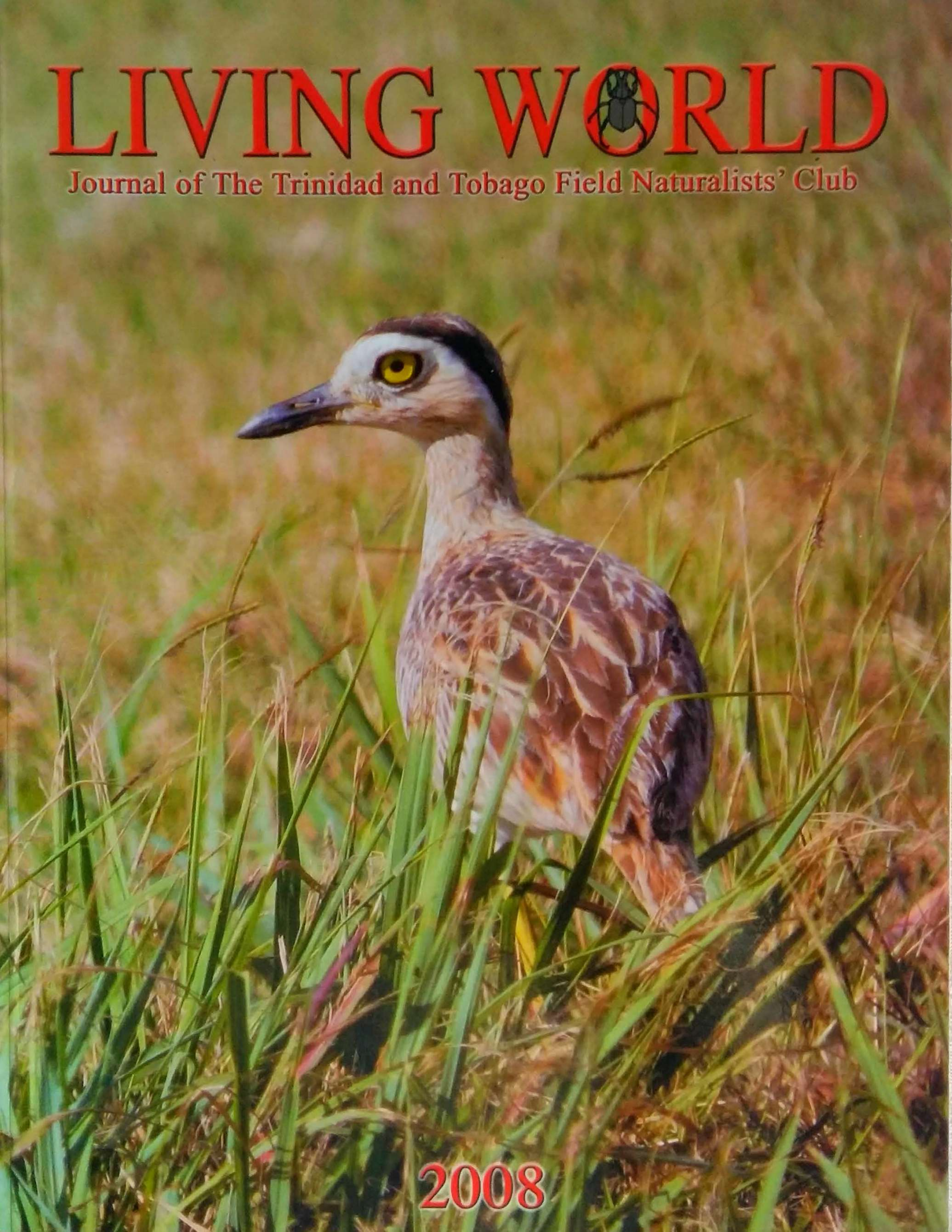
LIVING WORLD

Journal of The Trinidad and Tobago Field Naturalists' Club



2008

THE TRINIDAD AND TOBAGO FIELD NATURALISTS' CLUB

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

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

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Inca clathrata quesneli Boos and Ratcliffe

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BG Trinidad & Tobago

We thank Mr. Michael Tikasingh for the design of the front and back covers.

Cover photograph

The **Double-striped Thick-knee*, Burhinus bistriatus*** is a large inland shorebird associated with open country. Unlike most shorebirds they are nocturnal, hence their large eyes. This species occasionally wanders across to Trinidad or Tobago from Venezuela. This one, only the second record for Tobago, was photographed at the Hilton Golf course,Lowlands on 25 February, 2007. (Photo -David Ascanio, Victor Emanuel Nature Tours).

Editorial

One of the more pleasing outcome of the 2008 issue of Living World was the endorsement received from former Professor of Zoology and former Club member Dr. Julian Kenny. In a newspaper article in The Express of 20 November, 2008, Dr. Kenny noted the "coming of age" of Living World and further that it had "settled down into a maturity that compares with science journals in developed countries". Such an accolade we hope will assist in the raising of more funds for the continuance, improvement and more frequent appearances of the journal.

As part of our continuing effort to improve the journal based on experiences with contributors we make changes in its format, however small. Accordingly, we have reviewed our criteria for Nature Notes. These Notes serve a dual purpose in that they offer an opportunity to record interesting or unusual observations which may be of significance, and they offer an opportunity to less experienced writers to record their observations. As such the title of the Nature Note should contain all key words and should not be longer than three journal pages including photos and tables. There is no need for an abstract or key words. References should be kept to a minimum.

It is now 35 years since we have had an article on mammals published in our journal. It is therefore, with pleasure that we welcome three articles in this issue on mammals. Ross Cooper provides a synopsis of endemic and invasive mammals in the Caribbean; Adam Brown on the status of introduced mammals on St. Martin and, the results of a small and limited trapping effort for small mammals in the Arima Valley by H. Nelson and E. Nelson. The Nelsons reported that they trapped an unidentified rodent which they believe was heretofore not recorded for Trinidad. Staff members of the Trinidad Regional Virus Laboratory trapped small mammals during arbovirus studies in various localities in Trinidad over a period of about 20 years and the only new mammal discovered was that of *Zygodontomys brevicauda soldadoensis*. It would be interesting to see if the unidentified species is in fact new to Trinidad.

Studies on reptiles are reported in three articles; two research papers and one Nature Note. Victor Quesnel continues his study on *Thecadactylus rapicauda,* this time reporting on its food and feeding behaviour. The last list of reptiles on Huevos Island off Trinidad's north-west coast was published in 1983 - 1984, so it was of interest to update the list. Stevland Charles and S. Smith visited the island in 2007 and five species of reptiles were recorded for the first time. The third reptile paper was a Nature Note based on the Gray Lora snake which is rare in Trinidad, but Allan Rodriguez reports on a fourth collection in the Cumaca Forest which was photographed by Hans Boos.

Studies on freshwater macroinvertebrates for the various West Indian islands have been reported serially by David Bass over the years and in this issue he reports on his work for the island of Saba. Bass records 17 species new to the island of Saba. In Trinidad, freshwater mussels have not been seen in our rivers for sometime and Ryan Mohammed in a Nature Note reports on collections of shells of two species in south-central Trinidad suggesting they might still be present in our rivers.

Matthew Cock's series of articles on the taxonomy, identification, biology and presence in Trinidad of the Hesperiidae is absent this year, but we hope the series will be back next year. However, Cock reports on the moth *Automeris metzli* which was previously misidentified as *A. janus;* the biology of *Pyrrhopyge amyclas amyclas* and *Mysoria barcastus alta;* and the life history observations in Trinidad of *Pseudosphinx tetrio* with its conspicuous caterpillar.

We welcome Victor Townsend, Daniel Proud and Michael Moore to our pages as they report on their collections of harvestmen from Trinidad. They collected 20 species including species new to Trinidad and provided a key to the families of harvestmen known from Trinidad. Daniel Proud and Victor Townsend in a Nature Note also reports on the homing ability of harvestmen, while Jo-Anne Sewlal and C. K. Starr report new records of daddy-long-legs from the Lesser Antilles.

Jo-Anne Sewlal also reports on her collection of spiders from St. Kitts which she compares with collections from nearby Nevis.

Not often one hears about bites from venomous snakes in Trinidad and Hans Boos records Mapepire bites inflicted on two individuals.

The Trinidad and Tobago Rare Birds Committee provides us with their fifth report with photos of some of the rare birds they encountered in Trinidad and Tobago in 2006 - 2007.

Two book reviews on a "Field Guide to the Birds of Trinidad and Tobago" and "The Spiders and Their Relatives of St. Vincent and the Grenadines" complete the 2008 issue of Living World.

EST

A Synopsis of Rodent Species in the Caribbean Islands, Endemic and Invasive

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ABSTRACT
Rodents form an important part of an ecosystem. Introduced rats and mice can have devastating consequences on indigenous rodent populations via inter-specific competition; competition for food and spread of disease. It is incumbent upon the Caribbean authorities, therefore, to actively prevent new species from becoming established by providing funding for interdiction efforts, research before an invasive species becomes widespread, and restricting the movements of species. The colonization of the Caribbean by South American mammals between the Palaeocene and the Middle Miocene included hystricognath rodents. A rodent nearly the size of the American black bear inhabited the small islands of Anguilla and St. Martin until it was apparently hunted to extinction by natives. Hutias (*Geocapromys* spp.), large rodents that resemble South American agoutis, proliferated into a variety of species on the large islands of the Greater Antilles. There are two endemic rodent families: Solenodontidae and Capromyidae. The family Solenodontidae includes two surviving species, the Cuban solenodon (*Solenodon cubanus*, EN), and Hispaniolan solenodon (*S. paradoxus*, EN), which are rare giant shrews threatened by human exploitation and invasive species, including mongooses, feral cats, rats and dogs. Invasive species include the Norway (Brown) Rat (*Rattus norvegicus*), the House Mouse (*Mus musculus*) and the Black/Roof/Ship/House Rat (*Rattus rattus*). Invasive predators have devastating consequences on endemic species, often as a consequence of successful reproductive rates, short generation times, a generalised diet, smallish in stature and secretive. Live collections of rodents should be housed in the zoo in Port of Spain, Trinidad for educational purposes. It is most unfortunate that the museum at the Department of Life Sciences at UWI does not have in its collection sufficient taxidermied rodent specimens, or enough literature on them. Eradication of nuisance predators like cats and mongooses in order to protect endemic rodent species should incorporate effective quarantine programmes, and enforcing policies prohibiting the presence of potentially invasive pets should be a major component of conservation plans in insular environments such as those found on small islands.

Key words: Caribbean, endemic, invasive rodents.

INTRODUCTION

Rodents form an important part of an ecosystem often consuming waste vegetable matter and seeds, and providing themselves food for predators (Cooper 1998, 1999, 2000; Smithers 1975). However, the irresponsible activities of mankind have allowed the rat to become invasive in many parts of the world, often via shipping routes (Cooper 2006). Introduced rats and mice can have devastating consequences on indigenous rodent populations via inter-specific competition; competition for food and spread of disease. Inappropriate housing (Cooper and Erlwanger 2007) has prompted escapees as evidenced by the African Giant Rat, *Cricetomys gambianus* [Rodentia: Nesomyidae] (Epperson 2005) (Fig. 1). It is unfortunate that during previous human invasions and coloniser activities that no due regard was made for the regulation of animal movement and inspection of products was lacking or took no regard of impacts on native ecosystems (Pitt and Witmer 2007). It is incumbent upon the Caribbean authorities therefore, to actively prevent new species from becoming established by providing funding for interdiction efforts, research before an invasive species becomes widespread, and restricting the movements of species.

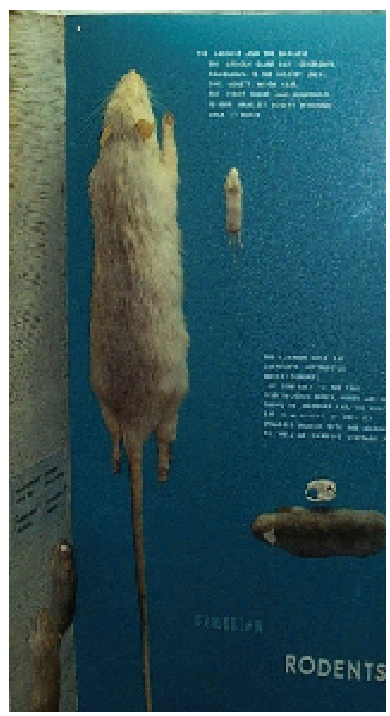

Fig. 1. A museum specimen of the African Giant Rat (*Cricetomys gambianus*), National Museum of Zimbabwe, Harare, Zimbabwe.

RODENTS, HABITS, LOCALITY AND CONTROL

The colonization of the Caribbean by South American mammals between the Palaeocene and the Middle Miocene included hystricognath rodents, which fitted the pattern of divergence from the mainland implied by the Gaarlandia hypothesis (Dávalos 2004). This hypothesis basically describes the dispersal of animal groups via the link between North and South America at a time when the western portion of the Greater Antilles was separated from the Central American landmass by two narrow straits (Pennington and Dick 2004). Murid rodents, however, show patterns of divergence from the mainland that are inconsistent with the Gaarlandia hypothesis and seem to require taxon-specific biogeographical explanations (Dávalos 2004).

Cuba, Puerto Rico, Hispaniola and Jamaica had a variety of unusual native rodents and shrew like insectivores prior to the arrival of European explorers and settlers in the 1600s; many were ancient species (Nilsson 1983). When native Caribbean populations settled the islands after the Ice Ages, rodents as big as marmots inhabited the larger islands (Nilsson 1983). A rodent nearly the size of the American black bear inhabited the small islands of Anguilla and St. Martin until it was apparently hunted to extinction by natives. Cuba, Puerto Rico and Hispaniola were once attached to the mainland of Central America, but this large land mass became separated and drifted off into the Caribbean (Nilsson 1983). Some of the native fauna and flora present more than a million years ago survived until a few thousand years ago. Most of the 40 mammals that became extinct on Caribbean islands after the 1600s were rodents and insectivores (Nilsson 1983). A muskrat and a rice rat became extinct on Martinique when Mt. Pelee erupted in 1902 – one of the few examples of a naturally caused modern extinction. Hutias (*Geocapromys* spp.), large rodents that resemble South American agoutis, proliferated into a variety of species on the large islands of the Greater Antilles (Nilsson 1983). Settlement, deforestation and hunting caused at least five species of Hutias to become extinct, and the few remaining species are now highly endangered. Native marsupials and rodents were gradually eliminated by massive habitat destruction and predation from animals introduced by European settlers (Nilsson 1983).

The Caribbean islands have approximately 90 mammal species, of which more than 40 are endemic (McGinley 2007) and 97 species located in Trinidad including bats. This includes two endemic rodent families: Solenodontidae and Capromyidae. The family Solenodontidae includes two surviving species, the Cuban solenodon (*Solenodon cubanus*, EN), and Hispaniolan solenodon (*S. paradoxus*, EN), which are rare giant shrews threatened by human exploitation and invasive species, including mongooses, feral cats, rats and dogs (McGinley 2007). The Capromyidae includes 20 species of rodents, known locally as Hutias, which are prized for their meat and threatened by hunting, habitat loss and invasive species (McGinley 2007). Meat eating in Trinidad amongst some people includes the large rodents, *Dasyprocta agouti* and *Agouti paca*. It is believed that numerous species of rodents have been made extinct through the activities of invasive rodent species. A new subspecies of *Zygodontomys* rodent has been described (Goodwin 1965). Worth (1967) described the reproduction, development and behaviour of captive *Oryzomys laticeps* and *Zygodontomys brevicauda* in Trinidad.

In the Caribbean, invasive rodent species are exactly the same on all islands, excluding those found on mainland Caribbean countries. The Norway (Brown) Rat (*Rattus norvegicus*) [Rodentia: Muridae], the House Mouse (*Mus musculus*) [Rodentia: Muridae] and the Black/Roof/Ship/House Rat (*Rattus rattus*) [Rodentia: Muridae] pervade the environment (Morton 2008), all of which were introduced during the time of Columbus. The current article is not the place to describe these species' life, habits, feeding and reproduction, details of which can be read via an internet search on Wikipedia. The main diagnostic features between the Black and Norway rat are detailed in Table 1.

Table 1. Notable differences between the black and brown rat.

Name	Black Rat	Brown/Norway Rat
Species	*Rattus rattus*	*Rattus norvegicus*
Swimming	Poor	Excellent
Agility	Excellent climber	Poor climber
Length body (cm)	15-20	25
Length tail (cm)	20	25
Fur	Black-light brown with lighter underside	Brown or dark grey with lighter grey or brown underparts
Habits	Nocturnal & omnivorous	Nocturnal & omnivorous
Nesting	Arboreal	Underground
Breeding	3-6 litters pa, up to 10 pups	5 litters pa, up to 14 pups
Lifespan	2-3 yr.	3 yr.

Only one Caribbean Environmental Health Department provided information on my request for information out of a total of 15 island territories contacted either by fax, letter and/or email. Seven separate listings did not have any rodent information to hand. Additionally, currently the Department of Life Sciences, University of the West Indies, Emperor Valley Zoo, Port of Spain, and the National Museum and Art Gallery, Port of Spain informed me that there are no papers or taxidermied rodent specimens nor skins. There are, however, extensive listings of mammals in Trinidad by Alkins (1979). Additionally, Boos (1986) provided a checklist of mammals in Trinidad and Tobago and there are mammal skins in the National Museum and a good collection in the Museum of the Caribbean Epidemiology Centre, Port of Spain, some collected by Chapman in 1895.

Unfortunately, there is largely a negative tone and stance associated with all rodents in the Caribbean islands and it is normally the job of the Environmental Health Department to control groups of individuals or populations of rodents in large communities. This is suggestive that people do not like to admit they have a rodent problem. Eradication measures were suggested as those including identification of the rodent species, appreciation of rodent biology [historical background and life history, general activity of rodents, rodent reactions to strange objects, and rodent food habits], and rodent population characteristics (Morton 2008). Proper sanitation is appreciated as the most effective, lasting and efficient measure available for the control of rodents including storage, collection and disposal of refuse. Limiting the availability of food, water and harbourage areas will limit rat populations. Sites of infestation should be cleared rapidly and completely, treatment must cover the entire area irrespective of property boundaries of infested ground or buildings. As rodents are highly active mammals, all adjacent and community areas need equal attention at the same time. Related programmes including rat poisoning operations and refuse management should receive equal importance in eradication procedures. In St. Kitts, vector control programmes include focus on source reduction, community participation, health education and minimal chemical usage (Morton 2008).

Information regarding the threats and eradication of rodents are summarised henceforth. The potential for disease transmission stated includes communicable disease directly via contamination of food and water with faeces and urine, and indirectly via ectoparasites including lice, mites (*Allodermanyssus sanguineus*), ticks and fleas (*Xenopsylla cheopis*). Diseases cited include leptospirosis, salmonellosis, murine typhus fever, rickettsial pox, rat bite fever and bubonic plague (Morton 2008). Significant leptospirosis infestation has been recorded in rats and mice on Barbados (Everard *et al*. 1995). Another infectious disease emerging in the Caribbean include angiostrongyliasis caused by the nematode (rat lungworm) infection with *Angiostrongylus cantonensis* that often expresses itself sub-clinically (Caribbean Islands, 2008), (Lindo *et al*. 2004). Once the larvae migrate to the CNS they cause eosinophilic meningoencephalitis. Nematode infection with *A. costaricensis* of the gastro-intestinal tract (GIT) results in cutaneous, intestinal and pulmonary infestations, and, occasionally, hyperinflation syndrome (Caribbean Islands, 2008). After an outbreak in 2000 of eosinophilic meningitis in tourists to Jamaica, *A. cantonensis* in rats and snails were investigated, revealing 22% (n=24/109) of rats harboured adult worms, and 8% (n=4/48) of snails harboured *A. cantonensis* larvae, with predictable impacts on human eosinophilic meningitis (Lindo *et al*. 2002; Waugh *et al*. 2005). In rats, adult worms recovered from the cardiopulmonary systems of 24 rats (n=20/78 *Rattus norvegicus* & n=4/31 *Rattus rattus*) had microscopic features typical of *A. cantonensis* (Lindo *et al*. 2002). Humans can become infected with *A. cantonensis* following consumption of the intermediate hosts; slugs and snails, and freshwater shrimp serve as paratenic host and reservoirs of infections for humans (Waugh *et al*. 2005). It is apparent that freshwater shrimp or mussels are eaten raw directly from rivers. The application of molluscicide onto lettuce has proved ineffective (Waugh *et al*. 2005). Failure to detect rat-borne *A. cantonensis* in Barbados has been noted (Levett *et al*. 2004). In the Dominican Republic three species of non-endemic rodent introduced originally in post-Columbian times, demonstrated 44 *R. rattus* from one locality being sero-positive for antibodies against *Leishmania* suggesting a role of the rodents in the epidemiological cycle (Johnson *et al*. 1992). Rodent leishmaniasis has been described in Trinidad (Tikasingh 1974). *Trypanasoma cruzi* has been isolated from *Rattus rattus* (Downs 1963). One should not ignore the possibility of infectious diseases caused by rats on cruise ships (Minooee and Rickman 1999). The Trinidad Regional Virus Laboratory made extensive collections on mammals from various parts of Trinidad, e.g. of the biology of two rodents, *Proechimys guyannensis trinitatis* and *Oryzomys capito velutinus* in the Turure Forest, Trinidad (Everard and Tikasingh 1970). In Trinidad, Bush Bush Forest, 262 of Venezuelan equine encephalitis, 71 of Caraparu-like, three of Oriboca, two of Restan, 63 of Bimiti, 56 of Catu and 87 of Guamá, revealed seven virus types which undergo a period of multiplication and viremia in forest-floor rodents and in mosquitoes of the *Culex portesi* type (Jonkers *et al*. 1968). Trinidad virus TRVL 34053-1 was demonstrated to circulate in the blood of naturally and experimentally infected *Oryzomys laticeps velutinus* (Jonkers *et al*. 1964). Studies with 80 experimentally infected animals, 40 *Oryzomys* and 40 *Zygodontomys b. brevicauda* showed that haemagglutination-inhibiting, complement fixing and neutralising antibodies persist for at least one year after infection with 34053-1 virus (Jonkers *et al*. 1964). Nariva virus has been isolated from *Zygodontomys b. brevicauda* trapped in Bush Bush Forest in the Nariva Swamp, eastern Trinidad in 1962/3 (Tikasingh *et al*. 1966). It is essential that scientific attention is paid to rodent populations in terms of their dynamics, longevity and range (Worth *et al*. 1968) if epidemiology of infective viruses is to be understood. Arboviruses and parasitological studies in rodents and influence on human health has been discussed (Tikasingh and Everard 1970). This should be followed up by detailed studies of rodents in areas associated with potential disease transmission with effective protocols of trapping, population density determination, home range and longevity studies completed (Everard and Tikasingh 1970).

Destruction to property includes gnawing and undermining wooden constructions, causing fires through short-circuiting electrical cables. Amazingly, rodents in the Caribbean have been associated with physical death including infants attacked in a crib, invalid or inebriated adults, and wrongful straying/trespassing into areas with tremendous rat populations (Morton 2008). Rodents can consume vast quantities of food in fields, homes, food stores, supermarkets and warehouses. One could also add that food may be spoiled by rodents on ships, trains and trucks. In areas with massive rodent populations, annoyance may arise especially at night from fighting/playing rodents, squeaking pups, and gnawing activities. People may be aesthetically repulsed by the presence of rats and mice in their houses. Rats and mice have extremely short gestation periods of approximately 22 and 19 days, respectively. Mating of dows can begin 48 hrs after parturition. At three months of age, young rodents are highly active and completely independent (Morton 2008).

Black rat (*Rattus rattus*) genetic signatures on populations before and three years following eradication procedures on four islets off the Martinique coast (French Caribbean) which demonstrated some incidence of numerous new alleles increasing genetic diversity (Abdelkrim *et al*. 2007). The authors recommended that trapping procedures should prevent individuals surviving and re-invading islets by establishing permanent trapping and poisoning devices in addition to regular monitoring, and the use of molecular biological tools (Abdelkrim *et al*. 2007).

MAMMALIAN PREDATOR POPULATIONS

Invasive predators have devastating consequences on endemic species, often as a consequence of successful reproductive rates, short generation times, a generalised diet, smallish in stature and secretive (Pitt and Witmer 2007). Additionally, ecosystems with a limited assemblage of native are more susceptible to invasion from mammalian predators, often having devastating impacts on prey populations, e.g. destructive activities of black rats, feral cats and the mongoose (Pitt and Witmer 2007). Many native birds and reptiles have become endangered as a result of introduced predator activities. Black rats (*Rattus rattus*) are perfectly capable of co-habiting with feral cats (*Felus catus*) with 42% of the former trapped in the Caribbean National Forest in Puerto Rico (Engerman *et al*. 2006), both potentially endangering rare birdlife, including parrots. Cat predation has had major adverse effects on *Geocapromys* spp. (Nogales *et al*. 2004). Eradication of the cat on Caribbean islands may be problematic due to associations with humans. The Indian mongoose (*Herpestes javanicus*), a voracious and opportunistic predator, introduced to Fiji, West Indies, Mauritius and Hawaii to control rats has instead, caused the local extinction of several endemic species of birds, reptiles, and amphibians (McNeely *et al*. 2004). Another species of mongoose, *H. auropunctatus*, was introduced to assist in removing the massive rat populations in the sugar cane fields with devastating effects on local mammal populations (Nellis and McManus 1974). The Hispaniolan spiny rat (*Brotomys voratus*) was present on Hispaniola in 1930 and is now extinct due to the activity of the Indian mongoose (Hays and Conant 2007; Woods and Ottenwalder 1992). The mongoose introduced to limit cane rats, resulted, in Trinidad, in extreme reductions thereof, although the roof rat populations were as high as 50% in parts of St. Croix (Hays and Conant 2007). Mongooses may drive rats into arboreal habitats as in St. Croix and Jamaica (Hoagland *et al*. 1989). In Puerto Rico, Norway rats are common only in mongoose-free urban areas (Pimental 1955).

CONCLUSION

Live collections of rodents should be housed in the zoo in Port of Spain, Trinidad for educational purposes. It is most unfortunate that the museum at the Department of Life Sciences at UWI does not have in its collection sufficient taxidermied rodent specimens, or significant associated literature. Notes can be provided discussing the ecology of the rat and its possible dangers to man, as illustrated in Fig. 2. With education, the likelihood of rodents causing harm to man will be reduced if appropriate hygienic and environmental measures are taken. Although the dangers of excessive rodent populations cannot be ignored, it is prudent to note the ecological importance of native rodent populations to provide food for predators, a notion completely lacking in reports from the region. Reference to the like could be made in museums and school projects. Local and regional conferences on effects of invasive species, including rodents, would be beneficial to the advancement of science.

Eradication of nuisance predators like cats and mongooses in order to protect endemic rodent species should incorporate effective quarantine programmes, and enforcing policies prohibiting the presence of potentially invasive pets should be a major component of conservation plans in insular environments such as those found on small islands (Nogales *et al*. 2004). A more conjugant assessment of rodent invasion may take cognisance of the following

Fig. 2. Live rodent displays, Birmingham Nature Centre, Birmingham, UK.

considerations: what bio-indicators exist for invasion impact?; does species richness impact community change?; how do impacts on population characteristics affect ecosystem functionality?; do invaders with significant impact utilise extensive ranges, spread rapidly, or develop the greatest abundance?; and how do quantitative measures of invasive species impact depend upon the ecosystem? (Gherardi and Angiolini 2002). National Wildlife Research Centre scientists are studying captive wild rats in order to determine social behaviour and responses to new lures, toxic baits, bait stations and various traps, hopefully, better equipping the Caribbean environmental officers' ability to monitor, manage and eradicate invasive rats (Witmer 2004). The Animals (Diseases & Importation) Act in the Caribbean, and the Animals (International Movement & Disease) Act in Antigua and Barbuda, Dominica, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines (Kairo *et al*. 2003), should continue to be strictly abided by and adhered to.

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NATURE NOTE

The Gray Lora *Leptophis stimsoni,* a Rare Snake in Trinidad, West Indies

The Gray Lora, *Leptophis stimsoni*, is endemic and one of the rarer snakes to Trinidad. The first specimen was collected by Ivan Sanderson in 1937 (Sanderson 1940) and I was present when the second specimen was collected near the Cumaca Cave in 1987. To date, only three specimens have been collected and lodged in museums as examples of this species.

My interest lies in snakes, so whenever I go into the bush I look for them, as well as for other animals. On the 6 May, 2007, while in the Cumaca Forest, I noticed a small snake lying upon some dried leaves along a narrow hunter's track. It seemed different from the common horsewhip, *Oxybelis aeneus*, the colour on the dorsal surface seemed glossier, and the head was not as sharply pointed. Recalling the photograph in the book "The Snakes of Trinidad and Tobago" (Boos 2001), I came to the conclusion that it was a specimen of the Gray Lora, *Leptophis stimsoni*. The identification was confirmed by Hans Boos on 10 May, 2007, who took the photograph (above).

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Population Density of Small Mammals in the Arima Valley, Trinidad, West Indies

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ABSTRACT
A trapping study of small mammal species richness was conducted at the Springhill Estate in the Arima Valley, Trinidad between 9 April and 11 May, 2005. A total of 12 individuals and 12 recaptures of two rodent and one marsupial species was observed after 1848.5 trap nights. Densities of *Oryzomys capito* and *Marmosa robinsoni* were estimated at 362.9 and 305.3 per square kilometre, respectively.

Key words: Arima Valley, premontane forest, small mammals, population density.

INTRODUCTION

Small mammal trapping in the Neotropics can be notoriously challenging. Tropical forest communities are complex three-dimensional systems (Hice and Schmidly 2002; Vieira and Monteiro-Filho 2003), mammalian species densities are often naturally low (Nelson 1996), sampling techniques can be logistically difficult and resource seasonality, bait type, rain, ants, and moonlight all affect trapping success (Smythe 1986; Voss and Emmons 1996). All these factors have contributed to a relatively limited number of studies devoted to assessment of small mammal species richness in Trinidad in the last two decades. This is especially true for higher elevation habitats in the country, for which there have been few published studies. Studies to date have included work done during the 1950s by the Trinidad Regional Virus Laboratory (now the Caribbean Epidemiology Centre – CAREC) while conducting studies on arboviruses (Worth *et al*. 1968; Tikasingh 2000); a limited study of the mammals of Simla (Alkins 1979); an inventory of the Arima Valley by Beebe (1952); and work at Turure Forest by Everard and Tikasingh (1973). The study presented here was a preliminary investigation into small mammal species richness on Asa Wright Nature Centre's Springhill Estate.

