (orange in specimen collected on *Olyra latifolia* on Mt. Tabor, 04/13A). Spiracles T1, A8 dark; remainder pale; all inconspicuous. Legs concolorous. No wax glands.

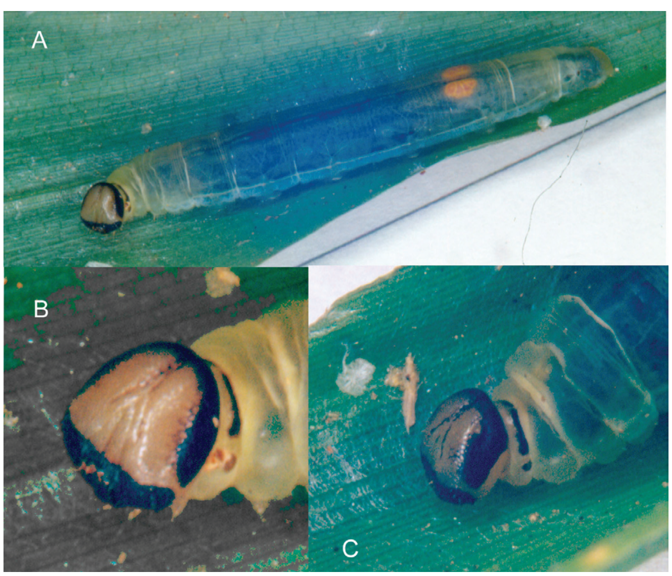


Fig. 48. Instar 5 caterpillars of *Parphorus storax storax*. **A**, dorsolateral view, collected 25.iii.2003 on *Orthoclada laxa*, Mt. Harris, 23 mm, Ref. 03/228B; **B**, detail of head, anterolateral view, as A; **C**, detail of head, anterodorsolateral view, collected 12.i.2004 on *Olyra latifolia*, Mt. Tabor, 12.i.2004, pupated 23.i.2004, photographed 12.i.2004; 19 mm, Ref. 04/13A.

There was no white waxy powder on the pupa or inside the pupal leaf shelter, nor was there a silk girdle. The pupal skin was transparent so that the colouring reflected the contents and changed over time. Pupa 14-15 mm; eyes slightly bulbous; proboscis sheath extends at least two segments beyond the wing cases or up to the base of the cremaster and is brown beyond the end of the wing cases and black at apex; frontal protuberance distinctive, T-shaped: on a short black dorso-ventrally flattened stalk a bulbous cross piece, about twice as wide as projection; at the base of the stalk, the black marking extends dorsolaterally in a variable bulge, so that in anterodorsal view there may appear to be a four-lobed black marking (Fig. 49). Head, thorax, appendages transparent pale yellowish brown; a brown stripe down middle of eye; abdomen transparent pale green; a subventral spot on each of the first three or four segments beyond the wing cases. Spira-

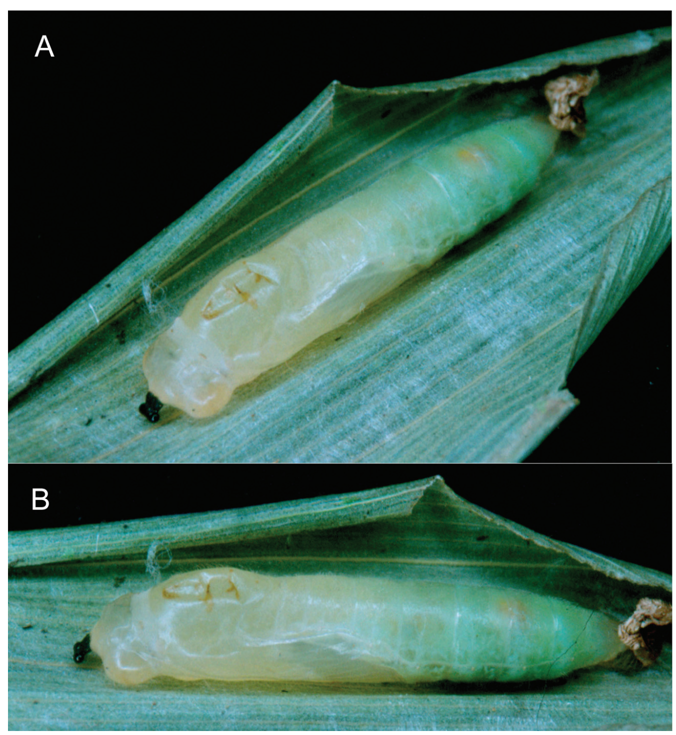


Fig. 49. Pupa of *Parphorus storax storax* collected 12.i.2004 on *Olyra latifolia*, Mt. Tabor, 12.i.2004, pupated 23.i.2004, photographed 27.i.2004, 14 mm, Ref. 04/13A. **A**, anterodorsolateral view; **B**, dorsolateral view.

cles inconspicuous; tracheal line visible; cremaster has a dark submarginal line dorsally.

There are two emerged pupae and one associated final instar head capsule in the NHM over this name which are likely to be from Moss' collection, although not included in Moss (1949). The head capsule is brown, darker basally. The pupae are flimsy and have collapsed; the frontal spike is either absent or missing from these specimens.

J34/2 *Parphorus decora* (Herrich-Schäffer 1869 in Herrich-Schäffer 1867-1871)

Figs. 50-51.

This species is widespread from Mexico to Argentina (Hayward 1934; Evans 1955; De Jong 1983). Kaye (1904) included this species as *Vorates decora* (*Vorates* is a synonym of *Parphorus*) in his first catalogue, based on "A single specimen taken in May 1898 at Tabaquite (W. J. Kaye)". Later, he adds "seen in several small collections" and "fairly common at Siparia on *Eupatorium* (W. J. Kaye)" (Kaye 1921, no. 426).

Sheldon (1936, 1938) did not record this species from Tobago, but Evans (1955) lists a female in the NHM from Tobago (Cock 1982). I have examined this specimen and conclude that Evans made an unusual error for him, since the specimen is a female *C. juventus*. Accordingly, *P. decora* should no longer be considered a Tobago species.

Godman (1901 in Godman 1899-1901, plate 101, Figs. 26-29) illustrates the UPS, UNS, male venation and genitalia as *Vorates decorus*. Hayward (1950, plate x.5) illustrates the male genitalia as *Vorates substriata* Hayward, a synonym.

The separation of this species from other species with UNH and apex UNF veins pale or yellow is discussed above. The combination of no spots in the UNH spaces and no spot in space 1B UNF is distinctive.

The majority of the 33 specimens that I have seen were from the Northern Range, from Scotland Bay east to Lalaja Ridge, and up to around 2,000 ft. (610 m, Arima-Blanchisseuse Road, Andrew's Trace, Lalaja Ridge). Scattered records from Caparo (♂ in NHM), Las Lomas, Spanish Farm (♀ 16.i.1982) and Inniss Field (♂ 16.i.2004) suggest this species could turn up throughout the island. The typical habitat is in forested areas and it doesn't normally come to flowers outside the forest. Captures are most frequent in January, but also occur through the year.

Kendall (1976) reports rearing this species in Mexico from a caterpillar and two pupae collected on a grass, *Lasiacis* sp. (?*ruscifolia*). In Brazil (Belem), Moss (1949) twice reared this species "from a caterpillar found in a

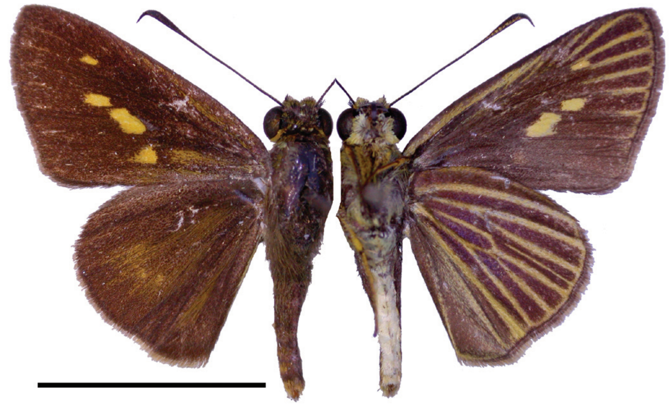


Fig. 50. Adult ♂ *Parphorus decora*, Lalaja Ridge, 15.xi.1980. Scale bar = 1cm.

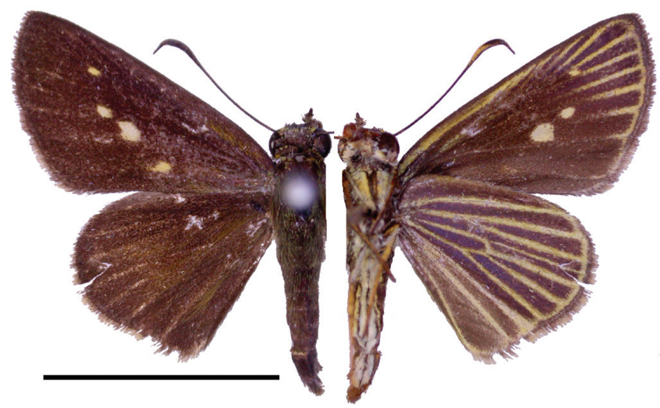


Fig. 51. Adult ♀ *Parphorus decora*, Arima-Blanchisseuse Road, Andrew's Trace, 27.xi.1980. Scale bar = 1cm.

tight roll of a leaf of ground bamboo", i.e. *Olyra* sp.; he notes that the head of the caterpillar has four white marks, but does not illustrate the early stages. Janzen and Hallwachs (2010) have reared this species nearly 1,000 times, from perhaps more than 20 species of grasses, of which *Olyra latifolia* constitutes more than 80%. I identified my material (below) which I did not rear to adult, from their photos of the caterpillars and pupae.

I collected a caterpillar (94/42) and dead pupa (94/43) on *Olyra* sp. on the path behind St. Benet's Hall, Mt. St. Benedict, 1.x.1994. The former was collected in the penultimate instar and died in the final instar, while the latter was parasitized.

The penultimate instar caterpillar was in a shelter made by folding a long flap upwards from the side of one of the terminal leaves; there was extensive feeding from the opposite margin. Similarly the pupa was in a shelter made by rolling a terminal leaf upwards.

The penultimate instar caterpillar measured 20 mm three days before moulting. The head was black, rounded; T1 with a narrow black dorsal plate; body translucent dull green. The final instar caterpillar had the head rounded, slightly wider basally; light brown; diffusely brown between apices; broad, heavy black band from stemmata to stemmata across bottom of face; T1 a narrow black plate across posterior margin; body dull translucent green; diffuse pale dorsolateral line; white lateral line through spiracles; spiracle T1 light brown, others pale, inconspicuous; all legs concolorous. The head capsule was a good match to that associated with the dead pupa (94/43).

The pupa measured 20 mm; a short, black T-shaped frontal projection; proboscis extends three abdominal segments beyond wing cases; a dark dorsolateral line on head, bulbous at each end. One to two weeks after collection, 61 chalcidoid parasitoids emerged from the pupa.

ACKNOWLEDGEMENTS

The following have very kindly assisted in providing access to the collections in their care: Dr. George McGavin of the Hope Entomological Collections, Oxford University Museum (HEC); Dr. Phillip Ackery and Blanca Huertas of the Natural History Museum (NHM) (formerly British Museum (Natural History)); Dr. Mark Shaw of the Royal Scottish Museum (NMS); Mr. Scott Alston-Smith to his private collection (SAS); Professor Julian Kenny and Dr. Gene Pollard of the University of the West Indies, St. Augustine (UWI); Dr. Gerald Legg of the Booth Museum, Brighton (BM); Drs. Lee and Jacqueline Miller of the Allyn Museum of Entomology, Sarasota, Florida (AME), now incorporated into McGuire Center for Lepidoptera and Biodiversity (MGCL).

The specimens of *C. juventus* shown in Figs. 3 and 4 are in the BM and NHM respectively. I thank Tarran P. Maharaj for allowing me to use several of his photographs of adult butterflies, Bryan Reynolds (www.botwf.org) who provided his photograph shown in Fig. 10C, Andy Warren who checked the MGCL for historical specimens, Jacques Pierre who unsuccessfully checked in the Muséum National d'Histoire Naturelle for the type of *Vehilius seriatus* and Scott Alston-Smith for adding information based on his observations.

REFERENCES

Austin, G. T., Haddad, N. M., Méndez, C., Sisk, T. D., Murphy, D. D., Launer, A. E. and **Ehrlich, P. R.** 1996. Annotated checklist of the butterflies of the Tikal National Park area of Guatemala. *Tropical Lepidoptera*, 7: 21-37.

Beccaloni, G. W., Viloria, Á. L., Hall, S. K. and **Robinson, G. S.** 2008. Catalogue of the hostplants of the Neotropical butterflies. Catálogo de las plantas huésped de las mariposas neotropicales. *Monografias Tercer Milenio*, 8: 536 p.

Beebe, W. 1951. Migration of Nymphalidae (Nymphalinae), Brassolidae, Morphidae, Libytheidae, Satyridae, Riodinidae, Lycaenidae and Hesperiidae (butterflies) through Portachuelo Pass, Rancho Grande, north-central Venezuela. *Zoologica (New York)*, 36: 1-16.

Bell, E. L. 1941a. New species of Neotropical Hesperiidae (Lepidoptera: Rhopalocera). *American Museum Novitates*, 1125: 10 pp.

Bell, E. L. 1941b. On *Lerodea telata* Herrich-Schäffer and *tyrtaeus* Plötz (Lepidoptera: Hesperiidae). *Entomological News*, 52: 183-185.

Burns, J. M. 1990. *Amblyscirtes*: problems with species, species groups, the limits of the genus, and genus groups beyond - a look at what is wrong with the skipper classification of Evans (Hesperiidae). *Journal of the Lepidopterists' Society*, 44: 11-27.

Butler, A. G. 1877. On the Lepidoptera of the Amazons collected by James W. H. Trail, Esq., during the years 1873 to 1875. *Transactions of the Entomological Society of London*, 1877: 105-156, plate 3.

Cock, M. J. W. 1981. Butterflies from Chacachacare Island including three species new to Trinidad. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1981-1982: 25.

Cock, M. J. W. 1982. The skipper butterflies (Hesperiidae) of Trinidad, Part II. Systematic list of the Trinidad and Tobago species. *Occasional Papers Dept. Zoology, UWI, St. Augustine*, 5: 49 p.

Cock, M. J. W. 1984. Lepidoptera Notes I-VI. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1983-1984: 35-37.

Cock, M. J. W. 2005. The skipper butterflies (Hesperiidae) of Trinidad Part 13, Hesperiinae, genera Group K. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2005: 23-47.

Cock, M. J. W. 2006. The skipper butterflies (Hesperiidae) of Trinidad Part 14, Hesperiinae, genera Group L. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2006: 8-26.

Cock, M. J. W. 2009. The skipper butterflies (Hesperiidae) of Trinidad Part 16, Hesperiinae, genera Group J, *Vettius - Naevolus*. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2009: 11-31.

Cock, M. J. W. 2010. The skipper butterflies (Hesperiidae) of Trinidad Part 17, Hesperiinae, Anthoptini and the remainder of Evans' genera Group I. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2010: 11-30.

Cramer, P. 1780-1782. De uitlandische Kapellen voorkomende in de drie Waereld-Deelen Asia, Africa en America. Papillons exotiques des trois parties du monde l'Asie, l'Afrique et l'Amérique. Amsteldam, J.S. Baalde; Utrecht, Barthelemy Wild. Vol. 4, 252 +29 p., plates 289-400.

Crowfoot, W. M. 1893. Preliminary list of Trinidad butterflies. *Journal of The Trinidad Field Naturalists' Club*, 1: 173-4.

De Jong, R. 1983. Annotated list of the Hesperiidae (Lepidoptera) of Surinam, with descriptions of new taxa. *Tijdschrift voor Entomologie*, 126: 233-268.

Dinther, J. B. M. van 1960. Insect pests of cultivated plants in Surinam. Landbouwproefstation in Surinam Bulletin No. 76. H. Wageningen, Netherlands, Veenen & Zonen N.V., 159 p.

Evans, W. H. 1955. A Catalogue of the American Hesperiidae in the British Museum (Natural History). Part IV. Hesperiinae and Megathyminae. London: British Museum (Natural History). 499 p., plates 54-88.

Fabricius, J. C. 1798. Supplementum. Entomologiae systematicae. Hafniae, Proft et Storch. [iv] + 572 pp.

Felder, C. [1863]. Verzeichniss der von den Naturforschern der k. k. Fregatte "Novara" gesammelten Macrolepidopteren. *Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien*, 12: 473-496.

Geyer, C. [1832]-[1833]. *In:* **Hübner, J.**, Zuträge zur Sammlung exotischer Schmettlinge. Augsburg, Jacob Hübner, 4: 1-48; 5: plates [138-151].

Godman, F. DuC. 1899-1901. Biologia Centrali-Americana. Insecta. Lepidoptera: Rhopalocera Vol. 2. London: Dulau & Co., Bernard Quaritch. 457-460, pl. 91 (1899), 461-588, pl. 92-100 (1900), 589-782pls. 101-111 (1901).

Harvard College 2010. MCZ type database @ Harvard Entomology. http://mcz-28168.oeb.harvard.edu/mcz (13 Aug. 2010).

Hayward, K. J. 1934. Lepidópteros argentinos. Familia Hesperidae. *Revista de la Sociedad Entomológica Argentina*, 6: 97-181, plates 5-19.

Hayward, K. J. 1950. Insecta, Lepidoptera (Rhopalocera), familia Hesperiidarum, Subfamilia Hesperiinarum. *In:* **Descole, H. R.** (Ed.), Genera et species animalium argentinorum, 2: [10] + 388 p., 26 plates. Buenos Aires, Guillermo Kraft.

Hemming, F. 1939. Notes on the generic nomenclature of the Lepidoptera: Rhopalocera I. *Proceedings of the Royal Entomological Society*, Series B, 8: 133-138.

Hemming, F. 1967. The generic names of the butterflies and their type-species (Lepidoptera: Rhopalocera). *Bulletin of the British Museum (Natural History) Entomology*, Supplement 9, 309 p.

Herrich-Schäffer, G. A. W. 1867-1871. Prodromus systematis lepidopterorum. Versuch einer systematischen Anordnung der Schmetterlinge. *Correspondenz-Blatt des zoologisch-mineralogischen Vereines in Regensburg*, 21 (1867): 100-106, 124-128, 138-144, 161-172; 22 (1868): 119-138, 172-176; 23 (1869): 56-64, 67-77, 130-141, 163-172, 184-204; 24 (1870): 154-160; 25 (1871): 103-104.

Hewitson, W. C. 1866. Descriptions of new Hesperiidae. *Transactions of the Entomological Society of London*, Series 3, 2: 479-501.

Janzen, D. H. and **Hallwachs, W.** 2010. Dynamic database for an inventory of the macrocaterpillar fauna, and its food plants and parasitoids, of Area de Conservacion Guanacaste (ACG), northwestern Costa Rica. http://janzen.sas.upenn.edu (Last accessed 11 Oct. 2010).

Kaye, W. J. 1904. A catalogue of the Lepidoptera: Rhopalocera of Trinidad. *Transactions of the Entomological Society of London*, 1904: 159-224.

Kaye, W. J. 1914. Additions and corrections to my catalogue of the Lepidoptera: Rhopalocera of Trinidad (1904). *Transactions of the Entomological Society of London*, 1913: 545-585, plate 30.

Kaye, W. J. 1921. Catalogue of the Trinidad Lepidoptera: Rhopalocera. *Memoirs of the Department of Agriculture, Trinidad and Tobago*, 2: 163 p.

Kendall, R. O. 1976. Larval food plants for thirty species of skippers (Lepidoptera: Hesperiidae) from Mexico. *Bulletin of the Allyn Museum*, 39: 9 p.

Longstaff, G. B. 1908. On some of the butterflies of Tobago. *Transactions of the Entomological Society of London*, 1908: 53-57. [Reprinted: *Agricultural Society Paper (Port of Spain)*, 586, 81-87.]

Longstaff, G. B 1912. Butterfly-hunting in many lands. Notes of a field naturalist. London: Longmans, Green & Co. 728 p.

Mabille, P. 1883. Description d'hespéries. *Annales de la Société Entomologique de Belgique*, 27: li-lxxviii.

Mabille, P. 1878. Description de lépidoptères nouveaux de la famille des hespérides. *Petites Nouvelles Entomologiques*, 2: 242, 261.

Mabille, P. 1891. Description d'hespérides nouvelles. *Annales de la Société Entomologique de Belgique*, 35: lix-lxxxviii, cvi-cxxi, clxviii-clxxxvii.

McGuire, W. W. and **Rickard, M. A.** 1974. An annotated checklist of the butterflies (Lepidoptera: Rhopalocera) of Bentsen-Rio Grande State Valley Park and vicinity (updated Quinn, M. 2001). Texas Parks & Wildlife Department, Bentsen-Rio Grande State Valley Park; Mission, Texas, USA, unpaginated. (Available from http://www.naba.org/ftp/bentsen_rgsvp.pdf; last accessed 15 Aug 2010).

Mielke, O. H. H. 2004. 95. Hesperiidae. p. 25-86. *In* **Lamas, G.** ed. Checklist: Part 4A Hesperioidea – Papilionoidea. Atlas of Neotropical Lepidoptera. Gainesville, Florida: Scientific Publishers.

Mielke, O. H. H. 2005. Catalogue of the American Hesperioidea: Hesperiidae (Lepidoptera). Curitiba, Brazil; Sociedade Brasiliera de Zoologia. 6 vols, 1536 p.

Mielke, O. H. H. and **Casagrande, M. M.** 2002. Notas taxonômicas em Hesperiidae neotropicais, com descrições de novos taxa (Lepidoptera). *Revista Brasiliera de Zoologia*, 19 (Supl. 1): 27-76.

Möschler, H. B. 1883. Beiträge zur Schmetterlings-Fauna von Surinam. V. (Supplement). *Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien*, 32: 303-362, plates 17-18.

Moss, A. M. 1949. Biological notes of some Hesperiidae of Para and the Amazon. *Acta Zoologica Lilloana Tucuman*, 7: 27-79.
Remillet, M. 1998. Catalogue des insectes ravageurs des cultures en Guyane Française. Editions de l'ORSTOM, Paris, France. 235 p.
Scott, J. A. 1986. The Butterflies of North America. A Natural History and Field Guide. Stanford, California: Stanford University Press. 583 p.
Scudder, S. H. 1872. A systematic revision of some of the American butterflies, with brief notes on those known to occur in Essex County, Massachusetts. *Report, Peabody Academy of Sciences*, 4: 24-83.
Sheldon, W. G. 1936. Tobago and its butterflies. *Entomologist*, 69: 1-9.
Sheldon, W. G. 1938. Additions to the butterflies of Tobago. *Entomologist*, 71: 29-31.
Steinhauser, S. R. 1975. An annotated list of the Hesperiidae of El Salvador. *Bulletin of the Allyn Museum*, 29: 34 p.
Stoll, C. (see Cramer, P.).
Tropicos 2009. Tropicos.org. Missouri Botanical Garden. http://www.tropicos.org (Last accessed 11 Oct 2010).
Warren, A. D. 2000. 30. Hesperioidea (Lepidoptera). *In* **Llorente Bousquets, J. E., González Soriano, E.** and **Papavero, N.** eds. Biodiversidad, Taxonomía y Biogeografía de Artrópodos de México: Hacia una Síntesis de su Conocimiento. Volumen II. Mexico City, Mexico, Universidad Nacional Autónoma de México, pp. 535-580.
Williams Jr., R. C. and **Bell, E. L.** 1931. Hesperiidae of the Forbes expedition to Dutch and British Guiana (Lepidoptera). *Transactions of the American Entomological Society*, 57: 249-287, 290, plate 25.

NATURE NOTE

Notes on the Snake *Erythrolamprus ocellatus* in Tobago, Trinidad and Tobago

Erythrolamprus ocellatus (Peters 1868) is an uncommon snake endemic to Tobago (see front cover). On 28 July, 2010, a specimen was collected by author (PC) at about 0700 h on the Des Vignes Road, Runnemede, close to the landmark silk cotton tree. This is the first specimen collected from the area, and the most western record for this species. The specimen's snout to vent length measured 453 mm, its tail 82 mm, and it weighed 38 g. There were 176 ventral scales and 44 paired subcaudals.

Emsley (1966) described this snake as "eager to bite" and "potentially dangerous". Our specimen however, never attempted to bite despite being extensively handled. Dave Hardy and Matt Kelly (personal communication) have confirmed that they have handled several specimens of this species and have never been bitten. The snake flattened its neck when disturbed, and upon attempting to handle it, swiped its head from side to side. This behaviour is similar to that of the common coral snake *Micrurus circinalis* in Trinidad. We spoke to several Tobagonians, most of whom used the name "coral snake" to refer to the harmless *Erythrolamprus ocellatus*. The lack of any banding pattern in the latter species easily distinguishes it from the former.

The captive specimen consumed two snakes (one *Tantilla melanocephala* and one *Attractus trilineatus*) and a worm lizard (*Amphisbaena fuliginosa*). *A fuliginosa* (not recorded on Tobago) is a new captive prey item for *E. ocellatus*. It attempted unsuccessfully to subdue two other snakes; *Sibon nebulata nebulata* and *Leptodeira annulata ashmeadi.* Julius Boos got one specimen to eat the lizard *Gymnopthalmus underwoodi* in captivity (Boos 2001), but our specimen refused several which were available. It was most active in the morning from 0630-0745 h and again at 1730-1815 h.

The specimen is lodged at the Zoology Museum of the University of the West Indies, St. Augustine, Trinidad as accession UWITT.2010.27.1, and is probably the only museum specimen of this species in the Caribbean region.

REFERENCES

Boos, H. E. A. 2001. The Snakes of Trinidad and Tobago. College Station, Texas: Texas A & M University Press. 270 p.
Emsley, M. G. 1966. The mimetic significance of *Erythrolamprus aesculapii ocellatus* Peters from Tobago. *Evolution,* 20: 663-665.

Stephen L.S. Smith
cascabeldormillon@yahoo.com

Stevland P. Charles
stevlandcharles@gmail.com

Peter Cox
petercoxtours@yahoo.com

A Preliminary Survey for Spiders on St. Lucia, West Indies

Jo-Anne Nina Sewlal
Dep't. of Life Sciences, University of the West Indies,
St. Augustine, Trinidad and Tobago.
joannesewlal@gmail.com

ABSTRACT
During a two-week period in August 2010, a wide variety of habitats on the island of St. Lucia, West Indies were surveyed for the presence of spiders. As in previous surveys in Grenada and Montserrat, St. Lucia produced more species in natural than in human-made or highly disturbed habitats. Thirteen localities were surveyed from 11 habitats, including five man-made habitats. Twenty-two families representing 40 species were collected. Members of the families Araneidae and Tetragnathidae comprised almost half of the species found.

Key words: Anapidae, Araneidae, Corinnidae, Linyphiidae, Lycosidae, Miturgidae, Mimetidae, Mysmenidae, Oecobiidae, Oxyopidae, Pholcidae, Pisauridae, Salticidae, Sparassidae, Scytodidae, Symphytognathidae, Tetragnathidae, Theridiidae, Theridiosomatidae, Thomisidae, Theraphosidae, Uloboridae.

Arthropods comprise the most diverse organisms in any terrestrial environment. However, sampling arthropods are particularly challenging due to traits such as small size, short generation time, diversity, limited distribution and strict environmental requirements (microhabitats). These traits make it possible in theory to map environmental diversity and track environmental changes faster and more precisely than longer lived and more flexible organisms like vertebrates and plants.