Trinidad and Tobago has a diverse native mammalian fauna comprising of 64 bat species and 32 non-volant mammals. This includes six native didelphid and eight native murid small mammal species (Nelson and Nelson in prep.). This rich and interesting fauna is typically continental, due to the separation of Trinidad from the South American mainland approximately 11,000 years ago (Kenny 1995).

The lack of data on basic ecological parameters such as the diversity and density of small mammals, presents a significant challenge to understanding patterns of metapopulation dynamics, community structure and prioritising research and conservation objectives of these species (O'Connell 1989; Malcolm 1990; Voss and Emmons 1996; Mares and Ernest 1995). In addition, the potential threat posed by colonising exotic mammalian species (e.g. *Cricetomys gambianus*) and their associated ecto- and endoparasites (Cooper 2006) makes comprehensive knowledge of the ecology of the native suite of small mammals essential for their conservation.

STUDY SITE

The Springhill Estate is located in the upper Arima Valley at 365 m from sea-level, on the south-facing slope of the Northern Range. This estate covers 193 acres and is one of several in the valley owned by the Asa Wright Nature Centre.

The forest in this area has been classified as tropical premontane moist forest by Nelson (2004) and as part of Beard's (1946) lower montane forest type. However, much of the estate is in various stages of succession following the historical conversion of the forest to a coffee and cocoa estate.

MATERIALS AND METHODS

Trapping was conducted in the middle of Trinidad's dry season, between 9 April, 2005 and 11 May, 2005. A total of 88 commercially built Sherman traps (23 cm x 7.5 cm x 7.5 cm; Fig. 1) was laid at 5 m intervals along a 215 m trap-line, with two traps at each station. The trap-line was established within a late successional secondary forest, and roughly followed the 'Adventure Trail' of the Springhill Estate. Traps were laid along natural runways on the forest floor, such as logs and roots, or under low undergrowth. Where possible, one trap at each station was strung up on lianas and branches above the ground (0.5 – 1.5 m). A mixture of peanut butter, jam, oats and either sardines or bacon fat was used as bait. Traps were checked in the morning (0600 - 0800) and in the evening (1600 - 1800), when they were also re-baited. Each trapping session lasted five to seven consecutive nights.

Every individual was weighed, measured, examined for age, sex, ectoparasites, and the location of capture

Fig. 1. Sherman trap used in this study. 23 cm x 7.5 cm x 7.5 cm.

Fig. 2. Common Rice Rat, *Oryzomys capito*.

was noted. Ectoparasites were preserved in alcohol for future examination. Identifications were made using Emmons (1997), Eisenberg (1989), Patton *et al*. (2000), Voss *et al*. (2001) and Voss *et al*. (2004). Animals were marked using fur-clipping and by painting an ear with nail-polish. All animals were released, except for one unidentified murid rodent, which was kept for identification purpose and details of which will be published separately. All research activities were consistent with the American Society of Mammalogists guidelines for the capture, handling, and care of mammals (ASM 1998).

The area sampled by the trap-line was calculated using Malcolm's approximation (1990), which estimates the area sampled for each species using the maximum distance between recaptures. Density was estimated using Schumacher's modification of Schnabel's estimator (Caughley 1977).

RESULTS

Trapping was conducted for a total of 1936 trap nights and 1848.5 effective trap nights (subtracting half a trap night for each closed trap). Twelve individuals of three species, (one marsupial and two rodents) were captured 24 times, for a trap success rate of 1.3%. Terrestrial traps had all but one of the total captures. Average capture rates per 100 trap nights were 0.54 for *Oryzomys capito*, 0.70 for *Marmosa robinsoni*, and 0.05 for the unidentified murid.

Five individuals of the Common Rice Rat, *O. capito* (Fig. 2), were caught, with one individual re-captured three times and two individuals re-captured once. Six individuals of Robinson's Mouse Opossum, *M. robinsoni* (Fig. 3) were caught. One *M. robinsoni* individual was re-caught five times and two were re-caught once. One unidentified murid rodent (Fig. 4) was caught in the understory level traps. Morphometrics of all individuals are presented at Table 1.

Fig. 3. Robinson's Mouse Opossum, *Marmosa robinsoni*.

Fig. 4. Unidentified murid rodent.

The sampling area of the trap-line was estimated to 2.37 ha and 1.63 ha for *O. capito* and *M. robinsoni,* respectively. Density estimates using Schnabel's estimator were 362.9 per km^2 for *O. capito*, and 305.3 per km^2 for *M. robinsoni*.

Table 1. Morphometric measurements (mm) and weights (g) of small mammal captures at the Springhill Estate, Arima Valley.

Species	Head Body	Tail	Total Length	Ear	Hind Foot	Weight	Sex	Age
Marmosa robinsoni	124.79	138.01	262.8	21.06	16.74	56	m	adult
	121.68	133.66	255.34	17.6	17.87	58	m	adult
	82.45	98.58	181.03	14.01	13.66	11.5	f	juvenile
	103.65	154	257.65	18.09	19.71	73.5	m	adult
	109.57	136.5	246.07	20.28	15.56	38.5	f	juvenile
	128	152	280	21	20	54.5	m	adult
Average	**111.69**	**135.46**	**247.15**	**18.67**	**17.26**	**48.67**		
Oryzomys capito	102.66	96.66	199.32	13.3	25.15	50	m	sub-adult
	111.3	100	211.3	15.42	21.28	59	m	adult
	115.03	105.11	220.14	17.61	25.54	61	m	sub-adult
	114.14	100.21	214.35	16.79	26.72	57	f	adult
	114.01	91.94	205.95	15.52	26.6	46.5	f	adult
Average	**111.43**	**98.78**	**210.21**	**15.73**	**25.06**	**54.70**		
Unidentified Murid	80.25	98.4	178.65	12.37	17.32	21.5	m	sub-adult

DISCUSSION

Low capture success is common among trapping studies of Neotropical mammals. Our trapping success rates were low but consistent with other studies, where trap success rates of between 0.45 – 7.1% have been reported (Emmons 1984; Patton *et al.* 2000; Caro *et al.* 2001;Voss *et al.* 2001; Hice and Schmidly 2002; Grelle 2003). Nelson (1996) also reported low capture success whilst trapping in the Trinity Hills Wildlife Sanctuary in southern Trinidad.

Rates of captures per trap nights for *O. capito* observed in this survey are comparable with those found in other studies (Table 2). It should be noted that seasonal changes in capture response for both *O. capito* and *M. robinsoni* have been reported elsewhere (O'Connell 1989). In this regard, Everard and Tikasingh (1973) also observed large increases in capture rates of *O. capito* during the course of their three year study in Trinidad.

Our density estimates also appear consistent with densities of *M. robinsoni* and *O. capito* reported in other studies (Table 2). The large variation in the densities reported for both species from other sites in the Neotropics reflects inter-year and between-site variations (Table 2). In Venezuela for instance, *O. capito* populations were highest in the rainy season, while *M. robinsoni* were higher in the dry season (O'Connell 1989). Fleming (1971, 1972) found fluctuating densities of both *M. robinsoni* and *O. capito* in Panama over a one-year period. Both populations had significant increases in population size towards the end of the wet season. Population explosions of *O. capito* in Trinidad were noted by Everard and Tikasingh (1973). Our study only estimated population density during a single dry season, and so we were unable to detect inter-seasonal variations in density for our study site. Food availability, seasonality, predation and intrinsic reproductive cycles have been proposed as limiting factors for small mammal populations (Fleming 1971; O'Connell 1989; Glanz 1990; Mares and Ernest 1995). Emmons (1984) noted that the large differences in densities between sites could also be accounted for by edaphic variability.

The density we observed for *M. robinsoni* and *O. capito* suggests that they are abundant and may constitute a significant proportion of the small mammal biomass at the Springhill Estate. Everard and Tikasingh (1973) previously found *O. capito* to be the most numerous of the ground-dwelling mammals at the Turure Forest in Trinidad. It is typical for trapping to be dominated by a few taxa, comprising of morphologically unspecialised forest floor dwellers, such as *Oryzomys* species (Voss and Emmons 1996).

The low capture rate for the unidentified murid we detected in this study suggests that this species is relatively uncommon, and is perhaps an indication of why it previously remained unrecorded.

It is possible that this rodent has not been captured in

Table 2. Reported densities of *M. robinsoni* and *O. capito*.

Country	Density (per km^2)		Capture Rates per 100 Trap Nights	
	Oryzomys capito	*Marmosa robinsoni*	*Oryzomys capito*	*Marmosa robinsoni*
Brazil	40.4˜	45 - 200 ^	2.78, 0.70 and 0.91 ˜	
Panama	34 - 430 §	27 ^ ; 31 - 225§		
Trinidad	372 ▫		0.20, 0.54 and 1.33 (over 3 years) ▫	
Venezuela	0 - 320 °	137 ^ ; 30 - 550 °; 25 - 425 °		1.47°
Unknown	276.9 ±	123.5 ±		
This study	363	305	0.54	0.70

Sources: § Fleming 1972; °O'Connell 1983; ±Robinson and Redford 1986; ^ Glanz 1990; ▫ Everard and Tikasingh 1973; ˜ Malcolm 1990.

previous studies as the habitat requirements of some rice rat species can be very specialised (Emmons 1997). We detected this rodent in premontane moist forest, a habitat where there have been very limited previous surveys. Additionally, this rodent was trapped above ground, a mammalian habitat dimension that has not been extensively surveyed in Trinidad and Tobago.

Estimating density and home range from trapping and mark-recapture studies are fraught with difficulties. This is due to the numerous assumptions associated with each population estimator, such as the presence of open or closed populations, the definition of effective sampling areas, metapopulation dynamics and edge effects (Caughley 1977; Slade and Blair 2000). It is in this context that we acknowledge the limitations of this study especially given our small sample size and limited sampling period.

In this study, only traps of one size were used. The authors propose that a larger size of Sherman trap would be better suited for capturing the suite of small mammals present in Trinidad, both due to the size of animals and to prevent trap injuries (a particular problem with the long tailed marsupials). Additionally, many small mammals spend their entire lives in the canopy, and are often not trapped by terrestrial or low-level traps (Malcolm 1990; Voss and Emmons 1996; Grelle 2003; Vieira and Monteiro-Filho 2003). Several methods in canopy-trapping have been recently developed (Malcolm 1991; Vieira 1998), which could be used to further study the arboreal mammal community in Trinidad. Finally, some small mammals are also only taken by pitfall trapping (Voss *et al*. 2001), including rare species (Hice and Schmidly 2002). This last technique has not to our knowledge, been extensively used in Trinidad.

The published data suggests that only a limited suite of sampling techniques have been used in Trinidad and Tobago to survey small mammals. This factor and the related limited diversity of habitats surveyed to date, point to a need to undertake more thorough surveys of the small mammalian fauna of Trinidad and Tobago.

More extensive surveying of the Springhill Estate is required to give a complete picture of the small mammalian species richness there. Canopy trapping and surveys of riparian habitats would greatly enhance any future assessment.

Studies of this kind are fundamental for establishing a baseline of small mammal population ecology. With forest cover on Trinidad declining at a rate of 0.8% annually (FAO 2003), due to the human-induced habitat change, native small mammal populations may become threatened with extirpation in some parts of the island. Habitat degradation and fragmentation, remain key threats to the biodiversity of the Northern Range (EMA 2005), and can also increase the chance of colonisation by exotic species. However, there is little published work on recent mammalian colonisation in the Northern Range. Conservation efforts on Neotropical mammals often risk being ineffective in the absence of baseline data on distribution, diversity, abundance and biomass (Mares and Ernest 1995). We hope this study adds to the body of work on small mammals, and encourages future research of mammalian ecology in Trinidad.

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NATURE NOTE

A *Urania leilus* Migration

The White-tailed page, *Urania leilus,* is a day-flying moth which is resident in Trinidad being more common in the south than north of the island. Migration of the moth occurs periodically during the petit careme, usually in an easterly direction. Major migrations have occurred in 1969, 1973 and 1995 (Quesnel 1971, 1975, 1996). Another migration occurred in 2007 from 14 September to 13 October when the last one was seen. This migration was seen along the main roads from Talparo to Port of Spain, but they were fewer in numbers when compared to previous years.

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Status and Range of Introduced Mammals on St. Martin, Lesser Antilles

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ABSTRACT
The introduction of mammals to islands is one of the leading causes of extirpation of native biota worldwide. Data gaps in the introduction of mammals to islands have led to inadequate management practices which do not take into consideration the potential destruction caused by those mammals. Herein, we report the current status of introduced mammals on the island of St. Martin within the Lesser Antilles region of the Caribbean. We surveyed the island for introduced mammals and interviewed residents on their observations, from 2000 - 2007. In addition to recording domesticated mammals (i.e. dogs, *Canis familiaris*), we recorded six species of feral introduced mammals including raccoons (*Procyon lotor*) and African green vervet monkeys (*Cercopithecus aethiops*).

Key words: Introduced mammals, African green vervet monkey, mongoose, raccoon, rat, mouse, St. Martin, Tintamarre, Caribbean, Lesser Antilles.

INTRODUCTION

The invasion of ecosystems by exotic species is currently viewed as one of the main causes of global ecological change, mostly due to biodiversity loss (Vitousek *et al*. 1997). The largest part of this loss has occurred on islands where indigenous species had thrived in the absence of competition. The effect of introduced species on an ecosystem may be simple or very complex, depending on the array of introduced species on the island and the interaction among those introduced species, but the effect is almost always destructive (Courchamp *et al*. 2003). Therefore, there is an urgent need to understand and counteract the processes by which biological invasions threaten biodiversity within insular ecosystems.

Oceanic islands are home to plant and animal communities with relatively little diversification, simplified trophic webs, and high rates of endemism. Therefore, island communities are highly susceptible to disturbances and subsequent high rates of species extinction (Chapuis 1995). The majority of worldwide extinctions have occurred in insular ecosystems, where more than 90% of the recorded extinctions in reptiles and amphibians have been island forms (Honnegger 1981). Furthermore, predation by introduced animals has been a major cause of 42% of island bird extinctions in the past and is a major factor endangering 40% of currently threatened island bird species (King 1985).

Introduced mammals have caused more problems than any other vertebrate group and are responsible for the best documented ecological disturbances resulting from biological invasions (Ebenhard 1988; Lever 1994). This is due in part to a lack of naturally occurring mammals on most remote islands (Atkinson 2001). The introduction of mammals is known to affect native species in many ways, most notably by predating on native species and affecting plant populations and the species that rely on the structure of those plant communities (Ebenhard 1988).

The Caribbean islands are visited annually by migratory birds from both North America and South America (Brown and Collier 2004). These naturally occurring migratory species seasonally visit and inhabit most environments on islands (Brown and Collier 2004). Resident avian species have developed strategies to co-exist within habitats alongside migratory species to ensure adequate food sources as well as safe roost and nesting areas (Johnson *et al*. 2005).

Mammalian biological invasions in the Caribbean are not well documented with the exception of a few species. The Indian mongoose (*Herpestes auropunctatus*) was introduced to Jamaica from India in 1872 to predate on rats in the sugar cane fields and has since been the source of populations on 29 Caribbean islands, including St. Martin (Nellis and Everard 1983). This population of mongoose has been responsible for the eradication of multiple species of invertebrates, reptiles, amphibians, birds, and mammals in the Caribbean (Westermann 1953; Nellis and Everard 1983; Lever 1994). The African green vervet monkey (*Cercopithecus aethiops*) was first introduced from Africa in 1650 to Barbados, St. Kitts, and Nevis (Denham 1987). While not well documented, we assume that rodents such as *Rattus rattus, R. norvegicus,* and *Mus musculus* as well as domesticated animals are found commonly on most inhabited Caribbean islands and less commonly on many uninhabited offshore islands, all presumably having arrived to the Caribbean with European settlers from the 15th century to the present. The recent discovery of the African Giant Rat (*Cricetomys gambianus*) to southern Florida in the United States raises the possibility that the species might also be established in the Caribbean, given the regularity of ship trade between these two regions. It is within this context of gaps in the knowledge base, that we found it vital to document the current status and range of introduced mammals on St. Martin.

MATERIALS AND METHODS

St. Martin is a small island (95 km^2) located in the northern windward islands of the Lesser Antilles (Latitude 18° 02' 295 N and Longitude 063° 07' 207 W). Politically and physically, the island is divided between the French and Dutch. The island was formed during the height of Pleistocene glaciations and the non-volcanic island consists mainly of limestone and igneous diorite. Pic Paradise is the highest point on the island at 425 m. In Philipsburg, the highest mean temperature is recorded in August at 27.9° C and the coolest months are January and February with a mean of 24.7° C (Stoffers 1956). Mean annual rainfall is 1000 - 1125 mm, but precipitation varies annually and long periods of drought occur (Stoffers 1956). The island lies within the Caribbean hurricane zone and the most recent hurricanes making landfall were: Luis, 1995; Bertha, 1996; Georges, 1998; Jose and Lenny, 1999 (Caribbean Hurricane Network 2005).

Primary hardwood forests once covered the majority of the island, but most of these were removed and replaced with sugar cane during the 17th century. However, at the present time there is little sign of agriculture and St. Martin is dominated by scrub habitat with small exceptions of remnant dry forest occurring in a few high mountain valleys on the island. Additionally, wetlands occur along much of the island's lowland areas, covering approximately a fifth of the entire island.

Tintamarre Island is a small (9 km^2) French - owned islet located 3 km northeast of St. Martin. The island itself is managed as a French Reserve Naturelle and is managed locally by staff on St. Martin. The island consists of low scrubby brush. There are scattered rock outcroppings along the island's shorelines, upon which large numbers of seabirds nest throughout the year. There is a popular tourist beach which is visited daily by sailboat tour operations.

Data on mammals was collected during our annual periodic research on the bird communities of St. Martin from January, 2000 – April, 2007. We surveyed birds within all habitats of the island on a weekly basis and therefore had complete geographic coverage of the island. Although mammals were not the focus of our research, we regularly encountered the mammals reported herein. When mammals were encountered, we recorded total number of animals observed as well as the location of the observation. Additionally, we collected data on mammals encountered while surveying the small satellite islet, Tintamarre Island.

An effort was made to quantify the density of rats on Tintamarre Island. During May, 2004, 50 snap traps were placed during the evening in a one km^2 coastal area, directly adjacent to a Red-billed Tropicbird (*Phaethon aethreus*) colony. Traps were checked the following morning. Permission for trapping was given by the Reserve Naturelle land managers.

Information on the presence and distribution of introduced mammals was recorded during interviews with residents of St. Martin. Residents were surveyed at Maho, Lowlands, Marigot, Rambaud, Columbier, Grand Case, French Cul-de-Sac, French Quarter, Philipsburg, and Simpson Bay, the major villages on the island. The inhabitants were asked what mammals they observed near their homes as well as the regularity the mammals were observed.

RESULTS

Introduced mammals were found in all habitats on St. Martin as well as on Tintamarre Island. Domestic animals, specifically cats (*Felis catus*), dogs (*Canis familiaris*), goats (*Capra hircus*), pigs (*Sus scrofa*), and cattle (*Bos taurus*) were regularly encountered on St. Martin as well as goats and cows on Tintamarre. Six species of feral introduced mammals were recorded including two species of rat, one species of mouse, one species of mongoose, one species of raccoon, and one species of monkey (Table 1).

Table 1. Introduced mammals recorded on St. Martin from 2000 - 2007.

Common Name	Scientific Name
Horse	*Equus caballus*
Donkey	*Equus asinus*
Cow	*Bos taurus*
Ox	*Ovibos moschatus*
Sheep	*Ovis aries*
Goat	*Capra hircus*
Pig	*Sus scrofa*
Cat	*Felis catus*
Dog	*Canis familiaris*
House mouse	*Mus musculus*
Brown rat	*Rattus norvegicus*
Black Roof rat	*Rattus rattus*
Indian mongoose	*Herpestes auropunctatus*
Raccoon	*Procyon lotor*
African green vervet monkey	*Cercopithecus aethiops*

Rats (*Rattus* sp.): Two species of rats were found on St. Martin, the Black Roof or Ship rat *Rattus rattus*, and the Brown or Norwegian rat *R. norvegicus*. Both species were observed regularly in all habitats on St. Martin, as well as on Tintamarre Island. During the trapping effort in May, 2004, each of the 50 traps set captured a Norwegian rat.

House mouse (*Mus musculus*): This species was found on both St. Martin and Tintamarre. Tracks and individuals of this species were regularly observed in all habitats on St. Martin, but rarely throughout Tintamarre Island.

Indian mongoose (*Herpestes auropunctatus*): The mongoose was widespread on St. Martin. The species was encountered weekly at all St. Martin survey locations, observing it within all habitats and within all villages. The species was not observed on Tintamarre Island.

African green vervet monkey (*Cercopithecus aethiops*): This monkey was encountered on St. Martin within both dry forest and scrub habitats. The species, which was previously unreported for St. Martin, was first noted during bird surveys in dry forest within the Rambaud Valley on the northeast side of Pic Paradise during 2001. In 2001, five individuals were noted, but they appear to be increasing annually and in 2007, 50 individuals were noted in Rambaud Valley. Furthermore, during January, 2007, landowners within this valley regularly observed 35-50 individuals. In the coastal hills behind Guana Bay a scrub habitat of 10-15 monkeys were noted during 2001. Recent observations of this troop by residents of Guana Bay show the population to remain at approximately 10-15 individuals.

Raccoon (*Procyon lotor*): This species was not seen during the diurnal bird surveys, but the residents of Columbier report seeing the species regularly at night. Raccoons were first observed on St. Martin in 1957, when an individual was observed around the small village at Guana Bay (pers. comm., E. Millot-Dubois). The current population resides in the village of Columbier, where it was first observed in 1985. Recently, an individual was recorded in the village of French Cul-de-Sac (pers. comm., E. Millot-Dubois). The population in Columbier is estimated at 20 - 30 individuals by residents of the village and is reported to be stable.

DISCUSSION

While recording the current status of introduced mammals on St. Martin, we were able to document the continued presence of multiple species of domesticated animals: one species of mouse, two species of rat, and one species of mongoose. Furthermore, we were able to document two previously unpublished introduced mammal species: raccoon and African green vervet monkey.

Cats and goats are widespread in all habitats on the island and both are incredibly destructive to native biota on island ecosystems. The destruction to bird communities due to the introduction of cats is well documented; where in one extreme case a single pair of introduced cats on an island soon led to the destruction of over a million birds a year due to the introduced cat's offspring (Pascal 1980). Introduced goats, due to the large spectrum of their diet, are generally seen as one of the most destructive feral mammals to native vegetation. They severely reduce vegetation cover by overgrazing and trampling which in turn affects native species of birds and reptiles (Coblentz 1978). While it is unlikely that cats will be removed from St. Martin, it is imperative that they are not introduced to Tintamarre, where they would likely decimate the seabird colonies. The direct and indirect consequences of introduced goats on Tintamarre have been the most evident within the tropicbird colony, where nests have been found trampled in some cases. While eradication of the goat population on Tintamarre would benefit the breeding seabird colonies, the island is currently under private ownership. Securing landowner co-operation to manage or remove the goat population from Tintamarre is necessary.

The widespread range of rodents on St. Martin is not surprising, however, their densities in unpopulated areas is cause for concern. The origin of mice and *Rattus* sp. to St. Martin is unclear; however it is likely that these species were introduced to St. Martin when the first European settlers arrived in 1631. Rats have been implicated in greatest number of extinctions due to predators, 54% (King 1985). We did not observe direct predation events on bird or reptile populations, however it is highly likely that the rats predate on numerous species of both groups on the island. Currently on Tintamarre, the Red-billed Tropicbird colony has little breeding success (Collier *et al*. 2002). While potentially due to oceanographic conditions (i.e. food availability), it is likely that the colony is suffering from rat predation on eggs and chicks. Furthermore, the impact that rats have on the vegetation of the islands they have invaded is extremely important. Rats eat leaves, seeds, fruits, flowers, bark and stems of many plants and trees, therefore hindering regeneration and modifying entire plant communities and affecting associated fauna (Courchamp *et al*. 2003). Eradication of rats on St. Martin would be a difficult goal, due to the large area and population. Conversely, eradication of rats on Tintamarre has great potential due to the small size of the island, the lack of any harbor on the island, and the likely positive and immediate response by local seabird populations to the removal of rats. However, political and financial issues have hindered previous planning efforts at rat eradication on Tintamarre.

Mongoose were introduced to St. Martin in 1888 to combat rat infestation of the sugar cane fields (Nellis and Everard 1983). During mark/re-capture research, Newton (2004) found mongoose densities to be consistent island-wide, with no notable habitat dependencies. During diet analysis, Newton found mongoose to predate on land crabs, multiple species of reptile, as well as bird species, most commonly the Common Ground Dove (*Columbina passerina*) and the Zenaida Dove (*Zenaida aurita*). All of the aforementioned species have not adapted to the presence of a mammalian predator and therefore have been highly affected by the introduction of the mongoose to St. Martin. Sea turtles are well-known prey of mongoose as well (Nellis and Small 1983). Densities of mongoose in coastal areas of St. Martin were found to be at approximately 22 individuals per 2 km^2 (Newton 2004). It is highly likely that mongoose predate on sea turtles on St. Martin due to the high density of animals within close proximity to known sea turtle nesting areas (Debrot *et al*. 2005). While eradication of mongoose from St. Martin is unlikely, it is important to work towards preventing mongoose from becoming established on Tintamarre, where their introduction would be highly detrimental to seabird colonies.

There are 50 forms of the raccoon genus *Procyon* found in the North America, South America, and the Caribbean (Goldman 1950). Three of these forms were historically recorded from the Caribbean; *P. maynardi*

(New Providence), *P. minor* (Gaudeloupe), and *P. gloveralleni* (Barbados) (Goldman 1950). However, recent research has indicated that all three of these forms are likely related to the North American form *P. lotor* (Helgen and Wilson 2003). Raccoons from other populations have been introduced to the Caribbean as well, in Trinidad and Tobago (*P. cancrivorus*) and Grand Bahama (*P. lotor*). The origin of the St. Martin population is unclear and further research into this population is warranted. This species is considered a pest species by the residents in the Columbier Valley and regular culling of the population through hunting and trapping likely keeps the population stable (pers. comm., E. Millot-Dubois).

The introduction of the African green vervet monkey might have some of the costliest implications for wildlife on St. Martin. On St. Kitts, it is widely speculated that the introduction of the green vervet monkey caused the eradication of the endemic St. Kitts Bullfinch (*Loxigilla portoricensus grandis*) (Rafaelle 1977). This species has the potential to cause major declines in bird populations on St. Martin. Although we have not observed any direct predation on birds by monkeys, it is likely that predation has occurred and that recent reductions in dove and thrasher populations in the Rambaud Valley are directly related to the introduction of monkeys to the forest (Brown and Collier 2006). Eradication efforts on Barbados in the past have shown that despite constant removal efforts, where up to 1,000 individuals were trapped annually, the population remained stable. With such a small population of monkeys on St. Martin, there is potential to successfully trap and remove all the monkeys from the island within a short period of time. If such a trapping effort is to take place, it should happen in the near future before the population gets too large for complete eradication.

It is well understood that introduced mammals to island ecosystems are highly disruptive, however, it is difficult to explain to landowners and stakeholders that the removal of those species will be beneficial to the island. Human empathy to protect animals such as monkeys, cats, and goats is strong, despite the ecological destruction that such species can cause on an island. Educating the public about island specific threats from introduced species is a necessary first step. Furthermore, promotion of the benefits resulting from prior eradication programs, even from other islands, would be beneficial. While immediate removal might not be practical for some introduced species, monitoring of their respective populations and ranges will be highly useful in further understanding the effects each species currently has on the native island biota.

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Food and Feeding Behaviour of the Nocturnal Neotropical Gecko *Thecadactylus rapicauda* (Houttuyn) in a Dwelling House in Trinidad, West Indies

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ABSTRACT
Thecadactylus rapicauda is a sit-and-wait predator. In ambush on a vertical surface it prefers a vertical orientation to a horizontal one. Its diet includes a wide variety of insects, at least one spider and some vertebrates. The insects come mainly from the orders Lepidoptera and Orthoptera. Three vertebrate species are recorded as prey for the first time. They are the frog *Scinax rubra* and the lizards *Gonatodes vittatus* and *Tropidurus plica*. Though basically nocturnal, *T. rapicauda* spends some time hunting by day and eats diurnal species as well as nocturnal ones. It prefers big prey to small prey and uses a head-down posture when battering its prey items to death before swallowing them. An argument is advanced to show that as the force of battering increased through the preferential selection of big prey, the need for a secure foothold on the vertical surface increased and led to the evolution of the highly effective adhesive pads on the digits. Only a few observations have been made on the feeding of the spider *Avicularia avicularia,* but from these it is deduced that it is a direct competitor of *T. rapicauda*. The two species eat each other.

Key words: *Thecadactylus rapicauda,* food, prey items, big prey, battering.

INTRODUCTION

This paper is the second of a short series describing the behaviour of *Thecadactylus rapicauda*. The first (Quesnel 2006) dealt with reproductive behaviour; this one deals with food, feeding and associated activities such as drinking and defecating. *T. rapicauda* is a sit-and-wait predator (Quesnel 2004) and is most often seen immobile. However, the frequent battering that takes place when a *Thecadactylus rapicauda* has caught relatively large prey attracts attention because of the sound it makes. Thus, by such means and by chance encounters with feeding individuals, a body of knowledge has gradually been built up over the past twenty-two years and is here presented.

STUDY SITE AND METHODS

The study site was my home on Leotaud Trace near Talparo, Trinidad. The house was described in the earlier publication and will not be described here. The lights, some of which are never switched off, attract a variety of insects, the therophosid spider *Avicularia avicularia* and other lizards such as *Gonatodes humeralis, Gonatodes vittatus*, *Hemidactylus mabouia*, and *Sphaerodactylus molei*. In the dry season the frog *Scinax rubra* is attracted by the water in the bathroom.

Because *Thecadactylus rapicauda* is nocturnal, a torch (flashlight) was often required for better observation of details. Most of the adults were habituated to human presence and allowed a sufficiently close approach that the prey could sometimes be identified to species while being eaten. However, in presenting the results in tabular form they are often assigned to orders and families. Times of capture were recorded and, later in the study, a short description of size and appearance. If the individual lizard could be identified from characteristic markings, its identity was also recorded. The behaviour was described as completely as conditions permitted. Prey items that appeared to be spat out because they were distasteful were not counted as food. Prey items that seemed to be lost accidentally when the predator was trying to subdue them were counted as food.

Butterflies of the genera *Caligo* and *Eryphanis* are important prey items for *Thecadactylus rapicauda* and the eyespots on the under surfaces of the wings frequently deflect attack to a non-vital part of the insect. Eighty-four individuals of the four species (three of *Caligo* and one of *Eryphanis*) were identified as victims of *T. rapicauda* attacks. Six of the victims perished and 78 survived at the cost of pieces of wing which were eaten by the lizards. These 78 individuals all qualified for inclusion in this study and appear in Table 1. For convenience the terms ‘arm’, ‘leg’, ‘hand’ and ‘foot’ are used with the same meaning as for human limbs. Dates are given in the form day/month/year.

OBSERVATIONS

Orientation of the Predator in Ambush

It has been mentioned already that *Thecadactylus rapicauda* is a sit-and-wait predator (Quesnel 2004). Casual observation suggested that it preferred vertical surfaces to horizontal ones when sitting in ambush. It seemed to use the floor only in pursuit of prey or to return to the wall after falling off. Though it occasionally lay in wait on the ceiling, it was much more often seen on the walls where individuals preferred an up-down orientation to a horizontal one. These ideas were tested in a series of 112 observations during the period 4/10/01 – 30/11/01. Observations were made only in the normal period of activity roughly between 1800 h and 0600 h and no more than one observation was made on one individual on any one day. At each observation the body axis was assigned visually to one quarter of a square according to the figure below. No observation was made on any lizard close enough to the floor or ceiling for its orientation to have been influenced by the near presence of the extra surface.

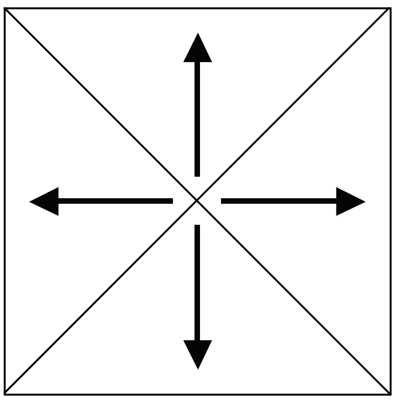


Fig. 1. Approach to description of body axis.

The distribution was as follows: head up 42, head down 35, head left 18, head right 17. Therefore, *T. rapicauda* does indeed seem to prefer a head-up stance in ambush. The counts revealed a population of at least eight individuals.

The Time of Feeding

Figure 2 is a frequency distribution of the time of capture of prey items by *Thecadactylus rapicauda* over 22 years of study. Four features are noteworthy: 1). most prey items (46, 58 %) were captured during the period 1800 h to midnight; 2). fewest (5, 6 %) were captured during the period midnight to 0600 h which coincides with the observer's usual period of sleep during which there were few observations; 3). twenty-nine (36%) were captured during the period 0600 – 1800 h indicating that *T. rapicauda* is not strictly nocturnal; 4). there is no peak in the numbers captured at 1800 h although sunset is the time of maximum activity for important prey items such as species of *Caligo* and *Eryphanis* (Quesnel 2003). The 78 individuals of these genera that are known to have been attacked (Table 1) are unrepresented in Fig. 2 because the time of attack of each is unknown but also because of the prey's ability to elude capture.

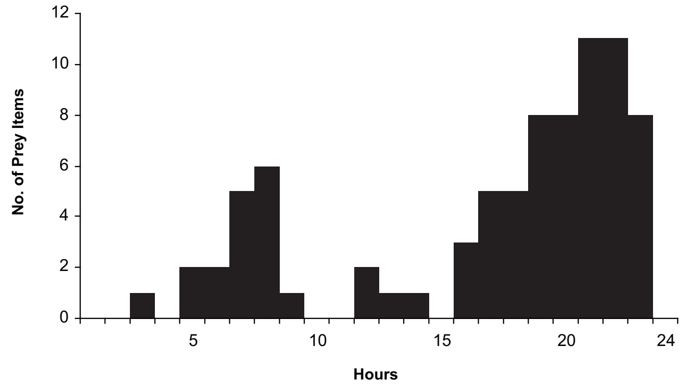


Fig. 2. Frequency distribution of the times of capture of prey by *Thecadactylus rapicauda* over the 22 years of the study.

Prey Consumed

Table 1 displays the range of prey attacked and consumed by *Thecadactylus rapicauda*. For the most part they are arranged by order and family in an order similar to that in Vitt and Zani (1997) so that the two tables may be easily compared. In a general way they follow the classification of insects by Kirkpatrick (1957). There are 22 categories of prey in all, in which six are families, four are single species and the other eight are groups ranging from orders to genera. Column 2 consists of items known to have been completely consumed whereas items in Column 3 escaped after capture or were eaten in part whether by accident or design. Thus 78 of the 96 items (81%) of those in Column 3 are individuals of *Caligo* or *Eryphanis* that were attacked as prey but escaped because the attack was directed at eyespots on the under sides of the wings and the butterflies escaped leaving a piece of wing for the lizard to eat. Four other brassolids similarly escaped capture, one sphingid moth was too large to be swallowed and was discarded, an *Avicularia avicularia* escaped after one leg was bitten and broken off and a young *Tropidurus plica* of S-V length 50 mm, was discarded as too big to swallow.

In Columns 5 - 7 the prey items have been classified by size in an attempt to show that *T. rapicauda* eats more big prey than small. This will be taken up again later but it may be stated here that strictly mathematical considerations are not appropriate. The animals in the large category have a body length (not counting the wings) of 36 mm and above. Those in the Small 2 category have a body length of 23 mm or less.

The category most often attacked (Col. 4) was that of the category *Caligo* plus *Eryphanis* with a total of 84 (28%). Taking the family Brassolidae as a whole for comparison with the other families, the number attacked rises to 95 (32%). The next largest category is the group Tettigoniidae plus Acridiidae followed by the group "other moths". Comparing the larger groupings such as orders

Table 1. Distribution of prey items by taxonomic status and size.

1	2	3	4	5	6	7
Orthoptera						
Tettigoniidae + Acridiidae	44	3	47	13		0
Gryllotalpidae	3	0	3	3	0	0
Blattodea	7	2	9	1	2	2
Mantodea	9	0	9	5	0	4
Isopterans	10	0	10	0	10	0
Homoptera (cicadas)	6	2	8	0	0	0
Coleoptera (beetles)						
Scarabiidae	11	0	11	0	7	7
Others	6	0	6	0	2	2
Lepidoptera						
Caligo + *Eryphanis*	6	78	84	84	0	0
Other brassolids	7	4	11	0	0	0
Hesperiids (skippers)	1	0	1	0	0	0
Saturniidae	4	2	6	1	0	0
Sphingidae (hawk moths)	20	3	23	4	0	5
Notodontidae	7	0	7	5	0	0
Other moths	38	0	38	1	15	31
Hymenoptera						
Formicidae (ant alates)	16	0	16	0	16	16
Odonata	2	0	2	2	0	0
Diptera						
Tabanidae (horseflies)	3	0	3	0	3	3
Arachnida						
Avicularia	0	1	1	1	0	0
Vertebrata						
Scinax rubra (frog)	1	0	1	0	0	0
Gonatodes vittatus	3	0	3	3	0	0
Tropidurus plica	0	1	1	1	0	0
	204	**96**	**300**	**124**	**55**	**70**

Col. 1. Edible species arranged taxonomically.
Col. 2. Number of prey items seen to be eaten.
Col. 3. Number of prey items attacked, but not known to be eaten.
Col. 4. The sum of Columns 2 and 3.
Col. 5. Number of individuals attacked above 35 mm long after connection for battering (see text).
Col. 6. Number of attacked individuals that were shorter than 20 mm. Small 1.
Col. 7. Number of attacked individuals that were shorter than 23 mm. Small 2.

the number consumed was largest in the Lepidoptera (82 - 40%), followed by Orthoptera (63 - 31%). Only one arachnid species appears in the table, and that only partially eaten, *Avicularia avicularia*.

Thecadactylus rapicauda does not eat everything that comes its way. Table 2 gives a summary of the species rejected as food with short descriptions of the behaviour observed with each. Some of the rejected items (assassin bugs, fire-flies, click beetles and *Apoica* sp.) were scrutinized at a distance of 3-10 cm before being rejected. Sometimes the scrutiny involved tongue flicks, at other times it seemed to be visual only. Other rejected items (cockroaches, stinkbugs, moths) were bitten or bitten and shaken before being rejected. It is assumed that the biting allowed the lizard to determine whether the object was distasteful or not.

Table 2. Insects rejected as food by *Thecadactylus rapicauda*.

Insects	Incidents	
	No.	Kind
Blaberus sp. (cockroach)	2 1	Touched with tongue; rejected Bitten, rejected; lizard wiped tongue
Pentatomidae (stink bug)	1	Bitten, shaken; lizard moved away
Reduviidae (assasin bug)	2	Scrutinized from ca. 3 cm; lizard moved
Lepidoptera (moths)	2	Both bitten and spat out
Cantharidae (fire-flies)	4	Scrutiny from about 5 cm, tongue flicks
Elateridae (click beetles)	1	Scrutinized close up
Apoica sp. (nocturnal wasps)	1	Scrutinized for 10 min. at about 3 cm

Capture and Ingestion of Prey

Since *Thecadactylus rapicauda* is a sit-and-wait predator, prey and predator most often meet when prey moves into the range of vision of the predator. When this has happened two different responses from the predator have been observed; a rapid run to attack and capture the prey or a period of scrutiny and slow approach. The former has occurred when the potential prey has kept on moving after attracting the predator's attention; the latter has occurred when the potential prey has ceased to move. Thus, when small active prey (ant alates, small beetles, small moths) have aroused the interest of the predator, the latter responded with a quick run to the prey which was then bitten, squeezed and swallowed at the site of capture. With large prey that has stopped moving the response has been different. The predator has stalked the prey with an advance so slow it was almost impossible to detect. This was the method used when hunting brassolid butterflies, moths and katydids. Table 3 gives some measurements of the speed of advance in such cases. The final move was either a quick run of two or three steps (impossible to see clearly) or a more carefully prepared strike in which the predator slowly moved one foot far forward to the armpit, anchored it to the substrate there and then lunged forward keeping the anchored foot in place. Head down now, squeezing the prey in its jaws, the lizard battered and scraped it on the substrate.

With the prey now subdued the lizard began the long process of swallowing it and early in the process turned head up. Then by adding two more movements to the two already described (scraping and battering) the lizards tried to engulf the inert prey. The first was a stretching upward with the mouth agape and the second the assumption of an S-shaped configuration of the body accompanied by a "pressing down" motion. On one occasion the lizard was first seen at 2255 h on 6/1/02 head down battering a species of *Crinodes* moth it had caught from behind. At 2309 h it turned head up and after 24 scrapes, 14 stretchings, 12 twists and three batterings the wing tips of the moth finally disappeared at 0055 h on 7/1/02. After more scrapes, stretchings, licking of the lips left and right, and licking of both eyes for another 10 minutes the meal was finally over. Clearly, the head up posture during the swallowing allows the force of gravity to aid the process.

Such is the usual course of events, but *Thecadactylus rapicauda* does not always have its way unspoilt. On at least 3 occasions prey has inadvertently shot out its mouth during the battering stage, presumably because it had not been held firmly enough. On one occasion it was a *Periplaneta* cockroach, on another it was a brassolid butterfly (*Opsiphanes cassiae*) and on the third occasion it was a sphingid moth. On every occasion the lizard paid no further attention to the prey on the floor below it even though it may have been in full view.

There have been at least two instances where an attacking *Thecadactylus rapicauda* has missed its target or barely touched it. In another similar occurrence a subadult individual approached a tettigoniid, closing the gap between them fairly quickly and flicking its tongue as it moved along. When still about 20 cm from the insect the lizard lunged towards it four times covering a distance of about 4 cm with each lunge. On the fifth lunge the lizard bit the insect, then let go and backed off as though afraid.

Table 3. Some measurements of the average speed of advance when *Thecadactylus rapicauda* stalks its prey.

Prey Item	Estimated distance mm	Time taken min.	Ave. rate mm/min.
Tettigoniid	50	12.5	4.0
Eryphanis automedon	81	60	1.35
Eryphanis automedon	200	60	3.3
Eryphanis automedon	125	50	2.5
Opsiphanes cassiae	140	15	9.3
Opsiphanes cassiae	80	225	0.36
Small moth	250	10	25

After two or three more ineffectual lunges the tettigoniid flew away. The whole incident was so unusual that it may have been a youthful lizard's first attack on a tettigoniid.

Table 1 records nine instances of *Tecadactylus rapicauda* eating mantids. In one or more the initial attack was unsuccessful. The mantis, thought to be a *Stagmatoptera septentrionalis,* was on my desk where it was noticed by a nearby *T. rapicauda* who approached it rapidly, bit it on the thorax, shook it 3-4 times and, surprisingly, let it go. The mantis then reacted with its full defensive display (see Fig. 32 in Crane 1952). The lizard fled but on the following day what seemed to be the same mantis, which had remained in the vicinity, was caught and eaten by a *T. rapicauda*.

Thecadactylus rapicauda and Brassolid Butterflies

Three species of *Caligo*, one of *Eryphanis*, two of *Opsiphanes* and one of *Catablepia* are often attacked by *T. rapicauda*. All of these species have eyespots on the under surface of the wings that are thought to deter or deflect a predator's attack. This study includes five individuals of the genus *Caligo* and one of *Eryphanis automedon* that were eaten by *T. rapicauda* (Table 1, Col. 2) and 78 individuals of the same genera with wing damage typical of *T. rapicauda* attack (Table 1, Col. 3). Unfortunately, the time of attack is not known for any of the individuals and they are thus unrepresented in Fig. 2.

T. rapicauda and *Avicularia*

Avicularia avicularia is the most common of several native theraphosid "tarantula" spiders and there may be as many as three or four of them in my home at any one time. From my limited observations it is clear that they eat moths, tettigoniids and cicadas as does *T. rapicauda* and the two species may be direct competitors. They even eat each other as the following observations will show. On 9/9/91 a *T. rapicauda* stalked and eventually grasped an *A. avicularia* by one leg. The lizard shook the spider, breaking off the leg it was holding while the spider fell to the floor. The lizard then ate the leg untroubled by the hairs. On 12/04/05 a scuffling sound attracted my attention to a calendar on the wall. Two *T. rapicauda* ran out from behind it and the leg of an *A. avicularia* appeared as well. Exposing the spider I could see that it was eating the tail of one of the lizards which was still wiggling. How the battle began I did not see, but it is certain that the spider's bite was strong enough to cause the bitten lizard to break off its tail and strong enough to cope with the spasms of the severed tail.

T. rapicauda and Vertebrate Prey

The only vertebrate previously listed as prey is *Sphaerodactylus molei* (Murphy 1997). This paper lists three more species; two lizards and a frog. My notes record *Gonatodes vittatus* as prey on three occasions with the added information on one occasion that *Thecadactylus rapicauda* swallowed it in only 2-3 min. The second lizard is *Tropidurus plica* whose S-V length is about 15% longer than that of *T. rapicauda*. Five hours and 20 mins after an adult *T. rapicauda* had captured a hatchling, the prey was discarded as too big to swallow. It had been seized from the rear and on ejection the entrails and most of the tail were missing, presumably digested. The corpse was measured and preserved in formalin. SVL = 59 mm, 49% of max *T. rapicauda* SVL.

The *Scinax rubra* was eaten on 19/4/03. As in the case above, the predator had caught its prey from the rear and its legs were sticking out from the side of the mouth when, attracted by the sound of battering, I arrived on the scene at about 2015 h. By 2032 h the swallowing was almost over. Murphy (1997) gives the SVL for males as 34 mm and for females 39 mm.

T. rapicauda and Big Prey

An adult male *Thecadactylus rapicauda* that had been preserved on 26/9/05 was measured and dissected: SVL = 88 mm, stomach = 42 mm long. A female that had been preserved on 1/1/02 after removal of the head for preparation of a skull was dissected and measured: stomach length = 39 mm. For easy calculation we can take 40 mm as the mean length of an adult stomach. Prey that can fill or nearly fill a stomach of this size is considered to be big prey. In the early years of the study attention was focused on what the lizards ate rather than the size of the prey, which was not measured. In any case the measurement of prey that was being consumed was impossible without interference. However, measurements of food items have been made more recently on insects caught or found dead in the study area or those in the collection at the University of the West Indies. A partial list of the measurements made is given in Table 4 as a guide in the process of determining to what size category prey should be assigned.

The problem now at hand is how to convert "can fill or nearly fill a stomach" into some more objective measurement. With insects like mole crickets, beetles and even short-horned grasshoppers whose shape is roughly the

Table 4. Prey size given in mm for some large to intermediate insects in the diet of *T. rapicauda*. Body length (Body L.) = length to tip of abdomen. Total length (Tot. L.) = length to tip of wings. For mole crickets and mantids these two are virtually identical. For Lepidoptera wing span is given instead of total length. %40 = % length of *Thecadactylus rapicauda* stomach.

Prey Items	**Tot. L.**	**%40**	**Body L.**	**%40**	**Class**	**Source**
Long-horned grasshoppers						
Unidentified	70	175	27	67.5	Large	VCQ*
	70	175	30	75	Large	VCQ*
	60	150	30	75	Large	VCQ*
	56	140	30	75	Large	VCQ*
Short-horned grasshoppers						
Unidentified	38	95	30	75	Inter	VCQ*
Mole crickets (Gryllotalpidae)						
Unidentified			38	95	Large	VCQ*
Cockroaches (Blattodea)						
Blaberus atropes	54	135	45	112	Large	R&W+
Periplaneta americana	31	77.5	28	70	Inter	R&W+
Mantids (Mantodea)						
Stagmatoptera septentrionalis			75	187	Large	Crane[x]
Vates lobata			60	150	Large	Crane[x]
Butterflies, moths (Lepidoptera)						
Caligo eurilochus	158	395	37	92.5	Large	VCQ*
Caligo illioneus	133	333	33	82.5	Large	VCQ*
Opsiphanes cassiae	81	203	32	80	Inter	VCQ*
Unidentified saturnid	107	267	39	97.5	Large	VCQ*
Unidentified sphingid	80	200	40	100	Large	VCQ*
Notodontidae (*Crinodes*)	37.5	93.7	35	87.5	Large	VCQ*
Odonata: *Anax junius*			58	145	Large	UWI[o]
Boyieria venosa			50	125	Large	UWI[o]

* Living or dead specimens measured by the author in the study area.
+ Size measured by the author from pictures in Roth and Willis (1960).
[x] Size stated in Crane (1952).
[o] Specimens in the UWI collection measured by the author. Similar in size to the ones eaten by *T. rapicauda*.

shape of the lizard's stomach, the decision was relatively easy: a length of 35 mm, 87.5% of 40 mm, was considered enough to put it in the large category. Below that, where wings were relatively large, the nearer to 30 mm the body became, the larger the wings would have to be to compensate for the smaller body size. The upper limit to small (Small 1 in Table 1) was set at 20 mm and with these guidelines a classification was made as follows: large 149, small 55, intermediate 96.

However, this calculation is biased in favour of large prey by the inclusion of the large prey brought to the notice of the observer by the sound of battering. The records were reviewed and all such instances removed. As a further countermeasure to bias the upper limit to the Small category (Small 2, Table 1) was raised to 23 mm. The total number of large is now down to 124 (Col. 5) and the small up to 70, but the number of large prey items is still 80% more than the number of small prey items.

However, this is not all the evidence. On two occasions *T. rapicauda* has tried to eat prey that was too big for it to swallow. On 26/5/04 a *T. rapicauda* tried to eat a large sphingid moth which it spat out after 35 minutes of battering and attempted swallowing. Unfortunately, this moth was not measured. The second occasion was the attempted eating of *T. plica* already described under the heading of '*T. rapicauda* and vertebrate prey'.

Drinking

Drinking has been observed 14 times. *Thecadactylus rapicauda* laps in the manner of a cat but without curling the tongue backward. Instead, it flattens the tongue against the wall of the container at the water level and alternately protrudes and retracts it. Eighty-three laps were counted on one occasion and 245 on another occasion. It would seem that *T. rapicauda* can stand dehydration for long periods, perhaps several weeks, and then rehydrate when the opportunity arises.

Defecation and Urination

It is well known that in lizards urination accompanies defecation, the urine appearing as a white blob of uric acid along with the faeces. This "double act" has been seen four times with the lizard hanging by its arms from a support with its legs swinging freely. During this the legs moved and the tailed arched as though the lizards had great difficulty in expelling the excreta. If this is true in fact, then it is not surprising seeing how much of the food consists of hard angular exoskeleton. A drop of liquid has often accompanied the excreta and, on one occasion, what seemed like a sort of sac such as some species of nestling birds produce, surrounded the excreta.

On one occasion the lizard hung from the ceiling by the arms and one leg with the other leg swinging free. On this occasion there were no faeces but uric acid alone. On two occasions urination alone has been seen, separate from defecation, and this may be much more common than previously thought.

Like *Gonatodes vittatus* (Quesnel 1957), *T. rapicauda* seems to have preferred sites for defecation.

DISCUSSION

Thecadactylus rapicauda has a wide distribution from Mexico southward to Ecuador and Brasil as far as the limit of Amazonia and from Necker in the British Virgin Islands through the Lesser Antilles to the Guianas (Peters and Donoso-Barros 1970; Vitt and Zani 1997; Maclean 1982). Donoso-Barros (1968) states that in Venezuela it "lives in all the habitats including arid, rainforest, cloud forest, savannas and human habitations." Vitt and Zani (1997) observe that it "appears to be the only primarily nocturnal lizard in lowland tropical forest of Central and South America, although occasional individuals have been reported active during the day." It is likely that in the area where it evolved vertical surfaces were present on tree trunks and rocky environment. Beebe (1944) has remarked that anywhere in the neotropical region "when human beings first occupy a house" *T. rapicauda* has already occupied it. So it was with me when I occupied my study site.

In buildings *Thecadactylus rapicauda* is more frequently found on the walls than on the ceiling and it is almost never found on the floor. The present study has shown that on vertical surfaces it is more often in an up-down orientation than a horizontal one. Possibly this preference evolved because it better suited the tree trunk habitat where the gecko's long axis is parallel to the long axis of the trunk. However, it may have evolved along with the head-down stance for battering and the head-up stance for swallowing large prey.

Vitt and Zani (1997) consider *Thecadactylus rapicauda* to be "strictly nocturnal." I have not found it to be so. As Fig. 1 shows, 29 prey items of a total of 80 (36%) were taken during daylight hours with two in the hour after mid-day. In the preceding paper in the series (Quesnel 2006) it was recorded in Fig. 1 that 16 copulations occurred in the same period, 15 between 0600 h and 0700 h and one between 1700 h and 1800 h, contributing 42.1% of the total. Thus, *T. rapicauda* is also reproductively active during daylight hours. (A correction needs to be made to Quesnel (2006) concerning Fig. 1. The figure itself is correct but the accompanying text is faulty. Where it reads "no copulation" it should read "one copulation" and where it reads "21 copulations" it should read "19 copulations.")

Vitt and Zani (1997) studied the diet of two populations of *Thecadactylus rapicauda* in Amazonia, an eastern site at Curuá-una near Santarem and a western site at Cuyabeno in eastern Ecuador. The former is approximately 1600 km SSE of Trinidad and the latter approximately 2000 km SW of Trinidad. The two Amazonian sites are approximately 1700 km apart so they are further apart than Santarem is from Trinidad. Both of these are areas of lowland forest probably not too different from the secondary forest and agricultural estates near my study site. At the eastern site (Curuá-una) *T. rapicauda* ate food falling into 18 categories (not counting its own shed skin) most of them being families of insects. At the western site (Cuyabeno) *T. rapicauda* ate food from only seven categories with 19 of the 30 items coming from what was the family Blattidae (cockroaches) and is now the order Blattodea.

My Table 1 above contains 18 insect categories plus one arachnid category and three vertebrate categories. There is more similarity in the diet of *Thecadactylus rapicauda* at Curuá-una and the Trinidad site than there is between the two Amazonian sites. Furthermore, the first five of the categories in Vitt and Zani's Table 2 correspond with the first five categories in my Table 1. Only two categories of those five occur at the Cuyabeno site. The Formicidae occur only at the Curuá-una and the Trinidad sites but not at the Cuyabeno site. Here the similarities end. Of six beetles in the diet at Curuá-una none was a scarab whereas in Trinidad 11 out of 17 (65%) were scarabs. Only one moth of 36 items (2.6%) occurred in the diet at Curuá-una whereas in Trinidad there were 74 in 300 items (24.6%). Perhaps some of the species in the Trinidad sample were attracted by fluorescent light but, more likely, the Amazonian collections were made when some species were not "in season". Vitt and Zani (1997) hint at this when they write "few researchers spend long enough time periods within the habitats of these lizards to collect adequate samples." It is particularly surprising that only one Lepidoptera was found in the stomachs of the lizards at each of the Brasilian sites when 170 lepidopterans were counted among the total of 300 food items (57%) of the lizards at the Trinidad site.

No vertebrates were found in the Brasilian lizards but three species are herein reported for the first time in the diet of Trinidadian *Thecadactylus rapicauda*: the frog *Scinax rubra* and the lizards *Gonatodes vittatus* and *Tropidurus plica*. Of the three *G. vittatus* seen to be eaten two were male and the sex of the third was not noted. In previous studies of *G. vittatus* (Quesnel 1957; Quesnel *et al*. 2002) populations have always had a preponderance of females. Is this the result of preferential preying on males by *T. rapicauda*? *G. vittatus* males have a vivid pattern which makes them more visible than females so there is a distinct possibility that *T. rapicauda* eats more males than females and is thus responsible for the uneven sex ratio.

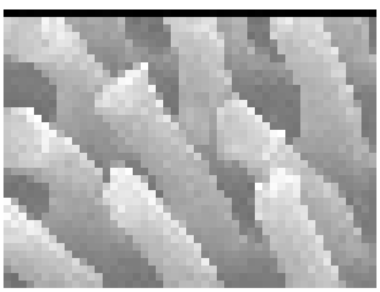
It was argued earlier that *Thecadactylus rapicauda* prefers big prey to small prey and it is time now to consider the consequences of this. Big prey is hard to swallow and can spend a long time (1-2 hours) in the throat of the predator. How does the lizard manage to breathe during this long period? The same problem is faced by snakes and their solution is "a special modification which allows the glottis (the opening of the windpipe) to be protruded and retracted" (Parker and Grandison 1977). When a bulky meal is being swallowed the glottis is protruded to the front of the mouth which allows breathing to continue. Does *T. rapicauda* have such a glottis?

Large meals imply that meals must be eaten sporadically with relatively long intervals between them. During these intervals the lizard's stomach must be empty and the lizard presumably hungry. I suggest that the individuals seen during daylight hours are hungry individuals extending their hours of hunting and, by being out in the open, extending the area under their surveillance. Presumably they can do this for long periods using the fat stored from the previous meal as the source of the little energy they need for this extra sitting and waiting. It was noted earlier that some individuals have expelled uric acid without expelling faeces at the same time. This is evidence that their digestive tracts were empty and a concomitant state of hunger highly likely. These ideas can be tested with captive specimens and should be tested if a more complete picture of feeding behaviour is to be acquired. The empty belly is known to affect foraging behaviour in the gecko *Goniurosaurus kuroiwae* (Werner *et al*. 2006).

The third consequence of eating large prey is the evolution of the highly effective pads on the feet of this species and it may have happened, I propose, in this way. *Thecadactylus rapicauda*, along with many other species, inherited the behaviour of battering its prey while standing head down on a vertical surface. There is no reason to believe that this behaviour is unique to it. In fact, I have seen the same behaviour in the much smaller *Gonatodes vittatus*. However, this behaviour was crucial to the evolution of the adhesive pads because it enlisted the force of gravity in subduing the prey. As the size of the prey increased, the power of the blows increased. This in turn put a premium on the ability of the lizard to hold on to its support, hence the evolution of the highly effective adhesive pads.

What happens when the lizard is not properly anchored to the substrate is illustrated by the difficulties encountered by Useless Leg. Some time prior to 20/11/00 this lizard had its left forelimb damaged. In time, the lower part rotted away leaving only the part above the elbow. He subsequently lost five digits on the remaining limbs. At 2230 h on 1/8/02 I found him on the kitchen floor trying to subdue a sphingid moth he had caught. He climbed the wall, turned head down and on beginning to batter the moth immediately fell off. He struggled back up, began battering again and promptly fell off again. He returned to the wall and managed to hold on until he turned head up at about 0105 h on 2/8/02. He had not managed to swallow the moth when by 0120 h observations ceased.

These observations indicate that the need for a tight hold on the vertical support when feeding, and not any imagined need to adhere to extraordinarily smooth surfaces, led to the evolution of the adhesive discs. While this paper was being prepared an article appeared in the Newsday of 7/12/06 announcing the development of a new adhesive "using light to etch three-dimensional patterns



Synthetic Gecko is composed of millions of mushroom-shaped hairs. (Photo taken from BBC.com world news story: **Geckos inspire 'super-adhesive'** http://news.bbc.co.uk/1/hi/sci/tech/5217240.stm)

on to the material. The resulting 'Synthetic Gecko' is made of layers covered with thousands of stalks with splayed tips made of a polyimide, a synthetic like Nylon." The article did not state what species of gecko had been used as a model nor did it give a scale to the accompanying illustration which I have copied above, but we have at last a plausible explanation for the adhesive power of the gecko's toes.

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Observations of Reptiles on Huevos Island, Trinidad, with Five Lizard Species Newly Recorded for the Island

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ABSTRACT

Observations of reptiles are reported for Huevos Island, Trinidad, with five new lizard records noted for the island. Interesting behaviour in the species *Cnemidophorus lemniscatus* and a fairly unique pattern of distribution in three congeners of *Gonatodes* raise interesting questions that may generate future scientific inquiry. Comments are made on the need for further research in the areas of biodiversity and biogeography in the region.

Key words: Bocas Islands, Huevos Island, *Gonatodes, Sphaerodactylus, Thecadactylus, Gymnophthalmus, Cnemidophorus, Iguana, Tropidurus, Mabuya, Eretmochelys.*

INTRODUCTION

Huevos is a tiny island of about 225 acres situated in the middle of the Bocas Islands between the Paria Peninsular of Venezuela and the Chaguaramas Peninsular of northwestern Trinidad. It is a very rugged island, rising to a height of just over 180 m. Steep cliffs line most of its coastline, with the most notable exception being a small sandy beach at Tortue Bay on the southern tip of the island. The island receives comparatively little rainfall. It is very dry and has a flora that forms a dry tropical deciduous forest that is typical of the Bocas Islands (Beard 1946).