Spiders have a worldwide distribution, occupying all land environments except at the polar extremes. Currently almost 42,000 species of spiders are described (Platnick 2010), representing what is believed to be roughly one-fifth of the total in the world. The spider fauna of the Neotropics remains relatively unknown. Currently, the islands of Barbados (G. Alayón and J. Horrocks, unpubl.), St. Vincent and the Grenadines (Simon 1894; de Silva *et al.* 2006), Anguilla (Sewlal and Starr, *in press*.), Antigua (Sewlal 2009a), Nevis (Sewlal and Starr 2007), St. Kitts (Sewlal 2008), Grenada (Sewlal 2009b) and Montserrat (Sewlal 2010a) are the only islands in the Caribbean whose spider fauna has been documented at the species level, although this has been done at the family level for Trinidad (Cutler 2005; Sewlal and Cutler 2003; Sewlal and Alayón 2007; Sewlal 2009c, 2010b). Additional information on the family Pholcidae of these islands, including Grenada, Anguilla and St. Kitts was documented by Sewlal and Starr (2008).

I spent two weeks (7 to 21 August, 2010) on the island of St. Lucia conducting a survey of its spider fauna with the aim of collecting a substantial part of the fauna in a broad variety of habitats. St. Lucia is one of the southern Lesser Antilles at (13°53'N, 60°58'W). St. Lucia has an area of 616 km^2. It is volcanic in origin with a highest elevation of approximately 950 m. It has a range of habitats including mangrove woodland, littoral woodland, deciduous and semi-evergreen seasonal forest and savanna.

The main collecting methods employed were sweep-netting and visual search, both at the ground level and above ground, including examining shrubs and low trees. Cryptic microhabitats, like under rocks, rotting logs and bark, were also searched. Both collecting methods were employed at each site visited. Each site was visited once due to the time constraints of the project. Only daytime surveys were conducted as nocturnal surveys would have been too dangerous to carry out. All specimens were stored in glass vials in 70% alcohol.

Thirteen localities covering 11 habitats were sampled, including five that were man-made habitats or heavily influenced by human activities. The sampling produced a total of 40 species from 22 families. Secondary vegetation produced the highest number of species (Table 1), while one natural habitat (coastal vegetation) and one human-made habitat (garden) showed the lowest species richness, yielding only four species each. An accumulation curve of the data (Fig. 1) levels off halfway through the sampling but then starts to climb again indicating that additional sampling is needed to document the fauna of this island.

The localities of natural habitats were concentrated in the south and east of the island as they are present in areas large enough to allow for adequate sampling. Also, as most of the localities are not heavily populated or cultivated, the conditions in these ecosystems can be considered close to pristine, which could account for the relatively high level of species richness and diversity of the natural habitats. Out of the natural habitats sampled, coastal vegetation showed the lowest species richness (Table 1), which can be taken as an indication of the

Table 1. Showing the species of both Araneomorphae and Mygalomorphae spiders for each habitat sampled in St. Lucia for the period 7th to 21st August, 2010.

Family and Species	**Habitat**											
	Garden	**In and on Buildings**	**Roadside**	**Farmland**	**Secondary Veg.**	**Riparian Veg.**	**Deciduous Forest**	**Semi-evergreen Forest**	**Lower Montane Forest**	**Mangrove**	**Littoral Woodland**	**Coastal Veg.**
Anapidae Sp. A			✓									
Araneidae *Acacesia* c.f. *hamata*								✓				
Argiope argentata	✓	✓	✓	✓	✓	✓	✓			✓		✓
Cyclosa caroli	✓				✓	✓		✓	✓			
c.f. *Eustala anastera*							✓	✓		✓		✓
Eustala fuscovittata				✓								
Gasteracantha cancriformis					✓	✓						
Metepeira compsa	✓	✓									✓	✓
Neoscona neothesis			✓	✓								
Corinnidae Sp. A										✓		
Linyphiidae Sp. A		✓										
Lycosidae Sp. A									✓			
Mimetidae Sp. A											✓	
Miturgidae c.f. *Cheracanthium* sp.										✓		
Mysmenidae Sp. A								✓				
Oecobiidae Sp. A		✓									✓	
Oxyopidae *Oxyopes salticus*			✓	✓		✓	✓	✓	✓	✓	✓	
Pholcidae Sp. A								✓				
Modisimus sp.			✓		✓				✓			
Physocyclus globosus		✓										
Pisauridae Sp. A						✓						

Family and Species	**Habitat**											
	Garden	**In and on Buildings**	**Roadside**	**Farmland**	**Secondary Veg.**	**Riparian Veg.**	**Deciduous Forest**	**Semi-evergreen Forest**	**Lower Montane Forest**	**Mangrove**	**Littoral Woodland**	**Coastal Veg.**
Salticidae Sp. A			✓								✓	
Sp. B		✓										
Sp. C			✓	✓			✓	✓			✓	
Sp. D					✓							
Lyssomanes sp.								✓				
Scytodidae *Scytodes longipes*										✓		
Sparassidae *"Olios"* sp.			✓		✓		✓		✓	✓		
Symphytognathidae Sp. A										✓		
Tetragnathidae *Aleimosphenus licinus*			✓				✓		✓			
Leucauge argyra	✓		✓	✓	✓	✓						
Leucauge regnyi			✓		✓	✓	✓	✓	✓	✓		
Tetragnatha nitens						✓		✓	✓			
Theridiidae Sp. A					✓							
Argyrodes elevatus				✓		✓	✓	✓	✓			✓
Theridiosomatidae Sp. A			✓		✓							
Theraphosidae Sp. A					✓							
Thomisidae c.f. *Misumenops asperatus*				✓		✓			✓		✓	
Uloboridae *Miagrammopes* sp.					✓				✓			
Uloborus pencillatus					✓				✓			
TOTAL	**4**	**6**	**12**	**8**	**13**	**10**	**8**	**11**	**12**	**9**	**7**	**4**

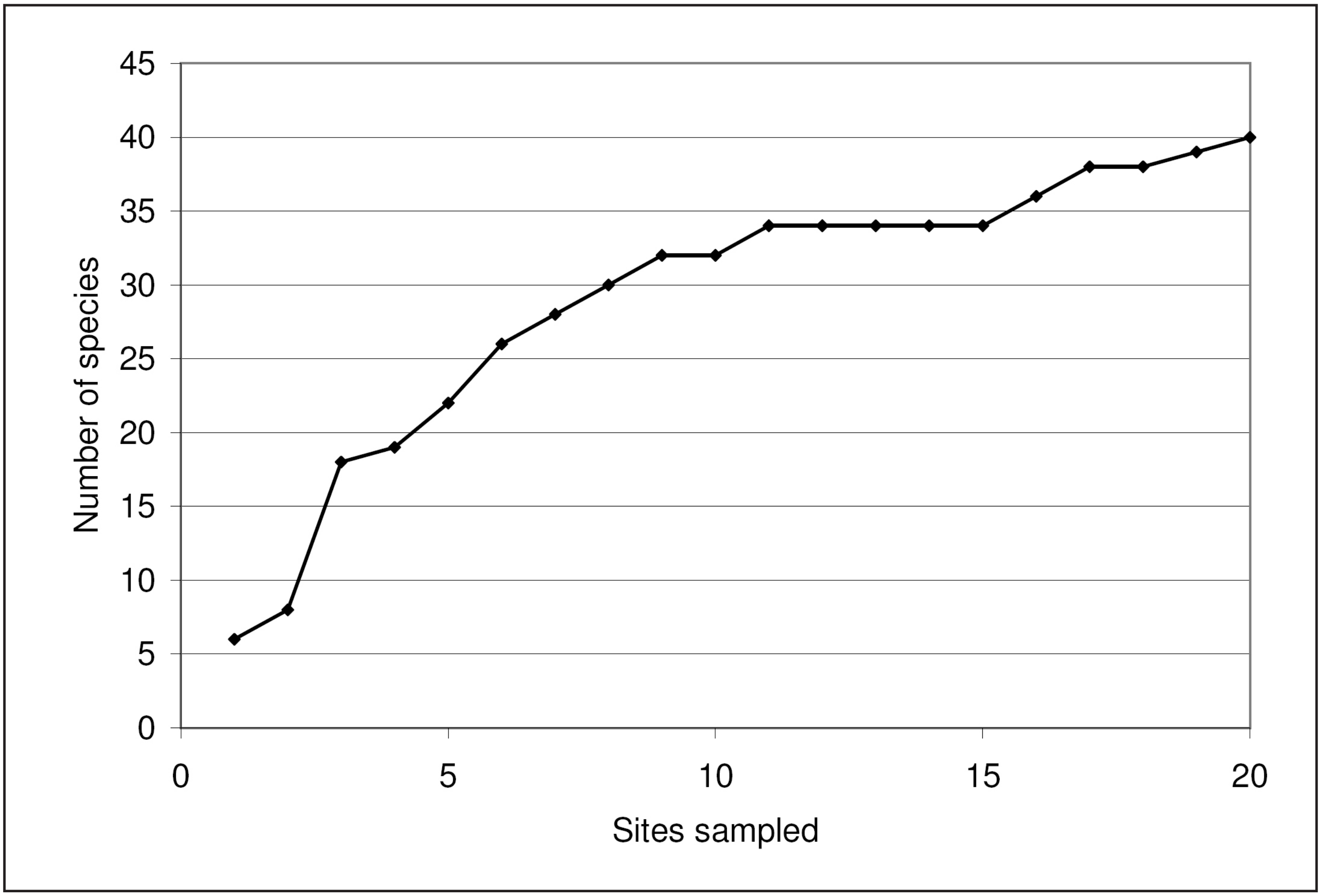


Fig. 1. Species accumulation curve of the species of both Araneomorphae and Mygalomorphae spiders for each habitat sampled in St. Lucia for the period 7th to 21st August, 2010.

harsh conditions found in this habitat, especially the constant exposure to strong winds.

With respect to secondary vegetation, the disturbance caused by logging of trees of commercial importance has constantly created new niches while some areas have remained undisturbed for decades, so that both generalist and specialist species can be found in these habitats, which in turn translates to high species richness. This is most likely, since as with other altered habitats, they provide many and/or suitable points of attachment for families that construct webs to catch their prey. Some habitats also provide a natural path or gap in the vegetation where prey, in particular flying insects, can be blown into webs. Another feature of most altered habitats is the presence of artificial lighting during the night which attracts flying insects, so that nocturnal species have a more or less steady food supply. However, gardens showed the lowest species richness of disturbed habitats producing only four species. A possible explanation for this is the use of pesticides in this habitat during the course of their maintenance.

The families Araneidae, Oxyopidae and Tetragnathidae were the most species rich yielding 9, 8 and 7 species respectively. Araneidae and Tetragnathidae were also the two most ecologically diverse families containing species collected from 11 and 9 habitats respectively. Species from nine families were found in single habitats, four of which were collected from mangrove woodland. This indicates that out of the natural habitats sampled, mangrove woodland had a unique species composition. However, this is a preliminary survey so that with further sampling more species from those families could be found in other habitats on the island.

Specimens from the Mygalomorphae group, or tarantulas commonly referred to locally as “Matutu”, were collected from disturbed forest habitats.

ACKNOWLEDGEMENTS

Thanks go out to the Ministry of Agriculture, Forestry Department in St. Lucia for all of their assistance. The following persons and organisations assisted in facilitation, transport, and assistance in the field: Alwin Dornelly, Anthony Donald, Nereus Mitchell, Julius Georges, Carl Augustine, George Antoine, Peter Jn. Baptiste, Onellmus Charleroy, Greg Pereira, Veronica Simon, Sally Erdle and John Kessell. Many thanks to Christopher Starr for commenting on this manuscript.

This project was partially funded by a grant from the British Arachnological Society and a Percy Sladen Memorial Fund Grant from The Linnean Society of London.

REFERENCES

Cutler, B. 2005. Synotaxidae, another Trinidadian spider (Araneida) family. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2005: 49.

de Silva, M., Alayón, G. and **Horrocks, J. A.** 2006. The Spiders and their Relatives of St. Vincent and the Grenadines. Mayreau Environmental Development Organization, Mayreau Island, St. Vincent and the Grenadines. 129 p.

Longino, J. T. 1994. How to measure arthropod diversity in a tropical rainforest. *Biology International,* 28: 3-13.

Platnick, N. I. 2010. The world spider catalog, version 11.0. American Museum of Natural History, online at http://research.amnh.org/entomology/spiders/catalog/index.html

Scharff, N., Coddington, C. A., Griswold, C. E., Horminga, G. and **Bjǿrn, P.** 2003. When to quit? Estimating spider species richness in a northern European deciduous forest. *Journal of Arachnology,* 31: 246-273.

Sewlal, J. N. 2008. A preliminary survey for spiders on St. Kitts, West Indies with comparative notes on Nevis. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2008: 66-69.

Sewlal, J. N. 2009a. A preliminary survey for spiders on Antigua, West Indies. *The College of the Bahamas Research Journal,* 15: 8-11.

Sewlal, J. N. 2009b. A preliminary survey for spiders on Grenada, West Indies. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2009: 37-39.

Sewlal, J. N. 2009c. Two additional spider (Arachnida: Araneida) families for Trinidad and Tobago. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2009: 36.

Sewlal, J. N. 2010a. A preliminary survey for spiders on Montserrat, West Indies. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2010: 31-34.

Sewlal, J. N. 2010b. Presence of the spider family Titanoecidae in Trinidad and Tobago. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2010: 63.

Sewlal, J. N. and **Cutler, B.** 2003. Annotated list of spider families of Trinidad and Tobago (Araneida). *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2003: 9-13.

Sewlal, J. N. and **Alayón, G.** 2007. Four more Trinidadian spider (Arachnida: Araneida) families. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2007: 85.

Sewlal, J. N. and **Starr, C. K.** 2007. A preliminary survey for spiders on Nevis, West Indies. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2007: 86-87.

Simon, E. 1894. On the spiders of the island of St. Vincent, II. *Proceedings of the Zoological Society of London,* 1894: 519-526.

Land Snails from the Five-Islands Archipelago, North-west Trinidad, West Indies

Mike G. Rutherford
Department of Life Sciences, University of the West Indies, St. Augustine, Trinidad and Tobago.
mike.rutherford@sta.uwi.edu

ABSTRACT
A small collection of unidentified land snails were found in the University of the West Indies Zoology Museum and discovered to be part of a study from 1995 looking at distributional ecology on the Five-Islands Archipelago, north-west Trinidad. The snails were identified and the results of the study were reassessed based on the new information gained.

Key words: Terrestrial molluscs.

BACKGROUND

The University of the West Indies Zoology Museum (UWIZM), based at its St. Augustine Campus, has extensive collections covering a wide variety of animal phyla including over 4000 molluscs. Amongst the molluscs is a small collection of terrestrial snails made by students during a field trip for the 1995 Caribbean Island Ecology class run by Dr. Stanley Temple.

The snails all came from the so-called Five-Islands, which are in fact a group of six islets lying just off the northwestern peninsula of Trinidad.

The students were investigating the distribution of island species in relation to the area of the island and the influence of habitat diversity on species numbers. They surveyed the islands for woody plants, ants, reptiles, land birds and land snails.

Of the organisms studied, the birds and reptiles were easily identified; plants were sent to the National Herbarium, University of the West Indies, and the ants to Mark Dubois of the Illinois Natural History Survey for identification. The snails were merely grouped into morphological types rather than species.

In this paper I identified the snails to species level and then recalculated the relevant statistics from Temple's paper.

METHODS AND RESULTS

Identification of specimens

The specimens each had a handwritten label with the time of day when the sample was collected, the name of the island on which it was found and a capital letter that indicated to which morphological type each specimen had been allocated.

The snails from the study were all identified to species level using a variety of journal papers and books (Guppy 1864, 1866; Smith 1896; Haas 1962; Venmans 1963; Emerson and Jacobson 1976; Auffenberg and Stange 1988). Nine species of snail were identified (see Table 1). The shells are stored in the UWIZM under the accession numbers UWITT.2011.4.1 to .20.

Table 1. Snail species in the study, Five-Islands, north-west Trinidad.

Family	**Species**
Subulinidae	*Allopeas gracile* (Hutton, 1834)
Subulinidae	*Beckianum beckianum* (L. Pfeiffer, 1846)
Subulinidae	*Allopeas micra* (d'Orbigny, 1835)
Subulinidae	*Subulina octona* (Bruguière, 1792)
Helicinidae	*Helicina dysoni* (L. Pfeiffer, 1849)
Orthalicidae	*Orthalicus undatus* (Bruguière, 1792)
Orthalicidae	*Plekocheilus glaber* (Gmelin, 1791)
Neocyclotidae	*Cyclohidalgoa translucidum trinitense* (Guppy, 1864)
Streptaxidae	*Streptaxis glaber* (L. Pfeiffer, 1849)

Three of the original samples were not found and have been presumed lost. Table 2 shows the species and the island on which they were found. The bottom three rows show the total number of snail species for each island – **A** is the number from the 1996 paper; **B** is the number of newly identified species and; **C** is the number used in the statistical analysis.

Several assumptions were made for the purposes of the statistical analyses. Firstly, it was assumed that for Caledonia Island snail "I" was a different species from all the other snails; as there was only one specimen assigned to this morphological type, it must have been distinctly different from the other specimens. Secondly, it was assumed that for Lenagan Island snail "B" was *Subulina octona* as snail "B" from Caledonia and Nelson Island were both *S. octona*. Thirdly, again for Lenagan Island, it was assumed that snail "E" was either *Beckianum beckianum* or *Allopeas gracile* as that is what the other two snail "E" were, thus although the exact species is not known it was surmised that there is a fourth species of snail for Lenagan Island.

Table 2. Snails found on the Five-Islands, north-west Trinidad during 1995.

Species	**Caledonia Island**	**Nelson Island**	**Lenagan Island**	**Pelican Island**	**Rock Island**	**Craig Island**
Snail "A"	*Subulina octona*	*Subulina octona* + *Allopeas gracile*	*Subulina octona*	*Subulina octona* + *Allopeas micra*	*Subulina octona* + *Beckianum beckianum*	
Snail "B"	*Subulina octona*	*Subulina octona*	Specimen lost			
Snail "C"	*Helicina dysoni*	*Helicina dysoni*	*Helicina dysoni*	*Helicina dysoni*	*Helicina dysoni*	
Snail "D"		*Plekocheilus glaber*				
Snail "E"	*Beckianum beckianum*	*Allopeas gracile*	Specimen lost			
Snail "F"			*Streptaxis glaber*	*Streptaxis glaber*		*Streptaxis glaber*
Snail "G"						*Orthalicus undatus*
Snail "H"	*Cyclohidalgoa translucidum trinitense*					
Snail "I"	Specimen lost					
Total **A**	6	5	5	3	2	2
Total **B**	4	4	3	4	3	2
Total **C**	5	4	4	4	3	2

Statistical analysis

In Temple's paper the two main statistical analyses carried out were the creation of species-area curves for each taxonomic group studied and correlation analyses looking at the relationship between the features on the islands and the number of species found.

The species-area curve was described using the power function equation $S = cA^z$, where S = number of species, A = island area and c and Z are constants that are taxa specific. As the number of snail species, after identification, is different for some of the islands, the equation for snails was recalculated using MS Excel.

In Temple's paper the original values for the equation were calculated as $S = 4.69\ A^{0.271}$, but when I used the original data to check the c and Z values, the values came back as $S = 4.72\ A^{0.309}$. To find the source of this discrepancy I checked back through the paper and noticed that in his Table 2 it says two snails were found on Pelican Island and three on Rock Island which was different from the numbers mentioned in the text which had three snails for Pelican and two for Rock. By checking the specimens, I confirmed that the Table was wrong and the text was correct. It is possible that the information from the table had been used when calculating the equation leading to the error. However, even when this was taken into account the equation still came back as $S = 4.64\ A^{0.290}$, a smaller difference and one that I suspect is due to the different computer programmes used to calculate the equation. Not having access to a 1995 version of SYSTAT, I cannot confirm this but for the purposes of this study I was willing to accept the minor difference.

With the new snail species totals for each island, new values of c and Z were calculated and the results were $S = 4.23\ A^{0.184}$.

In the original paper the correlation analyses for the snails showed that there was a significant positive correlation between the area of the island and the number of snail species and between the number of buildings and the number of snail species and a significant negative correlation between building cover and the number of snail species. Using the new snail species totals, these correlations were recalculated using MS Excel. Table 3 shows the original figure and the recalculated results. Only two of the three correlations remained significant after the recalculation.

Table 3. Correlations between number of snail species and island features. Only statistically significant correlations (r>0.725, p>0.10) are presented.

Number of Snail Species		
Features of Islands	**Temple's Paper (1996)**	**This Paper**
Area	+0.847	+0.749
Elevation		
Forest Cover		
Grass Cover		
Rock Cover		
Building Cover	-0.823	-0.909
No. of Buildings	+0.863	
Canopy Height		

DISCUSSION
Snail species

The nine species of snails identified are commonly found throughout Trinidad in a variety of habitats and as such their presence on the Five-Islands is not unexpected. They can, however, be split up into two main groups - the five smaller snails mainly from the Subulinidae family and the four larger snails from several different families.

Of the smaller snails several of them, *Subulina octona*, *Allopeas gracile* and *Allopeas micra,* are widespread throughout the tropics and subtropics and are also found as hothouse aliens in several temperate countries. *Beckianum beckianum* is found throughout the West Indies and Central America and *Streptaxis glaber* is found in northern South America and the southern Caribbean. In many cases these snails are recorded as introduced or alien species in the countries in which they are found.

Two of them, *A. gracile* and *Allopeas micra,* were only found on one island each with the former only on the second largest island and the latter only on the third smallest island, whilst *B. beckianum* was found on two islands, the largest one and the second smallest. *S. glaber* was found on three of the smaller islands but not the two larger ones; this is surprising as you might expect to find such a common snail on the larger islands first. Finally, the most widespread snail from this group was *S. octona,* which was found on five of the six islands. This mixed distribution could suggest that this species presence on the other islands is quite likely as they were on both small and large islands but that due to their very small size (often less than 10 mm long) they may have been missed in the sampling process. With all of these small snails I suspect that after further searching they will be found on the majority of the islands.

The larger snails, *Orthalicus undatus*, *Cyclohidalgoa translucidum trinitense* and *Plekocheilus glaber,* are more limited in their distribution. The first may only be found on Trinidad, the second on Trinidad and nearby Venezuela and the last one on Trinidad, Tobago, Grenada, Suriname and Guyana. All three species were represented by a single specimen each thus making it harder to draw conclusions about their distribution on the Five-Islands. *O. undatus*, the largest species in the study, was found only on the smallest island, which is at odds with expectations. However, it should be noted that this specimen was damaged and incomplete and might have been on the island as a result of being carried there by a predator.

The fourth largest snail, *Helicina dysoni,* is a bit of an exception; although it is similarly restricted as far as international distribution goes, it is amongst "the commonest of land shells in Trinidad" according to R.J.L. Guppy (1864). Specimens were found on five of the islands in large numbers.

In the 1995 study, the most mistakes in allocating snails to a morphological distinct type were made in snail groups A, B and E. All the snails in these three groups were from the family Subulinidae and were all of a similar size and shape if sorted by the naked eye. This shows that care should be taken when splitting snails up into morphologically distinct types for similar studies. Although this method can prove useful, some basic knowledge of the anatomy of the target group is essential.

Another contributing factor to the confusion was the fact that the snails in group "B" were actually juvenile *S. octona*. As juvenile snails often have a different number of whorls than the adults, it can be difficult to attribute them to the same species.

Species-area relationships

Temple (1996) stated that the relationship between island area and species diversity has strong theoretical and empirical support. It was also mentioned that the Z value in the species-area equation is usually in the range of 0.2 -0.4. Whilst this was true of the Z value in the 1995 paper, after the new species totals were used to calculate the equation, the Z value came out as 0.184. This is outside of the expected range. In the original study the only other group that was also outside of the expected range was the ants with a Z value of 0.077. This was explained as possibly being a result of the lack of suitable habitats for the ants on these small, dry islands and that only "super tramp" ant species could successfully colonize such a place. Although the Z value for the snails is nowhere near as low as the Z value for the ants, it is heading in the same direction and as such it could be said that two of the snails at least, *Subulina octona* and *Streptaxis glaber,* are snail "super tramps". *Helicina dysoni* could have been included in this category as it was very widespread in the islands. However, it is not as widespread regionally as the other two snails which could suggest that it does not have the same colonising ability.

Correlations

The changes in the correlations between species numbers and island features after recalculation showed that area was still a significant factor in predicting the number of species and that the percentage of building cover was even more significant than before. The number of buildings on the islands still had a fairly high positive correlation with number of species but was no longer above the statistically significant level. The reason for the island area and building cover on the islands having such an effect on the number of snail species is most likely a result of the range of different habitats available to the snails.

CONCLUSIONS

The original study showed some of the principal theories of island ecology. With the information gained from identifying the snail shells, a more accurate assessment could be made of the ecology of terrestrial molluscs on the Five-Islands. However, working on this paper just generated further questions and a more thorough study of the molluscan biota of Trinidad's islands needs to be undertaken.

ACKNOWLEDGEMENTS

Thanks to C.K. Starr for recognising the origin of the specimens and keeping the original paperwork of the study; to M.P. Oatham for refreshing my mind in regards to statistics and to David G. Robinson and A.S.H. Breure for help with snail taxonomy.

REFERENCES

Auffenberg, K. and **Stange, L. A.** 1988. The Subulinidae of Florida. *Entomology Circular No. 305*, Florida Department of Agriculture and Consumer Services.

Emerson, W. K. and **Jacobson, M. K.** 1976. The American Museum of Natural History Guide to Shells, Land, Freshwater and Marine, from Nova Scotia to Florida. New York: Alfred A. Knopf. 482 p.

Guppy, R. J. L. 1864. Descriptions of new species of Fluviatile and terrestrial operculate mollusca from Trinidad. *The Annals and Magazine of Natural History* (Ser. 3), 14: 243-248.

Guppy, R. J. L. 1866. Catalogue of the land and freshwater mollusca of Trinidad. *Proceedings of the Scientific Association of Trinidad,* 1866:10-35.

Haas, F. 1962. Caribbean land molluscs: Subulinidae and Oleacinidae. *Studies on the Fauna of Curaçao and other Caribbean Islands,* 13: 49-60.

Smith, E. A. 1896. A list of the land and freshwater mollusca of Trinidad. *Journal of Conchology,* 8: 231-251.

Temple, S. A. 1996. Distributional ecology of selected plants and animals on Trinidad's Five-Islands Archipelago. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1995-1996: 22-26.

Venmans, L. A. W. C. 1963. Caribbean land mollusks: Streptaxidae. *Studies on the Fauna of Curaçao and Other Caribbean Islands,* 61: 41-76.

The Distribution of the Frog *Eleutherodactylus johnstonei* (Amphibia: Eleutherodactylidae) in Trinidad, West Indies

Shiva A. Manickchan[1,2], **Christopher K. Starr**[1], **Carol Ramjohn**[2], **Srishti V. Mahabir**[2], **Kevin Mahabir**[2] and **Ryan S. Mohammed**[2]

1. Life Sciences Department, The University of the West Indies, St. Augustine, Trinidad and Tobago.
2. Strategic Environmental Services (SES) Ltd., 5 Henry Pierre Terrace, St. Augustine, Trinidad and Tobago.

Corresponding author: *s.a.manickchan@gmail.com*

ABSTRACT

Eleutherodactylus johnstonei is an invasive anuran of Trinidad, West Indies. Monitoring the spread has shown that its local range is the north-west of Trinidad. *E. johnstonei* is increasing in population size and is increasing its local range by expanding into disturbed habitats. No immediate ecological threat has been identified. Previous studies on high amplitude callers suggest that *E. johnstonei* has the potential to become a pest in urban residential areas due to its loud mating calls. It is likely that *E. johnstonei* has become a permanent part of Trinidad's biodiversity and its calls would become common in many more suitable disturbed areas in Trinidad.

Key words: *Eleutherodactylus, johnstonei,* invasive species, distribution, anuran, audio monitoring.