The island is uninhabited and largely undeveloped, with only one building and a strong concrete jetty at Tortue Bay. Huevos is the least visited and the least studied of the Bocas Islands. Although a few herpetological observations for Huevos exist in the literature (Boos 1967, 1977, 1983-1984; Bacon 1973, 1981; Emsley 1977) recent new locality records for herpetofauna on other Bocas Islands (Lall and Hayes 1999; Charles 2007a) encouraged us to visit Huevos with the intention of conducting a brief but intense herpetological survey to update the species list for the island.

METHODS

The authors visited Huevos between 3 and 5 July, 2007. The beach at Tortue Bay, along with the building and the surrounding yard, as well as the scrub forest for about 300 m along a gulley on the slope northwards of the beach served as our study area. Expansion to include a broader search area was limited by time and terrain.

We conducted visual searches for reptiles. We searched the outer walls and under-house area of the intact building as well as the shell of a nearby old wooden structure, now very dilapidated and vine-covered. We rummaged through piles of building debris, leaf litter and a pile of coconut husks in the area surrounding the house. The beach, the small and fairly open shrubby transitional area between the beach and the forest, as well as the forested gulley and slope were surveyed by examining the ground, the leaf litter and the low vegetation; the trunks and branches of the trees in the area were also checked for the presence of reptiles. We surveyed the forested area up the gulley by rummaging through leaf litter, overturning fallen logs, bark and rocks; we also examined low vegetation and cervices in tree trunks and rocks. The areas around the house and the beach were searched during daylight and night time hours, while the forested area was searched only during daylight hours and no later than 1730 h. A total of 18 hours and 17 minutes of day time searching and 5 hours and 30 minutes of night time searching was conducted over the course of the three-day survey.

Reptiles were identified using Murphy (1997). Captured specimens were measured from snout to vent (SVL) and on tail (T), and were weighed. In the case of turtles, carapace length (CL) and the broadest carapace width (CW) were determined. Sex was determined when possible and some lizards were marked by non-lethal toe-tip clipping and released as part of a more long-term population study. A few lizards were retained to serve as voucher material. All handling methods used were in keeping with standard methods endorsed by the three major professional herpetological societies in the United States of America (A.S.I.H.-H.L.-S.S.A.R., 2004). Data regarding the microhabitat in which each animal was observed were recorded.

OBSERVATIONS

Order Squamata, Suborder Sauria (Lizards)

Family Gekkonidae

Gonatodes ceciliae Donoso-Barros. There is no prior report on the occurrence of this species on Huevos Island. The first individual observed was a male sighted at 1232 h on 3 July by one of the authors (S.S.), 0.2 m up on the trunk of a tree on the forest-covered slope north of Tortue Bay. It appeared to have a solid red-brown coloured head. This individual was not caught. Subsequently on 3 and 4 July, a few males (including a sub-adult) were observed and caught in the area surrounding the first sighting. One male (retained as a voucher) did not have the solid red-brown coloured head; instead, on the red-brown background of its head there was a pattern of yellow variegation indistinctly outlined with black.

Gonatodes humeralis (Guichenot). This is the first record of this gecko for the island. An adult female was sighted by one of us (S.P.C.) on 3 July at 1600 h but eluded capture. It was on a vine, about 0.4 m off the ground, on the forested slope about 250 m up along the gulley. A few individuals of both sexes were subsequently seen and/or caught in the same area on 3, 4 and 5 July. A voucher specimen of each sex was taken.

Gonatodes v. vittatus (Lichtenstein). Boos (1967) reported the presence of this gecko on Huevos. Several individuals of both sexes were observed each day of the survey during daylight hours in rubble, on the walls around the house, as well as on the lower reaches (less than 1.5 m up) of the trunks of trees growing on the slopes about 250 m up along the gulley. A female specimen retained as a voucher had trombiculid mites (reddish-orange in colour) anterior to the cloaca.

Sphaerodactylus molei Boettger. No prior record of this species is known for Huevos. A gravid female was caught by one of us (S.P.C.) at 1143 h on 5 July. It was found in the house on the concrete floor of a toilet stall. The gecko was kept in cavity for several days and was later euthanized and prepared as a voucher specimen. During this time, it produced a single egg.

Thecadactylus rapicauda (Houttuyn). Surprisingly, this species was not previously recorded for Huevos. The first observation of this gecko was made (by S.S.) at 0840 h on 3 July, 2.3 m up on the concrete-paved inner wall of a toilet stall. It was caught, measured and released, but its sex was not noted. At least two other individuals were seen on the outer walls of the house between 1945 h and 2030 h on 4 July. The characteristic rattling chirp of some hidden individuals was heard between 0140 and 0200 h on 5 July at the house.

Family Gymnophthalmidae

Gymnophthalmus sp. Merrem. No prior record of this genus on Huevos was found in the literature. A juvenile specimen was found by one of us (S.P.C.) at 1130 h on 3 July in leaf litter in an open sunny area 8 m from the beach, close to the house. Two attempts to count the ventral scales between the pectoral and anal plates in order to assign it to one of two local congeners (Murphy 1997), resulted in a somewhat uncertain count of 22. Unfortunately, it was not kept as a voucher. Based on this uncertain scale count, we provisionally assign it to the species *G. underwoodi* Grant. When additional material becomes available in the future it may then be possible to determine whether or not the Huevos population is more closely aligned to *G. speciosus* (Hallowell) found about 1 km away on the nearby island of Chacachacare as well as from southeastern Mexico to northern South America, or to *G. underwoodi* which has a distribution ranging from the Orinoco Basin to Trinidad and the Lesser Antilles.

Family Teiidae

Cnemidophorus lemniscatus (Linnaeus). Boos (1967, 1983-1984) commented on the presence of this teiid and speculated on its mode of colonization of Huevos. We observed scores of individuals in the fairly open shrubby area just above the beach and around the house, foraging in the leaf litter and basking in the bright sunny hours on 3 July. Courtship activity was observed at 0915 h on 3 July. A few individuals were also observed on the upper part of the beach. None was seen on the following days, which were at times overcast and with intermittent rain. We caught an adult male that had been basking in the sun near the house at 0930 h on 3 July. There were a few small ticks on its head. The animal was kept in captivity for three days before it was prepared as a voucher specimen. During this time, it defecated seeds which came from a small, ovoid, reddish-orange fruit (less than 1 cm long) that grew on a shrub about 3 m in height near the house. The captive *C. lemniscatus* consumed this fruit when placed together with it.

Family Iguanidae

Iguana iguana iguana (Linnaeus). This large lizard was recorded on Huevos by Boos (1967). No live specimens were observed during our survey, but we found a partial skeleton of a large lizard with a lower jaw lined with teeth characteristic of this species. It was found in the leaf litter near the house.

Tropidurus plica (Linnaeus). This mainly arboreal iguanid (*sensu lato*) was previously recorded on Huevos by Boos (1967). We observed at least two individuals on tree trunks on the forested slope some distance up the gulley on 3 July.

Family Scincidae

Mabuya nigropunctata (Spix). (Miralles *et al*. 2005 have revised the *Mabuya* of Venezuela and concluded that in Trinidad, what was considered *M. bistriata* (Spix) should now be termed *M. nigropunctata*). This is the only skink species known to occur locally; it was first recorded on Huevos by Boos (1967). We made two observations of this species, one at 0938 h on 3 July and the other at 1106 h on 4 July. On both occasions it was seen foraging in leaf litter in the fairly open area above the beach, near the house.

Order Chelonia (Turtles)
Family Cheloniidae

Eretmochelys i. imbricata (Linnaeus). This species was previously reported on Huevos by Bacon (1973). At least three females were seen to come ashore between 2230 h on 4 July and 0125 h on 5 July and were observed searching for suitable nesting sites on the beach. One began to deposit eggs at 0035 h. The excavated hole in the sand was about 0.3 to 0.5 m deep and was located a few metres above the high water mark, in the middle of the beach under a machineel tree (*Hippomane mancinella*). The dimensions of the carapace of this female are given in Table 1. Oviposition of a few dozen eggs concluded at 0058 h, the nest was covered and the turtle returned to the sea at 0125 h on 5 July.

Table 1. Reptiles observed during study with abundance, specimen dimensions and habitat data.

Sauria (Lizards)

Genus	Species	Subspecies	Common Name	Sex/Age	Total No. of Sightings	Voucher Taken	SVL (mm)	T (mm)	mass (g)	Habitat of Observation
Gonatodes	*ceciliae* *		Variegated Gecko	M	4	Yes	48	62	2.6	Lower tree trunks on forested slope.
Gonatodes	*humeralis* *		Spot-nose Gecko	M	3	Yes	34	42	1.0	Lower tree trunks on forested slope.
				F	3	Yes	32	42	0.8	
Gonatodes	*vittatus*	*vittatus*	Streak Lizard	M	4	No				On walls and in rubble around house and on lower tree trunks on forested slope.
				F	12	Yes	35	43	1.2	
				Juvenile	1	No				
Sphaerodactylus	*molei* *		Mole's Gecko	F	1	Yes	26	25	0.5	Concrete floor of toilet stall at house.
Thecadactylus	*rapicauda* *		Woodslave	Adult	3	No	74	17	8.4	Walls around house.
Gymnophthalmus	*underwoodi* * #		Shiny Lizard	F*	1	No	24	39	0.3	Leaf litter in open sunny area near beach and house.
Cnemidophorus	*lemniscatus*		Foot-shaker Lizard	M	Uncounted	Yes	80	220	16	Leaf litter in open sunny area behind beach, upper beach and around house.
				F	Uncounted	No				
				Juvenile	Uncounted	No				
Iguana	*iguana* @	*iguana*	Green Iguana	Adult	1	Yes				Skeleton found in open shrubby area behind beach near house.
Tropidurus	*plica*		Spiny Tree Lizard	Adult	2	No				Tree trunks on forested slope.
Mabuya	*nigropunctata*		Bronze Skink	Adult	2	No				Leaf litter in fairly open shrubby area near house.

Chelonia (Turtles)

Genus	Species	Subspecies	Common Name	Sex/Age	Total No. of Sightings	Voucher Taken	CL (mm)	CW (mm)	Mass (g)	Habitat of Observation
Eretmochelys	*imbricata*	*imbricata*	Hawksbill Turtle	F	3	No	820	770	Not Rec'd	Sandy beach.

Key: * New record, # Tentative species assignment, @ Only skeletal material found

Table 2. Other reptiles previously recorded for Huevos but not observed during this study (from Boos, 1983-1984).

Sauria (Lizards)

Genus	Species	Subspecies	Common Name
Anolis	*chrysolepsis*	*planiceps*	Jungle Anole
Anolis	*extremus*		Barbados Anole

Serpentes (Snakes)

Genus	Species	Subspecies	Common Name
Atractus	*trilineatus* ®		Three-lined Snake
Leptodeira	*annulata* ®	*ashmeadi*	False Mapepire
Mastigodryas	*boddaerti*	*boddaerti*	Machete Couesse
Oxybelis	*aeneus* ®		Horse Whip
Sibon	*nebulata* ®	*nebulata*	Fiddle String Mapepire
Tantilla	*melanocephala* ®	*melanocephala*	Blackhead Snake

Key: ® Regard record as suspect until recollected and recorded

DISCUSSION

Several interesting questions have been raised by this survey. The authors note that typically no more than two species of diurnal geckos of the genus Gonatodes co-occur in most of their range in northeastern South America. In cases of two congeners in sympatry, the usual combination is of a large species and a comparatively smaller one (Powell and Henderson 2005). Powell and Henderson (2005) note that the situation on Trinidad and the adjacent area of the Paria Peninsular in Venezuela is different in that three species (the large *G. ceciliae*, the medium sized *G. humeralis* and the small *G. vittatus*) exist in sympatry. On Huevos, this arrangement is taken to the extreme in that in our observation, all three congeners could be found in a very small area of less than 12 m^2 and, in some cases, on the same tree trunk. What allows these very closely related species to partition their shared habitat and limited resources while sustaining seemingly vibrant populations?

Interesting also is our observation of the consumption of plant matter by *Cnemidophorus lemniscatus* on Huevos. Most populations of *C. lemniscatus* feed almost exclusively on small arthropods (mainly on insects). However, it has been found that some insular forms supplement their diets by consuming fruits, leaves and flowers and, in some island races of the species including *C. l. arubensis* and *C. l. murinus*, the diet is primarily vegetarian (Schall and Ressell 1991; Dearing and Schall 1992). It has been suggested that the herbivorous nature of these island forms is an adaptation that compensates for the impoverished assemblage of arthropods on small islands compared to mainland areas (Janzen 1973). To what extent then do *C. lemniscatus* on Huevos and by extension on nearby Chacachacare depend on plant matter for sustenance, and how do they compare in this regard to populations of the species on the southern and eastern coasts of Trinidad and on Tobago?

Lack of observation does not equate to absence but, on Huevos, this raises some important questions. Boos (1967) released six pairs of *Anolis extremus* (lizards native to Barbados) on Huevos to conduct an experiment in survival. Upon conducting a survey in 1976, the lizard was found to be present (Boos 1977). Our survey found no specimens of this introduced anole nor, for that matter, did we locate the cryptic native anole *Anolis chrysolepsis planiceps* which was noted by Boos (1967) to be present. Was *A. extremus* successful in establishing itself on Huevos and is it still extant? A particularly dry season prior to our survey in 2007 might explain the complete lack of snake sightings during our survey, but even Boos (1983-1984) cautioned readers with respect to the validity of Emsley's (1977) seemingly uncertain Huevos records of the following snake species:

Atractus trilineatus, *Leptodeira annulata ashmeadi*, *Oxybelis aeneus*, *Sibon nebulata nebulata* and *Tantilla melanocephala* (see Table 2). [Boos (1983-1984) suggested that his personal communication with Emsley of 1982 did nothing to clarify the records in question as Emsley had lost his notes and could not say where he might have deposited his specimens. Boos (1983-1984) also noted that the island's long standing status as privately leased land rendered access for exploration somewhat limited and implies some level of uncertainty regarding the circumstances of Emsley's visit to collect specimens there. As such, he suggested that the previously mentioned list of snakes recorded for Huevos be regarded as 'suspect' until recollected and recorded. There have been no records of any of the 'suspect' species since then to lend credence to Emsley's claims]. Also of interest is the complete absence of reports in the literature of the teiid *Ameiva ameiva* (Zandolie or Ground Lizard) on Huevos. This large ground-dwelling lizard is common on all the other Bocas Islands (Boos 1983-1984; Charles 2007b) and is not, under normal circumstances, difficult to locate in areas where they are present.

The biodiversity of Huevos Island and, by extension, that of the Bocas Islands is quite interesting. As Trinidad and Tobago hasten down a path of economic development, will our government and our society at large recognize that there is no sustainable economic development without a consideration of the ecology? The present lessees of the island of Huevos continue to promote conservation by their commitment to restrict development on the island. In three days, our two-person study added five reptilian species [all listed as probable inhabitants by Boos (1983-1984)]. This study has raised a number of academically interesting questions and, hopefully, will serve to generate further interest in scientific investigation into the biodiversity and biogeography of the Bocas Islands. Hopefully also, it may influence government policy and national sentiment towards conservation of biodiversity.

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Freshwater Macroinvertebrates and Their Habitats in Saba, West Indies

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ABSTRACT
A survey of macroinvertebrates inhabiting freshwater habitats of Saba was conducted during 1999 and 2006. Freshwater habitats in Saba include ornamental ponds, a spring, temporary pools, and open cisterns. A total of 18 species was collected during the research, 17 of which are reported for the first time on Saba. Generally the freshwater macroinvertebrate fauna of Saba is sparse, most likely due to the oceanic origin of the island, its small size, a limited amount of freshwater habitats, and challenges colonizing such a habitat.

Key words: Freshwater invertebrates, Saba, Lesser Antilles.

INTRODUCTION

Saba is a small island located near the northern end of the Lesser Antilles in the eastern Caribbean Sea. The island is volcanic in origin and 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).

A limited amount of information regarding the freshwater invertebrates of the Lesser Antilles and other small Caribbean islands is available. Biodiversity surveys of aquatic macroinvertebrates and related ecological studies have been conducted on some islands including Barbados (Bass 2003a), St. Vincent (Harrison and Rankin 1975, 1976), St. Lucia (McKillop and Harrison 1980), Dominica (Flint 1968, 1970; Chace and Hobbs 1969; Stone 1969; Donnelly 1970; Baumgardner *et al*. 2003; Bass 2004a, 2007), Antigua (Bass 2005), Grenada (Flint and Sykora 1993; Baumgardner *et al*. 2003; Bass 2004b), St. Kitts (Bass 2006), Nevis (Bass 2000, 2006), Montserrat (Baumgardner *et al*. 2003), Tobago (Hart 1980; Nieser and Alkins-Koo 1991; Botosaneanu and Alkins-Koo 1993; Flint 1996; Baumgardner *et al*. 2003; Bass 2003b), and Trinidad (Hynes 1971; Alkins *et al*. 1981; Alkins-Koo 1990; Nieser and Alkins-Koo 1991; Botosaneanu and Alkins-Koo 1993; Flint 1996). The only known freshwater macroinvertebrate from Saba is an aquatic hemipteran reported by Cobben (1960).

The objectives of this investigation include: 1) to determine the species of aquatic macroinvertebrates inhabiting freshwaters of Saba, 2) to note the microhabitat preferences of each species, 3) to determine the relative abundance of each species, and 4) to compare the Saban freshwater macroinvertebrate fauna to other such fauna on the different Lesser Antillean islands. Saba is the fourteenth island to be so examined.

MATERIALS AND METHODS

Nine collections were made from various freshwater habitats across Saba during May 1999, May 2006, and October 2006 (Figure 1). Water temperature was recorded from each site at the time of collection.

Several methods of collecting were employed to ensure as many species as possible were captured. Submerged debris, such as stones, leaves, and wood, were carefully examined and inhabitants were picked from the substrate using forceps. A dip net (mesh = 0.1mm) was swept through aquatic vegetation and the water column to capture macroinvertebrates occupying those microhabitats. The microhabitat from where each specimen occurred was noted. Collecting efforts continued at each site until no additional species were encountered. These collecting methods were similar to those used on other islands (Bass 2003a, 2003b, 2003c, 2004b, 2005, 2006, 2007) so comparisons of the results could be made.

Specimens were preserved in 70% ethanol and returned to the laboratory for further identification. Taxa that could not be identified to the species level were separated into morphospecies for subsequent analysis. Sorenson's index of similarity (1948) was used to compare these collections in Saba with similar endeavors on other small Caribbean islands. A published collection by Cobben (1960) was also consulted and included in the final listing of species, although it was not used in the similarity analysis, due to variations in collecting efforts between the studies.

RESULTS AND DISCUSSION

Freshwater Habitats

Very few natural freshwater habitats exist on Saba and none are permanent. Freshwater habitats sampled on Saba include ornamental ponds, a spring, temporary pools, and open (abandoned) cisterns. Water temperatures ranged from 23-29 ^{o}C in these habitats.

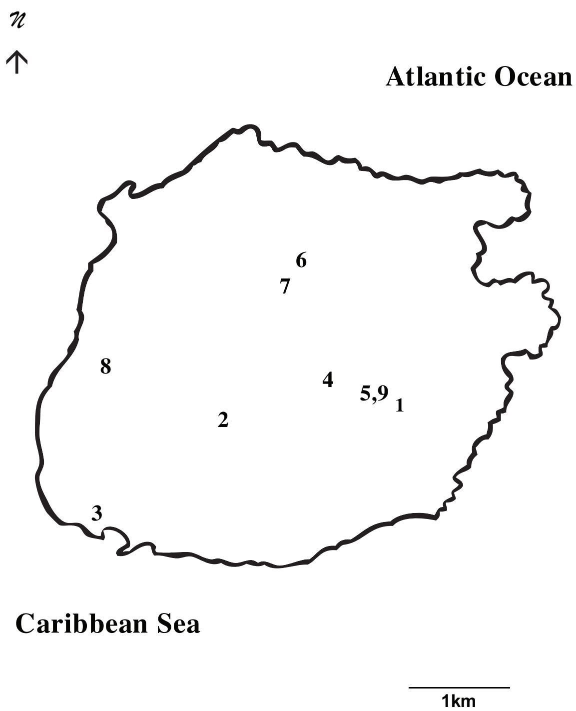

Fig. 1. Map indicating location of collecting sites in Saba. Specific location, collection, date, approximate elevation, and water temperature at sites are listed in legend of Table 1.

Small ornamental ponds began to be constructed on Saba during the late 1990's. These usually were composed of rock and often contained imported aquatic vascular plants. Most of these ponds have surface areas of less that 5 m^2 and depths of no more than 0.5 m. It is likely that some freshwater invertebrates associated with the imported plants were introduced to Saba inadvertently when those plants were placed in these artificial ponds.

Fort Bay Spring was a small spring with an emergence pool surface area of less than 2 m^2 and depth less than 0.1 m. This spring emerged on a steep slope on the south side of Bunker Hill approximately 10 meters above sea level. Fine silt and rock composed the bottom sediment, and goats were frequently observed to drink water from the spring. This spring was covered by a landslide that resulted from the heavy rainfall that occurred during Hurricane Lenny in November of 1999 and no longer exists.

Temporary pools may result following heavy rainfall, particularly in forested areas. The most persistent of these habitats occurs in a ravine located in the Saba National Park along the Sandy Cruz Trail. Decomposing leaves and sediments make up the substrate of this small pool that has a surface area of about 1 m^2 and maximum depth of 0.15 m. This particular pool holds water during all but the driest periods. However, it may be flushed and its inhabitants washed away during periods of sustained heavy rainfall, as was observed during October of 2006. Water may also be held for about 90 days in the bracts of *Heliconia caribaea* (wild plantain) and aquatic invertebrates have been observed living in these ephemeral microhabitats.

Because there are no permanent sources of fresh water on Saba, cisterns have been constructed by individuals to store water, mostly captured and diverted rainwater. Some of the older cisterns, which are abandoned today, were constructed over 200 years ago. These old cisterns are open to the environment, making them available habitats for invertebrates to colonize. They may contain as much as 5-10 m^3 of water throughout the year. Bottom sediments are mostly silt and decomposing plant debris.

Freshwater Macroinvertebrates

A total of at least 18 species representing eight major groups was collected from the freshwater habitats of Saba. Seventeen of these species are reported for the first time from the island (Table 1).

Hirudinea

A single specimen of *Helobdella elongata* was collected from the Saba Museum Pond (Table 1). This small ornamental pond contained imported aquatic vascular plants and the leech probably came to Saba with the plants. Unless other individuals of this species are present for mating, it did not reproduce and therefore did not leave behind offspring to continue to colonize this and other Saban ponds.

Gastropoda

Two taxa of snails were collected from ornamental ponds and cisterns, permanent man-made standing bodies of water that now exist in Saba (Table 1). The eurytolerant pond snail, *Physella*, is widespread in ponds throughout the Caribbean basin and *Tropicorbis pallidus* is common in the Lesser Antilles (Harrison and Rankin 1976; McKillop and Harrison 1980; Bass 2003a, 2003b, 2004b, 2005, 2006, 2007).

Ostracoda

Ostracods were extremely abundant in the forest pool near the Sandy Cruz Trail during May of 2006. All appeared to be the same species and were identified as *Heterocypris margarita* (Table 1). This species has been found in temporary pools on several small islands in the southern Caribbean basin (L. D. Delorme, personal communication). Additional ostracod taxa have been reported from other Lesser Antillean islands (Harrison and Rankin 1976; Bass 2005, 2006), but none have been collected from temporary pools in forests.

Table 1. List of freshwater macroinvertebrates, including collecting sites, life cycle stages present, relative occurrence, and microhabitats in Saba during May 1999, May 2006, and October 2006. *Indicates taxa previously not reported from Saba. Life cycle: A, adult; J, juvenile; L, larva; N, nymph. Occurrence: +++ abundant, ++ common, + rare.

Taxa	Collection Sites	Life Cycle	Occurrence	Microhabitat	Trophic Relationship[1]
Hirudinea					
*Helobdella elongata**	9	A	+	Detritus	Predator
Gastropoda					
Physella sp.*	1, 5, 9	J, A	+++	Detritus, Rock	Detritivore
*Tropicorbis pallidus**	2, 4, 5, 9	J, A	+++	Detritus, Rock	Detritivore
Ostracoda					
*Heterocypris margarita**	6	J, A	++	Plankton	Detritivore
Odonata					
*Ischnura ramburi**	1, 5, 9	N, A	++	Detritus	Predator
*Orthemis ferruginea**	8	N	+	Detritus	Predator
*Pantala flavescens**	1, 2	N	+	Detritus	Predator
Hemiptera					
Microvelia puchella	1, 2, 4, 10	N, A	+++	Neuston	Predator
Coleoptera					
Celina sp.*	6	A	+	Detritus	Predator
Laccobius sp.*	6	A	+	Detritus	Herbivore
*Tropisternus lateralis**	1	L	+	Detritus	Collector
Diptera					
Ablabesmyia poss. new species*	3, 8	L	+	Sediment	Predator
Aedes sp.*	7	L	+	Plankton	Collector
Apedilum sp.*	1	L	+	Sediment	Collector
Chironomus sp.*	4, 8	L	++	Detritus	Collector
Dasyhelea sp.*	7	L	+	Detritus	Collector
Stratiomys sp.*	7	L	+	Detritus	Collector
Acari					
Hydrachnida*	8	J, A	+	Detritus	Predator

1. Trophic relationship – Trophic relationships of insects based on Merritt and Cummins (1996) and non-insects on Thorp and Covich (2001).

Collection Sites: 1) Lynn Pond, Windwardside, 19 May 1999 (397m, 28°C); 2) St. John Cistern, St. John, 21 May 1999 (390m, 24°C); 3) Fort Bay Spring, Fort Bay, 21 May 1999 (8m, 29°C); 4) Ecolodge Pond, Windwardside, 16 May 2006 (513m, 25°C); 5) Saba Museum Pond, Windwardside, 17 May 2006 (386m, 28°C); 6) Sandy Cruz Trail Pool, Saba National Park, 21 May 2006 (570m, 23°C); 7) *Heliconia* Inflorescence, Mt. Scenery (north slope), 21 May 2006 (780m); 8) Cow Pasture Cistern, The Gap, 21 May 2006 (150m, 25°C); 9) Museum Pond, Windwardside, 17 October 2006 (386m, 28°C); 10) Collected and reported by Cobben (1960).

Odonata

Three species of odonates, one damselfly and two dragonflies, were collected from permanent man-made aquatic habitats (Table 1). These act as predators, probably feeding mostly on other small insects. Nymphs were found crawling among living aquatic vascular plants and decomposing plant debris. All have been reported from other Lesser Antillean islands (Donnelly 1970; Harrison and Rankin 1976; Bass 2003a, 2003b, 2004b, 2005, 2006, 2007). Adult odonates are strong fliers and could have easily colonized Saba from other nearby islands.

Hemiptera

The broad-shouldered water strider, *Microvelia* *puchella*, was the only species of hemipteran collected in this study. *Microvelia* is reported to be widespread throughout the Caribbean islands (Harrison and Rankin 1976; Bass 2003a, 2003b, 2003c, 2004b, 2005, 2006, 2007). This species was previously reported from Saba by Cobben (1960) in collections made almost 50 years ago. All specimens collected were wingless adults, an adaptation to island habitats (Roff 1990).

Coleoptera

Three species of beetles were collected from aquatic habitats on Saba (Table 1). Two of these, *Celina* and *Laccobius*, inhabited the temporary pool while *Tropisternus lateralis* was found in an ornamental pond. *T. lateralis* is one of the most widespread aquatic beetles in the eastern Caribbean basin, being reported from Barbados (Bass 2003), Antigua (Bass 2005), St. Kitts and Nevis (Bass 2006). Because larvae of *T. lateralis* were collected, this species is probably persisting and reproducing on Saba.

Diptera

Six genera of dipterans were collected from a variety of freshwater habitats across the island (Table 1). Three of these, *Aedes*, *Dasyhelea*, and *Stratiomys*, were found only in the water-filled bracts of *Heliconia caribaea* on the northern slope of Mount Scenery within the Saba National Park. The remaining three, *Ablabesmyia*, *Apedilum*, and *Chironomus*, are all midges of the family Chironomidae. The eurytolerant *Chironomus* has a widespread distribution throughout the Holarctic region (Wiederholm 1983).

Larval specimens of what appears to be a new species of *Ablabesmyia* were first collected during May 1999 from Fort Bay Spring, a habitat that no longer exists. However, no adults were encountered so this could not be described as a new species. Because this site was the only known location from where this species was found, it was thought the species had gone extinct before it could be described. Fortunately, a larva of this species was discovered in a collection from Cow Pasteur Cistern during May 2006. Although it appears this species still persists, it remains undescribed until adults are observed.

Acari

Both juvenile and adult specimens of water mites (Ascidae) were collected from water in the bracts of *Heliconia caribaea*. These appear to be abundant in this habitat, but the water-filled bracts are the only habitat from where they were encountered. Because both juveniles and adults were found, it is reasonable to assume the population is healthy and reproducing.

The similarity analysis of fauna (Sorenson 1948) produced results that are unclear (Table 2). The two islands nearest to Saba in this study, St. Kitts and Nevis, had similarity values of 0.13 and 0.17, respectively. Saba shared the greatest faunal similarity with Antigua (0.27), a somewhat nearby island that has quite a few agricultural ponds and few streams. However, it was unexpected to find Grand Cayman, a distant island possessing a few ponds and lacking flowing water altogether, had the next highest similarity value (0.26). Because only standing water is present on Saba, it is reasonable that Antigua and Grand Cayman showed the highest faunal similarity values to Saba as the fauna of all three islands is largely composed of lentic species. In addition, the relatively low number of species present in Saba, Antigua, and Grand Cayman allow for only a few taxa in common between islands to raise the similarity values.

Table 2. Sorensen's index of similarity values comparing the freshwater macroinvertebrate fauna of Saba to that of other small Caribbean islands, including approximate distances to those islands from Saba and approximate island sizes. Range of values: 0.00 = 0% common taxa and 1.00 = 100% common taxa.

Island	Approximate Distance (km)	Approximate Size (km^2)	Similarity Value
St. Kitts	50	177	0.13
Nevis	80	94	0.17
Montserrat	130	83	0.10
Antigua	150	280	0.27
Dominica	295	751	0.12
St. Lucia	440	616	0.17
Barbados	595	430	0.18
Grenada	610	346	0.12
Tobago	760	300	0.11
Cayman Brac	1,780	37	0.16
Little Cayman	1,805	26	0.00
Grand Cayman	1,920	197	0.26
Guanaja	2,430	69	0.06

Island biogeography theory (MacArthur and Wilson 1967) predicts that the number of species present on an island will increase as island size increases. Saba is considerably smaller (13 km^2) than other islands of the eastern Caribbean where published surveys of freshwater macroinvertebrates have occurred and it possesses only 18 species, the lowest number observed among these studies. The nearby islands of St. Kitts (177 km^2) and Nevis (94 km^2) have reports of 57 and 61 species, respectively (Bass 2006). Dominica (751 km^2) is the largest of these islands and it is known to have at least 116 species (Bass 2007). Not only does a smaller island have fewer suitable habitats, but it is also a smaller target for colonizers to locate.

Currently an investigation describing the community of aquatic macroinvertebrates inhabiting the water-filled bracts of *Heliconia caribaea* inflorescences in Saba is being conducted (C. Bass, personal communication). Results from this study are likely to increase the number of aquatic invertebrate species known from Saba.

CONCLUSIONS

It is suspected that additional species of freshwater invertebrates will be found in Saba as additional plants are imported. Therefore, it is recommended that plants arriving from off the island be closely examined to reduce the number of introduced aquatic invertebrates. Additionally, imported aquatic plants should be held in quarantine long enough for eggs of aquatic invertebrates to hatch so immatures will be detected more easily. The species diversity of Saba is relatively low, primarily due to a lack of freshwater habitats. There are no naturally-occurring permanent waters on the island; only a few small cisterns and ornamental ponds have been constructed in recent times to permanently contain water. Also, the island is quite small and oceanic in origin, making it difficult to be reached and colonized by freshwater invertebrates. As some of the ephemeral habitats are further studied, such as water-filled *H. caribaea* bracts, it is likely that the number of aquatic invertebrate species reported on Saba will increase.

ACKNOWLEDGEMENTS

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Errata

The Screening of Mushrooms Found in Trinidad to Determine the Presence of the Psychoactive Substances Psilocin and Psilocybin

Louis Garraway and **Rean Maharaj**
Living World, J. of The Trinidad and Tobago Field Naturalists' Club, 2007. p.12.

In the above article we erroneously credited Dr. Mary Alkins-Koo as one who rendered assistance in identifying the specimens we collected for testing. She was not involved in any way in this project. We apologise to her for this error.

In the article we also mistakenly lumped all the fungi collected as mushrooms. There are other errors in the Table 1 as well. Here are the corrections (numbers refer to Table numbers):

1. *Leucoprinus* sp. = *Leucocoprinus* sp.
2. *Cookeina* sp. = An Ascomycete
6. *Macroleptiota molybdites* sp. = *Macrolepiota molybdites*
7. *Polypore* sp. should be listed as Polyporaceae
8. *Ascomycete* sp. = Ascomycete
9. *Auricalaria* sp. = *Auricularia* sp.
11. *Coprinaceae* sp. = Coprinaceae

We apologise to readers for these errors.

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Automeris metzli Sallé (Lepidoptera: Saturniidae) in Trinidad, West Indies

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ABSTRACT
The saturniid moth recorded from Trinidad as *Automeris janus* (Cramer) is shown to have been misidentified, and all supposed specimens checked are actually *A. metzli* Sallé. Trinidad food plant records from *Erythrina* and coconut for *A. janus* should therefore be associated with *A. metzli* instead. The caterpillar is described and illustrated, and compared with published illustrations.

Key words: *Automeris janus*, *Automeris metzli, Belvosia formosa, Erythrina* sp., coconut, Trinidad, Tobago.

Saturniidae is a family of large moths with more than 40 species known from Trinidad (Cock 2003). The large moths and conspicuous, colourful caterpillars, which have urticating spines, are often encountered by naturalists and the general public. Adult moths of the genus *Automeris* characteristically have conspicuous eyespots set in yellow, orange or red on the upper surface of the hind wing, which are normally covered by the forewing in the resting position. Lemaire (2002), in his definitive monograph of the Hemileucinae (Saturniidae), distinguishes three rather similar species of *Automeris*, which until quite recently have been confused under the name *A. janus* (Cramer): i.e., *A. janus*, *A. metzli* Sallé and *A. exigua* Lemaire. *Automeris janus* and *A. metzli* have only been recognized as separate, valid species since 1952, based on their sympatric occurrence in Rancho Grande, north-central Venezuela (Flemming 1952). Lemaire (2002) gives the distribution of *A. janus* as Guiano-Amazonian, extending into north-central Venezuela, of *A. metzli* as Central America and western Andes (Colombia and Ecuador) and north-central Venezuela, and of *A. exigua* as overlapping with *A. metzli* except that it does not occur in Venezuela. He does not include Trinidad in the distribution data for any of the three species. Nevertheless, *A. janus* is reported in the literature from Trinidad (Kaye 1901; Kaye and Lamont 1927; Chadee *et al*. 1982). The purpose of this note is to clarify which species of this group occurs in Trinidad and record observations of the biology in comparison with observations from Central and South America.

Kaye (1901) reports a specimen of *A. janus* "in the National Collection", i.e. The Natural History Museum, London (NHM). I have found no specimens of *A. janus* from Trinidad in the NHM, but there is a male specimen of *A. metzli* collected by E. Lafond at Belmont, which is of the right vintage to be the specimen to which Kaye refers.

Kaye and Lamont (1927) repeat the NHM record of *A. janus* adding Lamont's records from "Palmiste, very common on *Erythrina* etc., 20.ii.1916; 14.xi.1917; 5.xii.1917 (N.L.). Kept in check through parasitization by a tachinid fly." Three specimens, a male and two females, with these data are in the collection of Sir Norman Lamont preserved at the University of the West Indies, St. Augustine (UWI), labeled as *A. janus*. The female from 5.xii.1917 is labelled "emerged". In Lamont's collection in the National Museums of Scotland, there are five specimens curated as *A. metzli*, only one of which has full data, from Palmiste, 22.xi.1935. However, two of these specimens are labelled as *"Automeris janus"*, one in Lamont's writing (K. Bland, pers. comm. 2007), so it seems clear that Lamont had considered this series to be *A. janus*. There are also two males collected by Lamont at Palmiste, 9.xii.1917 and 11.xii.1917, in the Hope Entomological Collections, Oxford University Museum. All of Lamont's material is *A. metzli*.

Chadee *et al*. (1982) report the tachinid fly *Belvosia formosa* Aldrich parasitizing *A. janus* caterpillars collected from coconut on Monos Island, Trinidad, but I have not seen their host material. There are two unlabelled tachinids in Lamont's collection in UWI, placed next to the specimens of *A. metzli*, which must represent the tachinid to which Kaye and Lamont (1927) refer, and which may also be *B. formosa*.

D'Abrera (1995) includes Trinidad in the range of *A. janus*, but not of *A. metzli*, based on his interpretation of the NHM collection. I have checked the NHM collection, and the only Trinidad specimens of this group that I found were *A. metzli* (see comments above on Kaye (1901) and below), suggesting that D'Abrera's record is an error.

In addition to these published records, there is a male *A. metzli* collected at Port of Spain by F. Birch in the NHM, and there are specimens of *A. metzli* from Curepe, Arima Valley (Simla), Hollis Reservoir, and Morne Bleu (Textel Installation) in my collection and the CABI collection in Curepe.

Thus, I have seen no specimens of *A. janus* from Tridad, and all published records that I have checked from specimens are *A. metzli*, often incorrectly identified as *A. janus*. It seems likely that *A. metzli* is the only species of this group occurring in Trinidad. There are no records of either species from Tobago.

Automeris metzli seems to be widespread in Trinidad, and could turn up almost anywhere. Lemaire (2002) was not aware of naturally used food plants (as opposed to food plants accepted in captivity), so the two food plant records, *Erythrina* and coconut, are noteworthy, and suggest a wide host plant range for the caterpillars. However, although Kaye and Lamont (1927) considered it common, I would consider *A. metzli* an occasional species in Trinidad, most often seen either as caterpillars, or as adults coming to lights.

The adult moths (Figs. 1-3) are large, with a forewing length of 60 mm or more. The forewings are marked in light olive-grey, with a darker discal line, and a small white spot surrounded by an irregular polygon of seven dots joined by a narrow line. The hind wings are pale olive-brown. The eyespot is pale lilac centrally, with white along the veins creating a ramified line; surrounded by a black border; a narrow black line distally to this; a broader red line distal to this, dark at costa and dorsum. Base of hind wing bright red, extending along the dorsum to the level of the eye marking in the male and joining the narrow line distal to the eye marking, stopping well short in the female. Red on centre of costa hind wing, more pronounced in male, joining the end of the narrow black line around the eyespot. The underside is pale olive-grey. Forewing with a large black eyespot around a small white cross, a red flush on the disc, and the discal line more diffuse and segmented. Hind wing with a small white spot at end cell, and two diffuse discal bands. The sexes are similar as adults, but the female has the fore wings more falcate, and the abdomen is very large, since saturniid moths do not feed as adults, and emerge with all eggs already formed and ready to be laid.

In Trinidad, this species can be recognized by its large size, olive-grey ground colour, the red markings, and the distinctive eyespot. There are no other closely similar species known from Trinidad, but *A. janus* is similar and could also be found to occur in the future. It has the wings less pointed and generally darker, the red markings on the hind wing upper side more extensive, and the discal line on the forewing upper side is slightly undulate (Lemaire 2002). Colour pictures of both species can be found in D'Abrera (1995), Lemaire (2002) and at several sites on the internet, e.g. Biodiversity Institute of Ontario (2008).

On 19 November 1978, I found a mature caterpillar (Figs. 4-6) crawling on the North Coast Road close to milestone 10. When disturbed it curled up (Fig. 5) presenting

Fig. 1. *Automeris metzli* adult male, upper side, forewing 62 mm. Arima Valley, Simla, at Mercury Vapour Light, 6.viii.1982, M.J.W. Cock (in coll. MJWC).

Fig. 2. *Automeris metzli* adult male, underside (data as Fig. 1).

Fig. 3. *Automeris metzli* adult female, upper side, forewing 65 mm. Collected as caterpillar on North Coast Road, milestone 10, 19.xi.1978, adult 21.xii.1978, M.J.W. Cock (in coll. MJWC).

urticating spines in all directions. The caterpillar spun up a cocoon between leaves without feeding.

The cocoon measured about 80 x 40 mm externally. It was constructed with dark brown silk in two distinct layers. The outer cocoon was a finely woven mesh. In the gaps between leaves, the inner cocoon was of coarsely reticulate mesh (2-3 mm apart) formed of multiple strands of silk combined together. On the inside of this, there was a pad of finer spun silk towards one end, in which the cremaster was embedded. The two layers of the cocoon were combined where a leaf was incorporated into the cocoon and the coarse reticulation was not then present.

An adult female *A. metzli* emerged on 21 December 1978. Although I did not record the dates of cocoon formation and pupation, these would have been within a few days of collection and thus in line with Chadee *et al*. (1992) who noted three weeks for pupation.

The mature caterpillar measured 80 mm in length and about 15 mm in diameter. Lemaire (2002) writes that the caterpillars of *Automeris* spp., in common with other Hemileucinae, bear scoli on the body segments: on T1-A9 pairs of lateral, sub-dorsal and dorsal scoli; T1-3, A1-2, A7 also have a pair of ventral scoli; and A8-9 have a mid-dorsal scolus. I did not observe the ventral scoli on this living caterpillar, but recorded that on T2 and A1-A7 the lateral scoli measure about 5 mm, the dorso-lateral 12-13 mm, and the sub-dorsal 15 mm. The scoli on T1 shorter and those on T3, A8 and A9 longer, and may measure up to 20-23 mm.

Head oval; glabrous apart from a few scattered, short, pale setae in ventral half; green with black markings (Fig. 7). Body glabrous; green with black markings (Fig. 6) and faint yellow dorsal and lateral stripes. Scoli mauve-red with green spines. Spiracles white, with black markings anterior and posterior. Legs dark; prolegs covered with

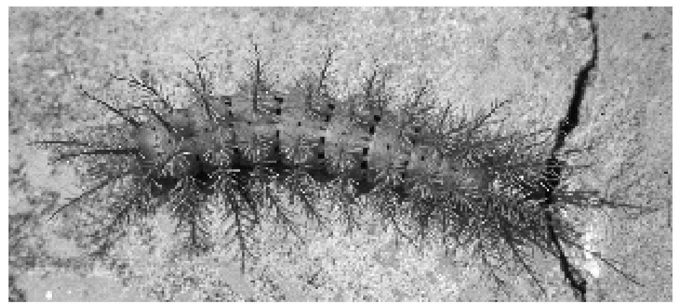

Fig. 4. Mature caterpillar of *Automeris metzli* (data as Fig. 3), 80 mm (head to the right).

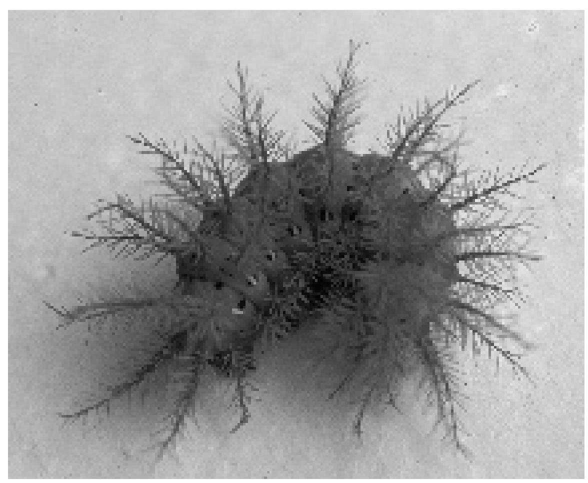

Fig. 5. Mature caterpillar of *Automeris metzli* (data as Fig. 3), defensive posture in response to disturbance (head to the right).

setae.

The pupa was 25 mm long and about 15 mm at its widest (measurements on emerged pupa). Pupa dark brown, matt, rugose, with scattered short brown setae.

Lemaire (2002) considers that earlier published life histories of *A. janus* actually refer to *A. metzli*. He provides a brief description of all instars and illustrates larvae from Mexico with heavier black markings than those shown here from Trinidad (Plate ES5.1-3). Caterpillars may have green scoli (Plate ES5.1) or red-mauve scoli (Plate ES5.2-

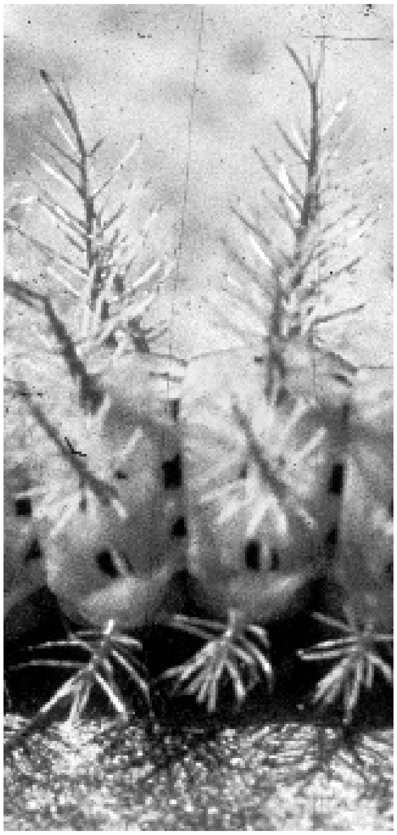

Fig. 6. Mature caterpillar of *Automeris metzli* (data as Fig. 3): lateral view, segments A8-A9 (head to the right).

Fig. 7. Cast head capsule of final instar caterpillar of *Automeris metzli* (data as Fig. 3), approx. 8 x 8 mm. In life, the pale areas were bright green.

3) like the Trinidad specimen described here. A caterpillar illustrated as *A. janus* (?) from Venezuela (Plate ES4.11) resembles the caterpillar from Trinidad, and may well actually be of *A. metzli* as well. In contrast, the caterpillar of *A. exigua* is black, with pale spines and conspicuous red-brown spiracles (Plate ES4.12).

I thank the following for facilitating access to the collections in their care: Mary Alkins-Koo, Julian Kenny, Gene Pollard and Chris Starr (UWI, St. Augustine), Martin Honey (The Natural History Museum, London), George McGavin (Hope Entomological Collections, Oxford University Museum). Keith Bland checked the collections of the National Museums of Scotland for Lamont's specimens of this group, and Perry Polar checked the CABI collection in Curepe and photographed specimens for me.

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Observations on the Biology of *Pyrrhopyge amyclas amyclas* (Cramer) and *Mysoria barcastus alta* Evans (Lepidoptera: Hesperiidae) in Trinidad, West Indies

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ABSTRACT

Partial life histories of two Pyrrhopyginae skippers (Hesperiidae) are described and illustrated from Trinidad. *Pyrrhopyge amyclas amyclas* (Cramer) occurs very locally on *Terminalia catappa* (Combretaceae) and *Mysoria barcastus alta* Evans is widespread on *Casearia* spp. (Salicaceae), including *C. sylvestris, C. guianensis* and *C. spinescens.*

Key words: Pyrrhopyginae, *Pyrrhopyge amyclas, Mysoria barcastus,* life history, Salicaceae, *Terminalia catappa*.

INTRODUCTION

In an earlier publication (Cock 1981), I summarized what was known about the subfamily Pyrrhopyginae (Hesperiidae) in Trinidad and Tobago at that time. Since then I have reared *Pyrrhopyge amyclas amyclas* (Cramer) and *Mysoria barcastus alta* Evans from caterpillars collected in Trinidad. Here I describe and illustrate aspects of the biology of these two species. Terminology of shelters follows Greeney and Jones (2003), and other terminology follows that used in my series on the skipper butterflies of Trinidad (Cock 2007 and preceding papers).

Pyrrhopyge amyclas amyclas (Cramer)

In Cock (1981), I recorded that my only observations of adults of this species were two records from the edge of the Nariva Swamp. Scott Alston-Smith (pers. comm. 1995) discovered that along the Manzanilla Cocal, the food plant of this species is tropical almond, *Terminalia catappa* L. (Combretaceae) and the caterpillars are easy to find there, e.g., near the old estate buildings. Neither of us has found caterpillars or adults in other parts of the island, in spite of the widespread distribution of the food plant. This food plant discovery suggests why the only two specimens that I had previously seen were on the edge of Nariva Swamp, not far from these tropical almond trees. However, *T. catappa* is a South-east Asian species, naturalized in Trinidad and Tobago, mostly by the seaside (Williams 1932), so it seems most likely that *P. amyclas* originally and perhaps normally uses other host plants, probably also in the Combretaceae, several of which are also restricted to coastal and swamp areas (Williams 1932). S. Alston-Smith and I collected caterpillars on the Cocal (7.v.1995, ref. 95/32) and the following account is based on these.

The eggs and caterpillar shelters were found mostly on the lower and partially shaded parts of trees. The eggs, which are hemispherical, 1.3 mm diameter, smooth and white, are laid on the leaf upper surface.

a.
b.
c.

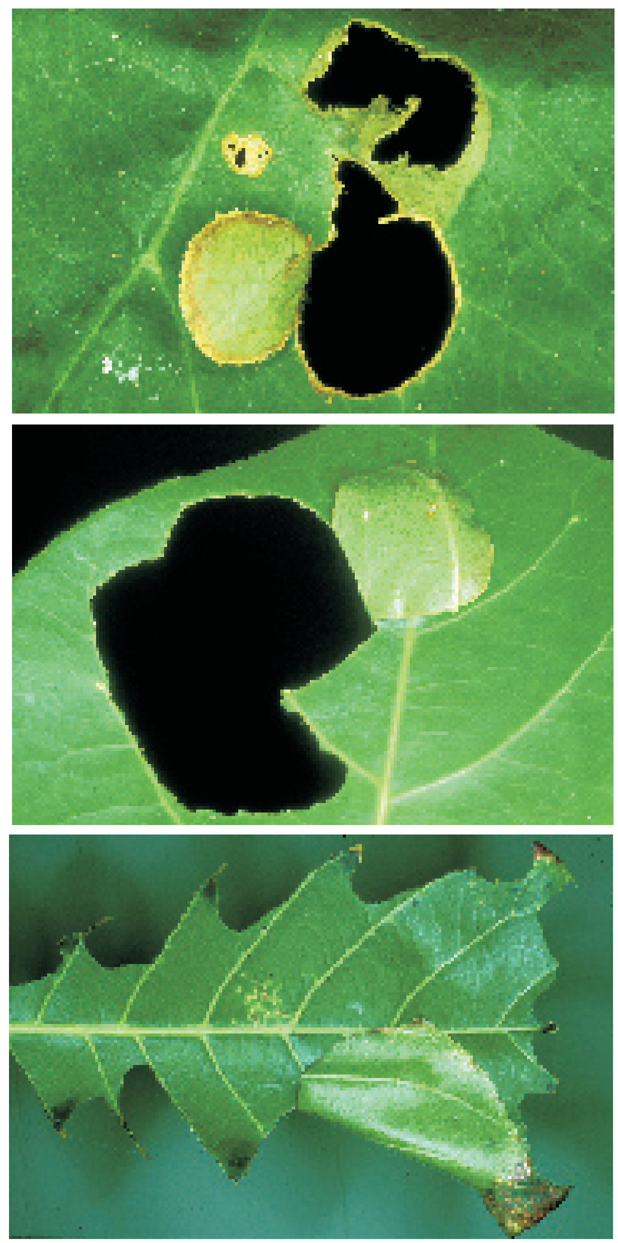


Fig. 1. *Pyrrhopyge amyclas amyclas* shelters and associated feeding damage on *Terminalia catappa*, Manzanilla Cocal, 7.v.1995 (a) shelter I, (b) shelter II, (c) shelter III.

Shelter I (Fig. 1a) is a Type 5 centre-cut fold. The shelter lid is an oval, approximately 7 x 6 mm, cut from the middle of the leaf lamina and with the bridge (hinge) along the long axis (not on a vein), folded over upwards and held with silk to make a pocket. Shelter II (Fig. 1b) is similar, but larger (examples of 24 x 20, 20 x 15, 25 x 18, 17 x 13 mm); the bridge may include a vein, or may parallel a vein. The shelter lid is domed (i.e., it is a tented shelter) by making minor cuts from the edge of the shelter lid and pulling the edges together with silk. Shelter III (Fig. 1c) can be similar to shelter II, but larger again (examples of 60 x 33, 50 x 28, 45 x 30, 42 x 28 mm) and often includes the leaf margin, i.e., a two-cut stem fold with a wide shelter bridge (Type 9).

The fifth instar caterpillar (Fig. 2) measures about 40 mm when mature. The head (Fig. 2a) is chordate, about 5 mm across; red with narrow dark brown stripes down the face; covered with short red and long white setae. T1 red-brown. Body deep dark red; T2-A8 each with a narrow, bright yellow, transverse band to the level of the spiracles; covered with scattered long white setae. Legs concolorous; spiracles light brown. Feeding by the larger caterpillars leaves the main veins of the leaf bare and projecting (Fig. 1c).

a.

b.

Fig. 2. *Pyrrhopyge amyclas amyclas* fifth instar caterpillar, Manzanilla Cocal, 7.v.1995 (ref. 95/32) (a) head, (b) caterpillar.

The pupa (Fig. 3) measures 24 mm. In outline it is generally rounded, although slightly bulbous frontally; the proboscis sheath reaches the end of the wing cases. Ground colour deep orange-red; inter-segmental areas of abdomen and vertical stripe through eye brown-orange. Abdomen, thorax and head covered with short red setae and long white setae – on the abdomen in a band around each segment; T1 similarly in a transverse band; antennae, legs and wings bare. Spiracles red-brown, quite large, but not conspicuous.

a.

b.

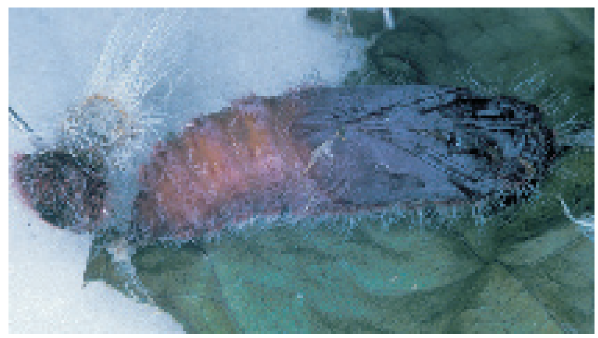


Fig. 3. *Pyrrhopyge amyclas amyclas* pupa, collected as caterpillar on *Terminalia catappa*, Manzanilla Cocal, 7.v.1995 (ref. 95/32) (a) dorso-lateral view, (b) ventral view.

I was able rear one male (Fig. 4) from these caterpillars to confirm their identity.

Fig. 4. *Pyrrhopyge amyclas amyclas* adult male, reared from a caterpillar collected on *Terminalia catappa*, Manzanilla Cocal, 7.v.1995 (ref. 95/32).

S. Alston-Smith (pers. comm. 1995) has reared an unidentified, gregarious, pupal parasite (Chalcididae, ?*Brachymeria* sp.) from material he collected at Manzanilla.

***Mysoria barcastus alta* Evans 1951**

Moss (1949) found caterpillars of *M. barcastus* at Santarem, Brazil: "half a dozen mauve larvae, rather hairy and prettily belted with lemon-yellow. They were feeding on small bushes of *Casearia minima* (Flacourtiaceae) on waste ground". "*Casearia minima*" does not seem to be a valid name (IPNI 2007). The family Flacourtiaceae is now synonymized with Salicaceae and most members of the former Flacourtiaceae, including *Casearia* spp., have been transferred to Salicaceae (Stevens 2007).

On the basis of Moss's observation, when I summarized information on this species in Trinidad (Cock 1981), I suggested that likely host plants in Trinidad would be wild coffee, *C. sylvestris* Sw., and pipe wood, *C. guianensis* (Aubl.) Urb. At that time, I was unaware that in 1937, Margaret E. Fontaine had reared this species in Trinidad on *C. guianensis* (Cock 2004) and included the caterpillar and pupa in her unpublished sketchbooks (in the Entomology Library of the Natural History Museum, London). Her illustrations match the early stages I describe and illustrate below.

My collections in Trinidad over the last 25 years have shown that *C. sylvestris, C. guianensis* and *C. spinescens* Griseb. are regularly used as food plants in Trinidad. I have observed oviposition on, and collected caterpillars from, *C. guianensis* at Fort George (x.1981; ref. 81/8C), and collected caterpillars on the same food plant at Mt. Tabor, c. 1,000 ft. (xii.1981, ref. 81/27A), Curepe (x.1981, ref. 81/8D), and Mt. Tamana (14.x.1995, ref. 95/60). I have also collected caterpillars on *C. sylvestris* at St. Augustine (x.1981, ref. 81/16) and Macoya Gardens (ii.1982, ref. 82/45B) and on *C. spinescens* at St. Benedict's (8.x.1994, ref. 94/62), Point Gourde (8.x.1995, ref. 95/42) and Port of Spain (10.x.1995, ref. 95/50). The following descriptions are based largely upon the Point Gourde collection (ref. 95/42).

Eggs are laid on the upper surface of leaves; small isolated bushes are frequently preferred. The stage I shelter (Fig. 5) is a centre-cut fold (Type 5) made by cutting a 3/4 circular flap, 7 x 6 mm, from the mid-lamina, and folded over upwards along the longer axis. There is some feeding from the edge of the resultant hole, but mostly the caterpillar feeds from the edge of the lamina. The stage II shelter is similar, 13 x 10 mm, either fully within the leaf lamina (Type 5 shelter), or using the leaf margin for part of the edge, i.e. a two-cut stem fold (Type 10). Feeding is extensive from the edge of the lamina, leaving major veins intact. Shelter III (Fig. 5) is a rough oval, about 20 x 15 mm, using part of the leaf margin (Type 10); a major cut is made at one end along the fold, to create a slight overlap at that point, as the shelter lid is pulled into a convex shape. Feeding is from the leaf margin and main veins are consumed at this stage. Fifth instar caterpillars make a shelter IV by tying two leaves, one on top of the other, with silk strands – a two leaf shelter (Type 4). The same or a similar shelter is lined with silk when used for pupation. Within this, two Y shaped girdles of silk support the cremaster and thorax of the pupa.

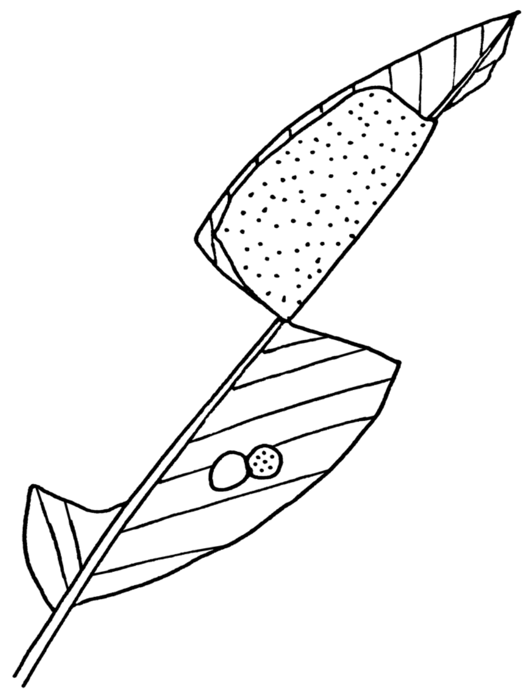
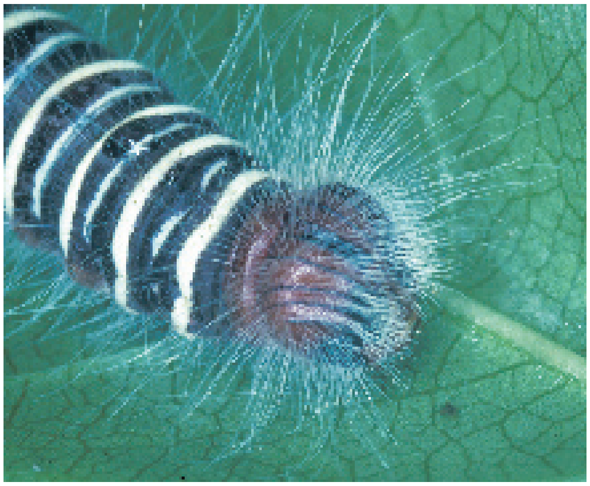


Fig. 5. Schematic leaf of *Casearia* sp. with first and third caterpillar shelters of *M. barcastus* (stippled areas represent leaf undersurface where folded over).

When mature the caterpillar (Fig. 6) measures about 40 mm. The head (Fig. 6a) is rounded, slightly chordate; red-brown with a series of narrow, sharply-defined, dark red lines from near posterior margin, over epicranial region: (1) parallel to epicranial suture as far as the clypeus, the area between being black except for the posterior 2 mm; (2) a group of three from around external angle to clypeal suture; (3) a single line, mid-way between (1) and (2); a black mark over the stemmata and the area posterior to them; a black mark adjacent to the clypeus uniting the bases of lines (2) and (3); narrow black line down basal 2/3 of centre of clypeus; head covered with long, pale setae of 2-3 mm, and very long pale setae of 5 mm.

a.



b.