INTRODUCTION

Eleutherodactylus johnstonei is an invasive anuran first reported in Trinidad by Kenny (1979) as *E. martinicensis.* It is a small, dull coloured frog, brown to gray dorsally with a creamy under surface (Savage 2002). Adult males are 17-25 mm long and adult females 17-35 mm (Savage 2002).

Males call from sunset to after midnight producing a short, high-pitched two note call. A short 2000 Hz note followed by a longer 3500 Hz note makes up the call (Watkins *et al.* 1970). Males call from ground level to 3 m above the ground (Murphy 1997). In Trinidad, calling males were heard mostly in disturbed habitats often in hedges and potted plants around residences and business places.

E. johnstonei feeds mostly on ants, but also on leafhoppers, spiders, termites and springtails (Savage 2002; Murphy 1997). It is most likely eaten by many predators including other anurans. *E. johnstonei* is a leaf litter and cavity breeding frog. It is not dependent on standing water for any part of its life cycle including metamorphosis (Bourne 1997). Calling and reproduction occurs throughout the year however, reproduction is highest during the wettest months of the year. Studies in Guyana showed that males sired 3.3 clutches/year while females produced 4.3 clutches/year (Bourne 1997). Egg clutches contain on average 14 eggs; hatched froglets have a snout-to-vent length of 3.5 mm and reach sexual maturity in about a year (Bourne 1997).

E. johnstonei's current range is the Lesser Antilles and is considered to be an invasion species of Bermuda, Jamaica, Trinidad, Venezuela, Curaçao, Guyana, Anguilla, Dominica and Panama City (Schwartz and Henderson 1991; Kaiser 1992; Kaiser and Hardy 1994). Its ability to colonise and use a great variety of habitats is based on *E. johnstonei's* broad physiological tolerance to dehydration and high temperatures and its non dependence on standing water (Pough *et al.* 1977; Stewart and Martin 1980; Stewart 1977).

The last published range of *E. johnstonei* in Trinidad includes a report from Kaiser (1997) of two populations existing outside the Port of Spain harbour. Murphy (1997) described the distribution in Trinidad as the Port of Spain dock area in the vicinity of the Port of Spain Holiday Inn (now Crowne Plaza). Since then the range of *E. johnstonei* has expanded greatly. Monitoring *E. johnstonei's* spread in Trinidad is continuing and this study updates the known distribution of *E. johnstonei* in Trinidad up to February 2011.

METHOD

Male *E. johnstonei* have distinctive mating calls and usually calls from just after sunset to early hours of the morning. This distinctive call alllows one to monitor for their presence. Accordingly, monitoring was done from just after sunset until midnight along the roadways of Trinidad. Monitoring was done from 2000 until 2002 (Manickchan 2003). More recently the monitoring period spanned two cycles of wet and dry seasons from October 2009 to February 2011. A total of 100 nights of monitoring was achieved within this period, 25 per season, per year.

Most monitoring was done during Sunday to Thursday nights. Friday and Saturday nights were largely avoided as the human sound factor sometimes made acoustic monitoring difficult. To monitor, the vehicle was stopped at intervals for a two-minute period and presence/absence data was collected for that point (small area within audio range of calling individuals, diameter about 50 m). Usually over 100 points could be monitored per night. Over 2000 points were monitored. Many northern areas from Chaguaramas to Toco, western areas Curepe to Icacos, southern and central areas and eastern areas from Manzanilla to Guayaguayare were monitored. Areas monitored were chosen to cover as much of Trinidad as possible. Points were chosen to reflect a range of levels and types of disturbance and habitat types. A few off-road sites were also monitored. Within a chosen area, of around 5 km^2, 5 -10 points were randomly chosen and monitored. If *E. johnstonei* was found to be present in the area, more intensive monitoring was achieved by monitoring every 50 m. This allowed entire population sizes to be estimated. Beyond the monitoring days, several amateur herpetologists and all field assistants (over 10 people) were trained to identify *E. johnstonei's* calls and noted its presence wherever found. These areas were checked or rechecked. All anecdotal presence data from other herpetologists were also checked. Records of recent Trinidadian anuran surveys, mostly Environmental Impact Assessments, were also examined.

RESULTS

E. johnstonei's distribution is currently limited to the north-west portion of the island. Figure 1 shows the currently known distribution of *Eleutherodactylus johnstonei* in Trinidad.

The areas shown in Fig. 1, from west to east, are Chaguaramas, Carenage, Goodwood Park, Westmoorings, Four Roads junction, Morne Coco Road, Sierra Leone, St. Lucien, Water Wheel, Cocorite, Maraval, St. James, Woodbrook, Port of Spain, Barataria, San Juan, El Socorro, Aranguez, St. Joseph, Curepe, St. Augustine, Macoya, Maloney and La Horquetta.

The largest populations of *E. johnstonei* were found at Diego Martin, Woodbrook, San Juan and El Socorro (over 2000 calling individuals per area). The most westerly located presence sites, Chaguaramas, Carenage and Goodwood Park, and the most easterly located presence sites, St. Joseph, Curepe, St. Augustine, Macoya, Maloney and La Horquetta, have relatively small populations of less than 50 calling individuals (often less than 10).

DISCUSSION

The presence of *E. johnstonei* was first noted in Trinidad by Kenny (1979) and the frog has now become established in a few locations of Trinidad. In 1992, two small populations of *E. johnstonei* 200 m apart were observed in Port of Spain (Kaiser 1997). By the end of 2002, the population was in the thousands and extended

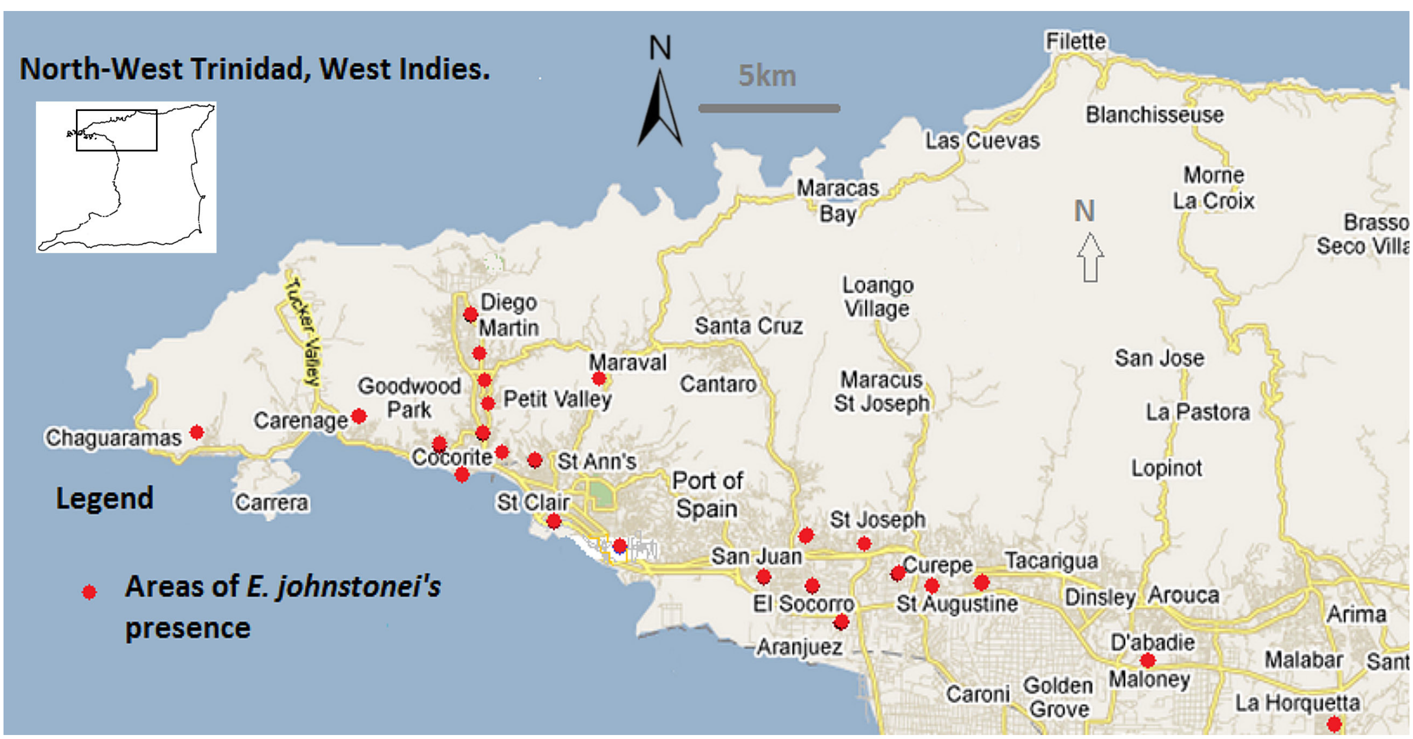


Fig. 1. Currently known distribution of *Eleutherodactylus johnstonei* in Trinidad, West Indies.

from Goodwood Park to Curepe (Manickchan 2003). Currently the population extends from Chaguaramas to La Horquetta. All areas of *E. johnstonei's* distribution in Trinidad were in highly disturbed areas.

The distribution of *E. johnstonei* in Trinidad has followed a pattern seen in several other countries such as Panama City, Dominica, Venezuela and Guyana. *E. johnstonei* was introduced in Panama City by 1987 and by 1997 was common in gardens of residential areas (Kaiser 1997); in Dominica *E. johnstonei* was introduced by 1979 and by 1997 no undisturbed habitat had been colonized (Kaiser 1997); in Venezuela *E. johnstonei* has been present since the 1960's and 20 years later (Gorzula S. 1989; La Marca 1992) no natural habitats in Venezuela were colonised by the frog. In Guyana, voucher specimens of *E. johnstonei* were collected since 1919 (Kaiser 1997), but by 2002 populations of *E. johnstonei* remained confined to the urban areas although agricultural land and anthropogenic disturbed forest were close by (Kaiser *et al.* 2002).

Although *E. johnstonei* has successfully colonised many countries, its range expansion is largely limited to areas of habitat disturbance caused mainly by human expansion (Kaiser 1997). Competition and predation factors probably account for its rare occurrence in less disturbed areas. It is transported to new countries along with importation products (Kaiser 1997).

An invasive species can degrade an ecosystem in many ways such as by hosting diseases, altering natural processes, altering community structures, disrupting food webs and reducing biodiversity. Invasive organisms also reduce the habitat area available to local endemics and can cause population fragmentation. Documented negative impacts of invasive anurans include poisoning of native species, vectoring of parasites and diseases, water contamination and genetic contamination via hybridisation. Kaiser (1997) considers management of *E. johnstonei* to include prevention of further or repeat introductions, close monitoring of ranges and preservation of native habitat to ensure survival of local endemics.

The most commonly occurring calling sites of *E. johnstonei* in Trinidad are low elevation, well manicured urban residences with many plants. It is likely that *E. johnstonei* will continue to spread only into disturbed areas of Trinidad. Studies in Jamaica (Schwartz and Henderson 1991) and Venezuela (Hardy and Harris 1979), show that *E. johnstonei* is able to out-compete local endemics only in highly disturbed areas. As this niche is not the major habitat of any local endemics, *E. johnstonei* is unlikely to negatively affect any local endemics more than reducing the size of their available habitat. Besides habitat usage and competition factors, no other negative ecological impacts have been reported or observed for *E. johnstonei*.

An invading species will be considered a pest if it negatively affects the economy or aesthetics of an area. The main pest consideration for *E. johnstonei* is its loud continuous calls. At calling sites with very large numbers of callers, the sound is very loud and can be viewed as a disturbance. Some local residents complain about the sound but many seem so acclimatized as not to notice it (Manickchan, pers. comm.). Reports from Bermuda state that some visitors claim that *E. johnstonei* calls disturb their sleep while others learn to love the sound (Forbes 1992). An invasive anuran, *Eleutherodactylus coqui* was declared a pest in 2006 in Hawaii for several reasons including its loud mating calls (Kraus 2007). Studies show that this anuran's call has negatively affected the economy by negatively affecting tourism and property prices (Beard and Pitt 2005). Eradication of *E. coqui* in Hawaii has not been attempted due to its large population size and control and management of local populations has proven to be very difficult (Kraus 2007). No similar studies have been found for *E. johnstonei.*

The worldwide trend of increased habitat disturbance and documented *E. johnstonei* population growth patterns suggest that locally *E. johnstonei's* population will continue to expand into suitable disturbed habitats. Macro climate modelling studies also suggest that the rate of *E. johnstonei's* population growth would increase in the future (Rodder 2009). It is likely that *E. johnstonei* has become a permanent part of Trinidad's biodiversity and its calls will become common in many disturbed areas of Trinidad.

REFERENCES

Beard, K. H. and **Pitt, W. C.** 2005. Potential consequences of the *E. coqui* frog invasion in Hawaii. *Diversity and Distribution,* 11: 427-433.

Bourne, G. R. 1997. Reproductive behaviour of terrestrial breeding frogs *Eleutherodactylus johnstonei* in Guyana. *Journal of Herpetology,* 31(2): 221-229.

Forbes, K. A. Bermuda online - Bermuda's Fauna [internet] Bermuda: The Royal Gazette 1992 [updated 2011 April 9; cited 2011 January 11]. Available from http://www.bermuda-online.org/fauna.htm

Gorzula, S. 1989. Geographic distribution: *Eleutherodactylus johnstonei. Herpetological Review,* 20: 56.

Hardy Jr., J. D. and **Harris, H. S.** 1979. Occurrence of the West Indian frog *Eleutherodactylus johnstonei* in South America and on the island of Curaçao. *Bulletin of the Maryland Herpetological Society,* 15: 124-133.

Kaiser, H. 1992. The trade mediated introduction of *Eleutherodactylus martinicensis* (Anuran: Leptodactylae) on St. Barthelemy, French Antilles, and its implication for Lesser Antillean biography. *Journal of Herpetology,* 26: 264-73.

Kaiser, H. and **Hardy, J. D.** 1994. *Eleutherodactylus johnstonei. Catalogue of American Amphibians and Reptiles,* 581: 1-5.

Kaiser, H. 1997. Origins and introduction of the Caribbean frog *Eleutherodactylus johnstonei* (Leptodactylae): management and conservation concerns. *Biodiversity and Conservation,* 6: 1391-1407.

Kenny, J. S. 1979. Some recent animal colonizations. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 1978-1979: 27.

Kraus, F. 2007. Using Pathway Analysis to inform prevention strategies for alien reptiles and amphibians. University of Nebraska, Lincoln. Available from http://digitalcommons.unl.edu/nwcinvasive/21

La Marca, E. 1992. *Catálogo taxonómico, biogeográfico y bibliográfico de las ranas de Venezuela.* Cuad.Geogr.Univ.Los Andes, Mérida, 1-197.

Manickchan, S. A. 2003. The Effect of Habitat Degradation and Biological Invasion on Species Richness and Abundance of Anuran Communities in Trinidad, West Indies. M.Phil. Dissertation, University of the West Indies, 2003.

Murphy, J. C. 1997. Amphibians and Reptiles of Trinidad and Tobago. Malabar, Florida: Krieger Publishing Company. 245 p.

Pough, F. M., Stewart, M. M. and **Thomas, R. G.** 1977. Physiological basis of habitat portioning in Jamaican *Eleutherodactylus*. *Oecologia (Berl.),* 27: 285-293.

Rodder, D. 2009. How to predict the future? On niches and potential distribution of amphibians and reptiles in a changing climate. Available from http://hss.ulb.uni-bonn.de/diss-online

Savage, J. M. 2002. The Amphibians and Reptiles of Costa Rica. Chicago and London: University of Chicago Press. 934 p.

Schwartz, A. and **Henderson, R. W.** 1991. Amphibians and Reptiles of the West Indies: Description, Distribution and Natural History. Gainesville, Florida: University of Florida Press. 720 p.

Stewart, M. M. 1977. The role of introduced species in a Jamaican frog community. p 110-46. *In* **H. Wolda,** ed. Proceedings IV Symposium Internacional de Ecología Tropical. Panama City, Panama.

Stewart, M. M. and **Martin, G. E.** 1980. Coconut husk-piles – a unique habitat for Jamaican terrestrial frogs. *Biotropica,* 12: 107-16.

Watkins, W. A., Baylor, E. R. and **Bowen, A. T.** 1970. The call of *Eleutherodactylus johnstonei*, the whistling frog of Bermuda. *Copeia,* 3: 558-561.

The Establishment of *Anolis aeneus* (Gray) in Southwestern Tobago, Trinidad and Tobago

Graham White[1], **Stephen Smith**[2] and **Stevland P. Charles**[3]

1. Surrey Village, Arouca, Trinidad and Tobago.
g.whitett@gmail.com

2. 8 Park Avenue, Queen's Park East, Port of Spain, Trinidad and Tobago.
cascabeldormillon@yahoo.com

3. Department of Biology, Howard University, Washington, U.S.A.
stevlandcharles@gmail.com

ABSTRACT

Anolis aeneus (Gray), a species native to Grenada, was first recorded in Tobago (The Republic of Trinidad and Tobago) in May 2007. During a survey conducted in November 2008, *A. aeneus* was found to be well established in south-west Tobago. There are no native anoles in Tobago but the exotic *A. richardii* (Duméril and Bibron), also native to Grenada, is widespread and abundant in disturbed areas. The presence of *Anolis aeneus* in Tobago recreates the competitive relationship that occurs in their original home in Grenada.

Key words: *Anolis, aeneus, richardii,* exotic species.

INTRODUCTION

The Caribbean Islands are home to about 150 species of *Anolis* lizards (Roughgarden 1995). On the smaller islands, especially in the eastern Caribbean, there are usually only one or two indigenous species and many species are restricted to a single island. These lizards serve as ideal subjects for ecological and evolutionary studies (Losos and De Queiroz 1997). Anthropogenic factors have led to the introduction of species to other islands where they compete with the indigenous or other exotic *Anolis* species. These introductions provide opportunities to test hypotheses developed from the study of the species in their natural range.

In Trinidad there are five exotic *Anolis* species: *A. aeneus* (Gray), *A. extremus* (Garman), *A. trinitatis* (Reinhardt and Lutken) (Murphy 1997) and more recently *A. wattsi* (Boulenger) (White and Hailey 2006) and *A. sagrei* (Duméril and Bibron) (Charles, in preparation). The indigenous species *Norops chrysolepis planiceps* (Troschel) (=*A. chrysolepis planiceps* (Troschel)) was previously placed in the genus *Anolis* (Murphy 2008). *Anolis aeneus* is native to Grenada but has long been naturalised in Trinidad with published records dating from as early as 1900 (Murphy 1997). It has adapted well to the suburban environment and is now the commonest *Anolis* species in Trinidad. In Grenada, *A. aeneus* exists in two colour forms, a grey form associated with dry forest and a green form associated with wet forest at higher altitude (Gorman 2003). The *A. aeneus* population in Trinidad is of the grey form (Gorman 2003). There are no native *Anolis* species on Tobago but *A. richardii* (Duméril and Bibron) also native to Grenada, is widespread and abundant in disturbed areas (Murphy 1997). Despite the considerable movement of people and materials between Trinidad and Tobago, there have been no reports of *A. aeneus* in Tobago prior to 2007.

Lizards which appeared to be *Anolis aeneus* (Gray) were observed and photographed at Crown Point Airport on 6 May, 2007 (See Plate). Subsequently further individuals of *A. aeneus* were observed on grounds of the Tobago Hilton on 20 July, 2007 and at the Store Bay Beach Facility on 3 January, 2008. This survey was conducted to confirm the presence of, and determine the current distribution of *A. aeneus* in Tobago.

METHODOLOGY

A rapid survey was conducted to determine the distribution of *Anolis aeneus* in Tobago. The survey was conducted on 27-28 November, 2008 at 22 sites across Tobago with an emphasis on the south-west of the island. Sites with managed lawns interspersed with small trees and shrubs and/or fences were selected for the survey as this is the preferred habitat of *A. aeneus* in Trinidad. Hotel grounds were selected as they provided suitable habitat and in addition were likely locations to which plants had been transported. Few rural areas and no natural vegetation were surveyed.

At each site a fifteen minute search was conducted by two observers, both of whom were experienced with *Anolis aeneus* in Trinidad. Searches were conducted be-

Plate. *Anolis aeneus.* **Above**, female or immature male, Crown Point, Tobago, May 2007. **Below**, (male) Store Bay, Tobago, January 2008. Photos, GW and SC.

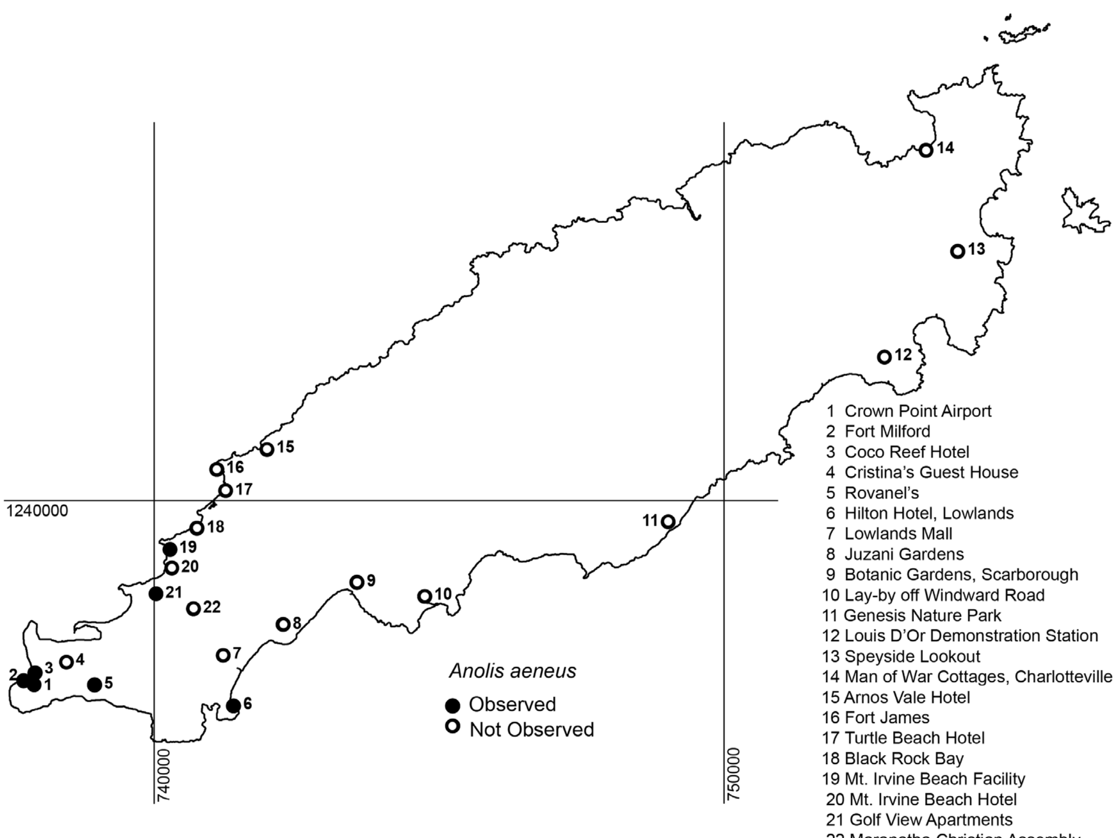


Fig. 1. Distribution of *Anolis aeneus* in Tobago, November 2008.

tween 0900 h and 1600 h when the lizards are most active. At each site the stem and main branches of small trees, shrubs and fences were examined and any *Anolis* observed, *A. aeneus* or *A. richardii,* were noted. During the survey the weather was generally sunny with about 50% cloud cover.

Specimens were photographed and their identity confirmed from the photographs by Robert Powell, Avila University, Kansas City, Missouri, USA. Specimens were lodged in the Zoology Museum at the University of the West Indies (Accession number UWITT.2011.5).

RESULTS AND OBSERVATIONS

Anolis aeneus were observed at six of the sites surveyed, all in the south-west of the island, Fig. 1. At all but two sites *A. richardii* were observed. At sites where both species were present, *A. aeneus* generally outnumbered *A. richardii.* The one exception was the Mount Irvine Beach Facility. The *A. richardii* appeared to prefer larger trees and areas of denser vegetation than the *A. aeneus*. The *Anolis aeneus* observed in Tobago, like those common in Trinidad, were of the grey colour form associated with dry scrub in Grenada.

DISCUSSION

The observed distribution and population size of *Anolis aeneus* suggests that the species is well established in southwestern Tobago. Recent development in south-west Tobago, and associated transport of building materials, household items and possibly plants from Trinidad, might have brought the lizards to Tobago. It is less likely that the introduction to Tobago came directly from Grenada as the movement of people and goods between Trinidad and Tobago is far greater than movement between Grenada and Tobago.

The presence of *Anolis richardii* was used as an indicator that the site was generally suitable for *Anolis* species. The observation that *A. richardii* appeared to prefer the larger trees and more shaded vegetation is consistent with what is observed in Grenada (Harris *et al*. 2004) where *A. richardii* is more common in densely shaded habitats and *A. aeneus* prefers, or is more tolerant of, open sunny areas.

The establishment of *Anolis aeneus* in Tobago presents an opportunity to observe any niche segregation and/or character displacement that develops as the population comes into contact with the much larger *A. richardii*. It is expected that both species will coexist in Tobago as they do in their original homeland of Grenada. However, it would be interesting to compare their precise ecological relationships to that which pertains in Grenada and to determine whether *A. aeneus* becomes established in natural forest.

In Grenada, *Anolis aeneus* is found throughout the island irrespective of land use or level of disturbance (Germano *et al.* 2003). In Trinidad, however, *A. aeneus* is seldom if ever observed away from urban and residential habitats.

The scarcity of *Anolis aeneus* in natural vegetation in Trinidad may be related to the presence of a suite of predators and competitors of continental origin that are absent in the Antilles; and, that the Anoles of Antillean origin have not evolved the defensive and competitive strategies to succeed alongside them. Two candidate components of this suite are woodcreepers (formerly Dendrocolaptinae) and army ants (sub-family Ecitoninae).

Table 1. Distribution of *Anolis aeneus* and *A. richardii* at selected sites in Tobago, November 2008. Locations provided in Fig. 1.

Location	Grid Reference (UTM 20n)	Number of	
		A. aeneus	*A. richardii*
1	735792, 1233538	4	0
2	735424, 1233677	17	2
3	735045, 1233952	7	4
4	736926, 1234333	0	5
5	737916, 1233533	15	0
6	742790, 1232794	20	0
7	742428, 1234569	0	0
8	744534, 1235655	0	3
9	747122, 1237131	0	16
10	749500, 1236641	0	11
11	758045, 1239254	0	10
12	765633, 1245037	0	3
13	768204, 1248750	0	0
14	767095, 1252298	0	0
15	743966, 1241793	0	12
16	742206, 1241097	0	1
17	742515, 1240350	0	8
18	741507, 1239031	0	8
19	740563, 1238286	2	10
20	740624, 1237636	0	14
21	740072, 1236731	10	0
22	741382, 1236206	0	0

Woodcreepers are common in continental South and Central America (Restall *et al.* 2006) but are absent from the West Indian Islands from Cuba and the Bahamas through to Grenada (Raffaele *et al.* 1998). They forage on the trunks and main branches of trees and may prey upon and compete with arboreal *Anolis* lizards. There are three species of woodcreeper resident in Tobago (Kenefick *et al*. 2007), including the Plain-brown Woodcreeper *Dendrocincla fuliginosa,* a known predator of *Anolis* in Panama (Willis 1972; Poulin *et al.* 2001), especially small individuals with a mean SVL of 33.5 mm (Poulin *et al.* 2001). One author (GW) has observed a Straight-billed Woodcreeper, *Xiphorhynchus picus* preying upon *A. aeneus* in the mangrove of Caroni Swamp in Trinidad.