Fig. 6. *Mysoria barcastus alta* fifth instar caterpillar, collected on *Casearia spinescens*, Point Gourde, 8.x.1995 (ref. 95/42), (a) head, (b) caterpillar.

T1 shiny red with very long pale setae. Body deep maroon-red with transverse bands. T2 with 1 mm wide yellow band from middle of segment to sub-ventral flange; trace of yellow-white narrow band on posterior margin. T3 yellow band as T2. A1-A8 yellow band stops just short of spiracles; a narrower yellow-white band on anterior margin, partially hidden as body is flexed. A9 with narrower yellow band; trace of yellow-white anterior band. A10 red. Ventro-lateral flange red in centre of segments, pale in-between. Body covered with long pale setae, and very long pale setae on yellow bands. All legs red. Spiracles concolorous. The yellow-white bands are less pronounced in earlier instars (Fig. 7).

Fig. 7. *Mysoria barcastus alta* fourth instar caterpillar, collected on *Casearia guianensis* at Mt. Tamana, 14.x.1995 (ref. 95/60).

The pupa of ref. 95/42 (Fig. 8) is a particularly strongly marked individual, and is described in detail here. It measures about 25 mm, and is light chestnut brown, with black markings and partially covered with a light layer of white waxy powder. The white waxy powder covers: posterior half of eyes; all appendages; posterior half of thorax, extending anteriorly in dorsal and dorso-lateral streaks; A1-5 dorsal line, dorso-lateral line and posterior margin (with rounded corners); A6-A8 broad band around each segment, apart from a circle around each spiracle; A9 narrow posterior band dorsally and laterally, continuous ventrally and a narrow dorsal line; A10 ventrally and along dorsal line; A11 all. The black markings comprise: eyes, except central vertical stripe; a broad rounded bar across frons; collar a broad sub-dorsal bar, rounded laterally; thorax a sub-dorsal spot, and diagonal mark at base of wings; streaks on T2 legs with gap in middle; streaks on T3 legs with broad gap in middle; streak in distal half of antennae; on FW a spot at base of costa, base of space 1A, streaks on veins 1 (distal 1/3), 2 (distal 1/2), 3 (all), 4 (all, joined to 3 at base), 5-7 (distal portion only), end cell; on A6-A8 a bar ventrally in centre of segment, pointed laterally, strongest on A6, A7; on A1-5 and increasingly strong sub-dorsal streak on anterior margin of white waxy posterior border; on A8 an obscure, narrow line along posterior margin; on A9 a strong line on posterior margin; similarly on A9 but interrupted at dorsal line. Spiracles T1 ground colour, on anterior margin of black mark at base of wings; inconspicuous. Spiracles A2-A6 dark brown, in centre of clear patch of ground colour, bordered with black as follows: A2 narrowly on dorso-posterior angle; A3 similar, but extends further; A4 along posterior margin, extending slightly along dorsal margin, and at ventro-posterior margin enclosing two of an arc of four small shining ground colour ovals; A5-A7 broadly along posterior margin of increasingly small ground colour area around spiracles. Distinctive shining, ground colour ovals: A2-A4 anterior and slightly dorsal to spiracles, with ground colour surround; A4 an arc (concave dorsally) below spiracles; A5-A6 a pair below spiracle; A7 two, one above the other ventrally to the spiracle. Cremaster brown. Long white erect setae (c. 2 mm) as follows: eyes except central band; front of head; dorsally on collar and thorax; all abdomen segments (but not intersegmental area).

In contrast, the pupa of the male reared as ref. 82/16 is much less heavily marked (based on an examination of the emerged pupa). The white waxy powder is more extensive, and covers most of the abdomen apart from the intersegmental bands, and partial bare bands subdorsally on A1-A4 in anterior part of each segment. The black markings are lighter and reduced: the thorax markings are present but reduced; the spot at the base of the wings is missing; the legs and antennae are unmarked; only veins 1-6 distally and end cell of the FW are dark; most of the abdomen markings are absent and those that remain, e.g., lateral spots, are obscured by the more extensive white waxy powder. The pupa which Margaret Fontaine illustrated in her sketchbook (in lateral view) is similar, but perhaps with even more reduced markings. The lightly marked pupa of ref. 82/16 was male while the heavily marked pupa of ref. 95/42 was female, but I have not studied and kept enough material to suggest whether this is a sexually linked variation, or not.

a. b. c.

Fig. 8. *Mysoria barcastus alta* pupa, collected as caterpillar on *Casearia spinescens*, Point Gourde, 8.x.1995 (ref. 95/42) (a) dorso-lateral view, (b) lateral view, (c) ventral view.

As noted in Cock (1981), this species is widespread in Trinidad but seldom common. It can be taken feeding at flowers (e.g., avocado, eupatorium) and rests either with its wings spread or with them held more or less erect above its body (Fig. 9).

I have reared a eulophid parasitoid from pupae found in a stage I shelter with the remains of a first instar *M. barcastus* caterpillar (ref. 81/8D), and a tachinid from a fourth instar caterpillar (puparium formed 16.xii.1981, adult 30.xii.1981, ref. 81/27A), but neither has been identified.

a. b.

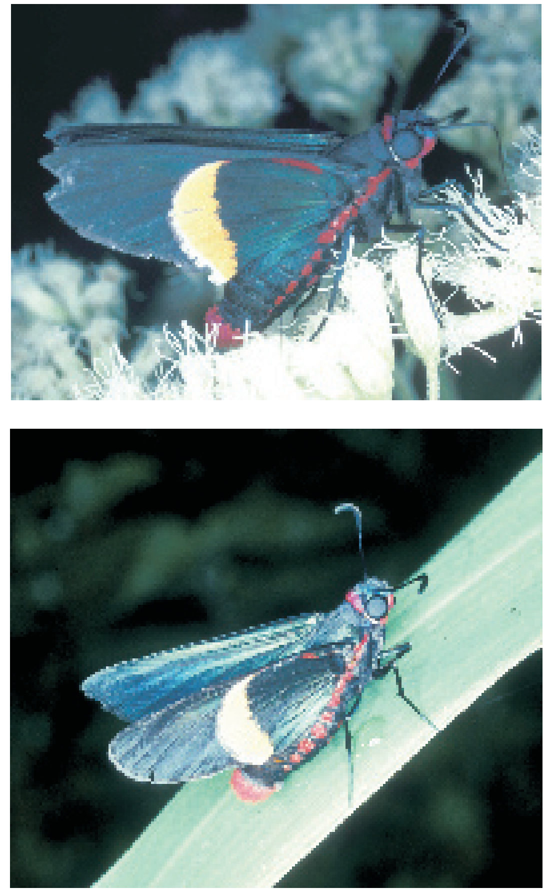


Fig. 9. *Mysoria barcastus alta* adult female, (a) at flowers of *Austroeupatorium inulaefolium*, Rio Claro-Guayaguayare Road, 11.x.1993, (b) St. Benedict's, 16.x.1993.

Burns and Janzen (2001) describe and illustrate the life history of *M. ambigua* (Mabille & Boullet) from Costa Rica. This species is closely related to *M. barcastus*, so much so that Evans (1951) treated *ambigua* as a subspecies of *M. barcastus*. The adults are similar in appearance, but differ in the male genitalia (Evans 1951; Burns and Janzen 2001). The food plants of *M. ambigua* are also species of Salicaceae, most commonly *C. corymbosa* Kunth, but occasionally *C. sylvestris*, *C. arguta* Kunth, and *Zuelania guidonia* Britton & Millsp., but several other species of *Casearia* and Salicaceae in the same area are not used. Burns and Janzen (2001) do not provide descriptions of the caterpillar, but the colour figure is similar to that of *M. barcastus alta* illustrated here. Their illustration of the pupa is in lateral view, but suggests that the distribution of white waxy powder and dark markings differ. However, a more detailed examination of the variation of the two populations would be needed to draw conclusions as to the differences. Burns & Janzen (2001) note that parasitism levels of *M. ambigua* are low but parasitoids include five species of tachinid and a braconid.

DISCUSSION

The Pyrrhopyginae with which I am familiar all make centre-cut fold Type 5 for their first shelters. However, Burns and Janzen (2001) summarizing the biology of the Costa Rican fauna they dealt with, note that first shelters may also be cut from the edge of a leaf, so this generalization does not seem to hold for the whole subfamily.

Evans (1951) considered the Old World subfamily Coeliadinae to parallel the Pyrrhopyginae, but I have observed that the caterpillars of Coeliadinae, although equally brightly coloured are hairless, the first shelters are two-cut stemmed folds (Type 10) or a more complicated four-cut fold perforated shelter not covered by Greeney and Jones (2003). Later shelters are mostly of this later type, although mature caterpillars of *Pyrrhochalcia iphis* (Drury) in particular do not make a shelter (M.J.W. Cock unpublished). As far as the early stages are concerned, the similarity between the two subfamilies is rather limited.

ACKNOWLEDGEMENTS

Scott Alston-Smith shared his discoveries regarding *P. a. amyclas* with me. The *Casearia* spp. food plants were identified at the National Herbarium, St. Augustine, by Dennis Adams, Yasmin Baksh-Comeau, and Winston Johnson. I was able to consult the sketchbooks of Margaret E. Fontaine at the Entomology Library of the Natural History Museum, London, facilitated on one occasion by Martin Honey. My thanks and appreciation to all these colleagues for their help.

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Pseudosphinx tetrio (L.) (Lepidoptera: Sphingidae) in Trinidad and Tobago

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ABSTRACT
A summary of observations on the hawkmoth *Pseudosphinx tetrio* (L.) in Trinidad and Tobago is given with notes on food plants of three families which generally produce a lactiferous sap.

Key words: *Pseudosphinx tetrio,* Apocynaceae, Asclepiadaceae, Euphorbiaceae, frangipani, Trinidad and Tobago.

Pseudosphinx tetrio (L.) is one of the largest hawkmoths (Sphingidae) found in Trinidad and Tobago, and its caterpillars are amongst the most conspicuous, so much so that one has been used to illustrate a brochure for eco-vacations to Trinidad and Tobago (TIDCTT undated, "sphingid caterpillar on frangipani"). The caterpillars are gregarious and well-known for their defoliation of ornamental frangipani trees (*Plumeria* spp.: Apocynaceae), when they are very conspicuous and noticed by naturalists and the general public. The purpose of this note is to summarise observations of this species in Trinidad and Tobago, and further comment on the food plants of the caterpillars.

Pseudosphinx tetrio was first described by Linnaeus in 1771 from "America" (Kitching and Cadiou 2000). Well before this, the caterpillar was amongst the first known from South America, as it was illustrated by Merian (1705, plate V) from Surinam. Its range is from southern USA through the Caribbean to Paraguay and Uruguay (Schreiber 1978), and it was recorded from Trinidad by Kaye (1901) and Kaye and Lamont (1927). It has not been recorded from Tobago, but the moths of Tobago have not been documented yet (Cock 2003). D. J. Stradling (pers. comm. 1995) ran a mercury vapour light (MVL) trap at Prospect, Arnos Vale, 8.viii.1977 and caught two males and a female *P. tetrio*. Ciesla (2008) shows pictures of a caterpillar photographed at Plymouth, Tobago. Additional observations are reported below, and so the regular presence of *P. tetrio* in Tobago is confirmed.

Adult moths are marked in shades of grey (Figs. 1-4), and their size (up to 15 cm wing span, with females larger than males), markings and lack of red, orange or yellow markings on the upper surface of the abdomen or hind wing should serve to identify them in Trinidad and Tobago. Adults moths are noticed much less often than the conspicuous caterpillars, and come only occasionally to light in Trinidad. Thus, Stradling *et al.* (1983) record just 12 males and six females from 3,767 MVL trap nights in the St. Augustine area, 1969-1977. A few years later, I recorded four specimens in 302 MVL trap nights at Curepe, 1978-1981 (MJWC unpublished). Its distribution within Trinidad is not well documented, but it can occur from the centre of Port of Spain (Fig. 3) to the heights of the Northern Range (Fig. 1), and could probably be found anywhere in the island.

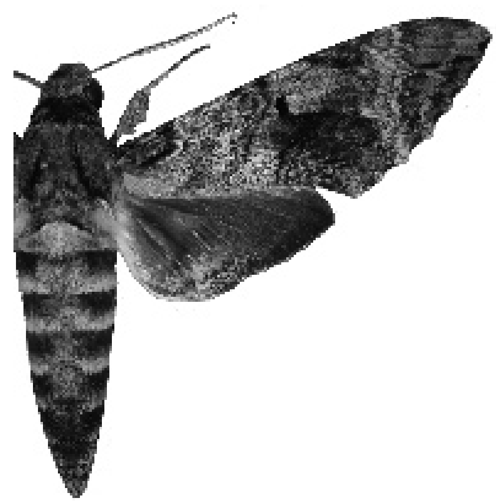

Fig. 1. *Pseudosphinx tetrio* male upper side, collected Morne Bleu, Textel Installation, at light, 26.vii.1978, M.J.W. Cock (coll. MJWC). Approx. 0.9 x life size, forewing length 57 mm.

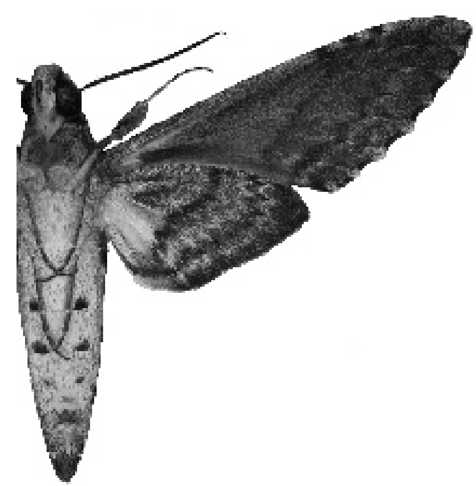

Fig. 2. *Pseudosphinx tetrio* male under side of specimen in Fig. 1.

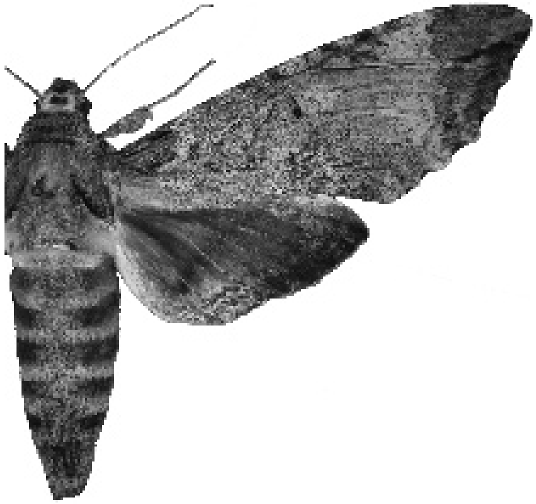

Fig. 3. *Pseudosphinx tetrio* female upper side, collected Port of Spain, 12.vii.1978, W. de Voogd (coll. MJWC). Approx. 0.8 x life size, forewing length 67 mm.

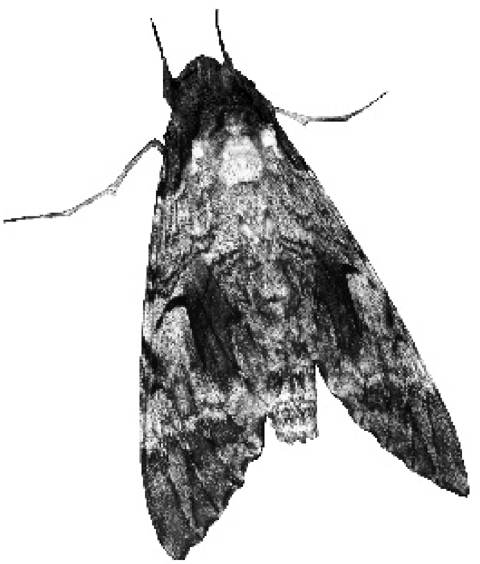

Fig. 4. *Pseudosphinx tetrio* female, in resting position, attracted to street lights, St. Benedict's, 12.x.1993. Approx. 0.75 x life size. The background (black tarmac) has been edited out for clarity.

The caterpillar is very distinctive, and well documented in publications (Merian 1705; Moss 1912; Janzen 1980, 1983; Santiago-Blay 1985; Tuttle 2007), and on the internet (Ciesla 2008; Janzen and Hallwachs 2008; Oehlke 2008, etc.). With its red-brown head and anal segment, yellow-banded black body and whiplash tail, it can be mistaken for no other species (Figs. 5, 7).

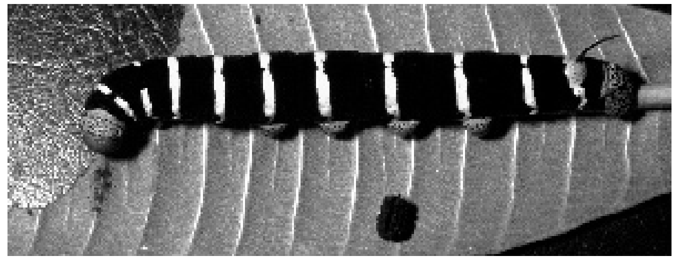

Fig. 5. *Pseudosphinx tetrio* fifth instar caterpillar, on *Plumeria* sp., Trinidad, 1987-81, no further data, approx. life size.

The pupa (Fig. 6) is formed at ground level between leaves pulled together with a few strands of silk (Moss 1920). It is rich mahogany brown with black markings most visible as lines on the wing cases.

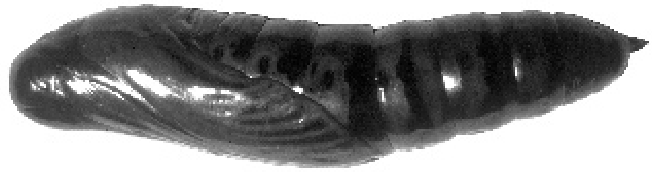

Fig. 6. *Pseudosphinx tetrio* pupa, lateral view. Trinidad, 1987-81, no further data, approx. 1.2 x life size.

The mature caterpillars wander away from their food plants to pupate (Moss 1912) and may be found on other plants that are not used as food at this time, so observations on apparently new food plants should be critically assessed. For example, I have a photograph of a fifth instar caterpillar on a coarse grass (St. Benedict's, Pax Guest House, 15.x.1993), but this is not a food plant.

As Kitching and Cadiou (2000) point out, the caterpillar and pupa of *Pseudosphinx tetrio* illustrated by Merian (1705, plate V) are incorrectly associated with an adult of *Manduca rustica* (F.). The food plant association with cassava is also most likely incorrect for both species.

Moss (1912) notes that the food plant in the foothills east of the Andes in Peru is a wild rubber ("caucho de monte"). He subsequently found that at Pará (now Belem) in Brazil, frangipani is the normal food plant (Moss 1912, 1920), and this is the food plant normally associated with this species (Janzen and Hallwachs 2008; Kaye and Lamont 1927; Santiago-Blay 1985; Tuttle 2007, etc). Santiago-Blay (1985) records that *Plumeria rubra* L. is the main food plant recorded in Puerto Rico, but *P. alba* L. and *P. obtusa* L. are also used.

Santiago-Blay (1985) reported one record of caterpillars feeding naturally on *Allamanda cathartica* L. (Apocynaceae), but in captivity, he found that leaves of

A. cathartica were eaten only slowly. Laboratory trials with *A. blanchetii* A. DC. (= *violacea* Gardn. & Field.) and *Nerium oleander* L. (Apocynaceae) showed these plants were not accepted by *Pseudosphinx tetrio* caterpillars. In Trinidad, *A. cathartica* was probably introduced from South America (Cheesman 1947), and I have not found caterpillars of *P. tetrio* on it, although it is the normal food plant of another, closely related sphingid, *Isognathos scyron* (Cramer). It is therefore interesting and noteworthy, that two observers have told me of caterpillars of *P. tetrio* feeding on *A. cathartica* in Tobago (C. D. Adams, pers. comm. 1981 and Fig. 7; P. Rush, pers. comm. 1981). These reports provide confirmation that *A. cathartica* is used as a food plant at least occasionally.

Fig. 7. *Pseudosphinx tetrio* fifth instar caterpillar, on *Allamanda cathartica*, dorso-lateral view. Argyll Bay, Tobago, 28.ii.1981 (photo C. D. Adams), approx 0.75 x life size. The stem that the caterpillar holds with its anal claspers (arrow) has been defoliated (arrow), while the stem held with its legs and prolegs is untouched.

Ciesla (2008) gives the Old World *Calotropis gigantea* (L.) W. T. Aiton (Asclepiadaceae) as the food plant for his pictures of the caterpillar taken at Plymouth, Tobago. In addition to the 155 rearing records from *Plumeria rubra*, Janzen and Hallwachs (2008) list one record from *Sapium macrocarpum* Müll.Arg. (Euphorbiaceae). Jahnes *et al.* (2002) report studies on another food plant, *Himatanthus sucuuba* (Spruce ex Müll.Arg.) Woodson (Apocynaceae), in Peru.

Therefore, it seems that in addition to the ubiquitous *Plumeria* spp., *Pseudosphinx tetrio* can on occasion use a variety of plants in the families Apocynaceae, Asclepiadaceae and Euphorbiaceae – three families, the species of which generally produce a lactiferous sap.

An infestation of brightly coloured caterpillars on a defoliated frangipani is very conspicuous, and the caterpillars must be obvious to predators, yet they are not eaten. Observers have assumed that the black, yellow and red caterpillars show warning colouration reflecting that the larvae are distasteful due to sequestered noxious compounds from the milky sap of frangipani. If this is the case, are these sequestered chemicals also present in the adult moth? If they are present, why is the moth so cryptically coloured? There have been no experimental tests as to whether chemicals in frangipani sap, caterpillars or adult moths are distasteful to predators, and some interesting studies could be carried out with this system.

Plumeria spp. are not indigenous in Trinidad and Tobago, although they are indigenous in Central and South America (Cheesman 1947). This raises the interesting question as to whether *Pseudosphinx tetrio* is an indigenous species with other food plants amongst the native Apocynaceae, Asclepiadaceae or Euphorbiaceae or whether it extended its range to Trinidad and Tobago, only once *Plumeria* spp. were introduced and planted as ornamentals. Sphingidae are generally considered highly mobile, and records of vagrant specimens of *Pseudosphinx tetrio* well into the USA (Tuttle 2007) suggest it would be capable of colonising new areas where *Plumeria* spp. were planted. *Pseudosphinx tetrio* has only been present in Bermuda since the 1930s and Ferguson *et al*. (1991) include it amongst "migratory immigrants that apparently became established naturally following changes in the habitat caused by man", i.e. the planting of *Plumeria* spp. The situation in southern Florida is similar, and Tuttle (2007) suspects that *Pseudosphinx tetrio* only established breeding populations there once *Plumeria* spp. were introduced. Because *Pseudosphinx tetrio* lays its eggs in batches (Santiago-Blay 1985) and the larvae are voracious and wasteful feeders (Kaye and Lamont 1927; Moss 1912, 1920; Tuttle 2007), any indigenous plant routinely used as a food plant would need to be a large plant with plenty of leaves, probably a tree, or a bush growing in clumps. It seems likely that naturalists would have observed the conspicuous gregarious larvae on large plants other than *Plumeria* spp. if they were regularly used as food plants. Thus, although it would be premature to say there are no indigenous food plants in Trinidad and Tobago, it may well be that *Pseudosphinx tetrio* has only established breeding populations in historical times.

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Harvestmen (Arachnida: Opiliones) of Trinidad, West Indies

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ABSTRACT
From 2005-2007, we observed 20 species of harvestmen representing nine families, primarily in northern Trinidad. Of these taxa, we collected previously unreported or undescribed species for the families Kimulidae, Samoidae, Sclerosomatidae, and Stygnommatidae. In this paper, we provide a brief summary of the characters and natural history, as well as photographs of each species. The most common and widespread taxa in Trinidad include species in the families Cosmetidae, Cranaidae, Manaosbiidae, and Sclerosomatidae. Species that were less common or had a limited geographic range include representatives from the families Agoristenidae, Kimulidae, Manaosbiidae, Samoidae, Sclerosomatidae, Stygnidae, and Stygnommatidae. A taxonomic key for identification of the 10 families of harvestmen known from Trinidad was developed through the modification of published keys in conjunction with characters that we observed for these taxa.

Key words: Biogeography, Caribbean, Laniatores, neotropical, taxonomy.

INTRODUCTION

The Opiliones (synonym Phalangida) represents the third largest order of arachnids (5,948 described species) and has a worldwide distribution. These animals are commonly referred to as harvestmen, daddy longlegs, or harvest spiders. Presently, four major suborders (Cyphophthalmi, Eupnoi, Dyspnoi, and Laniatores), 45 families and approximately 1,500 genera (Machado *et al*. 2007) are recognized. Although superficially resembling spiders, harvestmen do not have an externally divided prosoma (cephalothorax) and opisthosoma (abdomen). They also do not possess fangs or poison glands (a common misconception about the group) nor do they have the capacity to produce silk (lacking spinnerets). Among arachnids, harvestmen are unique in having direct sperm transfer from male to female (via a male copulatory organ, referred to as a penis) and with regards to digestive physiology. In contrast to other arachnids, harvestmen are not fluid feeders, but ingest solid food particles. Most species are generalist predators and scavengers, feeding upon small invertebrates (worms, snails, aphids, or other harvestmen) and plant tissues, including floral parts and fruits (Adams 1984; Halaj and Cady 2000; Acosta and Machado 2007). Many species of harvestmen have been observed to form mass aggregations of up to several thousand individuals (Holmberg *et al*. 1984; Coddington *et al*. 1990; Machado and Vasconcelos 1998; Machado *et al*. 2000; Machado and Macías-Ordóñez 2007a; Grether and Donaldson 2007). Harvestmen are also well-known for their diverse array of defensive behaviors and adaptations which may include death feigning, leg autotomy, and the secretion of defensive compounds from paired, repugnatory glands (Cokendolpher 1987; Guffey 1998; Machado *et al*. 2005; Gnaspini and Hara 2007).

Most species of harvestmen are nocturnal and remain hidden during the day (Todd 1949; Edgar and Yuan 1968; Curtis and Machado 2007). In temperate environments, the typical lifespan is one year (Machado and Macías-Ordóñez 2007b). The most common life history pattern involves oviposition in the soil, the overwintering of individuals as eggs or larvae, development and maturation in the spring and early summer, mating in late summer or early autumn, with death soon afterwards (Edgar 1971). The life history patterns of tropical species are not well studied. However, individuals of several taxa have been observed to live at least 2 years and may reproduce throughout the year, particularly when conditions (e.g., high humidity and availability of food) are most conducive to activity (Machado and Macías-Ordóñez 2007b).

In forested habitats, harvestmen are among the most commonly encountered arthropods. However, relatively little is known about the ecology or natural history of most species. In the eastern Caribbean and Venezuela, 12 families of the order Laniatores and the sclerosomatid subfamily Gagrellinae (order Eupnoi) are known to occur (Kury 2003). In Trinidad, 24 described species representing 8 families have been documented (Table 1). There are 3 families of harvestmen (Guasiniidae, Icaleptidae, Kimulidae) that occur in Venezuela that have not been previously observed in Trinidad (Giribet and Kury 2007). Similarly, the Caribbean family Biantidae is known from several islands, but has not been reported for Trinidad (Giribet and Kury 2007). Of the species occurring in Trinidad, only *Ethobunus tuberculata* (Zalmoxidae), *Paecilaema inglei* (Cosmetidae), *Phareicranaus calcariferus* (Cranaidae), *Prionostemma insulare* (Sclerosomatidae), *P. vittatum*, *Rhopalocranaus albilineatus* (Manaosbiidae), *Santinezia serratotibialis* (Cranaidae), and *Stygnoplus clavotibialis* (Stygnidae) are known from additional locations, primarily Venezuela (Goodnight and Goodnight 1947; Cokendolpher and Camilo-Rivera 1989; Kury 2003; Pinto-da-Rocha and Kury 2003; Villarreal-M and Rodríguez 2004). In addition, at least one undescribed species of the family Stygnommatidae occurs on the island (Pérez-González 2007).

Very little is known about the biology or distribution of the harvestmen on Trinidad (Cokendolpher and Camilo-Rivera 1989; Kury 2003). Diurnal and nocturnal activity has been observed for an agoristenid species as well as for several cosmetids (Kury and Pinto-da-Rocha 2002). Recently, parental care was reported for both species from the family Cranaidae (Machado and Warfel 2006; Hunter *et al*. 2007). These observations are the first published studies of this behavior for the family. Similarly, the use of tree buttresses by species of cosmetids, manaosbiids, sclerosomatids, and stygnids was also recently examined, and the first report of aggregation behavior for the family Stygnidae was noted (Burns *et al*. 2007).

Over the course of three years (2005-2007), we collected harvestmen from a variety of locations, mostly in northern Trinidad during the wet season (July and early August). On many occasions, we were able to make behavioral observations in the field. Our main objective was to investigate the natural history of these animals. Owing to the rather limited nature of the locality records for most species (Goodnight and Goodnight 1947; Turk 1948; Cokendolpher and Camilo-Rivera 1989; Kury 2003; Pinto-da-Rocha and Kury 2003), we also attempted to assess the relative abundance of species across a variety of habitats.

METHODS

Most of the harvestmen examined in this study were collected during the beginning of the wet season in July and August 2005-2007. Specific dates were 10 July - 3 August, 2005; 9 July - 1 August, 2006 and 4 - 10 July, 2007. For 2005, we collected harvestmen from Mt. Tamana, Grande Tacarib, Petite Tacarib, Lalaja Trace, near Brasso Seco Paria Village, Morne Bleu Ridge and from the intersection of the Lalaja Trace to the summit of Mt. Aripo. For 2006, we sampled these locations again and also collected at Salybia, Tucker Valley, and Hollis Reservoir. Although not permitted to collect, we visited Trinity Hills and Nariva Swamp in 2006 and observed the most common species in the leaf litter. In 2007, we focused our efforts primarily on the summit of Mt. Aripo, but also collected specimens along the Lalaja Trace. In addition to these collections, we discovered five individuals (four adults, one nymph) of a previously unknown samoid species during the course of sorting invertebrate samples collected in May, 2003 from tank bromeliads (*Aechmea nudicaulis*) occurring in the high canopy of mango and sandbox trees near Petite and Grande Tacarib.

The habitats of these areas included crappo-cocorite forest (Petite Tacarib and Grande Tacarib), seasonal deciduous forest (Mt. Tamana, Trinity Hills, Tucker Valley, Salybia, Hollis Reservoir), lower montane rainforest (Lalaja Trace), upper montane rainforest (Morne Bleu Ridge), and elfin woodland (summit of Mt. Aripo). They differ markedly with regards to physical characteristics and vegetation (summary provided by Murphy 1997 based upon Beard 1946). During sampling, harvestmen were found by turning and breaking apart logs, palm frond sheaths, and bamboo (especially in Tucker Valley) and carefully searching the surfaces, crevices, and litter associated with tree buttresses. Along Morne Bleu Ridge and Mt. Aripo, harvestmen were encountered in the sheaths of palm fronds of *Euterpe broadwayi* (Comeau *et al*. 2003). Sampling occurred during daylight hours (0800 to 1730 hrs), although we collected after dusk at several sites including Mt. Tamana, Petite Tacarib, Grande Tacarib, Morne Bleu Ridge, and Mt. Aripo. All harvestmen were captured by hand and immediately placed in 70% ethanol or 10% buffered formalin. Upon our return to the U.S., specimens preserved in formalin were transferred to 70% ethanol for long-term storage. Identifications of adults were made with the aid of the original taxonomic descriptions and from comparisons with holotypes borrowed from the American Museum of Natural History (AMNH). During sampling, we collected mostly adults, however, we found nymphs of species from the Cosmetidae, Cranaidae, Sclerosomatidae, and Stygnidae. We deposited voucher specimens into the collections of the AMNH, Louisiana State Arthropod Museum (LSAM),

Table 1. Locality records for the 24 described species of harvestmen known for Trinidad (Kury 2003). Citations for specific locality records indicate additional records for species that were not specified or listed in the original taxonomic description.

Taxa	Locality Record
Agoristenidae	
Trinella albiornata (Goodnight and Goodnight 1947)	Lopinot Caves (Turk 1948)
Trinella intermedia (Goodnight and Goodnight 1947)	St. Augustine
Trinella leiobuniformis (Šilhavý 1973)	Trinidad, no location specified
Cosmetidae	
Cynortula granulata (Roewer 1912)	Blue Basin, El Tucuche, Sangre Grande, Tucker Valley (Goodnight and Goodnight 1947)
Cynortula modesta (Sørenson 1932)	Port of Spain
Cynortula undulata (Roewer 1947)	Trinidad, no location specified
Libitiosoma granulatum (Roewer 1947)	Trinidad, no location specified
Paecilaema adspersum (Roewer 1947)	Trinidad, no location specified
Paecilaema inglei (Goodnight and Goodnight 1947)	Diego Martin, El Tucuche, St. Anne
Paecilaema paucipustulatum (Roewer 1947)	Trinidad, no location specified
Vonones testaceus (Roewer 1947)	Trinidad, no location specified
Cranaidae	
Phareicranaus calcariferus (Simon 1879)	Tucker Valley (Goodnight and Goodnight 1947)
Santinezia serratotibialis (Roewer 1932)	4 mi. N road to Arima to Blanchisseuse, St. Paul Merchiston (Pinto-da-Rocha and Kury 2002)
Manaosbiidae	
Cranellus montgomeryi (Goodnight and Goodnight 1947)	El Tucuche
Rhopalocranaus albilineatus (Roewer 1932)	Tucker Valley (Goodnight and Goodnight 1947)
Samoidae	
Maracaynatum trinidadense (Šilhavý 1979)	Simla, Point Fortin
Pellobunus longipalpus (Goodnight and Goodnight 1947)	St. Augustine
Sclerosomatidae	
Holcobunus aureopunctata (Roewer 1953)	Trinidad, no location specified
Prionostemma fulginosum (Roewer 1953)	Trinidad, no location specified
Prionostemma insulare (Roewer 1953)	Trinidad, no location specified
Prionostemma referens (Roewer 1953)	Trinidad, no location specified
Prionostemma vittatum (Roewer 1910)	Tucker Valley (Goodnight and Goodnight 1947)
Stygnidae	
Stygnoplus clavotibialis (Goodnight and Goodnight 1947)	Arima Road near Blanchisseuse, Caparo, 1 mi. W Morne Bleu, Piarco, Port of Spain, Sangre Grande, Simla
Zalmoxidae	
Ethobunus tuberculatus (Goodnight and Goodnight 1947)	Tucker Valley

and California Academy of Sciences (CAS).

In the laboratory, specimens were photographed with a digital camera. In addition, we prepared several harvestmen for scanning electron microscopy (SEM). These specimens were dehydrated in a graded ethanol series and chemically dried using hexamethyldisilizane (Nation 1983). Individuals were mounted on aluminum stubs with double stick tape, sputter-coated with 10-15 nm of gold, and examined at an accelerating voltage of 15 kV with the Hitachi S-3000N SEM in the Electron Microscopy Center at the University of Louisiana at Lafayette.

RESULTS AND DISCUSSION

We collected 20 species of harvestmen including representatives of nine families (Table 2). The only family that we did not collect was the Zalmoxidae. The three species from the Kimulidae represent the first reports of this family for Trinidad. A single adult specimen of the largest kimulid species (species 3) was found in 2007 in leaf litter near the summit of Mt. Aripo, and the smaller species were collected from logs near Petite Tacarib in 2005. The undescribed samoid species was collected from tank bromeliads (*Aechmea nudicaulis*) taken from Petite Tacarib and Grande Tacarib in 2003. The third species of *Prionostemma* was only found in elfin woodland near the summit of Mt. Aripo in 2007. Comparisons with published lists (Cokendolpher and Camilo-Rivera 1989; Kury 2003) and descriptions of known species (Roewer 1953; González-Sponga 1987) indicate that this sclerosomatid species has not been formally described. In addition, we also collected an individual for an undescribed, but previously reported species of Stygnommatidae (Pérez-González 2007).

Our results indicate that the most common species in Trinidad are *Cynortula* sp. 1, *Paecilaema inglei*, *Prionostemma vittatum*, and *Rhopalocranaus albilineatus* (Table 2). These species occurred in most habitats and were abundant in several locations. In contrast, we found few individuals for the families Agoristenidae, Kimulidae, Samoidae, Stygnidae, and Stygnommatidae. We only collected *Trinella* sp. and *Cranellus montgomeryi* (Manaosbiidae) in upper montane forest or elfin woodland. The following is a detailed summary of our observations of species for each family. In addition to these descriptions, we developed a taxonomic key (Appendix 1) that can be used to identify harvestmen to family.

Agoristenidae

Members of the genus *Trinella* exhibit a sexual dimorphism with males having relatively large chelicerae (Fig. 1A) in comparison to females. The first leg in both sexes is filiform and narrower than legs II-IV. Individuals superficially resemble in size small species of *Prionostemma*, but differ in having armed and robust pedipalps and two tarsal claws on legs III and IV. We collected individuals for only one species that was common in the leaf litter on Mt. Aripo and active day and night (Table 2). A few individuals were also found in lower and upper montane rainforest (Table 2).

Cosmetidae

We collected four taxa for this family including two species of *Cynortula* (Figs. 1B, 1C) and two species of *Paecilaema* (Figs. 1D-G). In addition, we observed (but did not collect) a fifth species in the Bush-Bush area of Nariva Swamp. In Trinidad, eight species of cosmetids have been described, including three species each for *Cynortula* and *Paecilaema* (Table 1). In *Paecilaema*, but not *Cynortula*, chelicerae are sexually dimorphic (Figs. 1B, 1C). We did not collect specimens of either *Libitiosoma granulatum* or *Vonones testaceus*. Identification of genera and species is difficult owing to the fact that many genera are not well-defined and in many species there can be considerable phenotypic plasticity (Goodnight and Goodnight 1953; Kury and Pinto-da-Rocha 2007). However, in Trinidad, species of *Paecilaema* are much larger than *Cynortula* in scutal length (2-3 mm) and differ in having large posterior spines on the dorsum (Fig. 1G). In addition, the body of *Cynortula* is generally flattened, whereas in *Paecilaema*, the body is sloped, with the abdomen being much higher than the anterior region of the body. The two species of *Cynortula* differ from each with respect to the dorsal pattern (Figs. 1C, 1D). Similarly, in *P. inglei*, the dorsal pattern features small white spots that are absent in *Paecilaema* sp. 2 (Figs. 1D-F). To confirm the identities of the cosmetid species, we will have to examine the holotypes.

With respect to natural history, cosmetids were the most abundant harvestmen in the habitats that we surveyed (Table 2). They are active in the litter day and night, and also occur within or beneath logs, palm frond sheaths, or in bamboo shoots. These harvestmen also occupy crevices in tree buttresses (Burns *et al*. 2007). We collected nymphs for both genera. Immature individuals were recognized by their elongate, non-spatulate (= cylindrical) pedipalps.

Cranaidae

We collected specimens of both cranaid species known for Trinidad (Figs. 1H-L). These species are sexually dimorphic with males having more armature on the femur and tibia of leg IV (Figs. 1H, 1J, 1L). Male *Phareicranaus calcariferus* are smaller in total body length (7.4 - 9.6 mm) than *Santinezia serratotibialis* (9.6 - 11.9 mm) and also lack spines on the ventral surface of coxae IV (Fig. 1K). In addition, male *S. serratotibialis* have more prominent spines on femur IV (Fig. 1H). Female cranaids are difficult to distinguish, although

Table 2. Relative abundance of harvestmen for Mount Tamana (MTT: 10°28'15.5"N, 61°11'50.5"W; WGS84), Petite Tacarib and Grande Tacarib (TAC: 10°47'39"N, 61°13'33"W; WGS84), Lalaja Trace (LTR: 10°44'47"N, 61°15'54"W; WGS84), Salybia (SAL: 10°44'19.3"N, 61°16'16.6"W; WGS84), Trinity Hills (TRI), Tucker Valley (TUV: 10°43'22"N, 61°36'39"W; WGS84), Hollis Reservoir (HOR: 10°41'21.2"N, 61°11'46.6"W; WGS84), Morne Bleu Ridge (MBR: 10°43'53"N, 61°15'08"W; WGS84), and the summit of Mt. Aripo (SMA). +++ = 20+ individuals collected, ++ = 5-20 individuals collected, + = less than 5 individuals.

Taxa	MTT	TAC	LTR	SAL	TRI	TUV	HOR	MBR	SMA
Agoristenidae									
Trinella sp.			+					++	++
Cosmetidae									
Cynortula sp. 1	+++	+++	+++	++	++			++	++
Cynortula sp. 2	+	+++	++			+			
P. inglei	+	+++	+++	+	++	++	+	+	
Paecilaema sp. 2				+			+		
Cranaidae									
P. calcariferus	++	++	+					++	+
S. serratotibialis	+	+	+				+	++	++
Kimulidae									
sp. 1		+							
sp. 2		+							
sp. 3									+
Manaosbiidae									
C. montgomeryi								+++	+++
R. albilineatus	+++	+++	+	++		++	+	+	
Samoidae									
M. trinidadense		+	+						
P. longipalpus			+					+	+
sp. 3		++							
Sclerosomatidae									
P. vitttatum	+++	+++	+		++	++	++	++	++
Prionostemma insulare			++	+			+	+	
Prionostemma sp. 3									+
Stygnidae									
S. clavotibialis	+	+++	+	+			+	+	
Stygnommatidae									
Stygnomma sp.			+						

individuals of *S. serratotibialis* tend to be slightly larger (1-3 mm). With respect to overall body size, cranaids are the largest harvestmen in Trinidad.

Cranaids are inactive during the day, occupying logs or palm frond sheaths. At night, these species climb the vegetation, presumably to forage. Both species reproduce during the wet season and are syntopic. Adults associate with and presumably guard eggs, larvae and nymphs (Hunter *et al.* 2007). We found cranaids to be common in forests with abundant rotting logs or palm frond sheaths and absent from habitats with little ground cover (Table 2).

Kimulidae

We discovered three species for this family in Trinidad. Specimens were collected from leaf litter and decaying logs. Kimulids often exhibit sexually dimorphic traits, with the male possessing a larger, more heavily armed leg IV. Kimulids have a different body shape than samoids and all three species had patterns of alternating light and dark bands (Figs. 2A-E). We are in the process of describing these species. The most useful characters for distinguishing kimulids include spines on the posterior border of the scutum, relative body size, armature on the trochanter and femur of leg IV, and shape of the abdomen. Species 1 (Figs. 2A, 2B) has a pair of spines on posterior margin of the scutum, numerous small spines on leg IV, and a broad abdomen. Species 2 (Fig. 2C) lacks posterior spines on the scutum, has less armature on leg IV and a more elongate abdomen. Species 3 is nearly twice the size (total length = 6.2 mm) of the other kimulids (total length = 3.8 and 3.9 mm, respectively) and has a tapering abdomen with large, prominent spines on the trochanter and femur of leg IV (Figs. 2D, 2E)

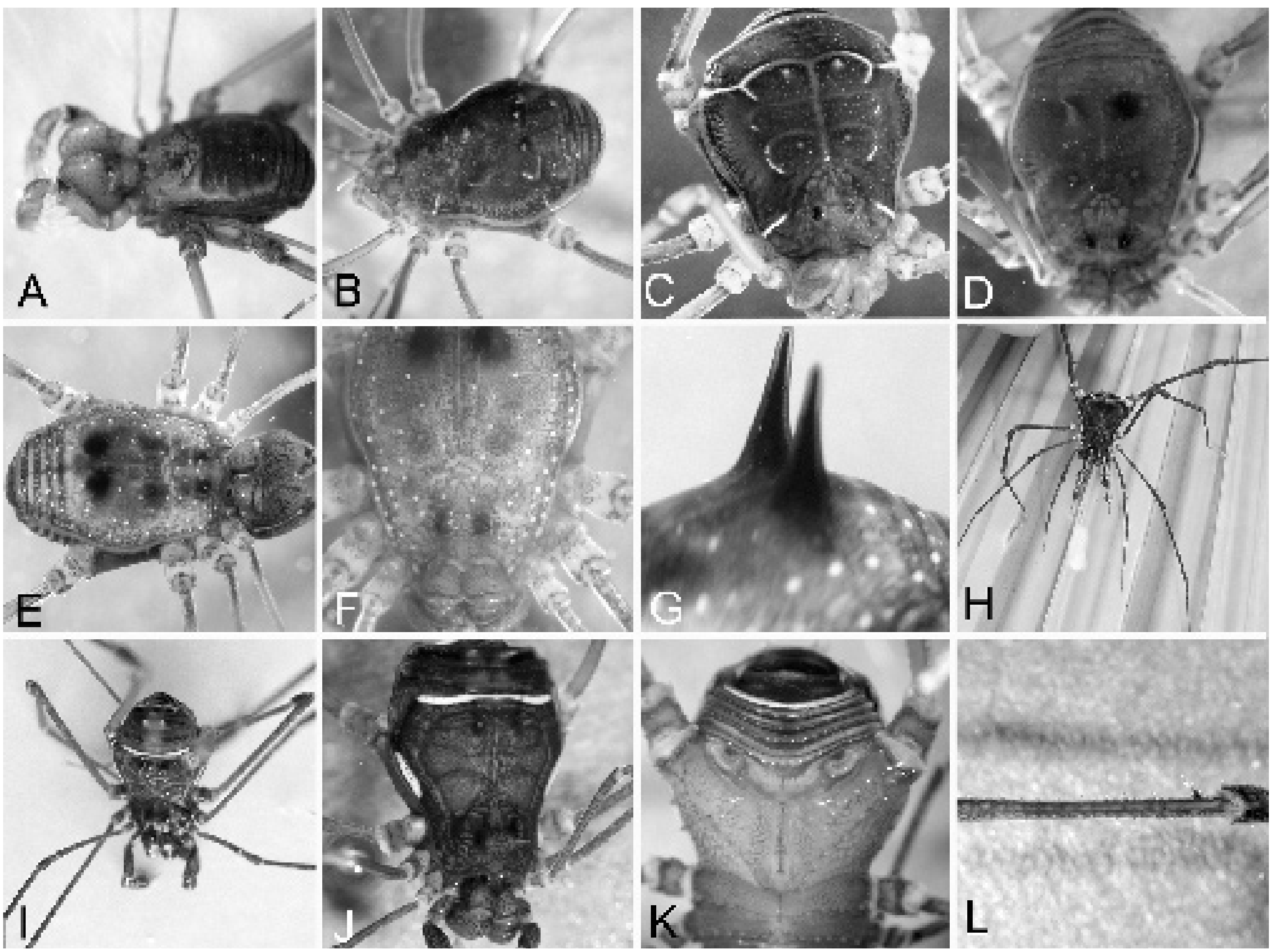

Fig. 1. Photographs of harvestmen from the families Agoristenidae, Cosmetidae, and Cranaidae. **A.** Lateral view of a male *Trinella* sp. (Agoristenidae). **B.** Dorsal view of *Cynortula* sp. 1 (Cosmetidae). **C.** Dorsal view of *Cynortula* sp. 2 (Cosmetidae). **D.** Dorsal view of *Paecilaema* sp. 2 (Cosmetidae). **E.** Dorsal view of a male *Paecilaema inglei* (Cosmetidae). **F.** Dorsal view of a female *P. inglei*. **G.** Lateral view of large spines on the posterior dorsum of a *P. inglei*. **H.** Dorsal view of a male *Santinezia serratotibialis* (Cranaidae). **I.** Dorsal view of a female *S. serratotibialis*. **J.** Dorsal view of a male *Phareicranaus calcariferus* (Cranaidae). **K.** Ventral view of the smooth coxae of leg IV of a male *P. calcariferus*. **L.** Lateral view of tibia IV of a male *P. calcariferus*.

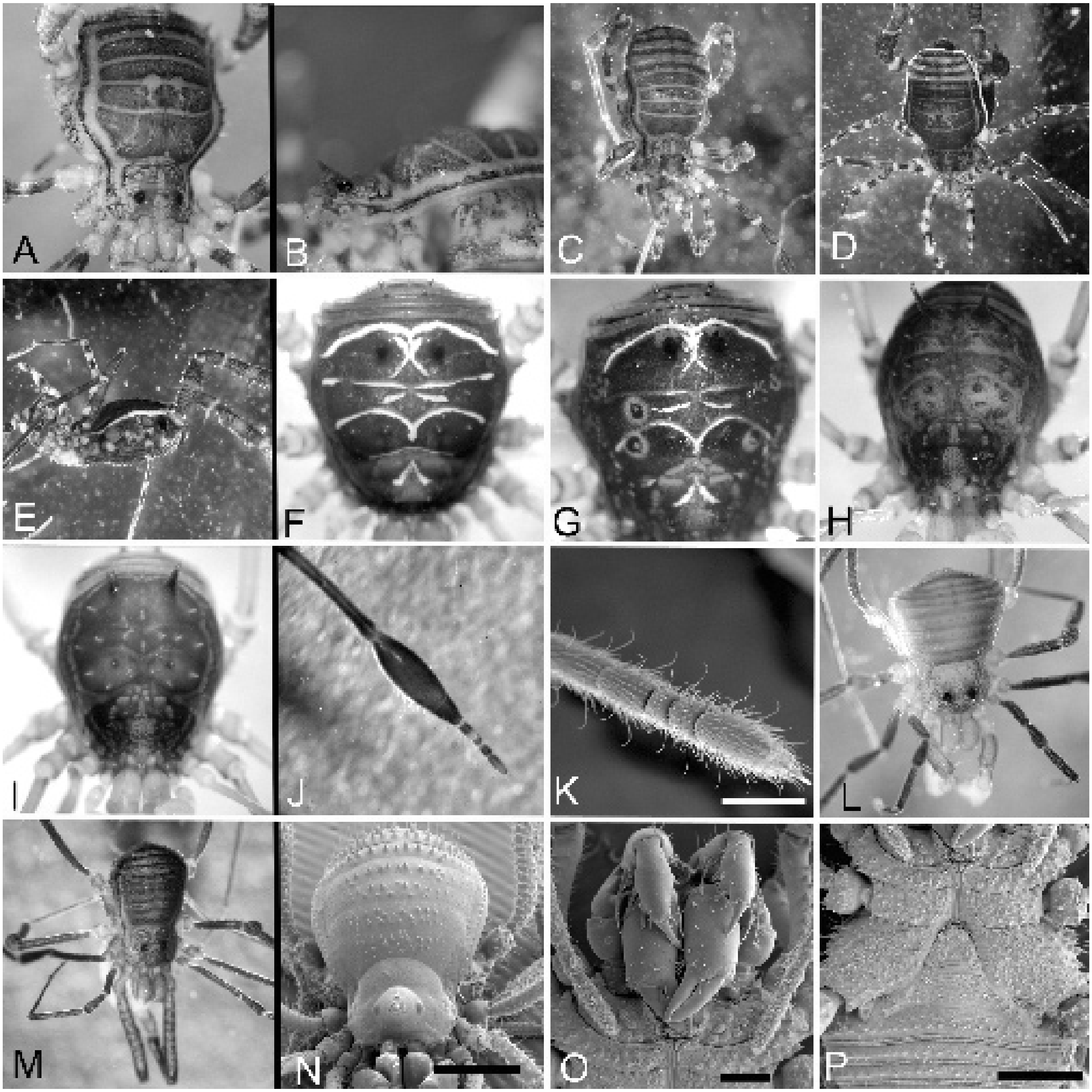

Fig. 2. Photographs and SEM micrographs of harvestmen from the families Kimulidae, Manaosbiidae, and Samoidae. **A.** Dorsal view of undescribed species 1 (Kimulidae). **B.** Lateral view of eye mound and dorsum of kimulid sp. 1. **C.** Dorsal view of undescribed species 2 (Kimulidae). **D.** Dorsal view of undescribed species 3 (Kimulidae). **E.** Lateral view of kimulid sp. 3. **F.** Dorsal view of female *Rhopalocranaus albilineatus* (Manaosbiidae) with typical dorsal pattern. **G.** Dorsal view of male *R. albilineatus* showing unusual pattern (white rings around several dorsal spines) exhibited by individuals captured from Salybia. **H.** Dorsal view of a male *Cranellus montgomeryi* (Manaosbiidae). **I.** Dorsal view of a female *C. montgomeryi*. **J.** Tarsus of leg I of a male *C. montgomeryi* showing spindled morphology. **K.** SEM micrograph of distitarsus of leg I of female *C. montgomeryi*, scale bar = 250 µm. **L.** Dorsal view of *Maracaynatum trinidadense* (Samoidae). **M.** Dorsal view of *Pellobunus longipalpus* (Samoidae). **N.** SEM micrograph of the dorsal view of unidentified species collected from bromeliads (Samoidae), scale bar = 0.5 mm. **O.** SEM micrograph of chelicerae and pedipalps of unidentified samoid, scale bar = 250 µm. **P.** SEM micrograph of the ventral surface of unidentified samoid, scale bar = 0.5 mm.

Manaosbiidae

We collected specimens of both species known for Trinidad (Figs. 2F-K). In this family, the male possess a spindled basitarsus of leg I (Fig. 2J), not exhibited by the female (Fig. 2K). *Rhopalocranaus albilineatus* has a striking pattern or white or yellowish lines on its dorsum. This pattern was consistent across localities with the exception of specimens collected from Salybia (Fig. 2G), which had white rings around 2-3 of the spines, near the mid-dorsum. In contrast, *Cranellus montgomeryi* (Figs. 2H, 2I), has a uniform brown dorsum with light brown legs, and yellowish chelicerae and pedipalps. With respect to distribution, *R. albilineatus* is common (Table 2), whereas *C. montgomeryi* was collected only from Morne Bleu Ridge and the summit of Mt. Aripo (Table 2). In general, we found relatively few manaosbiid nymphs, indicating that these species were not reproducing during our sampling periods or that nymphs occupy microhabitats that were not sampled.

Samoidae

We collected few specimens of both known species for this family as well as five specimens for a third, probably new, species (Table 2). Samoid harvestmen are relatively small (less than 5 mm total body length) and can be differentiated from kimulids on the basis of the armature and relative size of the leg IV. The three samoid species differ with respect to the length of the femur of the pedipalps (Figs. 2L, 2M, 2O). In *Pellobunus longipalpus*, the femur of the tibia is very long (Fig. 2M). *Maracaynatum trinidadense* (Fig. 2L) differs from the unidentified species with respect to eye mound morphology (not cone-shaped) and morphology of leg IV. The unidentified species was collected from canopy bromeliad samples. We are in the process of describing this species.

Sclerosomatidae

We collected *Prionostemma vittatum, P. insulare* and an additional species of *Prionostemma*. Five species for this family are known for Trinidad (Table 1). *Prionostemma vittatum* (Figs. 3A, 3B) differs from others in having lightly colored coxae, with a dark eye mound, and broken or complete black lines on its dorsum. It is one of the most common harvestmen on Trinidad (Table 2). *Prionostemma insulare* (Figs. 3C, 3D) has black coxae and trochanters and a darker dorsum. The undescribed species (Figs. 3E, 3F) was only found at the summit of Mt. Aripo. This species had white patches on the lateral surfaces of the abdomen (Fig. 3E) and the trochanters had four light spots each (Fig. 3G). We did not collect individuals of *Holcobunus*, *P. fulginosum* (gold flecks on its dorsum), or *P. referens*.

We observed *P. vittatum* feeding upon dipteran larvae, conspecifics, fruit and floral parts. This species is active in the litter day and night. We observed one mass aggregation of thousands of individuals beneath the PAX Guesthouse.

Stygnidae

We collected *Stygnoplus clavotibialis* from several locations (Table 2). Males possess large chelicerae (Fig. 3H) in comparison to females (Fig. 3I). The chelicerae of females exhibit a clipper-like morphology (Fig. 3J). In males, they have a pliar-like morphology (Fig. 3K). As in agoristenids, the first leg is filiform (Figs. 3M, 3N), however, in stygnids, the dorsum is adorned with large spines and the eyes are not on a common mound.

Individuals were collected from logs and the surfaces of tree buttresses, but were not found in the leaf litter. We observed two aggregations (25 and 32 individuals) of adults and nymphs in 2005 (Burns *et al*. 2007). At night on the Morne Bleu Ridge, we observed a solitary individual moving to different locations on the underside of a large leaf and remaining still for several minutes at a time. This behavior may indicate active searching for prey or a mate.

Stygnommatidae

We collected a single adult male (Figs. 3L-O) from beneath a log at Lalaja Trace (Table 2). In contrast to other species, *Stygnomma* sp. is unique in having massive chelicerae (Fig. 3M) that tower above the body (Fig. 3N) and robust pedipalps (Fig. 3O) and legs.

Zalmoxidae

We did not collect any specimens for this family during our study. However, we did borrow and photograph the holotype (Fig. 3P) from the AMNH collection. This holotype was either a female or sexually immature.

SUMMARY

Although many species are widely distributed in Trinidad, there were several harvestmen that we found in only one location. These taxa included species from the families Kimulidae, Samoidae, Sclerosomatidae, and Stygnommatidae. Owing to small sample sizes (n < 10), inferences regarding the distribution and status of these species are limited. Given our collection methods, we may have undersampled small species in the leaf litter. For taxa that were locally abundant in only a few locations, i.e., *Cranellus montgomeryi*, samoid species 3, *Prionostemma* sp. 3, and *Trinella* sp., we propose the hypothesis that these species may have specific habitat or microhabitat preferences. In addition, the collection of the unidentified samoid species from only tank bromeliad samples, indicates that this spe-

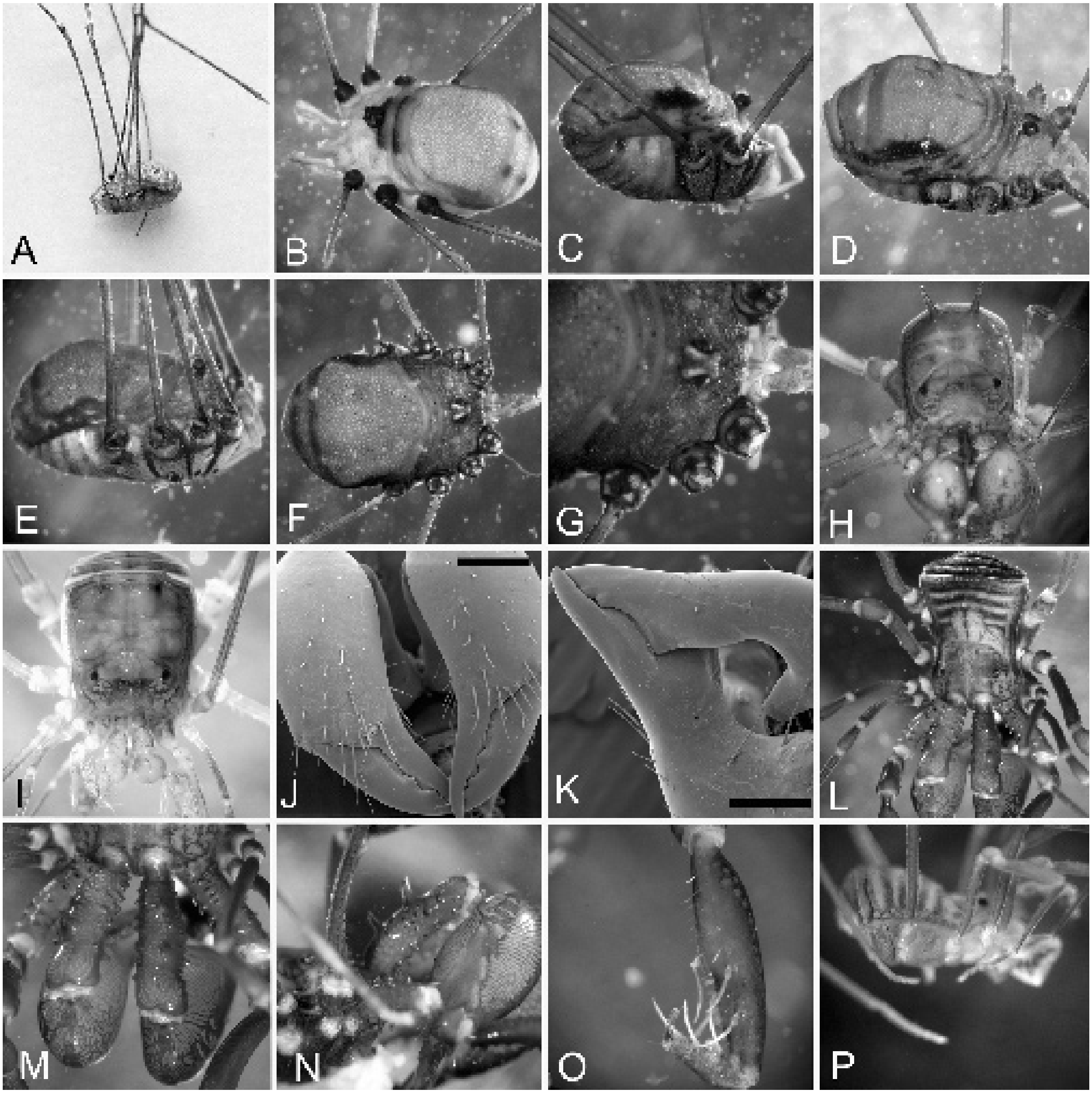

Fig. 3. Photographs and SEM micrographs of harvestmen from the families Sclerosomatidae, Stygnidae, Stygnommatidae, and Zalmoxidae. **A.** Lateral view of *Prionostemma vittatum* (Sclerosomatidae). **B.** Dorsal view of *P. vittatum*. **C.** Lateral view of *P. insulare*. **D.** Dorsal view of *P. insulare*. **E.** Lateral view of undescribed species of *Prionostemma* from Mt. Aripo. **F.** Dorsal view of undescribed sclerosomatid. **G.** Dorsal view of the trochanters of undescribed sclerosomatid. **H.** Dorsal view of a male *Stygnoplus clavotibialis* (Stygnidae). **I.** Dorsal view of a female *S. clavotibialis*. **J.** SEM micrograph of the chelicerae of a stygnid female, scale bar = 250 µm. **K.** SEM micrograph of a chelicera of a stygnid male, scale bar = 0.5 mm. **L.** Dorsal view of *Stygnomma* sp. (Stygnommatidae). **M.** Dorsal view of the chelicerae of *Stygnomma* sp. **N.** Lateral view of the chelicerae of *Stygnomma* sp. **O.** Ventral view of the pedipalp of *Stygnomma* sp. **P.** Lateral view of the AMNH holotype of *Ethobunus tuberculata* (Zalmoxidae).

cies may be a specialist within phytotelmata.