Four of the five new world genera of army ants are known to occur in the forests and open areas of both Trinidad and Tobago but on the West Indian Islands where *Anolis* lizards are abundant, they are largely absent (Wilson 2006). Army ants generally prey on other arthropods, especially social insects, with many species preying almost exclusively on the brood of other ants and are unlikely to prey upon healthy *Anolis*. However, there may be a level of competition.

The spread of *Anolis aeneus* in Tobago offers an opportunity to compare the survival and competition of the two Grenadian *Anolis* species in an environment which includes predators and competitors of continental origin.

ACKNOWLEDGEMENTS

The authors thank Dr. Robert Powell of Avila University, Kansas City, Missouri, USA for identifying the *A. aeneus* from photographs submitted and Gordon Snelling for sharing his data relating to the army ants of Tobago.

REFERENCES

Germano, J. M., Sander, J. M., Henderson, R. W. and **Powell, R.** 2003. Herpetofaunal communities in Grenada: a comparison of altered sites, with an annotated checklist of Grenadian amphibians and reptiles. *Caribbean Journal of Science*, 39: 68-76.

Gorman, G. C. 2003. The mule lizards of Trinidad: Jungle dreams and backyard explorations. pp. 279-293. *In* **R. W. Henderson** and **R. Powell,** eds. Islands and the Sea: Essays on Herpetological Exploration in the West Indies. Contributions to Herpetology, Vol 20. Ithaca, New York: Society for the Study of Amphibians and Reptiles.

Harris, B. R., Yorks, D. T., Bohnert, C. B., Parmerlee Jr., J. S. and **Powell, R.** 2004. Population densities and structural habitats in lowland populations of *Anolis* lizards on Grenada. *Caribbean Journal of Science,* 40: 31-40.

Losos, J. B. and **De Queiroz, K.** 1997. Evolutionary consequences of ecological release in Caribbean *Anolis* lizards. *Biological Journal of the Linnean Society*, 61: 459-483.

Murphy, J. C. 1997. Amphibians and Reptiles of Trinidad and Tobago. Malabar, Florida: Krieger Publishing Company. 245 p.

Murphy, J. C. 2008. An update of the amphibians and reptiles of Trinidad and Tobago. Downloaded from http://blog.jcmnaturalhistory.com/?page_id=46"http://blog.jcmnaturalhistory.com/?page_id=46 (4 June 2008).

Kenefick, M., Restall, R. and **Hayes, F.** 2007. Birds of Trinidad & Tobago. Christopher Helm, London. 256 p.

Poulin, B., Lefebvre, G., Ibanez, R., Jaramillo, C., Hernandez, C. and **Rand, A. S.** 2001. HYPERLINK "http://www.csa.com/partners/viewrecord.php?requester=gs&collection=ENV&recid=5118933"Avian predation upon lizards and frogs in a Neotropical forest understorey. *Journal of Tropical Ecology,* 17: 21-40**.**

Raffaele, H., Wiley, J., Garrido, O., Keith, A. and **Raffaele, J.** 1998. A Guide to the Birds of the West Indies. Princeton: Princeton University Press. 511 p.

Restall, R., Rodner, C. and **Lentino, M.** 2006. Birds of Northern South America, An Identification Guide, Volume 1. New Haven and London: Yale University Press. 880 p.

Roughgarden, J. 1995. *Anolis* lizards of the Caribbean. Ecology, evolution and plate tectonics. *Oxford Series in Ecology and Evolution*. New York: Oxford University Press. 200 p.

White, G. L. and **Hailey, A.** 2006. The establishment of *Anolis wattsi* as a naturalized exotic lizard in Trinidad. *Applied Herpetology*, 3: 11-26.

Willis, E. O. 1972. The behaviour of Plain-brown Woodcreepers, *Dendrocincla fuliginosa*. *Wilson Bull.,* 84: 377-420.

Wilson, E. O. 2006. The Biogeography of West Indian Ants (Hymenoptera: Formicidae) p. 214-228. *In* **E. O. Wilson,** ed. Nature revealed: selected writings, 1949-2006 By Edward O. Wilson. The Johns Hopkins University Press; 1st edition (February 15, 2006) 719 p.

Terrestrial Herpetofauna of Some Satellite Islands North-east of Tobago with Preliminary Biogeographical Comparisons with Some Satellite Islands North-west of Trinidad

Stevland P. Charles[1], **Stephen Smith**[2] and **Jantina M. A. de Jonge**[3]

1. Department of Biology, Howard University, Washington D.C. 20059, U.S.A.
stevlandcharles@gmail.com

2. 8 Park Avenue, Queen's Park East, Port of Spain, Trinidad and Tobago.
cascabeldormillon@yahoo.com

3. Achterdiep NZ 15a, 9611BS Sappemeer, The Netherlands.
eastman.tina@gmail.com

ABSTRACT

Prior to this study, the only satellite island off Tobago surveyed for herpetofauna was the largest of these islands, Little Tobago Island. We conducted brief herpetological surveys on three satellite islands off Tobago's northeastern coast (Little Tobago Island, St. Giles Island and Goat Island). Here, we review the recorded observations of herpetofauna for Little Tobago Island in the literature and present nine new locality records for reptiles on St. Giles Island and Goat Island. The implications of these results for continued studies on the biogeography of the satellite islands of Trinidad and Tobago are discussed.

Key words: Tobago, satellite islands, Little Tobago Island, Goat Island, St. Giles Island, biogeography, herpetofauna, reptiles, amphibians, lizard, snake, frog, *Rhinella*, *Leptodactylus*, *Gonatodes*, *Hemidactylus*, *Thecadactylus*, *Sphaerodactylus, Iguana*, *Bachia*, *Anolis*, *Ameiva*, *Cnemidophorus*, *Mabuya*, *Leptophis*, *Mastigodryas.*

INTRODUCTION

The herpetofauna of the satellite islands off Trinidad is fairly well-known. The seminal work on this subject was produced by Boos (1984a) in his account of the terrestrial reptile fauna of the islands off the northwestern peninsula of Trinidad, in which he gave a comprehensive account of records made by previous workers, as well as a number of new records. Boos (1984a) also began a very interesting consideration of the biogeography of these islands. Several authors have contributed additions to the herpetofauna of these islands (Boos 1990; Boos and Quesnel 1994; Temple 1996; Lall and Hayes 2000; Hayes and Eitniear 2002; Charles 2007; Charles and Smith 2008; Charles and Smith 2009) as well as that found on Soldado Rock (Boos 1984b; ffrench 1990) off Trinidad's southwestern peninsula. By comparison, the herpetofauna of the satellite islands of Tobago is less well-known, with the main treatment being that on the reptiles of Little Tobago Island by Dinsmore (1970a). James J. Dinsmore resided on Little Tobago Island from 23 September, 1965 to 4 July, 1966, primarily conducting research on the dwindling (now extinct) population of introduced Greater Birds of Paradise (*Paradisaea apoda apoda*) (Dinsmore 1970b). During his stay there, he observed and collected a series of reptiles, including eight species of lizards and one species of snake (Dinsmore 1970a). Subsequently, references to one other snake and two species of frogs from Little Tobago were made in Murphy (1997) with no mention of the original observers. Until now, no other works have detailed the reptiles and amphibians of the satellite islands of Tobago.

In order to address this paucity of knowledge, the authors visited the second and third largest satellites of Tobago, namely St. Giles Island and Goat Island, to search for herpetofauna. This paper documents the findings of those brief searches and includes records for reptiles and amphibians on Little Tobago Island from Dinsmore (1970a) and Murphy (1997) which were reinforced by our own opportunistic observations during past visits to that island.

Goat Island, Little Tobago Island and St. Giles Island are all administered by the Tobago House of Assembly (T.H.A.) with the last two being categorized as game sanctuaries. Brief visits of only a few hours to each of the islands were made by the authors and searches were conducted for reptiles and amphibians. Microhabitats including leaf litter, tree trunks, under rocks, bark and logs, crevices in rocks, and anthropogenic locations including walls, ceilings and crawl spaces under buildings and piles of rubble that may serve as refuges for herpetofauna were searched.

OBSERVATIONS

Goat Island

Goat Island, located at 11° 18´ N, 60° 31´ W, is just over 0.7 km off the northeastern coast of Tobago. It is quite small, at about four hectares in area, and rises only to about 45 m above sea level. There is a very low sandy isthmus in the middle of the island where there exists a small landing jetty and a small complex of very recently abandoned buildings. For the majority of the 20th century, these buildings were part of a private holiday home. A few ornamental cultivated plants remain around the buildings. The rest of the island is covered by vegetation that is characteristic of dry tropical deciduous forest, with *Bursera simaruba* (Bursuraceae), *Coccothrinax barbadensis* (Arecaceae) and *Anthurium hookeri* (Araceae) being common. Apart from rainfall, no natural source of surface freshwater exists on the island.

We (S.P.C. and S.S.) visited the island on 28 February, 2010 from 0830 h to 1220 h and noted the species recorded below.

Thecadactylus rapicauda
(Houttuyn) (Reptilia: Sauria: Gekkonidae): Chec-a-chec.

One adult was seen about 3 m up on a wooden beam under the awning of the house. This is a new locality record.

Iguana iguana
(Linnaeus) (Reptilia: Sauria: Iguanidae): Green Iguana.

This is a new locality record. We observed a juvenile basking on the concrete floor of the yard at the house. Approximately eight other individuals (including neonates, juveniles and adults) were seen basking in vegetation on the southwestern end of the island. These lizards appear to be abundant on the island, but recent abandonment by the former occupants of the holiday home as the island has been transferred to State ownership may leave the unguarded population subject to poaching due to relative ease of access to the site.

Anolis richardii
(Duméril and Bibron) (Reptilia: Sauria: Polychrotidae): Gumangala.

This is a new locality record. Several of these lizards were seen on the rocks, walls and trees around the house. A few dead desiccated individuals were observed around the house (possible victims of the severe drought of 2010). The forested knoll on the southwestern end of the island was densely populated by these anoles. It is interesting that this species, so ubiquitous on Tobago, is not known from Little Tobago Island and this might be suggestive of anthropogenic introduction on Goat Island, possibly via building material or transplanted plants. However, the possibility of a natural colonization event via over-water rafting cannot be ruled out.

Cnemidophorus lemniscatus
(Linnaeus) (Reptilia: Sauria: Teiidae): Foot-shaker Lizard.

This is a new locality record. One young male and two adult females were seen on the scrub covered slope behind the house to the northeastern side of the island. A sub-adult female was caught on the sandy beach near the house. It was taken as a voucher specimen and will eventually be deposited in the Zoology Museum of the St. Augustine Campus of the University of the West Indies.

Little Tobago Island

Little Tobago Island is situated at 11° 18´ N, 60° 30´ W and is approximately 1.6 km off the northeastern coast of Tobago. At about 100 hectares, it is the largest of Tobago's satellite islands. It is somewhat steep sloped and attains a maximum elevation of 137 m above sea level. The island receives an annual average rainfall of 1520 mm and apart from this, the only natural source of surface freshwater is a small ephemeral seepage present only during the rainy season. As such, the island is quite dry and is covered largely by dry tropical deciduous forest (Beard 1944; Oatham and Boodram 2006). During the 18th and 19th centuries, parts of the island were cultivated with sea-island cotton (*Gossypium barbadense*), but abandoned early in the 20th century, allowing full recovery to the natural dry forest regime (Beard 1944). Although frequently visited, the island is uninhabited and the small concrete landing jetty and the dilapidated ruins of two small cabins are the only major edificarian structures remnant on the island.

Dinsmore (1970) spent nine months on Little Tobago and produced the first list of nine reptiles for the island while Murphy (1997) lists one other reptile and two amphibians for the island. We make use of the most recent taxonomy to recount their records below, as well as state our own observations made during visits to the island from 1000 h to 1500 h on 24 May, 2003 (S.S.) and from 0835 h to 1400 h on 19 July, 2007 (S.P.C.).

***Rhinella marina* (=*Bufo marinus*)**
(Linnaeus) (Amphibia: Anura: Bufonidae): Crapaud.

Murphy (1997) notes this toad as being recorded on Little Tobago, but does not give details regarding who made the original observation. This species is very hardy and tolerant of dry conditions and has been known to occur on Monos Island (Boos 1990) and Soldado Rock (ffrench 1990) in habitats similar to those found on Little Tobago Island. As such, its presence (at least at one time) on Little Tobago is completely plausible.

Leptodactylus fuscus
(Schneider) (Amphibia: Anura: Leptodactylidae): Whistling Frog.

This frog is also noted by Murphy (1997) as recorded for Little Tobago with no details on the original observer. *L. fuscus* is less tolerant of dry conditions and it seems highly unlikely that a breeding population could survive on Little Tobago under natural circumstances. Perhaps vagrants inadvertently transported by boats from mainland Tobago might have at one time landed on the island, where water troughs provided for birds by human caretakers might provide some refuge from the otherwise predominantly dry conditions.

Gonatodes ocellatus
(Gray) (Reptilia: Sauria: Gekkonidae): Ocellated Gecko.

This gecko was first recorded on the island by Dinsmore (1970). In 2007, one of us (S.P.C.) observed nine adult females and five adult males. Each of these males was of the rust-coloured head morph.

Hemidactylus palaichthus
(Kluge) (Reptilia: Sauria: Gekkonidae): Spiny Gecko.

Dinsmore (1970) collected this gecko on Little Tobago, but misidentified it as *H. mabouia* (Moreau de Jonnès). Tuck (1972) corrected this error.

Sphaerodactylus molei
(Boettger) (Reptilia: Sauria: Gekkonidae): Mole's Gecko.

These tiny geckos were first noted on the island by Dinsmore (1970).

Thecadactylus rapicauda
(Houttuyn) (Reptilia: Sauria: Gekkonidae): Chec-a-chec.

This large gecko was first recorded on Little Tobago by Dinsmore (1970).

Bachia heteropa alleni
(Barbour) (Reptilia: Sauria: Gymnophthalmidae): Ground Puppy.

Dinsmore (1970) using Underwood (1962), misidentified this subspecies as *Scolecosaurus trinitatis* (=*Bachia heteropa trinitatis* Barbour). He based his record on the observation (via binoculars from some distance away) of a dead lizard that fit the gross description of the species, which was being fed by an adult Blue-crowned Motmot (*Momotus momota*) to its young, as well as several fleeting glimpses of 'worm-like animals' that quickly burrowed away upon turning over rotten logs. Dixon (1973) settled the taxonomy of the subspecies on Tobago as it is currently recognized.

Ameiva ameiva
(Linnaeus) (Reptilia: Sauria: Teiidae): Zandolie.

This large terrestrial lizard was first noted on the island by Dinsmore (1970). We agree with Murphy's (1997) assertion that individuals on Little Tobago Island are notably large. One of us (S.S.) noted at least two adults in 2003 and S.P.C. observed several individuals including adults of both sexes and juveniles in 2007.

Cnemidophorus lemniscatus
(Linnaeus) (Reptilia: Sauria: Teiidae): Foot-shaker Lizard.

Dinsmore (1970) observed and collected these lizards on the island. One of us (S.S.) noted two individuals on a trip to the island in 2003.

Iguana iguana
(Linnaeus) (Reptilia: Sauria: Iguanidae): Green Iguana.

Dinsmore (1970) observed this large lizard on the island and expressed concerns that it might be subject to poaching there despite the island's status as a game sanctuary.

Leptophis ahaetulla coeruleodorus
(Oliver) (Reptilia: Serpentes: Colubridae): Green Lora.

Murphy (1997) lists this snake as present on Little Tobago based on the American Museum of Natural History specimen AMNH 84279. Dinsmore (1970) did not observe this species during his nine-month stay on the island. The island provides suitable habitat and potential prey for this snake in the form of small lizards and small fledgling birds and so its presence there is plausible. Future workers should keep a keen eye open and a quick hand ready to confirm this record.

Mastigodryas boddaerti dunni
(Stuart) (Reptilia: Serpentes: Colubridae): Machete Couesse.

Dinsmore (1970) observed and collected this species on the island. The taxonomy of the subspecies on Tobago has a long confused history. Dinsmore (1970) records it as *Drymobius boddaerti*. The taxonomy as it is currently understood was settled by Peters and Orejas-Miranda (1970).

St. Giles Island

St. Giles Island is located at 11° 21´ N, 60° 31´ W, about 0.8 km off the northeastern coast of Tobago. The island is about 30 hectares in extent and is the largest of a group of islands known collectively as St. Giles Islands or Meville Islands. With its highest point just about 115 m above sea level, the island is exceptionally precipitous on all sides. This coupled with its rocky coastline and rough waters make the island difficult to access. The island is particularly dry with no sources of surface freshwater. It is dominated by scrubby vegetation in tropical deciduous and wind-swept littoral forest formations. Very little trace is left of any human built structures on the island.

We (S.P.C., S.S. and J.M.A. de J.) visited St. Giles Island on 27 February, 2010 from 0830 h to 1230 h and noted the species recorded below.

Gonatodes ocellatus
(Gray) (Reptilia: Sauria: Gekkonidae): Ocellated Gecko.

This is a new locality record. Two adult males, one sub-adult male and two females were observed, all on the lower parts of tree trunks near the top of the ridge on the western side of the island. The head colour pattern of the adult males was not observed and that of the sub-adult male was not yet discernable. Only the two females were captured and taken as voucher specimens and will eventually be deposited in the Zoology Museum at the St. Augustine Campus of the University of the West Indies.

Thecadactylus rapicauda
(Houttuyn) (Reptilia: Sauria: Gekkonidae): Chec-a-chec.

This is a new locality record. One adult specimen was found under the bark of a dead but still standing tree trunk about 1.7 m above ground near the top of the ridge on the western side of the island. It was taken as a voucher specimen and will eventually be deposited in the Zoology Museum at the St. Augustine Campus of the University of the West Indies.

Iguana iguana
(Linnaeus) (Reptilia: Sauria: Iguanidae): Green Iguana.

This is a new locality record. A sub-adult was found dead and rotting on the forest floor on the southern slope of the western portion of the island. Pieces of shed skin assumed to be from this species were found on the forest floor near the top of the ridge on the western portion of the island. Iguanas as well as large sea birds may be vulnerable to poaching on the island. [Evidence of human visitors to the island included piles of plastic trash as well as a pile of the remains of about four dead Red-footed Boobies (*Sula sula*) assumed to have been poached].

Mabuya sp.
(Reptilia: Sauria: Scincidae): Bronze Skink.

This is a new locality record. One adult skink was seen basking on the ground near the top of the ridge on the western portion of the island. John C. Murphy (pers. comm.) states that recent evidence suggests that more than one species of the genus *Mabuya* may be present on both Trinidad and Tobago and that careful scrutiny of scale morphology and genetic testing may be the only way to determine the species identities of various populations. Systematic collections must be carried out to this end. Unfortunately, we failed to secure the observed specimen.

Mastigodryas boddaerti dunni
(Stuart) (Reptilia: Serpentes: Colubridae): Machete Couesse.

This is a new locality record. One specimen resembling this species was seen foraging on the forest floor along the ridge towards the western end of the island. It was approximately a metre in total length and of a light olive-brown shade. The specimen was not secured. Three separate partial snake skin casts were found on the southern slope of the western portion of the island. One of these was almost completely intact, with 180+ ventrals, a divided anal plate, divided subcaudals and 17 scale rows at mid-dorsum. No other species on Tobago fits this combination of characteristics.

DISCUSSION

The satellite islands of Tobago, like those of Trinidad, provide an exciting opportunity to examine biogeographical processes in a natural ecological and evolutionary laboratory. Temple (1996), utilizing the Five-Islands satellite group off Trinidad's northwestern peninsula, predicted that based on the biodiversity, island size and habitat diversity of these comparatively tiny islands, the nearby larger and more habitat diverse Bocas Islands would probably yield more unrecorded species of reptiles with continued sampling. His predictions were correct and confirmed by the combined observations of several workers (Lall and Hayes 2000; Hayes and Eitniear 2002; Charles 2007; Charles and Smith 2008; Charles and Smith 2009). Added to these, our findings present an interesting starting point for comparative studies of the island biogeography of the herpetofauna on the satellite islands of Trinidad and Tobago.

Lizards appear to be the dominant non-avian vertebrate fauna on the satellite islands of both Trinidad (Lall and Hayes 2000) and Tobago. The relatively high abundance of lizards on these islands and fair degree of simplicity involved in sampling lizard assemblages make them ideal candidates for making biogeographical comparisons among these satellites and between the satellites and the larger main islands. If one excludes all lizards that are suspected of having been introduced to Trinidad and Tobago and their satellites via anthropogenic actions (i.e. *Hemidactylus mabouia* and all *Anolis* spp. save *A. chrysolepis*), then one might begin to make some interesting comparisons. The four largest satellites of Trinidad (Monos, Chacachacare, Gaspar Grande and Huevos) as a group play host to a recorded seventeen native species (two, *H. palaichthus* and *Gymnophthalmus speciosus*, not confirmed on Trinidad proper) while Trinidad is home to eighteen confirmed native species. By contrast, the three largest satellites of Tobago (Little Tobago, St. Giles and Goat) host a recorded nine native lizard species (with only one, *H. palaichthus*, not being recorded from Tobago proper) while Tobago is known to host twelve confirmed native species.

Excluding the species which do not occur on the 'mainland' islands, Trinidad's satellites host 83.33% of its lizards, while Tobago's satellites host 66.67% of its lizard species. In both cases, given the relatively small total areas of the satellite islands versus the main islands, these are fairly large percentages of the main island lizard faunas. The basic concepts of the theory of island biogeography suggest that the larger the island, the closer it is to a source of colonization and the more varied its habitat structure, the greater the number of species that may be accommodated (MacArthur and Wilson 1967). Most of the species of herpetofauna on the satellites off Trinidad's northwestern peninsula are considered relicts of populations present on the larger continental land-bridge area that existed before the satellites were last formed after the last glacial maxium (Boos 1984a). The same may be assumed for the herpetofauna of Tobago's satellites and so, distance from the colonization source probably played less of an important role in determining their non-volant terrestrial faunal composition in the relatively short time since the isolation of the satellites from the main islands. As such, given the greater total area and greater average maximal altitude (= greater habitat complexity) of the four largest satellites of Trinidad (1041 ha and 210.9 m respectively) versus that of the three largest satellites of Tobago (134 ha and 99.45 m respectively), it is not surprising that a smaller percentage of Tobago's lizards are found on its satellite islands than is the case for Trinidad.

To even the playing field, a comparison of islands similar in size and elevation should be made. Gaspar Grande and Little Tobago are fairly similar in vegetation, microclimate, size (134 ha and 100 ha respectively) and elevation (103.7 m and 137.7 m respectively). Each of these islands has been fairly well surveyed and Gaspar Grande's native lizard fauna (exclusive of human introduced species) totals nine species whilst that of Little Tobago totals eight species; fairly similar species richness figures. With this particular example in mind, taken in this limited context of continental islands that were subject to alternating periods of isolation and reconnection through land-bridges as sea levels fluctuated over geological history (Murphy 1997), we may surmise that the island size and habitat complexity may play a larger role in determining species richness in relict species assemblages on satellite islands than does the number of species present before isolation from the source land masses (satellite islands playing host to somewhat depauperate relict faunas of the larger land masses, with localized extinctions and perhaps a few over-sea colonizations occurring over time).

Determining the species that reached the islands via over-sea dispersal may be a matter of conjecture, but the general distribution patterns of a few species do present some interesting clues. In particular, the somewhat disjunct populations of the lizard *Cnemidophorus lemniscatus* throughout Trinidad and Tobago are of interest. Boos (1984a) suggested that *C. lemniscatus* might be a recent over-water immigrant to Trinidad and Tobago, noting its disjunct distribution pattern, with populations occurring where prevailing sea currents abut the land (including two of Trinidad's satellites: Chacachacare and Huevos) and with notable absence from suitable habitat that lie outside of the path of these currents. A similar phenomenon seems to apply on Tobago, where populations exist in coastal areas of the southwestern end of the island and are absent from suitable habitat on the northeastern end of the island with the exception of the satellite islands of Little Tobago and Goat Island.

This discussion only briefly touches on aspects of the biogeography of the satellite islands of Tobago (and by extension Trinidad), and it is hoped that it will generate interest in continued ecological exploration of these islands. Our very brief surveys resulted in nine new locality records for reptiles on satellite islands off northeastern Tobago. It is quite probable that with greater future sampling efforts, more species may be added to the list of reptiles (and possibly amphibians) on the islands treated, as well as on a number of the other satellite islands of Tobago. We call on the policy makers of the Department of Natural Resources and the Environment of the T.H. A. to continue to encourage and facilitate surveys of the biodiversity of Tobago, and particularly, its satellite islands. These islands should be carefully managed to protect their tropical dry forest ecosystems of conservation significance (Oatham and Boodram 2006) and the small and somewhat isolated populations of species they harbour; populations which themselves may prove to harbour unique genetic traits not present, or rare, in mainland populations. In addition to their value as subjects of academic inquiry, if managed, utilizing sustainable approaches to conservation, these satellite islands can yield even greater economic value than they do at present as destinations for ecotourism.

ACKNOWLEDGEMENTS

We thank the Department of Natural Resources and the Environment of the Tobago House of Assembly for granting permission to conduct wildlife research on Tobago's offshore islands. We are also grateful to Mr. D. Eastman for providing transportation and to our respective families for their great moral and logistical support. Thanks also to H.E.A. Boos for providing literature and for the anonymous reviewers and Dr. G.A. Middendorf for useful comments on the manuscript.

REFERENCES

Beard, J. S. 1944. The natural vegetation of the island of Tobago, British West Indies. *Ecological Monographs*, 14: 135-163.

Boos, H. E. A. 1984a. A consideration of the terrestrial reptile fauna on some offshore islands north-west of Trinidad. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1983-1984: 19-26.

Boos, H. E. A. 1984b. Reptiles of Soldado Rock. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1983-84: 12.

Boos, H. E. A. 1990. Additions to the terrestrial fauna of the offshore islands north-west of Trinidad. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1989-1990: 9.

Boos, H. E. A. and **Quesnel, V. C.** 1994. Additional notes on the fauna recorded for the offshore islands north-west of Trinidad. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1993-1994: 6-7.

Charles, S. P. 2007. A first record of the gecko *Gonatodes ceciliae* for the island of Gaspar Grande, Trinidad and Tobago. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2007: 88.

Charles, S. P. and **Smith, S.** 2008. Observations of reptiles on Huevos Island, Trinidad, with five lizard species newly recorded for the island. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2008: 28-32.

Charles, S. P. and **Smith, S.** 2009. A new locality record for the coral snake *Micrurus circinalis* (Reptilia: Serpentes: Elapidae) on Monos Island, Trinidad and Tobago. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2009: 41.

Dinsmore, J. J. 1970a. Reptiles of Little Tobago Island, West Indies. *Quarterly Journal of the Florida Academy of Sciences,* 32 (1969): 307-309.

Dinsmore, J. J. 1970b. History and natural history of *Paradisaea apoda* on Little Tobago Island. *Caribbean Journal of Science*, 10: 93-104.

Dixon, J. R. 1973. A systematic review of the teiid lizards, genus *Bachia*, with remarks on *Heterodactylus* and *Anotosaura*. University of Kansas Museum of Natural History Miscellaneous Publication (57): 1-47.

ffrench, R. 1990. The birds and other vertebrates of Soldado Rock, Trinidad. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1989-90: 16-20.

Hayes, F. E. and **Eitniear, J. C.** 2002. First record of the spectacled caiman *Caiman c. crocodilus* for Chacachacare, Bocas Islands, Trinidad and Tobago. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2000: 57-58.

Lall, S. A. and **Hayes, F.** 2000. Observations on the reptiles and mammals of Chacachacare, Bocas Islands, with notes on five species new to the island. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1999-2000: 46-48.

MacArthur, R. H. and **Wilson, E. O.** 1967. The Theory of Island Biogeography. Princeton, New Jersey: Princeton University Press. 203 p.

Murphy, J. C. 1997. Amphibians and Reptiles of Trinidad and Tobago. Florida: Krieger. 245 p.

Oatham, M. P. and **Boodram, N.** 2006. The dry forest vegetation communities of Little Tobago Island, West Indies: floristic affinities. *Tropical Ecology*, 47: 211-228.

Peters, J. A. and **Orejas-Miranda, B.** 1970. Catalogue of the Neotropical Squamata. Part I. Snakes. *Bulletin of the United States National Museum*, 297: 1-347.

Tuck, R. G. 1972. New record: *Hemidactylus palaichthus*. *Herpetological Review,* 4(3): 93.

Temple, S. A. 1996. Distributional ecology of selected plants and animals on Trinidad's Five-Islands Archipelago. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 1995-1996: 22-26.

Underwood, G. 1962. Reptiles of the Eastern Caribbean. *Caribbean Affairs (New Series),* No. 1, Dept. of Extra-Mural Studies, University of the West Indies, Trinidad. 192 p.

Aquatic Invertebrate Community Structure in Water-filled Bracts of *Heliconia caribaea* (Heliconiaceae) on Saba, West Indies

Courtney M. Bass and **David Bass**
Department of Biology, University of Central Oklahoma, Edmond, Oklahoma, U.S.A. 73034.
dbass@uco.edu

ABSTRACT
The aquatic invertebrate community living in the liquid-filled bracts of *Heliconia caribaea* (Heliconiaceae) inflorescences was studied on Saba, a small island in the northeastern Caribbean Sea, during October 2006. Invertebrates were collected by inverting inflorescences (n=52) to drain all of the liquid and its contents from the bracts into zip-lock plastic bags. All 52 inflorescences had invertebrates present in their bracts. Totals of 15,282 individuals and 20 taxa were collected from the *H. caribaea* inflorescences, and all 20 taxa were found only in water-filled bracts of this plant on Saba. Immature dipterans and ascid mites comprised the most abundant groups found. An average of 6.2 species and a confidence interval of 294±101 individuals for each inflorescence were calculated. Spearman's rank order values indicated correlations between both the number of species and the population sizes and the volume of liquid in each inflorescence, findings that support the species-area aspect of island biogeography theory. The Mann-Whitney statistic indicated no significant differences in population sizes and species richness in collections made at different elevations. The Mann-Whitney statistic also indicated there were no significant differences in population sizes and species richness in collections made on the windward side of Saba compared with those from the leeward side of the island. Seventeen of the invertebrate taxa found living in the *H. caribaea* inflorescences are being reported from Saba for the first time.

Key words: Antilles, elevation, leeward, phytotelmata, Saba, species-area relationship, windward.

INTRODUCTION

Phytotelmata are structures formed by terrestrial plants that impound water. Such structures include modified leaves, leaf axils, flowers, stem holes or depressions, open fruits, and fallen leaves (Maguire 1971). The term "phytotelmata" is a Greek word meaning "plant pond" that was introduced by Varga who observed small bodies of water held in pitcher plants, bromeliads and teasel (Fish 1983). Lloyd (1942) cited observations by Rumphius in 1747 of surviving organisms among the dead remains of insects in the digestive fluid of Asian pitcher plants as the earliest record of the existence of an aquatic fauna inhabiting terrestrial plants. Scott (1914) noted the differences between fauna inhabiting terrestrial ponds and that of terrestrial plants, and referred to those plants containing aquatic fauna as "reservoir plants". Fish (1983) listed 29 families of plants forming phytotelmata from which aquatic insects have been reported.

Phytotelmata are formed by the highly modified bracts in the inflorescences of *Heliconia caribaea* L., commonly known as wild plantain or lobster claw (Fig. 1). This plant belongs to the family Heliconiaceae, which has a circumtropical distribution; however, *H. caribaea* is found primarily in the Caribbean region (Anonymous 2010). Water is pumped to the bracts through the roots of the plant (Bronstein 1986) with additional water accumulating through rainfall (Seifert and Seifert 1976; Seifert 1982). Often, aquatic invertebrate communities, dominated by dipteran larvae, develop in the fluid contained in the bracts (Richardson and Hull 2000). Although Skutch (1933) speculated that water-filled bracts may protect developing floral reproductive structures from herbivorous insects, Seifert and Seifert (1976) found that several species feed directly upon the submerged flowers. However, most of the invertebrates use nectar, bacteria, decaying floral structures and the bract lining as food resources (Seifert 1982; Naeem 1990). Very few quantitative investigations have examined these aquatic invertebrate communities in *Heliconia* inflorescences and none have been conducted with *H. caribaea* on Saba.

Objectives of this research were to: (1) determine how much water is present in the bracts of *H. caribaea* inflorescences; (2) determine the percent of *H. caribaea* inflorescences that contain invertebrates; (3) determine the invertebrate species present in *H. caribaea* bracts; (4) determine invertebrate population sizes for each inflorescence; (5) determine which invertebrates are most abundant in *H. caribaea* bracts; (6) compare *H. caribaea* inflorescence data from different sides of the island; (7) compare *H. caribaea* inflorescence data from different elevations; (8) compare the species occurring in *H. caribaea* bracts to the invertebrate species found in other aquatic habitats of Saba; and (9) compare the invertebrate fauna inhabiting water-filled bracts of *H. caribaea* in Saba to that found elsewhere in the Caribbean region.

MATERIALS AND METHODS

Study area

Saba is a small Caribbean island located in the northern end of the Lesser Antilles. The island is volcanic in origin and is thought to have emerged from the ocean approximately 30,000 years ago, with its last major eruption about 5,000 years ago. Maximum elevation reaches 887 m and its surface area encompasses approximately 13 km^2 (McLean 2004). Samples from *H. caribaea* inflorescences were collected during October 2006 along the Mount Scenery Trail (17°37'44.0"-17°38'4.3"N, 63°14'6.1"-63-°14'24.8"W) and the Sandy Cruz Trail (17°38'17.3"-17-°38'24.6", 63°14.0'6.1"- 63°14.0'24.8"W) in Saba. The vegetation of these areas grows on steep slopes of a tropical seasonal forest with a closed canopy where *H. caribaea* occurs as an understory plant.

Fig. 1. *Heliconia caribaea* (L) inflorescence on Saba, West Indies.

Sampling and data analysis

Fifty-two plants bearing inflorescences were sampled and their locations, including elevations, were determined using a Garmin GPS. Each inflorescence was covered with a zip-lock plastic bag and inverted to drain all of the water and its contents into the bag. This non-destructive method of sampling may not have allowed for complete collection of some invertebrates that clung tightly to the floral structures. The volume of water from each inflorescence was measured using a graduated cylinder. Invertebrates were strained from the water through a 0.25 mm Nitex net, preserved in 70 percent ethanol, and transported to the laboratory. In the laboratory, the invertebrate samples were sorted, identified, and counted under a stereoscope. Identification of the invertebrates was determined primarily using keys by Merritt, Cummins and Berg (2008) and Thorp and Covich (2001), and the numbers were statistically analyzed following formulae provided by Brower *et al*. (1997) and using Sigma Plot 10.0 (Systat Software, Inc. 2006). All specimens were deposited in the Caribbean Invertebrate Section of the University of Central Oklahoma Natural History Museum. Several larval and pupal specimen of *Aedes* (*Howardina*) *busckii* (Coquillett) have been transferred to the Entomology Collection in the British Natural History Museum.

RESULTS

The number of bracts on the inflorescences in the samples ranged from 2-10, with an average of 7.0 bracts per inflorescence (Table 1). The volume of the water sampled ranged from 16-528 ml, with an average of 118.8 ml of fluid associated with each inflorescence. An average of 17.0 ml of fluid occurred in each bract (s^2=18.9).

All of the inflorescences sampled had aquatic invertebrates living in them, resulting in a total of 15,282 individuals and 20 taxa collected from the 52 inflorescences (Table 1-2). The ranges for the number of individuals and number of species per inflorescence were 7-1428 and 3-12 respectively. Ninety-five percent confidence intervals of 294±101 (193-395) individuals and 6.2±0.52 (5.65-6.69) species were calculated for each inflorescence (52). A Spearman's rank order correlation value of 0.585 (P=0.000001) was calculated when inflorescence volume and population size were compared, indicating a correlation existed between volume and the number of individuals. Furthermore, a Spearman's rank order correlation value of 0.335 (P=0.0155) indicated a correlation existed between inflorescence volume and species richness.

The most abundant taxa were *Aedes* (*Howardina*) *busckii* (Culicidae) and species belonging to the Ascidae (Gamasida), and the genera *Dasyhelia* (Ceratopogonidae), *Polypedilum* (Chironomidae) and *Alepia* (Psychodidae). Of these, *A. busckii* was the most frequently encountered comprising 71.1 percent of the individuals collected (Table 2). This culicid, known only from the Lesser Antilles, has been collected previously from Dominica, Martinique, Guadeloupe, Grenada and St. Eustatius (Stone 1969), and is likely the species reported as *Aedes* sp. from Saba by Bass (2008). The second most abundant taxon was an unidentified mite belonging to the family Ascidae, making up 14.0 percent of the individuals. Single species each of *Polypedilum, Dasyhelia* and *Alepia* were the only other taxa collected that constituted over one percent of the individuals in the samples (Table 2).

Samples collected on the leeward side of Saba along the Sandy Cruz Trail were compared to samples taken on the windward side of the island along the Mount Scenery Trail (Table 1). Leeward side samples contained an average of 162.3 individuals per inflorescence, while those from the windward side had an average of 333.4 individuals per inflorescence. An average of 6.2 species was collected from each inflorescence on both sides of the island. Six species constituted over one percent of the in-

Table 1. Minimum, maximum, average per inflorescence, and total numerical for values number of individuals, number of species, volume of liquid, number of *H. caribaea* bracts, and elevation for all samples, leeward samples, windward samples, lower elevation samples, and higher elevation samples.

Sample Parameter	Minimum	Maximum	Average per Inflorescence	Total
All Samples (52)				
Number of Individuals	7	1,428	293.9	15,282
Number of Species	2	12	6.2	20
Volume of Liquid (ml)	16	528	118.8	6,179
Number of Bracts	2	10	7.0	363
Elevation (m)	489	820	696.0	
Leeward Samples (12)				
Number of Individuals	49	406	162.3	1,947
Number of Species	4	10	6.2	10
Volume of Liquid (ml)	52	154	96.7	1,160
Number of Bracts	5	9	6.9	83
Elevation (m)	536	665	579.2	
Windward Samples (40)				
Number of Individuals	7	1,428	333.4	13,335
Number of Species	2	12	6.2	20
Volume of Liquid (ml)	24	528	125.5	5,020
Number of Bracts	2	10	7.0	280
Elevation (m)	489	820	731.2	
Lower Elevation Samples (24)				
Number of Individuals	22	406	133.7	3,208
Number of Species	4	12	6.7	15
Volume of Liquid (ml)	16	209	108.1	2,594
Number of Bracts	2	9	6.8	163
Elevation (m)	489	713	565.4	
Higher Elevation Samples (28)				
Number of Individuals	7	1,428	431.2	12,074
Number of Species	2	10	5.8	20
Volume of Liquid (ml)	24	528	128.0	3,584
Number of Bracts	4	10	7.1	199
Elevation (m)	774	820	808.2	

dividuals collected on the leeward side, while only five species made up more than one percent of the individuals from the windward side. The most abundant species on both sides of the island was *A. busckii*. The average volume of liquid per inflorescence collected from the leeward side plants was 96.7 ml, whereas the average volume of liquid collected from inflorescences of the windward side plants was 125.5 ml. The average number of bracts per inflorescence, 6.9 and 7.0, differed very little between locations from plants on the leeward side and windward side respectively. The Mann-Whitney statistic (U=242.0, P=0.974) indicated there was no significant difference between invertebrate population sizes found in inflorescences existing on different sides of the island. In addition, the Mann-Whitney statistic (U=238.5, P=0.982) indicated there was no significant difference between invertebrate species richness found in inflorescences existing on different sides of the island.

The 52 collections were divided into two groups, based on elevations from where they were taken (Table 1). One set of samples was collected from an average elevation of 565.4 m asl (489-713 m asl), while the other set came from an average elevation of 808.2 m asl (774-820 m asl). Samples collected at the lower elevation had eight species that made up over one percent of the individuals, whereas those taken at higher elevations contained only four species that constituted over one percent of the individuals. The average number of individuals collected in the lower elevation samples was 133.7, while the average number of individuals in samples collected at higher elevations was 431.2. Samples collected from the lower elevations yielded a total of 15 species (average = 6.7 species/inflorescence) and samples taken from the upper elevations contained all 20 species (average = 5.8 species/inflorescence). At both elevations the dominate species was *A. busckii*. Samples taken from lower elevations contained an average volume of liquid per inflorescence of 108.1 ml, whereas samples taken from higher elevations had an average of 128.0 ml per inflorescence. The average number of bracts on inflorescences at lower elevations was 6.8, while inflorescences at higher elevations possessed an average 7.1 bracts. The Mann-Whitney statistic (U=435.0, P=0.071) indicated there was no significant difference between invertebrate population sizes found in inflorescences at different elevations. The Mann-Whitney statistic (U=250.5, P=0.111) also showed there was no significant difference between species richness found in inflorescences at different elevations.

Table 2. Taxa, average number of individuals per inflorescence, total number of individuals per inflorescence, and percent of total number of individuals for all samples.

Taxa	Average per Inflorescence	Total	Percent of Total
Tubificidae	2.69	140	<1
Cyclopoida	0.06	3	<1
Ascidae	41.17	2141	14.0
Isotomidae	0.21	11	<1
Aedes (*Howardina*) *busckii*	208.96	10,869	71.1
Alepia sp.	4.54	236	1.5
Ceratopogonidae sp. 1	0.02	1	<1
Dasyhelia sp.	12.21	635	4.2
Dolochopodidae	0.57	29	<1
Ephydridae sp. 1	0.23	12	<1
Ephydridae sp. 2	1.87	97	<1
Metriocnemus sp.	0.02	1	<1
Orthocladiinae	0.04	2	<1
Orthocladiinae Genus E Epler	0.02	1	<1
Polypedilum sp.	17.42	906	5.9
Syrphidae	1.23	64	<1
Stratiomyidae	1.04	54	<1
Diptera sp. 1	1.08	56	<1
Diptera sp. 2	0.42	22	<1
Diptera sp. 3	0.04	2	<1

DISCUSSION

Population sizes and species richness

Very little information regarding invertebrate population sizes and the number of taxa inhabiting water-filled bracts of *H. caribaea* exists in the literature. Richardson and Hull (2000) reported averages of 232 and 258 individuals per *H. caribaea* inflorescence from field studies in Puerto Rico during 1996 and 1998 respectively. Their studies also found seven taxa constituted 94 percent of the total number of individuals in 1996 and 93 percent of the total number of individuals in 1998. Twenty-one and 22 taxa were recorded from their samples in 1996 and 1998 respectively. Data recorded by Richardson and Hull (2000) in Puerto Rico are somewhat similar to data we collected in Saba: an average of 294 individuals per inflorescence and a total of 20 taxa were obtained from *H. caribaea* inflorescences (Table 1). Five taxa comprised 97 percent of individuals present in inflorescences of *H. caribaea* from Saba. Both larval and pupal stages of *A. busckii*, *Polypedilum* and *Dasyhelia* were collected. Sixteen of the 20 taxa found in these collections were dipterans, a finding similar to that reported by others (Richardson and Hull 2000) who studied inhabitants of *Heliconia* inflorescences. As noted earlier, the Saban collections were made by simply pouring water from the inflorescences, a non-destructive method that may have resulted in an underestimate of invertebrate populations.

Much variation exists in both the number of individuals present and species richness in different inflorescences. This is likely a reflection of the differences in ages of the inflorescences from which each collection was taken. Some inflorescences were relatively old and the dipteran larvae which developed in them had probably matured and emerged, hence the lower numbers in the collection from those inflorescences. Other inflorescences were younger, so they had not been present as a microhabitat for aquatic larval development as long.

The inflorescences of *H. caribaea* are seasonal. Although they are present for five to six months, the bracts deteriorate and hold water for only about 60-70 days (Richardson and Hull 2000). Therefore, invertebrates living in the bracts are specialized and have evolved faster life cycles than many of their relatives living in more permanent environments. Fish (1983) suggested that species which live in phytotelmata with higher turnover rates, such as *Heliconia*, are more specialized and exhibit greater habitat specificity than do those that inhabit phytotelmata with lower turnover rates. Many species of mosquito exist in temporary aquatic habitats and *A. busckii* is no exception. In addition to flower bracts of *Heliconia*, immature *A. busckii* have been found in rock holes, tree holes, broken and cut bamboo, fallen leaves, fruits and pods, and in the leaf axils of bromeliads and aroids (R. Harbach, pers. comm.). Dobkin (1990) described how ascid mites exhibit a specialized behaviour allowing them to be dispersed among *Heliconia trinidatis* L. inflorescences by visiting hummingbirds; a similar situation probably exists in this *H. caribaea* invertebrate community, as they were frequently observed near the plants.

Bass (2008) reported 18 invertebrate species from aquatic habitats such as forest pools, open cisterns, and small artificial ponds on Saba. Only three of those 18 taxa collected previously by Bass were associated with *H. caribaea* on the island: *Aedes, Dasyhelia* and Stratiomyidae. Elsewhere on the island, Bass did not find any *Polypedilum* or Ascidae, two of the more abundant taxa in the 52 collections from *H. caribaea* inflorescences. Therefore, 17 of the 20 taxa collected from these *H. caribaea* inflorescences were previously not known to exist on Saba and all 20 taxa associated with *H. caribaea* inflorescences were limited to that habitat on the island.

Studies of the *H. caribaea* fauna by Machado-Allison *et al*. (1983) in Venezuela and by Richardson *et al.* (2000) in Puerto Rico reveal many taxa similar to those found in the Saban phytotelmata, although fewer species were reported in the Venezuelan study. Machado-Allison *et al*. (1983) stated there should be more species of insect living in *Heliconia* bracts of mainland plants than in those of island plants. Interestingly, Machado-Allison *et al*. (1983) reported only about half the amount of water present in bracts as compared with Saba. Because the volume of water represents the habitat size, this may explain the lower species richness of the Venezuelan phytotelmata.

Species-area relationship

An aspect of island biogeography theory (MacArthur and Wilson 1967) predicts a positive correlation would exist between the size of the habitat and species richness. A Spearman's rank order correlation value of 0.335 (P=0.0155) was calculated when the volume of water in bracts and the number of species in each inflorescence were compared, indicating a correlation did exist. It is likely only a few invertebrate species are capable of inhabiting temporary aquatic habitats and a small amount of water is sufficient to support these species associated with *H. caribaea* inflorescences. However, this increase in species richness as volume increases may be limited because populations of common insects may increase more rapidly than additional species invading the liquid in the bract (Seifert 1975). A correlation value of 0.585 (P=0.000001) existed when comparing the amount of liquid in the bracts with the number of individuals inhabiting each inflorescence. This correlation was expected because a larger habitat has the potential to support more individuals.

Community succession

Richardson and Hull (2000) followed succession of the *H. caribaea* fauna in a mountain forest of Puerto Rico. They reported larval Ceratopogonidae were most abundant in younger bracts and declined in older bracts as decaying materials accumulated. Larval Psychodidae followed a similar pattern, although they lagged behind slightly. Those same trends were observed in the *H. caribaea* phytotelmata faunal samples collected in this current study from Saba. Because all instars of *A. busckii* larvae were present in all samples, these mosquitoes appeared to have no preference for bract age – they simply required the liquid to be present in sufficient quantities for a long enough period to allow development to be completed.

CONCLUSION

The nine objectives originally proposed were addressed. Results of this investigation in Saba generally agree with other studies of aquatic invertebrate populations inhabiting *Heliconia* inflorescences in different tropical locations, including the presence of similar taxonomic groups. All 20 taxa reported in this study were found only in water-filled bracts of *H. caribaea* on Saba, and 17 of the 20 taxa are being reported from this island for the first time, increasing the total number of aquatic invertebrates known from Saba to 35 taxa.

ACKNOWLEDGEMENTS

We thank the Saba Sea and Learn Program and its sponsors for logistical support while in Saba. In addition, the Executive Council of the Island Territory of Saba granted permits to collect and export invertebrates. We also recognize the University of Central Oklahoma for providing laboratory space and materials. Donna Bass helped collect data in the field and sort organisms in the laboratory. Ralph Harbach of the British Natural History Museum provided a species name for the immature *Aedes*.

REFERENCES

Anonymous. 2010. *Heliconia caribaea*. National Tropical Botanical Garden, Kalaheo, Hawaii, U.S.A. http://ntbg.org/plants/plant_details.php

Bass, D. 2008. Freshwater macroinvertebrates and their habitats in Saba, West Indies. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2008: 33-38.

Bronstein, J. L. 1986. The origin of bract liquid in Neotropical *Heliconia* species. *Biotropica,* 18: 111-114.

Brower, J., Zar, J. and **von Ende, C.** 1997. Field and Laboratory Methods for General Ecology. Fourth Edition. Dubuque, Iowa: Wm. C. Brown Publishers. 273 p.

Dobkin, D. S. 1990. Distribution patterns of hummingbird flower mites (Gamasida: Ascidae) in relation to floral availability on *Heliconia* inflorescences. *Behavioral Ecology,* 1 (2): 131-139.

Fish, D. 1983. Phytotelmata: terrestrial plants as hosts for aquatic insect communities. p. 1-27. *In* **J. H. Frank** and **L. P. Lounibos**, eds. Phytotelmata: Flora and Fauna. Medford, New Jersey: Plexus.

Lloyd, F. E. 1942. The Carnivorous Plants. Waltham, Massachusetts: Chronica Botanica.

MacArthur, R. and **Wilson, E. O.** 1967. The Theory of Island Biogeography. Princeton, New Jersey: Princeton University Press. 203 p.

Machado-Allison, C. E., Rodriguez, D. J., Barrera, R. R. and **Gomez Cova, C.** 1983. The insect community associated with inflorescences of *Heliconia caribaea* Larmarck. p. 247-270. *In* **J. H. Frank** and **L. P. Lounibos**, eds. Phytotelmata: Flora and Fauna. Medford, New Jersey: Plexus.

Maguire, B. 1971. Phytotelmata: biota and community structure determination in plant-held waters. *Annual Review of Ecology and Systematics,* 2: 439-464.

McLean, R. 2004. Saban Trails. St. Maarten: Saba Conservation Foundation. 50 p.

Merritt, R. W., Cummins, K. W. and **Berg, M. B.** 2008. An Introduction to the Aquatic Insects of North America. 4th ed. Dubuque, IA: Kendall/Hunt Publishing Co. 1158 p.

Naeem, S. 1990. Resource heterogeneity and community structure: a case study in *Heliconia imbricata* phytotelmata. *Oecologia,* 84: 29-38.

Richardson, B. A. and **Hull, G. W.** 2000. Insect colonization sequences in bracts of *Heliconia caribaea* in Puerto Rico. *Ecological Entomology,* 25: 460-466.

Richardson, B. A., Rogers, C. and **Richardson, M. J.** 2000. Nutrients, diversity, and community structure of two phytotelm systems in a lower montane forest, Puerto Rico. *Ecological Entomology,* 25: 348-356.

Scott, H. 1914. The fauna of "reservoir plants". *Zoologist,* 18: 183-195.

Seifert, R. P. 1975. Clumps of *Heliconia* inflorescences as ecological islands. *Ecology,* 56: 1416-1422.

Seifert, R. P. 1982. Neotropical *Heliconia* insect communities. *Quarterly Review of Biology,* 57: 1-28.

Seifert, R. P. and **Seifert, F. H.** 1976. Natural history of insects living in inflorescences of two species of *Heliconia*. *Journal of the New York Entomological Society,* 34: 233-244.

Skutch, A. F. 1933. The aquatic flowers of a terrestrial plant, *Heliconia bahai* L. *American Journal of Botany,* 20: 535-544.

Stone, A. 1969. Bredin-Archbold-Smithsonian biological survey of Dominica: the mosquitoes of Dominica (Diptera: Culicidae). *Smithsonian Contribution in Zoology,* 16: 1-16.

Thorp, J. H. and **Covich, A. P.** 2001. Ecology and Classification of North American Freshwater Invertebrates. 2nd ed. San Diego, CA: Academic Press, 1056 p.

Malaysian Prawns, *Macrobrachium rosenbergii,* Trinidad's Invasive Alien; Biological Indicator or Aquaculture Species?

Ryan S. Mohammed[1, 3], **Carol Ramjohn**[1] and **Rakesh Bhukal**[2, 3]

1. Strategic Environmental Services (SES) Ltd., 5 Henry Pierre Terrace, St. Augustine.

2. The University of the West Indies (UWI), School of Veterinary Medicine (SVM), Mt. Hope.

3. Aquaculture Association of Trinidad and Tobago (aQua-TT), c/o Trinidad and Tobago Agriculture Business Association (TTABA), Level 2 Auzonville Plaza, Eastern Main Road, Tunapuna.

Corresponding author: *ryansmohammed.ses@gmail.com*

ABSTRACT

An update of the distribution of *Macrobrachium rosenbergii* indicates a distribution within ten rivers, in comparison to two rivers as previously documented. These rivers have higher dissolved oxygen concentrations in comparison to those where they have not been collected. With this in mind it is proposed that this species could possibly be regarded as a biological indicator species in Trinidad. They have been found in low densities and it is presumed not to be an ecological threat to native species of aquatic fauna particularly other *Macrobrachium* species.

Key words: Malaysian prawns, *Macrobrachium, rosenbergii,* alien invasive, biological indicator, aquaculture.

INTRODUCTION

Internationally, Malaysian prawns, *Macrobrachium rosenbergii,* are regarded as an aquaculture species (Sandifer 1977) and are native to rivers of South East Asia (Raman 1967). They were originally introduced into Trinidad in 1985 at the Orange Grove Fish Farm and Institute of Marine Affairs (IMA) with hopes of establishing an aquaculture industry (Fisheries Division, Ministry of Agriculture, Land and Marine Affairs 1990). A prawn hatchery was subsequently established at the Orange Grove Fish Farm. It is presumed that individuals escaped from this facility, which is located within the Caroni Basin drainage system, and have now begun to slowly colonize various river systems of suitable water quality. This species relies on brackish water (5‰ to 10‰) to complete its life cycle (Bowles *et al.* 2000), and is very sensitive to changes in water quality (Rostant 2005). Their preferred dissolved oxygen concentration is 6 to 6.5 mg l^{-1} (Johnson 1978) when stocked at 12 individuals m^{-2} for culture purposes. Studies of the distribution of decapod crustaceans by Rostant (2005) indicated this species as occurring locally in the wild.

At present the two aforementioned production and hatchery facilities where the prawns were first introduced are no longer in operation; however, controlled and limited breeding occurs at the IMA in addition to two other private establishments. There are currently no new prawn farms in existence. The species has also infiltrated the local ornamental pet trade and has been sighted in pet shops by two of the authors in north, south and central Trinidad. The ecological impact of this species is unknown thus far. Due to its non-native origins and the subsequent natural spread into local rivers, it can be categorized as an invasive alien species (Devick 1991; Williams *et al.* 2001; Woodley *et al.* 2002).

METHODOLOGY

Baseline sampling of various west coast draining rivers were conducted between the years of 2005 and 2009 targeting aquatic macroinvertebrates and fish. This was facilitated using cast-netting (mesh size, 0.5 cm, 2.0, diameter), seining (mesh size 0.5 cm, 1.25m x 5.0 m) and setting of baited fish pots (mesh size, 0.5 cm, 60.0cm x 30.0cm x 30.0cm, 20.cm funnel opening diameter, 10.0 cm funnel base). At all sites the three methods of sampling were utilized and sampling effort standardized and the data acquired from this was pooled for analysis which consisted of counting and identifying all *Macrobrachium* species captured. Physico-chemical water quality parameters such as salinity, temperature, dissolved oxygen (DO) (using multiprobe YSI 85 meter) and pH (using YSI pH 100 meter) were monitored *in situ* to determine water quality. This was correlated to number of individuals caught using a linear regression and correlation analysis. An updated distribution map was prepared using ESRI ARC MAP 9.2.

RESULTS

No statistically significant correlations were noted when pH, salinity or temperature was compared to number of *Macrobrachium* individuals captured. Significant correlation was noted, however, when DO was compared

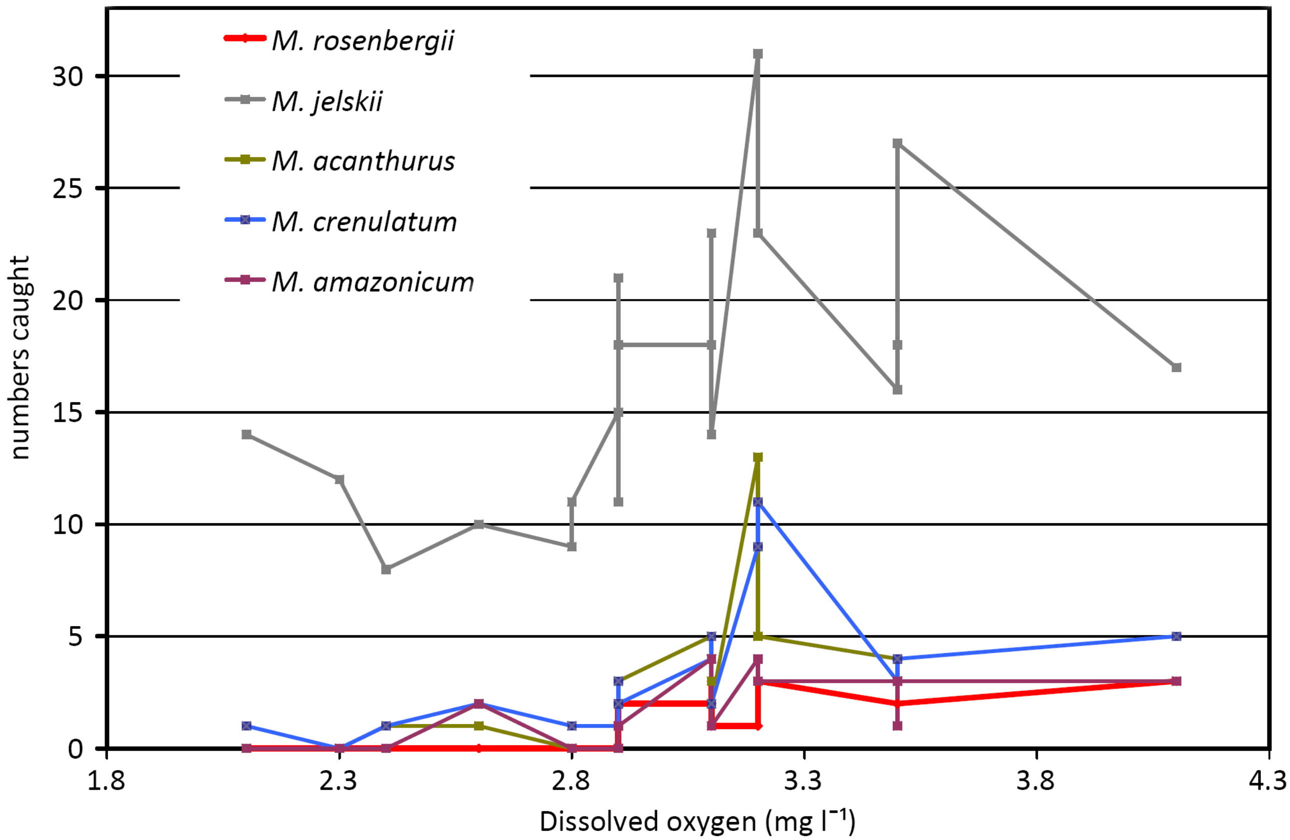


Fig. 1. Comparison of *Macrobrachium* species found during surveys of the west flowing rivers of Trinidad against dissolved oxygen concentrations (DO).

to the number of other *Macrobrachium* individuals, as seen in Fig.1 (see Appendix 1 for sites and year of collection). At the current survey sites, *M. acanthurus, M. jelskii* (found in the highest numbers), *M. crenulatum* and *M. amazonicum* were also found.

Table 1 shows that *M. rosenbergii* is most correlated to DO concentrations and *M. jelskii* is least correlated as indicated by the respective R^2 values and as displayed in Fig.1. Fig. 2 displays the current distribution of *Macrobrachium* species along the west coast of Trinidad, their proximity to the existing breeding facilities, and the historical distribution of this genus. *M. rosenbergii* was previously found only within the South Oropouche and Guapo Drainages (Rostant 2005). It has since been recorded at eight additional sites.

DISCUSSION

The new distribution of *M. rosenbergii* would imply colonizing and infiltrating of rivers if the water quality, particularly DO, is suitable for its survival.

The sensitivity of this species to waterways with low DO would indicate that there is potential for this species to serve as an aquatic biological indicator for Trinidad's rivers. At all sites and times when *M. rosenbergii* was absent, the DO was below 2 mg l^{-1}. Mohammed (2010) noted the low DO and poor water quality of several west coast rivers, particularly the Couva and Guaracara Rivers where *M. rosenbergii* has not yet been found.

The low numbers recorded would imply that *M. rosenbergii* is currently not an ecological threat to other native species of decapods particularly other *Macrobrachium* species. At all sites, with the exception of Guapo, Silver Stream and Caroni Rivers, smaller individuals (<4.0 cm) were found (personal observations). This would imply that they are juveniles transitioning from brackish water to freshwater. Both Rostant (2005) and this current survey reported populations in the Guapo River, which would imply that the prawns are breeding successfully. Guapo River also yielded the widest size range of specimens (carapace lengths of 3.8 to 10.9 cm).

Table 1. Correlation values for *Macrobrachium* species.

Species	*M. rosenbergii*	*M. jelskii*	*M. acanthurus*	*M. crenulatum*	*M. amazonicum*
R^2	0.5744	0.1993	0.2577	0.2088	0.3811

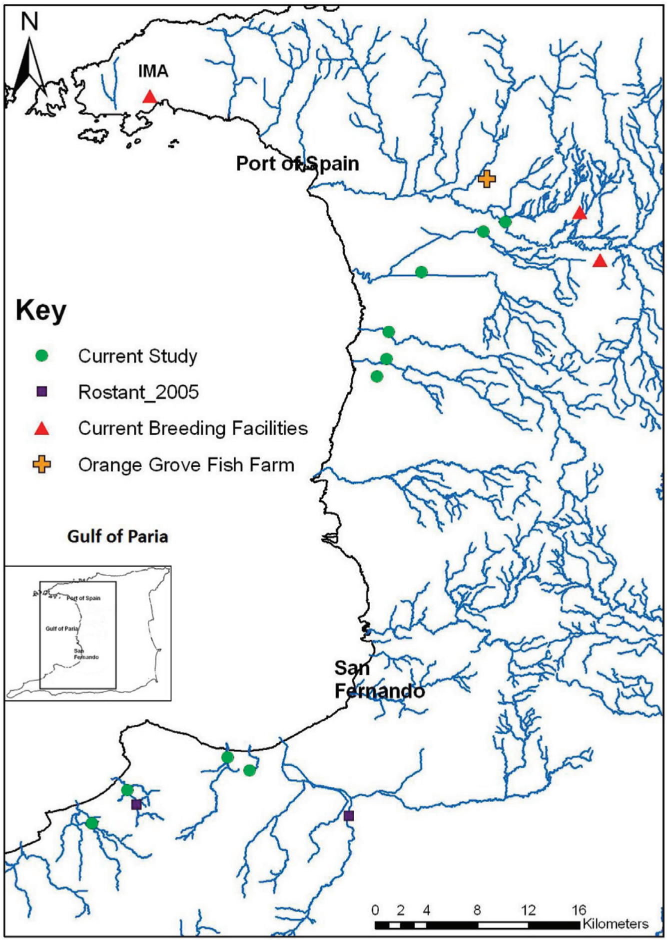


Fig. 2. West Trinidad showing the updated distribution of *M. rosenbergii*, the previous distribution and current captive breeding sites.

The common attribute that all occurrences have is relatively high DO. Heileman and Ramsaroop (1990) indicated that the salinity of the Gulf of Paria was sufficiently low to be characterized as estuarine. The low salinity (ranging between 5‰ and 20‰) and circular, clockwise-moving current (Kenny 1995) of the Gulf of Paria propelled by the Orinoco River discharge from the South American mainland, provide an efficient vehicle for the movement of larval *Macrobrachium*. Water quality would be a major contributing factor to the colonizing of the rivers, considering all west flowing rivers have similar assemblages of freshwater fishes (Kenny 1995) and hence similar predator pressures for juvenile prawns. Sampling events (Rostant 2005) across both islands have only produced specimens from the west flowing rivers of Trinidad.

M. rosenbergii can still be regarded as a freshwater alien species and care must be taken not to allow the spread of this species to Tobago's waterways. Rostant (2005) indicated an already high diversity and density of *Macrobrachium* species on that island. Should this species be introduced to the waterways there, it can potentially be a threat to the native species. This is based on easier access to estuarine conditions that would facilitate its reproductive cycle and waterways with high DO concentrations that favor its survival, thus allowing for high densities of this species which would ultimately put it into direct competition with other *Macrobrachium* species that exist there.

The Malaysian prawn, regardless of the threat of invading waterways, is still a potential aquaculture species due to tolerance of high stocking densities (Shanga and Fujimura 1977), and potential for fetching high prices. The hatchery operations for the breeding of this species must be managed effectively to prevent individuals from being added to the environment, and also to allow for the development of sustainable aquaculture practices.

REFERENCES

Bowles, D. E., Aziz, K. and **Knight, C. L.** 2000. *Macrobrachium* (Decapoda: Caridea: Palaemonidae) in the contiguous United States: a review of the species and assessment of threats to their survival. *Journal of Crustacean Biology,* 29: 158-171.

Heileman, L. I. and **Ramsaroop, D.** 1990. Seasonal variations in some oceanographic parameters in the Gulf of Paria, Trinidad and Tobago, West Indies. *Caribbean Marine Studies,* 1: 101-113.

Kenny, J. S. 1995. Views from the Bridge: A Memoir on the Freshwater Fishes of Trinidad. Julian Kenny, Port of Spain, Trinidad. 98 p.

Fisheries Division, Ministry of Agriculture, Land and Marine Affairs. 1990. Potential aquaculture species for Trinidad and Tobago.

Johnson, W. C. 1978. Culture of Freshwater Prawns (*Macrobrachium rosenbergii*) Using Geothermal Waste Water. Geo-Heat Center Klamath Falls, OR 97601. 11 p.

Mohammed, R. S. 2010. Investigation of Factors Affecting the Prevalence of Selected Parasites and Bacterial Pathogens on Three Species of Freshwater Catfish Exported from Trinidad. M. Phil Thesis. Department of Life Sciences, The University of the West Indies. 252 p.

Shanga, Y. C. and **Fujimura, T.** 1977. The production economics of freshwater prawn (*Macrobrachium rosenbergii*) farming in Hawaii. *Aquaculture*, 11 (2): 99-110.

Raman, K. 1967. Observations on the fishery and biology of the giant freshwater prawn *Macrobrachium rosenbergii* (de Man). *In* Proceedings of the Symposium on Crustacea, Part 2, MBAI, 12-16 January 1965, Ernakulam.

Rostant, W. G. 2005. Freshwater Decapod Communities of Trinidad and Tobago. M. Phil Thesis. Department of Life Sciences, The University of the West Indies. 180 p.

Sandifer, P. A. and **Smith, T. I. J.** 1977. Intensive rearing of post-larval Malaysian prawns (*Macrobrachium rosenbergii*) in a Closed Cycle Nursery System. Proceedings of the Annual Meeting - World Mariculture Society, *Journal of the World Aquaculture Society,* 8 (Issue 1-4): 225–235.

Williams Jr., E. H., Bunkley-Williams, L., Lilyestrom, C. G. and **Ortiz-Corps, E. A. R.** 2001. A review of recent introductions of aquatic invertebrates in Puerto Rico and implications for the management of exotic species. *Caribbean Journal of Science,* 37: 246-251.

Woodley, C. M., Slack, W. T., Peterson, M. S. and **Vervaeke, W.** 2002. Occurrence of the non-indigenous giant Malaysian prawn, *Macrobrachium rosenbergii,* (De Man 1879) in Simmons Bayou, Mississippi, U.S.A. *Crustaceana,* 75: 1025-1031.

APPENDIX 1

Distribution of *Macrobrachium* species on the west flowing rivers of Trinidad.

Year	**River Site**	**DO**	***M. amazonicum***	***M. jelskii***	***M. acanthurus***	***M. crenulatum***	***M. rosenbergii***
2006	Couva	2.1	0	14	0	1	0
2005	Couva	2.3	0	12	0	0	0
2006	Guaracara	2.4	0	8	1	1	0
2006	Tarouba	2.6	2	10	1	2	0
2005	Cipero	2.8	0	9	0	1	0
2006	Guaracara	2.8	0	11	0	1	0
2006	Cipero	2.9	0	15	0	1	0
2007	Guayamare	2.9	1	21	3	2	1
2008	Couva	2.9	0	11	1	3	0
2009	Caroni	2.9	1	18	3	2	2
2006	Guapo	3.1	4	18	5	4	2
2008	Carapichaima	3.1	4	23	3	5	3
2009	Cunupia	3.1	1	14	2	2	1
2006	Silver Stream	3.2	4	31	13	9	1
2008	Caparo	3.2	3	23	5	11	3
2008	Chandernagore	3.5	3	16	4	3	2
2009	Vance	3.5	1	18	3	1	2
2009	South Oropouche	3.5	3	27	3	4	2
2009	Tarouba	4.1	3	17	3	5	3

NATURE NOTES

Use of Coconut Endocarp as an Oviposition Site by a Neotropical Harvestman (Opiliones: Cranaidae)

Field observations of oviposition sites used by harvestmen indicate that these arachnids may lay eggs within cavities of plant stems, tank bromeliads, on surfaces of leaves, moss, fallen trunks, decaying sheaths of palm fronds, leaf litter, soil, moist fallen leaves, spaces beneath rocks, snail shells, and cave walls (reviewed by Machado and Maciás-Ordóñez 2007). Although some species of harvestmen feed upon or are attracted to tropical fruits (Machado and Pizo 2000), there are no published reports of the use of fruits (fresh or decaying) as oviposition sites. On the Caribbean island of Trinidad, two species of cranaid harvestmen, *Phareicranaus calcariferus* (Simon 1879) and *Santinezia serratotibialis* (Roewer 1932), occur island-wide (Kury 2003), are syntopic, and reproduce during the wet season (Townsend *et al.* 2008a). Adults have been observed in close association with eggs, larvae and nymphs in the damp pockets among tree roots, within the sheaths of palm fronds, and in cavities within rotting tree trunks (Machado and Warfel 2006; Hunter *et al.* 2007; Townsend *et al.* 2008b). Field observations have also revealed that adults of either sex (sometimes both) may be found in the immediate vicinity of eggs or young (Hunter *et al.* 2007; Townsend *et al.* 2008b) and that nymphs have the capacity to return to shelters, even after displacement of distances up to 10 m (Proud and Townsend 2008).

On 12 July 2008, we sampled harvestmen in the early afternoon (1200 to 1400 hr) among coconuts and fronds beneath palm trees adjacent to the beach at Grand Tacaribe along the northern coast of Trinidad (10°47.761'N, 61°13.040'W). The temperature was 30°C, humidity was greater than 90%, and the sky was partially cloudy. We collected several species of harvestmen including *Prionostemma vittatum* (adults, nymphs and larvae), *Paecilaema inglei* (adults and nymphs), *Cynortula granulata* (adults), *Santinezia serratotibialis* (adults and nymphs), *Rhopalocranaus albilineatus* (adults) and *Stygnoplus clavotibialis* (adults). At 1300 hr, we found an adult male and female *Phareicranaus calcariferus* within a coconut which featured an intact mesocarp (outer husk) and endocarp (inner stone) and had a small opening (approximately 1 cm in diameter) at the base. The adults within the endocarp were discovered only after the fruit had inadvertently split open. Careful examination of the hard, dry endosperm revealed the presence of 30 yellowish white eggs (mean = 1.39 mm, SD = 0.05, range = 1.29-1.47) and two larvae (Figure 1). Immediately following exposure, the adults remained motionless and in close proximity to the eggs. However, after 10-20 s, both individuals moved and were collected and preserved in 70% ethanol. The coconut containing the eggs was carefully taken to our camp, photographed and the eggs and larvae were preserved.

Our observation represents the first report of a harvestman using the cavity within a coconut as an oviposition site. This observation is consistent with the general pattern displayed by females within the Laniatores with respect to the selection of oviposition sites. Given the relatively short ovipositor of most species, eggs are gen-

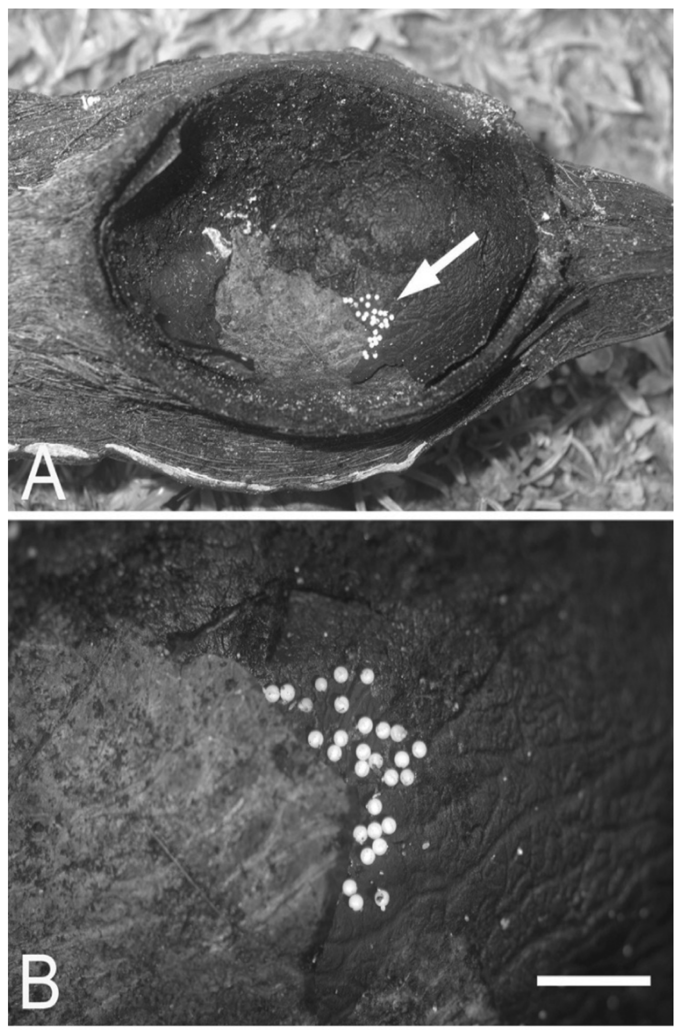


Fig. 1. A, Mesocarp and endocarp of coconut with eggs (arrow) of *P. calcariferus* and **B,** Eggs within endocarp of coconut. Scale bar = 18mm.

erally laid in natural cavities or covered with soil or other debris (Machado and Maciás-Ordóñez 2007). For species living near coastal areas, coconuts may confer several advantages over other oviposition sites, including protection of eggs from unfavorable environmental conditions (heavy rain, wind and salt spray) and potential predators (ants, conspecifics, etc.). The cavity within the coconut may also represent a relatively stable, favorable microclimate that is advantageous for embryonic development.

ACKNOWLEDGEMENTS

We thank M. Carr, S. Broadbridge and C. Fitzjames for assistance in the field. We are especially grateful to the Forestry Division of the Ministry of Agriculture, Land and Marine Resources of Trinidad and Tobago. Specimens were legally collected and exported under permit number 001339 issued to DNP. Vouchers will be deposited in the collection at the AMNH.

REFERENCES

Hunter, R. K., Proud, D. N., Burns, J. A., Tibbetts, J. A. and **Townsend Jr., V. R.** 2007. Parental care in the Neotropical harvestman *Phareicranaus calcariferus* (Opiliones: Laniatores: Cranaidae). *Journal of Arachnology*, 35: 199-201.

Kury, A. B. 2003. Annotated catalogue of the Laniatores of the New World (Arachnida: Opiliones). *Revista Ibérica de Aracnología, vol. especial monográfico*, 1: 1-337.

Machado, G. and **Maciás-Ordóñez, R.** 2007. Reproduction. p. 414-454. *In* **R. Pinto-da-Rocha, G. Machado** and **G. Giribet,** eds. Harvestmen: The Biology of Opiliones. Cambridge, Massachusetts: Harvard University Press.

Machado, G. and **Pizo, M. A.** 2000. The use of fruits by the Neotropical harvestman *Neosadocus variabilis* (Opiliones: Laniatores: Gonyleptidae). *Journal of Arachnology*, 28: 357-360.

Machado, G. and **Warfel, J.** 2006. First case of maternal care in the family Cranaidae (Opiliones: Laniatores). *Journal of Arachnology*, 34: 269-272.

Proud, D. N. and **Townsend Jr., V. R.** 2008. Homing ability of harvestmen nymphs (Opiliones: Cranaidae). *Living World*, 2008: 79-80.

Townsend Jr., V. R., Rana, N. J., Proud, D. N., Moore, M. K., Rock, P. and **Felgenhauer, B. E.** 2009. Morphological changes during post-embryonic development in two species of Neotropical harvestmen (Opiliones: Laniatores: Cranaidae). *Journal of Morphology*, 270: 1055-1068.

Townsend Jr., V. R., Proud, D. N. and **Moore, M. K.** 2008b. Harvestmen (Arachnida: Opiliones) of Trinidad, West Indies. *Living World*, *Journal of The Trinidad and Tobago Field Naturalists' Club*, 2008: 53-65.

Victor R. Townsend Jr.
Department of Biology, Virginia Wesleyan College,
1584 Wesleyan Drive, Norfolk, VA 23509, USA.
vtownsend@vwc.edu

Daniel N. Proud
dnp0646@louisiana.edu

Alan H. Savitzky
asavitzk@odu.edu

Merry V. Marshall
mvmarshall@ollusa.edu

First Record of the Hawkmoth *Aellopos clavipes* (Sphingidae) in Tobago, West Indies

On 17 February, 2009 at around 1730 h, I was at Englishman's Bay, Tobago, in Trinidad and Tobago. I observed a very unusual moth feeding on duranta flowers. Duranta is a cultivated bush or shrub (*Duranta* spp.), producing blue or white flowers and yellow/orange berries. The moth remained in the area for about five minutes and photographs were taken (Fig. 1 and Fig. 2). I have seen a similar type of moth, a type of "hawkmoth" in the northeastern United States, which are locally called "Hummingbird Moths", since their feeding behaviour looks similar to a hummingbird from a distance.

Photographs were sent to Dr. Matthew J.W. Cock for identification who stated that "based on D'Abrera (1986) and the characters which he gives, I conclude that it is *Aellopos clavipes clavipes* (Rothschild and Jordan)". Cock further noted that "five species are recorded from Trinidad – one with yellow markings and four with white markings, like yours. The one with yellow markings is quite common, but the four with white markings are not seen very often, and then usually in forest situations. These four are not easy to distinguish, even with pinned specimens. None of these *Aellopos* hawkmoths have been recorded from Tobago, but any of them might be found – the Lepidoptera of Tobago, especially moths, have been poorly collected, so there are many new discoveries to be made."

Other species of *Aellopos* have been reared (Moss 1920; Haber and Frankie 1983; Janzen 1985; Young 1985), all on species of Rubiaceae. The life history of *A. clavipes* does not seem to have been recorded, but Janzen and Hallwachs (2011) have reared it on *Randia aculeata, R. monantha*, and two other species of Rubiaceae. *Randia aculeata* has been recorded on both Trinidad and Tobago by Williams and Cheesman (1928).

Ever since my initial sighting, I have waited and watched for this moth to return, but so far, I have never seen it again. It must have strayed from the forest, which is very close, for this irregular meal.

I owe most of the information from the literature to Matthew Cock, who I thank for his assistance in putting this article together.

REFERENCES

D'Abrera, B. 1986. Sphingidae Mundi. Hawkmoths of the World. Faringdon, Oxon, UK: E.W. Classey Ltd. 226 p.

Haber, W. A. and **Frankie, G. W.** 1983. *Aellopos titan* (cinta blanca, white-banded sphinxlet). p. 680-681. *In* **D. H. Janzen**, ed. Costa Rican Natural History. Chicago, University of Chicago Press.

Janzen, D. H. 1985. A hostplant is more than its chemistry. *Illinois Natural History Survey Bulletin*, 33: 141-174

Janzen, D. H. and **Hallwachs, W.** 2011. Dynamic database for an inventory of the macrocaterpillar fauna, and its food plants and parasitoids, of Area de Conservacion Guanacaste (ACG), northwestern Costa Rica. http://janzen.sas.upenn.edu (Last accessed 22 Jan. 2011).

Moss, A. M. 1920. Sphingidae of Pará, Brazil. *Novitates Zoologicae*, XXVII: 333-424, plates i-xi.

Young, A. M. 1985. Natural history notes for *Aellopos ceculus* (Cramer) (Sphingidae) in northeastern Costa Rica. *Journal of the Lepidopterists' Society*, 39: 330–333.

Williams, R. O. and **Cheesman, E. E.** 1928. *Rubiales.* Flora of Trinidad and Tobago 2(1): 1-48.

Matt Kelly
123 Beach Hill Road,
New Ashford, MA 01237, USA.
veganpeace@earthlink.net

Fig. 1 Hawkmoth, *Aellopos clavipes.*

Fig. 2 Hawkmoth, *Aellopos clavipes.*

Viable Land Snail Eggs in a Bird Pellet

On 2 January, 2011 at my house in St. Augustine, Trinidad, I found a regurgitated bird pellet that was full of small snail shells (Fig. 1). The pellet was dissected and found to contain ten snail shells (average length 7 mm), three black seeds (average width 4 mm) and various insect body parts. The pellet was held together by a yellowish fibrous matter which I took to be fruit pulp.

The snail shells were mostly intact and were identified as nine specimens of *Allopeas micra* (d'Orbigny, 1835) and one specimen of *Huttonella bicolor* (Hutton, 1834). The transparent nature of the *A. micra* shells showed that much of the snails soft body parts were still intact on the inside, however the foot and lower parts of the soft body had been destroyed. Two of the *Allopeas* examined had small white eggs visible in the body whorl of the shell. Two eggs from each shell were removed and placed on a damp kitchen towel in a small glass dish then covered with a plastic lid. Over the course of the next nine days the kitchen towel was kept damp and the eggs were observed. On 12 January one of the eggs hatched, the hatchling crawled to the edge of the glass dish and had dried out before it was found. The three remaining eggs were left for several more days but did not hatch; they were dissected and found to be non-viable.

The animal that left the pellet was not observed so it cannot be said for certain from where the pellet came. However, as far as I am aware, no local mammal, reptile, amphibian or invertebrate has the necessary diet of fruit, insects and molluscs to have left the pellet and therefore I conclude that it must have been a bird. Also the location of the pellet, on my back porch under the roof gutter, suggests it was dropped there from above as a ground based animal would have been unlikely to come onto the porch due to the gate and wall surrounding it.

Based on dietary preferences, the size of the pellet and the species of bird that have been commonly observed in my garden, I surmise that it was likely to have been a Bare-eyed Thrush (*Turdus nudigenis* Lafresnaye 1848). Thrushes are well-known for their consumption of snails; in a review of the literature on avian predators of terrestrial molluscs the majority of records were about members of the genus *Turdus* (Allen 2004). Although they tend to feed on larger species (>10 mm length) from which they extract the soft parts by breaking the shell, many small species (<10 mm length) of snails are also eaten.

On a further note, the presence of a single shell of *H. bicolor* is quite interesting. This snail, as well as being an alien species to Trinidad, is a micro-predator of other snails, so it is quite possible that it was eaten by the bird whilst in the act of eating one of the *Allopeas.*

The survival of eggs following predation of adult snails by a bird raises the possibility of a new dispersal mechanism for land snails. There are many examples of molluscs being transported on the feet, legs and feathers of various birds and there are some examples of molluscs surviving passage through the digestive systems of various animals but, to my knowledge, there are no records of the eggs of a land snail hatching after the adult has been partly digested.

Fig. 1. Bird pellet with small snail shells.

Studies show that water-birds can transport a range of freshwater invertebrates and their eggs inside their gut (Frisch *et al*. 2007). It has also been observed that specimens of a marine gastropod have been found alive in the regurgitated pellets of a Willet (Sousa 1993). Another study observed that small land snails are often found virtually complete in the faeces of passerine birds, however, as no snails were found alive, it was suggested that this could be a dispersal technique only when conditions were optimal (Kawakami *et al.* 2008).

As the *Allopeas* that I found were in a regurgitated pellet rather than faeces, it is possible to assume that the snails spent a shorter period of time in the birds gut than they would have if excreted. This shorter time along with the fact that the eggs were protected by the shell and soft body of the adult snails, which were dead upon finding, would have contributed to the viability of one of the eggs.

Further investigation is required to confirm if this mechanism is really an option for dispersal. The fact that the eggs were manually removed from the dead adult shells and then placed in a favourable environment for hatching means that care has to be taken in claiming that the juvenile snails could hatch and survive without interference. Controlled feeding of captive birds with adult snails and then examination of the pellets produced could provide the answers.

Specimens are stored at The University of the West Indies Zoology Museum under the numbers UWITT.2011.13.1 and .2.

REFERENCES

Allen, J. A. 2004. Avian and Mammalian Predators of Terrestrial Gastropods. p.1-36. *In* **G. M. Barker,** ed. Natural Enemies of Terrestrial Molluscs. CABI Publishing, Oxfordshire, UK.

Frisch, D., Green, A. J. and **Figuerola, J.** 2007. High dispersal capacity of a broad spectrum of aquatic invertebrates via waterbirds. *Aquatic Sciences*, 69: 568-574.

Kawakami, K., Wada, S. and **Chiba, S.** 2008. Possible dispersal of land snails by birds. *Ornithological Science*, 7: 167-171.

Sousa, W. P. 1993. Size-dependent predation on the salt-marsh snail *Cerithidea californica* Haldeman. *Journal of Experimental Marine Biology and Ecology,* 166(1): 19-37.

Mike G. Rutherford
mike.rutherford@sta.uwi.edu

A Food Plant Record for *Memphis pithyusa* (Lepidoptera: Nymphalidae) in Trinidad

Memphis pithyusa pithyusa (R. Felder), the southern blue leaf shoemaker of Barcant (1970), is amongst the least known of the larger butterflies of Trinidad. It has been commonly known under the name *Anaea pithyusa*, but the genus *Anaea* has now been split into several genera and *pithyusa* is now placed in the genus *Memphis* in the subfamily Charaxinae of Nymphalidae (Lamas 2004). These are very rare and localised butterflies, last recorded brooding in September and October 1947 at Morne Diable Quarry Road, southern Trinidad by Barcant (1970). Since then there have been only four or so isolated captures from scattered localities.

On 23 August, 2010, I was collecting butterflies along the track at Point Gourde when I noticed several leaf tube shelters on one type of shrub that was very common along the track. Leaf tubes of this sort are characteristically made by caterpillars of the *Anaea* group of genera. The shelters are a funnel-shaped device held together by silk threads in which the caterpillar lives. As the caterpillar increases in size, so does the leaf shelter. These particular shelters were striking because of their silver-grey colour. The undersides of the leaves of this particular shrub are silver-grey in colour, so when rolled to form the leaf tube there is a noticeable contrast with the green of the upper surface of the leaf.

I returned to Point Gourde on 27 August and caught several *M. pithyusa,* both males and females. I was ecstatic to see and catch this little known, rare Trinidad butterfly. They were numerous but localised at the very end of the track adjacent to the Water and Sewerage Authority's facility. I returned to Point Gourde again on 29 August and encountered the butterflies at the same location but also along the track at varying intervals. This time I saw a female laying on the shrubs on which I had found the silver-grey leaf shelters. I suspected immediately that this was the food plant of *M. pithyusa*. The shrub was subsequently identified by the Herbarium at the University of the West Indies as *Croton niveus* (Euphorbiaceae) which is localised in the north-west peninsular of Trinidad and the offshore islands as far as Chacachacare (Philcox 1979). I collected and reared many caterpillars on these three visits and adult *M. pithyusa* emerged during September and October 2010 confirming the food plant of the butterfly.

In January 2011, I returned to collect but could find no trace of the butterfly and no signs of any leaf shelters. This was obviously a localised brooding phenomenon infrequently witnessed. Scott Alston-Smith (pers. comm.) has collected regularly at Point Gourde over the years and has never seen this butterfly or its caterpillars there before. What conditions favoured this localized brooding in August and September 2010 I do not know, but the food plant for *M. pithyusa* has at last been found, at least from the north-west of the island.

Although this butterfly is a great rarity in Trinidad, it is quite common in Central America. The life cycle in

El Salvador on *Croton reflexifolius* and *C. niveus* was described and illustrated by Muyshondt (1975), while Janzen and Hallwachs (2011) provide copious photographs of the early stages from Costa Rica. Based on 500 rearing records from Guanacaste, Costa Rica (Janzen and Hallwachs 2011), *C. schiedeanus* is the normal food plant, while about 5% of records were from *C. niveus*. Beccaloni *et al*. (2008) summarised the other known food plant records. Most are from Central America where seven species of *Croton* are reported as food plants, but one record is from Venezuela where *C. hircinus* is reported.

According to Philcox (1979), 11 species of *Croton* occur in Trinidad, including *C. niveus* and *C. hircinus*, the Venezuelan food plant, which is found in the Northern Range. It therefore seems likely that both of these may be used as food plants, but another species of *Croton* must be used in the south of the island.

I thank Matthew Cock for assisting with the literature on this butterfly.

REFERENCES

Barcant, M. 1970. Butterflies of Trinidad and Tobago. London: Collins. 314 p.

Beccaloni, G. W., Viloria, Á. L., Hall, S. K. and **Robinson, G. S.** 2008. Catalogue of the hostplants of the Neotropical butterflies. Catálogo de las plantas huésped de las mariposas neotropicales. *Monografias Tercer Milenio*, 8: 536 p.

Janzen, D. H. and **Hallwachs, W.** 2010. Dynamic database for an inventory of the macrocaterpillar fauna, and its food plants and parasitoids, of Area de Conservacion Guanacaste (ACG), northwestern Costa Rica. http://janzen.sas.upenn.edu (Last accessed 29 Jan. 2011).

Lamas, G. 2004. Charaxinae. p. 224-234 *In* **Lamas**, **G.**, ed. Checklist: Part 4A Hesperioidea – Papilionoidea. Atlas of Neotropical Lepidoptera. Gainesville, Florida: Scientific Publishers.

Muyshondt, A. 1975. Notes on the life cycle and natural history of butterflies of El Salvador. VI. *Anaea* (*Memphis*) *pithyusa* (Nymphalidae). *Journal of the Lepidopterists' Society*, 29: 168-176.

Philcox, D. 1979. Euphorbiaceae. *Flora of Trinidad and Tobago*, 2(10): 619-703.

Charles De Gannes
#3 Hibiscus Drive, Petit Valley, Trinidad and Tobago.
kathleendegannes@yahoo.com

Mass Movement of *Nicolaea besidia* (Hewitson) (Lepidoptera: Lycaenidae), a Species Not Previously Recorded from Trinidad, West Indies

The butterfly family Lycaenidae comprises a small number of "blues" (Polyommatinae), and a large number of hairstreaks (Theclinae) in Trinidad. The hairstreaks are usually small, blue and/or brown on the upper surface with a paler under surface marked with lines and spots. There are well over 1,000 species of Theclinae in the Neotropical Region including many undescribed species (Robbins 2004). Barcant (1970) lists 92 species of Lycaenidae from Trinidad of which all but three are Theclinae, but the authors are now aware of at least 130 species from the island, all but four being Theclinae.

Mass movements and migration of Lepidoptera are a well-known phenomenon in tropical and temperate regions (Williams 1958). Several species are known to migrate to Trinidad from Venezuela, including *Urania leilus* (Linnaeus), the white-tail page or green page (Uraniidae), and *Aphrissa statira* (Cramer), the yellow migrant (Pieridae) (Williams 1919, 1920; Barcant 1970; Quesnel 1971). Several species of Sphingidae are likely to migrate into Trinidad (Stradling *et al*. 1983) and recently, mass movements of *Hylesia metabus* (Cramer) have been reported in the south-west of the island (Polar *et al*. 2010).

Mass movements of Lycaenidae are rarely reported, especially in South America. In the only record from Trinidad, Williams (1920) describes a mass movement of "*Tmolus beon*" (Cramer) observed over the Pitch Lake, south-west Trinidad, on 23 March, 1919 at 1615-1630 h, the butterflies flying almost due south, with a strong breeze from the east, counted at rates of 8-25 per minute across a 30 yard front. Two male butterflies were caught and subsequently identified by W.J. Kaye as "*Tmolus beon*". Robbins and Small (1991) have suggested that this name may refer to *Calycopis isobeon* (Druce). Unfortunately, *beon* is a catch-all name applied by Kaye (1921) and Barcant (1970) to a variety of species in the genus *Calycopis* and similar genera of Lycaenidae (M.J.W. Cock unpublished), so Williams' observation might apply to any of a dozen or more species.

Beebe (1951) reports 20 species of Lycaenidae migrating at Portachula Pass, Rancho Grande, northern Venezuela. However, most of these represent captures of small numbers or singletons in the pass, and only two, *Ministrymon azia* (Hewitson) (Theclinae) and *Leptotes* *cassius cassius* (Cramer) (Polyommatinae), occurred in numbers sufficiently large to suggest a mass movement (Robbins and Small 1991). Both species flew through the pass in many thousands, the former in July, 1948 and the latter in June, 1948, in what are probably the largest mass movements of lycaenids recorded in the Neotropical Region. In Panama, Robbins and Small (1991) recorded more than 100 species of hairstreak dispersing annually on the trade winds in relatively small numbers (0-15 per hour along a 10 m stretch). We are aware of no other reports of mass movements of Lycaenidae from the Neotropical Region.

Here we report another mass movement of a lycaenid in Trinidad: *Nicolaea besidia* (Hewitson), a species not previously recorded from the island. On 18 November, 1979, the first author and the late F. Clive Urich were collecting on the seashore at St. Quintin Estate, Columbus Bay, Cedros, at the end of the southwestern peninsula of Trinidad, about 12 km from the South American mainland. It was late morning, between 1000 and 1200 h, when we noticed lycaenids flying in off the sea from the direction of Venezuela and settling on the mangrove trees behind us. They were flying at a height from slightly more than head height to about twice that, approximately 2.5-5.0 m. The wind was swirling, but on the beach as we watched them come in over the water, the wind was from the sea, i.e., the south-west. No attempt was made to quantify the numbers arriving, but certainly hundreds were observed over a five-minute period. They were flying in across the beach on a broad front of several hundred meters, perhaps as much as a kilometer. We were able to capture about 15 specimens, including both males and females. These were all the same species, and neither collector recognized them despite many years collecting in Trinidad. Voucher specimens for these observations are in the collections of both authors and that of F.C. Urich.

A specimen (Figure 1) was sent to the Commonwealth Institute of Entomology where Dr J.D. Holloway identified it as "*Thecla*" *besidia*, which was subsequently confirmed by the second author by comparison with Hewitson's type in the Natural History Museum, London and by Dr. R.K. Robbins of the Smithsonian Institution, Washington. *Thecla besidia* was described from Brazil (Hewitson 1868). Johnson (1991) inadvertently redescribed it from French Guiana as *Sipaea sepeina*, but this is now considered a synonym of *besidia* (Robbins 2004). D'Abrera (1995, p. 1170) illustrates the male and female upper surface and the male under surface, noting that it is found from Venezuela, Colombia, Amazonas to central Brazil; one specimen illustrated is from north-east Venezuela (Cocogal). *Thecla besidia* is now placed in the genus *Nicolaea* (Robbins 2004).

The identification of Neotropical Theclinae is not straightforward, often requiring dissection of the genitalia for confirmation. However, *N. besidia* (Figure 1) is a relatively distinctive species compared to other hairstreaks found in Trinidad. Key distinguishing characters include the two hind wing tails; on the underside, the heavy red line, its shape and alignment, dark shading distal to this line, the shape and position of the marginal and submarginal red spots; on the upper side, the shade and extent of the blue colouring and the brown scent spot at the end of the forewing cell in the male. This combination of features should suffice to identify this species in Trinidad.

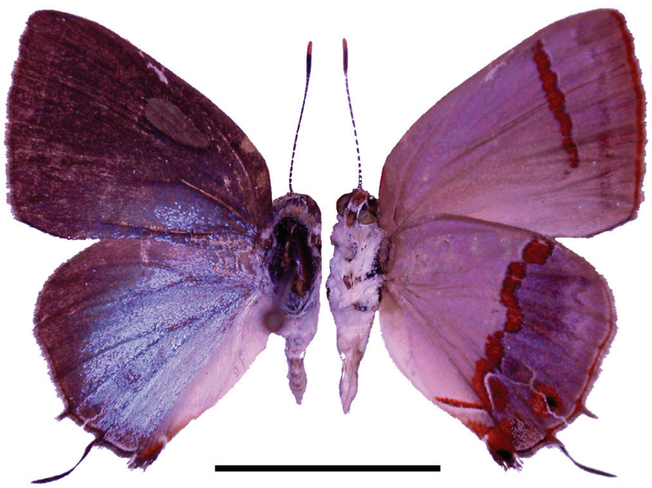


Fig. 1. Male *Nicolaea besidia* (Hewitson) captured at St. Quintin Estate, Columbus Bay, Cedros, Trinidad, 18 November, 1979, by S. Alston-Smith (specimen in collection of M.J.W. Cock). Scale bar = 1cm.

Since this 1979 observation, the first author has found that *N. besidia* is present in several mangrove swamps of the west side of Trinidad, including Chacachacare, Chaguaramas, Caroni, Pt. Fortin and Guapo, but has not confirmed it from Nariva Swamp on the east coast. These observations indicate that *N. besidia* is most probably resident in at least some of the mangrove swamps of Trinidad. The food plant is likely to be one or more swamp plants, probably one or more of the mangrove trees. The available evidence suggests that this is probably a long-term resident Trinidad species, hitherto overlooked, whose populations are reinforced by immigrations from the mangrove swamps of Venezuela. The parallel with *Hylesia metabus* (Polar *et al*. 2010) is evident, although the immigration of that moth to Trinidad is probably dependent on wind patterns that bring a weak flier from outbreaks in the mainland mangrove swamps to the island. *Nicolaea besidia* is a much stronger flier than *H. metabus* and would be able to move in a particular direction in spite of light wind – cf. Williams' (1920) observation of "*Tmolus beon*" flying south despite an east wind. Indeed, the possibility that the species that Williams observed was actually *N. besidia* cannot be ignored, but without examining the two specimens that Kaye identified, this cannot now be known. They do not seem to be in the McGuire Centre for Lepidoptera, which has Kaye's butterfly collection (A.D. Warren, pers. comm. 2010).

REFERENCES

Barcant, M. 1970. Butterflies of Trinidad and Tobago. London: Collins. 314 p.

Beebe, W. 1951. Migration of Nymphalidae (Nymphalinae), Brassolidae, Morphidae, Libytheidae, Satyridae, Riodinidae, Lycaenidae and Hesperiidae (butterflies) through Portachula Pass, Rancho Grande, north-central Venezuela. *Zoologica*, 36: 1-16, plates I-II.

D'Abrera, B. 1995. Butterflies of the Neotropical Region. Part VII. Lycaenidae. Black Rock, Australia: Hill House, xi + 1098-1270.

Hewitson, W. C. 1868. Descriptions of some new species of Lycaenidae. London: John Van Voorst. i + 36 p.

Johnson, K. 1991. Neotropical hairstreak butterflies: Genera of the "*Calycopis*/*Calystryma* Grade" of Eumaeini (Lepidoptera: Lycaenidae: Theclinae) and their diagnostics. *Reports of the Museum of Natural History, University of Wisconsin*, 21: [iv] + 128 pp.

Kaye, W. J. 1921. Catalogue of the Trinidad Lepidoptera: Rhopalocera. *Memoirs of the Department of Agriculture, Trinidad and Tobago*, 2: 163 p.

Polar, P., Cock, M. J. W., Frederickson, C., Hosein, M. and **Krauss, U.** 2010. Invasions of *Hylesia metabus* (Lepidoptera: Saturniidae: Hemileucinae) into Trinidad, West Indies. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club*, 2010: 1-10.

Quesnel, V. C. 1971. Lepidopteran migrations in 1969. *Journal of The Trinidad Field Naturalists' Club*, 1971: 48-51.

Robbins, R. K. 2004. 98 Lycaenidae: Theclinae Tribe Eumaeini. p. 118-137. *In* **G. Lamas,** ed. Checklist: Part 4A Hesperioidea – Papilionoidea. Atlas of Neotropical Lepidoptera. Gainesville, Florida: Scientific Publishers.

Robbins, R. K. and **Small Jr., G. B.** 1981. Wind dispersal of Panamanian hairstreak butterflies (Lepidoptera: Lycaenidae) and its evolutionary significance. *Biotropica*, 13: 308-315.

Stradling, D. J., Legg, C. J. and **Bennett, F. D.** 1983. Observations on the Sphingidae (Lepidoptera) of Trinidad. *Bulletin of Entomological Research*, 73: 201-232.

Williams, C. B. 1919. A migration of yellow butterflies (*Catopsilia statira*) in Trinidad. *Transactions of the Entomological Society of London*, 1919: 76-88, plates vi-x.

Williams, C. B. 1920. Records of insect migrations in tropical America. *Transactions of the Royal Entomological Society of London*, 1920-21: 146-165.

Williams, C. B. 1958. Insect Migration. London: Collins. xiii + 237 p.

Scott Alston-Smith
13 Hopeton Crown Trace,
Black Rock, Tobago.

Matthew J.W. Cock
m.cock@cabi.org

First Record of the Social Spider *Cyrtophora citricola* (Araneae: Araneidae) in the Bahamas

Cyrtophora citricola (Forskål) constructs a compound web in which the horizontal webs of the many individual spiders are interconnected (Buskirk 1975). It is native to the Old World (Levi 1997), but introduced by unknown means to several Neotropical territories, including the Dominican Republic (Alayón *et al.* 2001), Haiti (Starr 2005) and Cuba (Alayón 2003). We report here for the first time its presence in the Bahamas.

On 1 January, 2011, with the dry season already well underway, we found a series of aggregations of this species on Great Inagua. This island, at the southeastern end of the Bahamas chain, has an area of 1544 km^2, a dry climate (annual rainfall about 1000 mm) and relatively low vegetation (few trees above three metres).

The aggregations were on both sides of a country road through more or less natural habitat near the saline Lake Windsor (21°04'N, 73°34'W). All but two compound webs were on nearly leafless *Lycium americanum* (Solanaceae). This low, relatively dense shrub has narrow branches (diameter about 3 mm) without thorns. The silk was concentrated on the outside of the shrubs, with much less in the interior. The nearly leafless state of the shrubs was more likely a seasonal phenomenon than the result of blockage of photosynthesis due to the silk, as this did not seem very dense, and we noted the same condition in most *L. americanum* without webs.

Our search revealed 20 aggregations, all at the sides of the road. Almost all had an estimated volume of 0.5 m^3 or less (Table 1). The single exception (no. 3) extended for about three meters parallel to the road. Consistent with previous observations of this species in the Neotropics, the population was concentrated in a particular area, the two limits separated by about 141 m. We did not find *C. citricola* elsewhere in the island, nor had our ecotourist guide, Colin Ingraham.

We observed three other spiders in association with *C. citricola* webs: one individual each of *Leucauge argyra* (Tetragnathidae) and *Nephila clavipes* (Nephilidae) on the periphery and several of *Argyrodes elevatus* in the interior. Members of these genera have previously been reported in association with *C. citricola* (Leborgne *et al.* 1998; Rypstra 1979).

Mr. Ingraham led us to a place about 50 m beyond the last aggregation where he had noted two larger compound webs some months before, but there was no sign of either. This agrees with our impression of instability in aggregations of other Neotropical spiders such as *Anelosimus eximius*, *A. rupununi*, *Nephila clavipes* and *Philoponella republicana*. In our experience, even aggregations of hundreds of individuals can vanish over just a few weeks.

ACKNOWLEDGEMENTS

We thank Stephen Fawkes for facilitating our studies in Inagua and Winston Johnson for identifying *L. americanum*. Voucher specimens are deposited in the Gerace Research Centre of the College of the Bahamas and the Land Arthropod Collection of the University of the West Indies.

Table 1. Enumeration of a series of 20 compound webs of the spider *Cyrtophora citricola* in Great Inagua, Bahamas. All figures are by visual estimation. "Other side" indicates a position more or less directly across on the other side of the road.

Number	Volume	Distance from Preceding Web
1	0.5 m^3	--
2	<0.5 m^3	other side
3	1.5 m^3	32 m
4	0.5 m^3	<1 m
5	<0.5 m^3	5 m
6	<<0.5 m^3	other side
7	<<0.5 m^3	1 m from no. 5
8	0.5 m^3	3 m
9	<<0.5 m^3	5 m
10	<0.5 m^3	23 m
11	a few liters	1 m
12	<<0.5 m^3	1 m
13	<<0.5 m^3	other side
14	<<0.5 m^3	1 m
15	<<0.5 m^3	1 m
16	<<0.5 m^3	1 m
17	<<0.5 m^3	5 m
18	<<0.5 m^3	3 m
19	a few liters	58 m
20	a few liters	1 m

REFERENCES

Alayón, G. G. 2003. *Cyrtophora citricola* (Araneae: Araneidae), registro nuesvo de araña para Cuba. *Cocuyo,* 13: 14.

Alayón, G. G., de Armas, L. F. and **Abud, A. J.** 2001. Presencia de *Cyrtophora citricola* (Forskål 1775) (Araneae: Araneidae) en las Antillas. *Revista Ibérica de Aracnología,* 4: 9-10.

Buskirk, R. E. 1975. Coloniality, activity patterns and feeding in a tropical orb-weaving spider. *Ecology,* 56: 1314-28.

Leborgne, T., Cantarella, T. and **Pasquet, A.** 1998. Colonial life versus solitary life in *Cyrtophora citricola* (Araneae: Araneidae). *Insectes Sociaux,* 45: 125-34.

Levi, H. W. 1997. The American orb-weavers of the genera *Mecynogea*, *Manogea*, *Kapogea* and *Cyrtophora*. *Bulletin of the Museum of Comparative Zoology,* 155: 215-55.

Rypstra, A. L. 1979. Foraging flocks of spiders: A study of aggregate behavior in *Cyrtophora citricola* Forskål (Araneae: Araneidae) in West Africa. *Behavioral Ecology and Sociobiology,* 5: 291-300.

Starr, C. K. 2005. Observaciones sobre *Cyrtophora citricola* (Araneae: Araneidae) en Haití. *Cocuyo,* 15: 15.

Christopher K. Starr[1] and **Jo-Anne N. Sewlal**[2]
Dep't. of Life Sciences, Univ. of the West Indies,
St. Augustine, Trinidad and Tobago.
1. *ckstarr@gmail.com*
2. *joannesewlal@gmail.com*

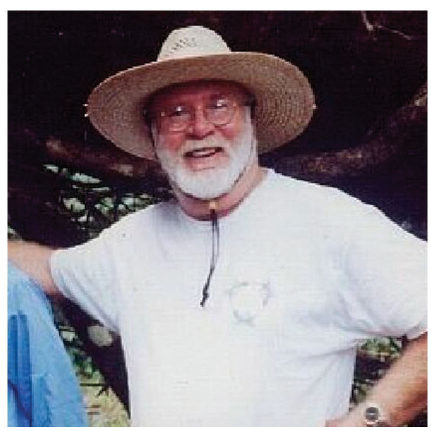
IN MEMORIAM

Julius O. Boos

1946 - 2010

A member of the Trinidad and Tobago Field Naturalists' Club of long standing, Julius Boos died in Miami on 11 July, 2010. He was an ardent and exuberant member of the Club when he lived in Trinidad. He has written many articles in our journal and was the senior author of a paper which described the Inca beetle *Inca clathrata quesneli* Boos and Ratcliffe which appears on the title page of Living World. An account of his life is given by his brother Hans Boos in the "Field Naturalist", our quarterly Bulletin, issue 3, July-Sept., 2010. p. 16-18.

The Editorial Committee extends its condolences to Hans and the rest of the family.



Eighth Report of the Trinidad and Tobago Rare Birds Committee: Rare Birds in Trinidad and Tobago 2010

Martyn Kenefick
36 Newalloville Ave., San Juan, Trinidad and Tobago.
martynkenefick@hotmail.com

The Trinidad and Tobago Rare Birds Committee (TTRBC) was established in 1995 with the principal aim to assess, document and archive the occurrence of rare or unusual birds in Trinidad and Tobago (T&T). The Committee has now assessed all records submitted during 2010. In all, 72 records were adjudged, representing 49 different species. No additional species have been added to the Official List of Birds of Trinidad and Tobago and the running total remains at 471 species. However, when considering our two islands separately, each have added a new species to their own lists during the year under review. Thus one species, previously recorded for Trinidad only, has been found on Tobago for the first time and one species previously recorded for Tobago has now been found in Trinidad for the first time. Of the submissions assessed, in only five cases did the Committee find the identification inconclusive. The decisions on two records are pending as the committee is seeking external expert opinions. The records tabulated below follow the nomenclature and taxonomic order of the American Ornithologists Union South American Checklist, January 2011.

The Committee comprises the following members: Martyn Kenefick (Secretary), Geoffrey Gomes, Floyd Hayes, Bill Murphy, Courtenay Rooks and Graham White.

Archived records including photographic submissions are held at 36 Newalloville Ave., San Juan. Previous reports of this Committee were prepared by Hayes and White (2000); White and Hayes (2002) and Kenefick (2005, 2007, 2008, 2009, 2010).

Members of the TTRBC are aware that a number of other rare birds are found each year in T&T and urge finders not only to report their sightings to us, but to document same. A recently revised list of those species considered by the 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 new website at http://rbc.ttfnc.org

RECORDS ACCEPTED

An adult **White-faced Whistling-Duck, *Dendrocygna viduata,*** was found amongst a flock of Black-bellied Whistling-Ducks at Kernaham on 11 September, 2010 (MK, GW). This is the first documented sighting for eight years although the species true status may be masked by lack of observer coverage at traditional feeding grounds.

An adult male **Muscovy Duck, *Cairina moschata,*** was photographed perched in a tree overlooking Los Blanquizales Swamp on 9 January, 2010 (KS). The TTRBC is aware of a release programme from the Pointe-à-Pierre Wildfowl Trust which may cloud the true origin of future records of this species.

Two male and one female **Comb Ducks, *Sarkidiornis melanotos,*** were photographed at Caroni Rice Project on 10 July, 2010 (MK, NL, DS). This is the first record of this casual visitor from mainland South America since 2002.

A female **Ring-necked Duck, *Aythya collaris,*** was photographed on a narrow pool within the Lowlands complex, Tobago on 30 January, 2010 (MKe, NL, DSm). It was still present until 19 March, at least. This winter visitor has now been found in six out of the last 10 years with all records from south-west Tobago.

A small flock comprising one breeding plumaged male and three female **Masked Ducks, *Nomonyx dominicus,*** were found in suitable nesting habitat in Tobago on 11 February, 2010 (MKe, NL, DSm). Birds were still present in early April and the Committee has decided to withhold the exact location.

Two **Trinidad Piping-Guans, *Pipile pipile,*** were photographed inside Cumaca Forest on 28 February, 2010 (MKe, FO, DSm). This is the first documented sighting from this area in the last 15 years at least.

An adult **White-tailed Tropicbird, *Phaethon lepturus,*** was photographed from the seabird watchpoint on Little Tobago island on 14 March, 2010 (MKe) (See Plate). Whilst there have been several verbal reports of this species appearing amongst the Red-billed Tropicbird breeding colony, this is the first documented report for nine years.

Two **American Flamingos, *Phoenicopterus ruber,*** were photographed at Orange Valley on 16 March, 2010 (SP) with one present at least until 2 April. All recent records have come from this stretch of tidal mudflats. The Committee has been told that at least some of the flock found in 2008 fell to the hunters rifle.

A juvenile **Wood Stork, *Mycteria americana,*** was found in roadside mangrove beside the Caroni Bird Sanctuary on 13 January, 2010 (SM, DR) (See Plate). The bird remained in the area, faithful to a particular roosting tree, at least until 17 January. This is the second documented record since 1942.

An immature **Rufescent Tiger-Heron, *Tigrisoma lineatum,*** was photographed perched in a tree beside Los Blanquizales Swamp on 9 January, 2010 (KS) (See Plate). Close by, a breeding plumaged adult was photographed on 20 June, 2010 (KS). Elsewhere an adult was seen in swamp forest close to Trinity Hills on 16 March, 2010 (GW) and two adults were found in the Aripo Savannah on 12 June, 2010 (MK, NL, DSm).

An immature **Purple Heron, *Ardea purpurea,*** was found at Bon Accord Lagoons, Tobago on 2 February, 2010 (BB *et al.*) (See Plate). It was extensively photographed and remained in the area, seen intermittently, until the end of the year (NG, pers. comm.). As a result of this submission, the TTRBC has re-assessed and accepted retrospectively a historical sighting from Buccoo Marsh, September 1999 (AS). There are now three records for Trinidad and Tobago. There are no other documented records for South America.

An adult **Cocoi Heron, *Ardea cocoi,*** was photographed inside Bon Accord Lagoon, Tobago on 8 March, 2010 (MKe). This is the fifth sighting from Tobago in the last 15 years.

Two immature **Glossy Ibis, *Plegadis falcinellus,*** were videotaped on exposed tidal mudflats within Caroni Swamp on 3 May, 2010 (SM, BM *et al.*). On 4 September, an immature was found on Caroni Rice Project (NL, DSm). Two immatures were subsequently found on 8 September approximately one kilometre further west (MK, GW), and another was photographed east of Woodland Settlement on 10 October (MK, DS, NL, HV). A total of 15 birds have now been found in the last 15 years.

An adult **Eurasian Spoonbill, *Platalea leucorodia,*** was seen in flight over Nariva Swamp on 12 November, 2010 (LF, PP, MD, CR). This is the first record for Trinidad; the only other sighting in this country was in Tobago, November 1986.

An adult male **Snail Kite, *Rostrhamus sociabilis*,** was photographed feeding in Valsayn rice fields on 24 May, 2010 (GW, DSm). It remained in the area until 5 June when it was last seen on the border of the Caroni Rice Project. Still a rare visitor from the mainland, there have been just four individuals documented in the last 15 years.

An adult **Crane Hawk, *Geranospiza caerulescens,*** was found in roadside palm trees close to the Piarco junction on the Churchill Roosevelt Highway on 26 September, 2010 (GG).

An immature **Rufous Crab-Hawk*, Buteogallus aequinoctialis,*** starting to attain adult plumage was photographed in roadside mangrove at Guayaguayare on 28 April, 2010 (GW, MK) (See Plate). Two adults were seen repeatedly mating and subsequently perched together and photographed on pylons at Icacos on 29 May, 2010 (KS). Whilst long suspected as a rare resident, this is the first documented evidence of breeding. The TTRBC is currently working on definitive criteria to identify birds in juvenile plumage.

A single adult **Great Black-Hawk, *Buteogallus urubitinga,*** was photographed drifting over Cat's Hill on 6 June, 2010 (KS, DSm). Whilst Great Black-Hawks are a fairly common resident of forested areas of eastern Tobago, they are still a rare bird in Trinidad.

Single adult **Black Hawk-Eagles, *Spizaetus tyrannus,*** were seen soaring over Edward's Trace, Guayguayare on 10 March, 2010 (GW); over Trinity Hills on 30 March, 2010 (GW) and over Pt. Fortin on 11 May, 2010 (SP).

An immature **Ornate Hawk-Eagle, *Spizaetus ornatus,*** was briefly seen perched in Trinity Hills on 10 March, 2010 (GW). Close by, at Cat's Hill, an adult was photographed on 11 April, 2010 (KS). These are the first reports of this species away from the Northern Range this decade.

Both adult and immature **Crested Caracaras, *Caracara cheriway,*** were widely reported from the Manzanilla and eastern Nariva coastline throughout the year (many observations) and breeding is suspected. Away from this stronghold, an immature was photographed at Galera Pt. on 25 May, 2010 (IK).

Juvenile **Aplomado Falcons, *Falco femoralis,*** were photographed east of Woodland Settlement on 31 August, 2010 (See Plate) and still present on 5 September at least (NL, DSm, KS). Another bird was seen at the Caroni Rice Project on 25 September, 2010 (DSm, FO, NL). There have now been 16 records this decade; 11 of which have been during the period August - October.

An adult **Paint-billed Crake, *Neocrex erythrops,*** was photographed crossing a narrow farm road east of Woodland Settlement on 25 July, 2010 (KS). Two crakes, possibly this species, were briefly seen at exactly the same place on the 27th (DS, MK). About 2 km to the south, another adult was seen on three occasions between 29 July - 4 August, 2010 (NL, TM *et al.*). The Committee awaits the submission of photographs to support a report of three more birds found in the Aripo area earlier in the year. Prior to 2010, there were only three records of this casual visitor from South America, the latest being in 2001.

A colour banded **Red Knot, *Calidris canutus,*** was photographed in San Fernando Bay on 13 August, 2008 (TM). Whilst not a national rarity, the event is worthy of documentation as investigation revealed that the bird was originally banded in the Rio Negro province, Argentina


1
2
3
4
5
6
7
8
9
10
11

Legends to Plate

1. Wood Stork, Caroni Swamp, 13 January, 2010. Photo, Dave Smith.
2. Purple Heron, Bon Accord Lagoon, Tobago, 11 February, 2010. Photo, Matt Kelly.
3. Dark-billed Cuckoo, Woodland, South Oropouche, 31 August, 2010. Photo, Kris Sookdeo.
4. White-tailed Tropicbird, Little Tobago, 14 March, 2010. Photo, Matt Kelly.
5. Magnolia Warbler, Castara, Tobago, 7 January, 2010. Photo, Zac Loman.
6. Crested Doradito (Male), Woodland, South Oropouche, August 2010. Photo, Dave Smith.
7. Rufescent Tiger-Heron, Los Blanquizales Swamp, 9 January, 2010. Photo, Kris Sookdeo.
8. Crested Doradito (Female), Woodland, South Oropouche, August 2010. Photo, Dave Smith.
9. Short-eared Owl, Caroni Rice Project, 3 October, 2010. Photo, Dave Smith.
10. Aplomado Falcon, Woodland, South Oropouche, 31 August, 2010. Photo, Dave Smith.
11. Rufous Crab-Hawk, Guayaguayare Bay, 28 April, 2010. Photo, Graham White.

on 28 March, 2006. This highlights the distance of their southbound migration.

An adult **Buff-breasted Sandpiper, *Tryngites subruficollis,*** was found in a ploughed field south-west of Debe and seen only briefly before flying strongly south on 18 September, 2010 (MK, GG). Thereafter, single birds were found in wet grassy areas at Couva on 7 October (DS, HV) and Kernaham on 9 October (MK, DS, KS, NL). These sightings fall within the established pattern of migration dates in T&T being 17 September - 16 October.

An adult **Ring-billed Gull, *Larus delawarensis,*** was found on the mudflats roosting site at Orange Valley on 10 February, 2010 and was seen intermittently until 2 April at least (NL, DS, MK). On 1 March it was briefly joined by a second bird which visually resembled the winter plumaged adult found in October 2009. Whilst now quite regularly reported from the west coast of Trinidad in recent times, all sightings may well just relate to two individual birds.

Two **Scaly-naped Pigeons, *Patagioenas squamosa,*** were photographed at Grafton Sanctuary, Tobago on 7 February, 2010 (MK, DS). Whilst widespread throughout the Lesser Antilles, this species was first found in T&T back in 2005. There have now been four documented sightings, all from Tobago.

Two **Dark-billed Cuckoos, *Coccyzus melacoryphus,*** were photographed in wet meadows east of Woodland Settlement on 31 August, 2010 (NL, DSm, KS) (See Plate). Both were still present on 5 September, one remaining until the 10 September at least. A rare visitor to Trinidad and only the third record in the last 15 years.

A **Short-eared Owl, *Asio flammeus,*** was photographed in a recently cut rice field in the Caroni Rice Project on 3 October, 2010 (KS, MK, DSm) (See Plate). The only previous record of this species for T&T was in late September 2001 in exactly the same field.

Single **Small-billed Elaenias, *Elaenia parvirostris,*** were photographed at Rousillac on 15 August, 2010 (KS) and east of Woodland Settlement on 5 September, 2010 (KS, MK, DS). With observers now more confident with the identification separation features of "the smaller Elaenias" and found in three of the last four years, this species may not be the extreme rarity previously considered.

Three pairs of **Crested Doraditos*, Pseudocolopteryx sclateri,*** were extensively studied in freshwater marsh east of Woodland Settlement. First found on 24 July, 2010 (MK, GW *et al.*), all remained until 18 August with at least one male remaining until 18 September (See Plate). All three pairs were observed carrying nesting material indicating a breeding attempt, however there was no evidence of success, presumed due to rising water levels. This is the first sighting in Trinidad since 1984, and the first away from the marshes bordering Caroni Swamp.

Single **Black-whiskered Vireo, *Vireo altiloquus,*** were recorded during the year as follows: Asa Wright, 7 March, 2010 (MK *et al.*); Aripo Agriculture Station, 8 March, 2010 (MK); Grande Riviere, 13 March, 2010 (MK *et al.*) and Morne Bleu, 14 November, 2010 (BM *et al.*). All are thought to be of the duller plumaged subspecies *bonairensis.* This brings to 24, the number seen this decade with all sightings during the period October - May.

A group of three **Southern Rough-winged Swallows, *Stelgidopteryx ruficollis,*** were found flying along the tide-line at Castara, Tobago on 26 March, 2010 (MKe). This is the first documented record from Tobago for many years.

An adult **Cliff Swallow, *Petrochelidon pyrrhonota,*** was found feeding with a group of Barn Swallows low over Bon Accord sewage ponds, Tobago on 18 - 19 April, 2010 (MK *et al.*). This brings to 20, the number found this decade, 12 of which have occurred between 3 March - 22 April.

A flock of 30 **Lined Seedeaters, *Sporophila lineola,*** were found at Sudama Steps on 14 August, 2010 (KS, DSm) with at least 12 still present on the 18 August. These birds attracted the attention of local bird-catchers and there were no further sightings. A short distance away, closer to Woodland Settlement, a male and a female were seen on 22 August (MK). Elsewhere an adult male was found north of Kernaham on 9 October, 2010 (KS, MK). Since first being found in south-west Trinidad in 2007, this species has been seen annually between mid August and early October. Many additional sightings of unidentified birds in non-breeding plumage were either this species or the near identical Lesson's Seedeater, *Sporophila bouvronides.*

An adult male **Large-billed Seed-Finch, *Oryzoborus crassirostris,*** was photographed in South Oropouche on 17 July, 2010 (KS, MK, DSm, TM). This record falls within the pattern of post-breeding dispersal from the mainland by several species of Seedeater and Seed-Finch, but is the first documented sighting for many years.

An immature male **Rose-breasted Grosbeak, *Pheucticus ludovicianus,*** was photographed close to the textel station at Morne Bleu on 14 November, 2010 (BM *et al.*). This is the first southbound migration sighting in the last 15 years; almost all records this decade have been in March and April.

A **Magnolia Warbler, *Dendroica magnolia,*** was photographed at Castara, Tobago on 7 January, 2010 (ZL) (See Plate). This was followed by a second bird found along Gilpin Trace on 15 March, 2010 (DG, MK *et al.*). These are just the third and fourth records for the country; the previous being in 1966 and 1967.

An adult female **Black-and-White Warbler, *Mniotilta varia,*** was seen briefly, loosely attached to a roving bird flock along the Blanchisseuse Rd., above Paria junction on 9 March, 2010 (MK *et al.*). There have now been nine records of this striking warbler in the last decade with sightings ranging from 10 October - 28 March.

An adult female **Bobolink, *Dolichonyx oryzivorus,*** was photographed at Bon Accord, Tobago on 11 May, 2010 (TM). This is the first northbound migrant documented in T&T for 45 years. On 3 October, 2010, groups totalling 12 birds were seen, and one photographed on Caroni Rice Project (KS, MK, DSm). Finally, five birds were photographed east of Woodland Settlement on 31 October (KS, DS). Of the 13 records documented in the last 15 years, 10 have been in October.

INTRODUCED SPECIES

A flock of up to 30 **Tricolored Munia, *Lonchura malacca,*** including many juveniles**,** were present throughout the year in South Oropouche, having first been photographed there back in 2007 (KS, MK, DSm). Whilst originally from the Indian sub-continent and south-east Asia, there are now resident populations in Venezuela, Colombia and Ecuador.

INCONCLUSIVE RECORDS

The following submissions were considered inconclusive: **Curlew Sandpiper**, ***Calidris ferruginea,*** (Tobago); **Blue-headed Parrot**, ***Pionus menstruus,*** (Tobago); **Lesser Elaenia**, ***Elaenia chiriquensis***; **Summer Tanager**, ***Piranga rubra*** and **Large-billed Seed-Finch**, ***Oryzoborus crassirostris***. Additionally, a submission of **White-eyed Parakeets**, ***Aratinga leucophthalma,*** whilst correct in identification, was known to have related to an escaped flock of birds from a collection north of Port of Spain.

SOUTH AMERICAN CLASSIFICATION COMMITTEE

For ornithological classification, Trinidad and Tobago are considered part of South America and, consequently, we contribute to the Official South American Checklist compiled and maintained by the above group. Their criteria for record acceptance of a new species to the region is far stricter than that adopted by the TTRBC, insisting on photographic or specimen evidence.

Currently, there are seven species accepted to the "T&T list" but not documented elsewhere in South America, where no such photographic evidence has been archived. The species involved are as follows:

Snow Goose, *Chen caerulescens*: sightings Dec. 1975 and Dec. 1984.

Northern Gannet, *Morus bassanus*: seen off north-east Tobago Nov. 1991 and again Aug. 2009.

Common Ringed Plover, *Charadrius hiaticula*: single bird mist netted in Oct. 1962.

Spotted Redshank, *Tringa erythropus*: single bird in Tobago Feb. 1983.

Common Greenshank, *Tringa nebularia*: two different sightings; south-west Tobago July 1977 and Wallerfield early 1987.

White-eyed Vireo, *Vireo griseus*: single record, Buccoo Marsh, Tobago Jan. 1998.

Red-winged Blackbird, *Agelaius phoeniceus*: one close to Caroni Swamp from June 1980 to mid 1981.

If anyone has photographic evidence of any of the above, the Committee would be delighted to hear from you.

NOMENCLATURE CHANGES

Part of the mission statement of the SACC 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. As a result, the following nomenclature change was made in 2010:

* **Green-backed Trogon, *T. viridis,*** (formerly White-tailed Trogon)
* **Guianan Trogon, *T. violaceus,*** (formerly Violaceous Trogon)

REVIEW OF THE DECADE

During the first decade of the 21st century, TTRBC has accessed a total of 610 submissions of 181 rare or unusual species found in Trinidad and Tobago. These observations have been submitted by 135 different contributors. Of those submitted, only 52 (14.8%) were determined inconclusive.

ACKNOWLEDGEMENTS

Records and contributions were received from the following: Bob Behrstock (BB), Marc Bik (MB), Stephen Broadbridge (SB), Michael Doolan (MD), Liam Feeney (LF), Theo Ferguson (TF), Newton George (NG), Geoffrey Gomes (GG), Dennis Gosper (DG), Martyn Kenefick (MK), Matt Kelly (MKe), Imran Khan (IK), Nigel Lallsingh (NL), Zac Loman (ZL), Shawn Madoo (SM), Tarran Maharaj (TM), Bill Murphy (BM), Feroze Omardeen (FO), Sanjiv Parasram (SP), Judd Patterson (JP), Pat Pykett (PP), Nina Rach (NR), Dave Ramlal (DR), Courtenay Rooks (CR), Mike Rutherford (MR), Dave Sadler (DS), Lynn Seucharan (LS), Kris Sookdeo (KS), Dave Smith (DSm), Pamela Stuart (PS), Becky Lomax-Sumner (BL), John Sumner (JS) and Graham White (GW).

REFERENCES

Hayes, F. E. and **White, G.** 2000. First report of the Trinidad and Tobago rare birds committee. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2000: 39-45.

Kenefick, M. 2005. Third report of the Trinidad and Tobago rare birds committee: rare birds in Trinidad and Tobago in 2001-2003. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2005: 56-61.

Kenefick, M. 2007. Fourth report of the Trinidad and Tobago rare birds committee: rare birds in Trinidad and Tobago in 2004 and 2005. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2007: 79-81.

Kenefick, M. 2008. Fifth report of the Trinidad and Tobago rare birds committee: rare birds in Trinidad and Tobago 2006 and 2007. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2008: 70-74.

Kenefick, M. 2009. Report of the Trinidad and Tobago rare birds committee: rare birds in Trinidad and Tobago 2008. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2009: 46-49.

Kenefick, M. 2010. Seventh report of the Trinidad and Tobago rare birds committee: rare birds in Trinidad and Tobago 2009. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2009: 78-83.

White, G. and **Hayes, F.** 2002. Second report of the Trinidad and Tobago rare birds committee. *Living World, Journal of The Trinidad and Tobago Field Naturalists' Club,* 2002: 51-56.

BOOK REVIEW

Wetlands of Trinidad and Tobago

Rahanna Juman
Institute of Marine Affairs, Media and Editorial Projects (MEP)
Port of Spain, Trinidad and Tobago. 2010. 91 p.

Indeed it was a very pleasant surprise to see such a long overdue book for Trinidad and Tobago (TT). This timely publication fills a gap, for at least one of our natural ecosystems. The book has some very good content and is written in clear, concise language and is therefore easy reading. Bearing in mind one of the target groups, (*students at secondary and tertiary levels and the general public*) this book will be well-received. One of the main goals (Preface) of the book is to: (i) "describe to domestic and international readers the importance of wetlands in the development of TT" and is (ii) "addressed to the makers of public policy, economic decision makers, land use planners, students at secondary and tertiary levels and the general public".

In terms of these 2 goals, the text was reasonably successful, presenting the information in a logical manner with appropriate headings. Chapter 1 explains what a wetland is and describes in detail the variety of services which wetlands provide: provisioning services, cultural, regulating, and supporting services. In Chapters 2 and 3, Emergent Wetlands ("those above sea level") are described in detail with key information on specific ones provided in the latter.

Chapter 4 should be re-titled "Submerged Wetlands - Seagrass Beds" since it presents very good and up to date information *only* on seagrass beds and similarly, Chapter 5 should be re-named "Submerged Wetlands - Coral Reefs" with its appropriate descriptions and beautiful photographs. It would have been more informative if for each of these (seagrass beds and coral reefs), their specific valuable services (provisioning, cultural, regulating and supporting) had been highlighted. It would have also been useful to detail specific activities and their negative impacts on these wetlands within the chapters themselves. Such clarification would have benefitted readers and "makers of public policy, economic decision makers and land use planners". Chapter 6 discusses threats to wetlands in general and although appropriate, the specific details are lacking. The various threatening activities should have been clearly presented and moreso the specific "service" which they impact on.

Chapter 7 entitled "Policy, Management and the Law" was quite appropriate to describe the status of wetland conservation and protection in terms of the existing policies and laws. The chapter is not very well written though, in that the information appears to have been plucked from a number of existing documents and the text and ideas do not flow. There is no clear conclusive statement with respect to what gaps exist, what needs to be done etc. Again, this section lacks those specific details which may have appealed to " the makers of public policy, economic decision makers and land use planners".

On pg. 83 there is an interesting "What we can do" box. This is a good idea and quite appropriate to present here in order for readers to better appreciate how specific activities can mitigate or reduce the negative impacts. The activities listed here are however not quite specific to "conservation of wetlands". The list reads more like a list of things "environmentally friendly" eg. "take shorter showers - do not waste water" and "car-pool when you can". This list could have been better used to identify actual activities persons (including decision makers) can do to reduce or mitigate the negative impacts on wetlands. For example: *Action* - Stop unmanaged clearing of land for agricultural and construction purposes. *Result* - Reduced siltation and contamination in wetlands.

General

Most of the photographs in this text are beautiful and quite appropriate. However, there should have been a standardized format in terms of acknowledgements. For example, on pg. 2, the photographer was not acknowledged while on pg. 3, she is. The use of "capital letters" for all captions is inappropriate and the actual text is inappropriate in many instances. For example, on pg. 3 the caption reads "Rivers attract cultural and religious activities, as shown by these flags beside the Moruga River"; it may have been more appropriate to say "Rivers are popular sites for religious (coloured flags) and cultural activities". Additionally on pg. 72, "The siting of an oil refinery close to the Guaracara River has sometimes led inevitably to pollution problems"; this sentence construction is clumsy.

This book lacks historical perspective in terms of the important contributions that a number of key wetland researchers/scientists and other contributors have made to wetland ecology in Trinidad and Tobago. Some of these include: Prof. Peter Bacon (deceased), Ms. Molly Gaskin, Ms. Karlene Sheppard, Dr. Eugene Ramcharan, Prof. Julien Kenny, Dr. Doon Ramsaroop, Mr. Richard Laydoo, Dr. Carol James, Ms. Nadra Nathai-Gyan and Mr. Gerard Alleng and members of the Wetland Committee to name a few. It is important to highlight the efforts of these researchers in this text which aims to "describe to domestic and international readers the importance of wetlands *in the development of TT*". It is due to much of their combined conservation efforts and work that both Nariva and Caroni Swamps, and the Buccoo Reef Lagoon, have finally been designated as Ramsar sites.

The author admits to having "assembled information from more than 100 published documents" (Preface) and a bibliography (pgs. 85 to 89) is presented. Under copyright laws, the general rule is that "the creator of a work is the first owner of copyright in that work, unless a contrary arrangement is made". The University of the West Indies' (UWI) policy on research ethics highlights the following: "Researchers should not knowingly represent the published or unpublished work of another person as their own" and "the use by a researcher of work done by other people must be appropriately and adequately acknowledged". In even more detail, the "attribution of authorship is addressed in a separate section and details the order in which author's names should be presented and especially in terms of their contributions to the work".

Good ethics dictates that it is therefore not adequate to present the bibliography as it is done in the book - a list of references at the end. Authors should have been acknowledged appropriately within the text where their work was being presented and/or where they were directly being quoted. In addition, referenced text is useful to guide those readers requiring in-depth information from original sources. I strongly recommend that this book be revised in the very near future bearing in mind some of the comments above and more importantly, that all works/research be properly attributed to the appropriate authors.

Judith Gobin
Dep't. of Life Sciences,
University of the West Indies,
St. Augustine, Trinidad and Tobago.
Judith.Gobin@sta.uwi.edu

A Letter to the Editor

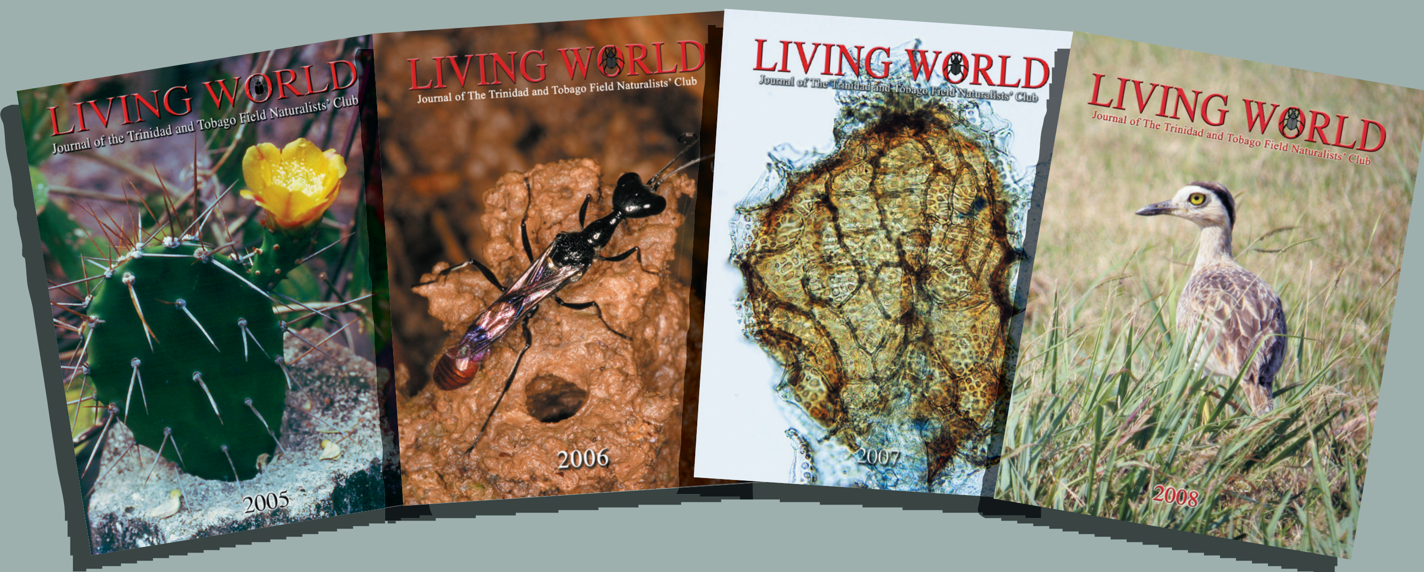
Dear Sir,

In response to a query raised by a reader of Living World re Fig 2. in our article "Invasions of *Hylesia metabus* (Lepidoptera: Saturniidae, Hemileucinae) into Trinidad, West Indies" by Polar *et al.* in which the reader suggested that the Fig. 2 shows "current patterns" instead of "wind patterns" I have a statement from a meteorologist, Ms. A Aaron, which states "from my research, residual surface currents seem to be wind driven currents which implies that the pattern shown for the currents are also the patterns of the wind. I hope this helps in some way".

I remain,
Perry Polar

PUBLICATIONS AVAILABLE FOR SALE

Back Issues of Living World, J. of The Trinidad and Tobago Field Naturalists' Club



Journal of the Trinidad Field Naturalists' Club
1892-1896, CD

The Trinidad and Tobago
Field Naturalists' Club Trail Guide (2nd Edition)

The Native Trees of
Trinidad and Tobago (2nd Edition)

For further information contact:

Email: admin@ttfnc.org

Website: www.ttfnc.org

CONTENTS

RPL (1991) LTD.