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Appendix

Taxonomic Key to the Families of Harvestmen Occurring in Trinidad and Venezuela

The following is a dichotomous key that can be used to identify harvestmen to family and is based upon those published by Kury and Pinto-da-Rocha (2002), Pinto-da-Rocha and Giribet (2007), and Kury (2007). Of the 13 families included in this key, only 10 are presently known from Trinidad. The families Guasiniidae and Icaleptidae (Kury and González 2007) occur in Venezuela. The family Biantidae is known from several islands in the Caribbean.

1. Single tarsal claw present on legs I-IV.......... 2
   Single tarsal claw present on legs I and II, two tarsal claws on legs III-IV.......... 3
2. Legs relatively long and slender, pedipalps slender and unarmed, eyes present on eye mound.......... **Sclerosomatidae**
   Legs shorter, pedipalps short and thick, eyes absent.......... **Guasiniidae**
3. Eye mound not separated, may have eminence between eyes (Figure 4A).......... 4
   Eye mound separated into 2 distinct parts.......... 11
4. Tarsal process (legs III-IV) present (Figure 5).......... 5
   Tarsal process absent.......... 7
5. Eye mound depressed between eyes and armed with large spines (Figure 4B); large body size, 8-13 mm scutal length.......... **Cranaidae**
   Eye mound not depressed (Figure 4C), may be armed; body size 7 mm or less.......... 6
6. Pedipalps are spatulate (Figure 4D), male basitarsus I not spindled.......... **Cosmetidae**
   Pedipalps are not spatulate, male basitarsus I spindled (Figure 4E).......... **Manaosbiidae**
7. Dorsal scutum with parallel lateral margins; leg I filiform.......... **Agoristenidae**
   Opisthosoma much wider than prosoma (Figure 4F); leg I not filiform.......... 8
8. Coxa IV inserted ventrally, eye mound large and unarmed and rises directly from frontal margin of carapace..........**Icaleptidae**
   Coxa IV inserts laterally, eye mound may be armed, not rising from frontal margin..........9
9. Prosoma slightly shorter than rest of the dorsal scutum; dorsal surface of body and legs without alternating light and dark bands..........**Samoidae**
   Prosoma much shorter than rest of the dorsal scutum; body with alternating light and dark bands..........10
10. Legs robust with light and dark bands; eye mound armed; coxae of leg IV of male visible from above; total body length 3.8 – 6.2 mm..........**Kimulidae**
    Legs slender and not banded; small body size (2.1 mm total length).......... **Zalmoxidae**
11. Chelicerae very large (almost equal to body length); dorsum smooth, clock-shaped, unarmed; large, robust pedipalps, no spine between eyes..........**Stygnommatidae**
    Chelicerae large in males only (less than 50% of body length), dorsum may be armed with posterior spines, pedipalps are long and slender..........12
12. Tarsal process (legs III-IV) present.......... **Stygnidae**
    Tarsal process absent.......... **Biantidae**

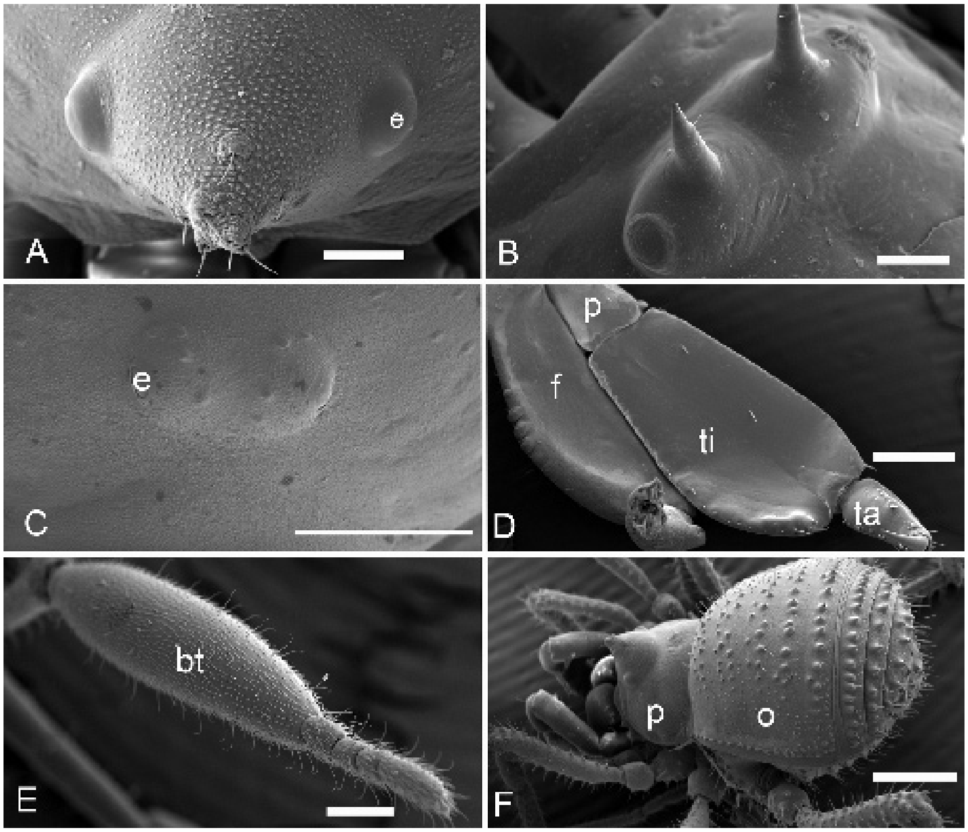

Fig. 4. Scanning electron micrographs of major morphological characters of harvestmen. **A.** Eye mound of a samoid harvestman with eminence between the eyes (e). **B.** Armed eye mound of a cranaid harvestman with a central depression. **C.** Unarmed, smooth eye mound of a cosmetid harvestman (e). **D.** Ventral view of the pedipalp of a cosmetid harvestman revealing the flattened, spatulate condition of the femur (f), patella (p), tibia (ti), and tarsus (ta). **E.** Basitarsus (bt) of leg I of a manaosbiid harvestman. **F.** Lateral view of a samoid harvestman. Note the significant difference in the width of the prosoma (p) and opisthosoma (o). Scale bars are 0.5 mm for C, D, and F; 100 µm for A; 150 µm for B; and 250 µm for E.

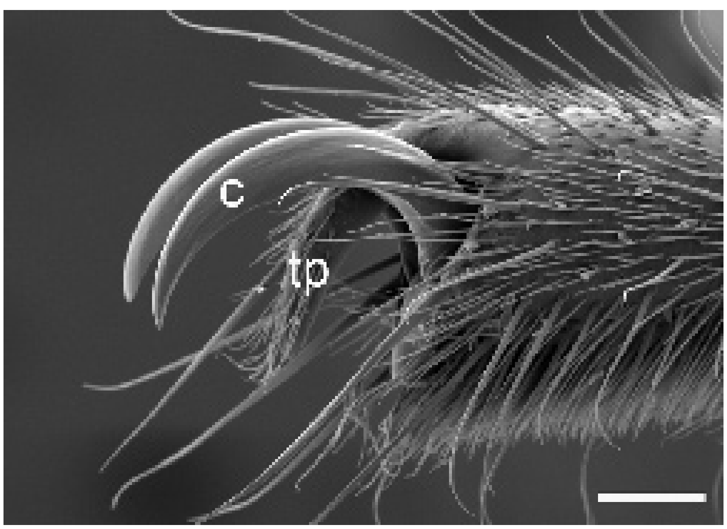

Fig. 5. Scanning electron micrograph of tarsal process (tp) and claws (c) on the third leg of an adult male *Santinezia serratotibialis*. Scale bar = 150 μm.

A Preliminary Survey for Spiders on St. Kitts, West Indies with Comparative Notes on Nevis

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ABSTRACT
A survey of the spider fauna of the island of St. Kitts, West Indies was carried out in early 2007 and compared with those found on the neighbouring island of Nevis in 2006. Eighteen localities in 17 habitats were sampled both natural and influenced by human activities. Specimens were collected by implementing visual search and sweep-netting techniques. Spiders were also collected from the nests of the mud-dauber wasps *Sceliphron* sp. The survey produced 36 species in 15 families, with human influenced habitats exhibiting higher species diversity than natural habitats on both islands, and six additional species not found on Nevis. The families Araneidae and Tetragnathidae also contained a majority of the species found on both islands.

Key words: Spiders, St. Kitts, Nevis, web-building, Araneidae, Tetragnathidae.

The distribution and habitats of spider fauna in the West Indian islands are poorly known. Lists to the species level are available only for Barbados (G. Alayón and J. Horrocks unpubl.), Cuba (Alayón 1995), Nevis (Sewlal and Starr 2007), Grenada (J. N. Sewlal unpubl.) and Anguilla (J. N. Sewlal and C. K. Starr unpubl.). The spiders of Trinidad have been surveyed at the family level (Cutler 2005; Sewlal and Alayón 2007; Sewlal and Cutler 2003), but at the species only for the Salticidae (Cutler and Edwards 2002).

During 26 January to the 9 February, 2007, I spent two weeks on the island of St. Kitts conducting a survey of its spider fauna with the aim of collecting a substantial part of the spider fauna in a broad variety of habitats. St. Kitts and its sister isle Nevis are located in the northern Leeward Islands in the Eastern Caribbean (17°20'N 62°45'W), separated by a 3 km wide channel called The Narrows. St. Kitts has an area of 168 km^2. It has a central point and the highest elevation on the island of approximately 1156 m. It has a range of natural and secondary habitats including; rainforest, secondary forest, dry evergreen forest, palm brake, elfin woodland, dry forest, farmland, pastureland, caves and salt ponds (Lindsay and Horwith 1999).

During this survey, 18 localities covering 17 habitats were sampled, including four that were man-made or heavily influenced by human activities. Eight more habitats were sampled in St. Kitts than in Nevis, because some were only available on this island, for example, salt ponds and caves. The main collecting method employed was through visual search, both at the ground level and above ground, including in shrubs and low trees and sweep-netting. The nests of mud-dauber wasps that hunt spiders to provision their nests also proved to be a valuable source of spiders (Krombein 1967). Therefore, nests of mud-dauber wasps of the genus *Sceliphron* sp. were collected and dissected as a means of obtaining species that would have escaped detection using the previous two methods. In addition, cryptic microhabitats, such as, under rocks and rotting logs, were also searched.

Voucher specimens were deposited in the Land Arthropod Collection of the University of the West Indies, St. Augustine, Trinidad and Tobago. A synoptic collection of the common species on the island was left at the St. Christopher Heritage Society.

The sampling effort produced a total of 15 families. Overall, natural habitats had less species than those that were man-made. Roadside vegetation as well as abandoned buildings and stone structures (mostly ruins from abandoned sugar estates) produced the highest number of species with 12 out of 36 species. However, on Nevis, garden and secondary forest habitats yielded the most species, with 13 and 11 respectively. The palm brake yielded the only one species and two on Nevis. This is to be expected as altered habitats provide suitable frequency and presence of 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. Both of these requirements are met by roadside habitat where nine of the 12 species found there build webs. Another feature of most altered habitats, in particular gardens and roadside vegetation, is the presence of artificial lighting which during the night attracts flying insects so that nocturnal species have a relatively steady food supply.

Almost half of the species found belonged to the orb-weaving families Araneidae and Tetragnathidae both in St. Kitts and neighbouring Nevis. Therefore it came as no surprise that the most ecologically diverse species found also belong to these families. This included *Leucauge regnyi* and *Metepeira compsa* which were recorded from 12 and 9 habitats respectively. Whereas, *L. regnyi* was also the second most ecologically diverse species recorded in Nevis.

It should also be noted that although no specimens from the Mygalomorphae group were collected, their presence on the island is indicated by holes in the ground often in gardens. This species most likely is of the family Theraphosidae and is commonly referred to as “Donkey Spiders”. However, their presence was not as abundant as on Nevis.

No species were found in caves most likely because they were not very extensive and the walls quite smooth therefore not providing many crevices for such cave dwelling families as Pholcidae and Scytodidae.

On reviewing observations made in Nevis, the characteristic pattern of webbing radiating from the entrances of burrows made by the family Filistatidae in rocky crevices, was also seen in Nevis in the ruins of old sugar plantations particularly in the base of windmills. However, this family was not recorded in Sewlal and Starr (2007).

An important source of potential bias is in the collecting method, which was directed mainly toward species that can be seen under ordinary circumstances. This undoubtedly accounts for the heavy preponderance of web-building spiders, especially of the orb-weaving families.

Six additional species were found in St. Kitts and not on Nevis. This does not indicate endemism as sampling was carried out in more habitats and better weather conditions allowed for a more thorough collection on St. Kitts.

While the results represent a good beginning, the use of methods suited to collect leaf-litter-dwelling and other cryptic spiders can be expected to yield many additional records.

ACKNOWLEDGEMENTS

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Family and Species	Habitat																
	Palm brake	**Elfin woodland**	**Garden**	**In and around houses**	**Caves**	**Cultivated land**	**Coastal**	**Abandoned buildings / ruins**	**Vegetation around salt ponds**	**Dry evergreen forest**	**Rainforest**	**Roadside**	**Sec. forest**	**Dry forest**	***Sceliphron* nests**	**Pastureland**	**Scrubland**
Araneidae																	
Araneus sp.									✓								
Argiope argentata				✓			✓	✓				✓				✓	✓
Argiope trifasciata							✓										
Chrysometa sp.						✓					✓						
Cyclosa walkenaeri												✓				✓	
Eustala fuscovitta						✓											
Eustala sp.			✓					✓									
Gasteracantha cancri-formis			✓			✓		✓	✓	✓		✓		✓		✓	
Kapogea sp.												✓					
Metepeira compsa			✓	✓		✓	✓	✓	✓			✓				✓	✓
Neoscona sp.							✓					✓				✓	
Ctenidae																	
Sp. A				✓													
Filistatidae																	
Kuhukania hibernalis										✓							
Linyphiidae																	
Sp. A						✓											
Miturgidae																	
Sp. A			✓	✓				✓							✓		
Oxyopidae																	
Oxyopes salticus							✓									✓	✓
Sp. A							✓		✓			✓					
Pholcidae																	
Modisimus sp.										✓	✓		✓				
Physocyclus globosus				✓				✓									
Salticidae																	
Corythalia sp.									✓								
Hentzia sp.			✓	✓				✓	✓			✓				✓	
Menemerus bivittatus				✓													
Scytodidae																	
Scytodes fusca								✓							✓		
Scytodes longipes								✓									

Family and Species	Habitat																
	Palm brake	**Elfin woodland**	**Garden**	**In and around houses**	**Caves**	**Cultivated land**	**Coastal**	**Abandoned buildings / ruins**	**Vegetation around salt ponds**	**Dry evergreen forest**	**Rainforest**	**Roadside**	**Sec. forest**	**Dry forest**	***Sceliphron* nests**	**Pastureland**	**Scrubland**
Segestriidae Sp. A								✓									
Sparassidae *Olios* sp.			✓	✓		✓	✓	✓		✓		✓				✓	
Theraphosidae Sp. A			✓														
Theridiidae *Argyrodes elevatus*			✓			✓	✓		✓			✓					✓
Latodectus geometricus							✓										
Theridion sp.						✓											
Thymoites sp.											✓						
Thomisidae *Misumenops* sp. A			✓				✓					✓				✓	
Tetragnathidae *Leucauge argyra*						✓			✓			✓				✓	
Leucauge regnyi	✓	✓	✓	✓		✓	✓	✓		✓	✓		✓	✓		✓	

Fifth Report of the Trinidad and Tobago Rare Birds Committee: Rare Birds in Trinidad and Tobago 2006 and 2007

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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. The Committee has now assessed all records submitted during 2006 and 2007. In all, 103 records were adjudged, representing 63 different species. As a result of these submissions, three additional species have been added to the Official List of Birds of Trinidad and Tobago, bringing the running total to 468 species. Additionally, a further four species have been found on Tobago for the first time. Of those assessed, in only eight cases did the Committee feel that the identification had been inconclusive. The records tabulated below follow the nomenclature and taxonomic order of the American Ornithologists Union South American checklist; 10th version February, 2006.

The Committee comprises the following members: Martyn Kenefick (Secretary), Richard ffrench, Geoffrey Gomes, Floyd Hayes, Bill Murphy, Courtenay Rooks and Graham White. Archived records including photographic submissions are held at 36 Newalloville Ave., San Juan.

We are aware that a number of other rare birds are found each year in Trinidad and Tobago (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 can be accessed, together with our Photo Gallery, from the home page of the Trinidad and Tobago Field Naturalists' Club at *www.wow.net/ttfnc*

RECORDS ACCEPTED

A non-breeding plumaged **American Wigeon, *Anas americana*** was found at Bon Accord sewage ponds, on 2 December, 2007 (MK *et al*.). This is the fourth record in the last 12 years, all from Tobago.

Two adult male and one female **Ring-necked Ducks, *Aythya collaris*** were found on a narrow freshwater pool within the Hilton Hotel complex at Lowlands, Tobago on 6 February, 2006 (PC, MK). In all, 12 birds have been found since 1995, all in Tobago.

Two female **Lesser Scaup, *Aythya affinis*** accompanied the Ring-necked Ducks mentioned above, at Lowlands, Tobago on 6 February, 2006 (PC, MK), until 12 March, at least. This remains a rare visitor with just five birds found since 1995.

Up to three **Trinidad Piping-Guans, *Pipile pipile*** were periodically seen close to the telecommunications station at Morne Bleu from the beginning of 2007; photographed on 4 March, and reported until end April at least. (AM, GW *et al*.). There are undocumented reports of the same birds being present from 22 October - mid December. Perhaps two of this same group were birds found at Las Lapas on 21 October, (MK, GW, PB) .

An adult **Rufescent Tiger-Heron, *Tigrisoma lineatum*** on 20 August, 2006 (MK) and a sub-adult on 26 October, 2006 (GW) were both found at a recognized freshwater swamp - forest site in the Aripo savannah. On 29 October, 2006 an adult was present at Los Blanquizales (FO). This latter report is the first documented record of this species from south Trinidad.

A sub-adult **Gray Heron, *Ardea cinerea*** was found at Caroni rice project on 5 May, 2006 (MK) and is the sixth record for T&T, and the fifth since 1999.

An adult **Cocoi Heron, *Ardea cocoi*** found at Bon Accord sewage ponds on 5 February, 2006 (PC, MK) and photographed at Turtle Beach in May, 2006 (DH) is the fourth record for Tobago.

A **Glossy Ibis, *Plegadis falcinellus*** was found feeding in a shallow creek close to Sudama steps, South Oropouche on 30 May, 2006 (HK). This is the first documented record of this species since 2002.

Three immature **Greater (Caribbean) Flamingos, *Phoenicopterus ruber*** were found feeding on the tidal mudflats at Waterloo on 11 October, 2006 (MK). Additionally, there are several unsubstantiated reports of "up to 25" birds occasionally seen in the Carli Bay area.

An adult **Hook-billed Kite, *Chondrohierax uncinatus*** was seen at Lowlands, Tobago on 10 January, 2006 (BM *et al*.). This is just the fourth record for the island. On the following day, an immature was found at Sudama steps, South Oropouche (MK, HK).

A single **Crane Hawk, *Geranospiza caerulescens*** was seen flying north, close to Freeport on 30 December, 2005 (NL). On 5 January, 2006, one was seen over the Arima By-pass (BM *et al*.) and on 28 January, 2006, two adults were seen together at Waller Field (MK). The destruction of habitat to prepare for industrialization at this latter site has undoubtedly caused this species to move away from this regular (and possible breeding) site. On a more positive note, three birds were found along Wilson Rd., Barrackpore on 8 December, 2007 (KS), the first record for south Trinidad.

An adult and an immature **Rufous Crab-Hawk, *Buteogallus aequinoctialis*** were seen at Carli Bay on 29 - 30 January, 2006 (NL, GW). What is presumably the same young bird was seen again on 11 November, 2006 (GGo) and possibly the same adult was present further up the coast at Brickfields on 3 March, 2007 (DS). At Guayaguayare, an adult was found on 22 February, 2006 in roadside mangrove (MK, GG); at North Manzanilla, an adult was found on 15 September, 2006 (GW, MK) and finally an adult was seen at the Moruga river mouth on 21 July, 2007 (FL). Despite the flurry of sightings in recent years, this bird remains a rare resident of Trinidad mangrove.

An adult and an immature **Great Black-Hawk, *Buteogallus urubitinga*** were soaring over Edward's Trace, just north of the Trinity Hills on 22 February, 2006 (GGo, MK) and a sub-adult was found and photographed at Nariva on 16 December, 2006 (CR). Whilst regularly seen over north-eastern Tobago, this species remains a rare resident in Trinidad.

A light morph immature **Swainson's Hawk, *Buteo swainsoni*** was seen on four occasions between 29 October - 14 November, 1999 on Chacachacare (FH *et al*.). This is just the sixth record for T&T; there have been none found since.

A **Zone-tailed Hawk, *Buteo albonotatus*** both seen and photographed on 11 December, 2006 at Barbados Beach, Tobago (MI, GJ) and subsequently widely reported, constitutes the first record for Tobago.

A single **Black Hawk-Eagle, *Spizaetus tyrannus*** was seen soaring over the disused airport site at Waller Field on 5 January, 2006 and, close by, a pair was seen attempting to mate on 28 January, 2006 (MK). The destruction of suitable habitat at this site in favour of the industrial park complex has eliminated any chance of breeding in the area. Elsewhere, an adult was photographed near Penal on 27 August, 2006 (KS); an adult was found near Lower Fishing Pond on 5 September, 2006 (MK, GW); a sub-adult was seen soaring over Siparia Forest Reserve on 18 August, 2007 (HK) and an adult photographed perched close to Pt. Fortin on 29 December, 2007 (KS).

An adult **Crested Caracara, *Caracara cheriway*** was seen at Caroni rice project on 30 December, 2005 (NL) and another at Aripo Agriculture Station on 6 January, 2006 (BM *et al*.). All remaining sightings of this species were from the palm lined coastal road between Manzanilla Beach Facility and the mouth of the Nariva River with an adult seen on 18 February, 2006 (GGo), an immature on 13 November, 2006 (GGo) and another adult on 9 October, 2007 (MK, BM).

An immature male **American Kestrel, *Falco sparverius*** was found hovering over the M2 Ring Road, south of La Romaine on 26 June, 2007 (HK). This is the first documented record for at least 11 years.

Single immature **Aplomado Falcons, *Falco femoralis*** were found hunting over Caroni rice project on 10 August, 2006 (MK, GW) and Kernaham on 9 October, 2007 (MK, BM). This brings the total of this scarce visitor to 13 birds found in the last 12 years.

A **Rufous-necked Wood-rail, *Aramides axillaris*** was photographed at Cacandee on 26 March, 2007 (RA). This species remains a rare resident in Trinidad, with all recent records coming from the mangrove lined west coast.

An **American Coot, *Fulica americana*** found at Bon Accord sewage ponds on 4 - 5 February, 2006 (MK) is only the fifth documented record for T&T, all from Tobago. We are aware of several undocumented reports and photographs. Due to its close similarity, and elsewhere hybridizing with Caribbean Coot, we urge all reports of this species to be submitted.

A **Double-striped Thick-knee, *Burhinus bistriatus*** was photographed at the Hilton golf course complex, Lowlands on 25 February, 2007 (DA). This is the first sighting in the last 10 years and only the second for Tobago.

A **Killdeer, *Charadrius vociferus*** was photographed at Lowlands Estate, Tobago on 10 January, 2006 (PE, BM *et al*.). This is just the third record in the last 12 years. There are undocumented reports that it remained in the area for several months.

An **American Oystercatcher, *Haematopus palliatus*** was found on the rocky shoreline of Little Tobago island on 25 February, 2007 (BM *et al*.). This is just the third record for Tobago.

A **Marbled Godwit, *Limosa fedoa*** was photographed on the tidal mudflats at Orange Valley on 18 August, 2006 (NL). This is the first sighting for six years.

An **Upland Sandpiper, *Bartramia longicauda*** was found in a flooded pumpkin field south of Caroni Rice Project on 16 September, 2007 (GW, MK). Still truly rare, there have been only three birds found since 2001.

Three adult **Buff-breasted Sandpipers, *Tryngites subruficollis*** were found in a burnt, ploughed field in Caroni Rice Project on 5 May, 2006 (MK, GW) and two birds were seen feeding on the short grass at Bon Accord sewage ponds, Tobago on 2 October, 2007 (BM *et al*.). Whilst still a scarce and sought after passage migrant, there have now been a total of 34 seen in the last 12 years.

An immature female **Ruff, *Philomachus pugnax*** was present at Caroni Rice Project from 30 Sept - 1 October, 2000 (FH *et al*.). Additionally, an immature male was seen varyingly at Caroni rice project and Orange Grove between 7 - 14 December, 2000 and an un-aged bird was found at Lowlands, Tobago on 22 December, 2000 (FH *et al.*). On 23 September, 2001, an immature female was found at Caroni Rice Project (FH, MK) and on 9 December, 2005 an immature male was found and photographed at Caroni Swamp (JD, BP). Still a truly uncommon passage migrant, there have now been a total of 10 birds found in the last seven years.

An immature **Wilson's Phalarope, *Phalaropus tricolor*** was photographed at Bon Accord sewage ponds on 3 August, 2006 (per NG). This is the second record for Tobago and the fifth for T&T. It is also the earliest recorded date for this very rare migrant (previously 28 August).

An adult **Black-headed Gull, *Larus ridibundus*** was found at Waterloo between 3 - 17 Febuary, 2001 (FH, NL). This is just the sixth record of this species in the last 12 years.

A first winter plumaged **Sabine's Gull, *Xema sabini*** was photographed at Waterloo on 27 January, 2002 (NH, FH, *et al.)*. This is just the second record for T&T.

A group of 16 adult **Black Skimmers, *Rynchops niger*** were found at Bon Accord sewage ponds on 13 August, 2005 (MK). Undocumented reports indicate the flock was initially at least 22 earlier in the month. The first record of this species for Tobago was from this site as recently as September, 2004. During 2007, there were numerous reports of a flock totaling at least 60 birds through much of August - September (many obs), with a party of nine still present 4 December at least (MK).

An immature male **Blue Ground-dove, *Claravis pretiosa*** was seen and photographed at Surrey Village, Lopinot Rd. on 11 December, 2007 (GW). This remains a rare and infrequently encountered resident in Trinidad.

A **Dark-billed Cuckoo, *Coccyzus melacoryphus*** repeatedly visited a private garden behind Diego Martin during August, 2006 (per GGo). This is just the third record for Trinidad in the last 12 years.

Three individual **Striped Owls, *Asio clamator*** were recorded in Tobago during the review period - at Bloody Bay, 19 January, 2005 (MKe); Runnemeade 10 January, 2006 and near Scarborough 13 January, 2006 (BM *et al.*). This remains a rarely seen resident on the island.

A **Lesser Nighthawk, *Chordeiles acutipennis*** was found hawking insects at dusk over Bon Accord sewage ponds on 11 December, 2006 (MK). This is the first documented record for Tobago.

A male **Blue-tailed Emerald, *Chlorostilbon mellisugus*** frequented a Surrey Village, Lopinot Rd. garden during June and July, 2007 before being joined by a female on 20 July (GW). This is the easternmost documented record of this species in Trinidad.

A female **Ringed Kingfisher, *Megaceryle torquata*** was found at Bon Accord on 16 June, 2007 (NG). This is the first record for Tobago.

A **Scaled Antpitta, *Grallaria guatimalensis*** was found on the upper Blanchisseuse Rd., just above Paria junction on 8 January, 2006 (MK, NH). There are undocumented sightings of this individual in the same area for several weeks thereafter.

Small-billed Elaenia, *Elaenia parvirostris.* At least two different birds were present and photographed in a Surrey Village, Lopinot Rd. garden on 18 September, 2006 and from 11 June - 30 September, 2007 (GW, MK). This is an austral migrant and the first sighting in Trinidad for at least 40 years.

A **Variegated Flycatcher, *Empidonomus varius*** was found and photographed on the lower Blanchisseuse Rd., below Paria junction on 7 December, 2007 (MK, DR, BH). A total of eight have now been recorded since 2000.

An unprecedented total of 12 **Black-whiskered Vireos, *Vireo altiloquus*** were found during this review period. On 22 February, 2006, two birds were found along Edwards Trace, Trinity Hills (MK, GGo). Singles were then found at Surrey Village, Lopinot Rd. on 14 January, 2007 (MK, GW) and Galera Pt. on 30 January, 2007 (MK). A group of three birds fed in a fruiting tree along Montevideo Trace, Grande Riviere on 1 February, 2007 (MK). During October, 2007, single birds were found at Morne Bleu and Paria junction on the 7th (MK, BM) and Aripo Agriculture Station on the 10th (MK). All these birds are considered the race *bonairensis*. A brighter plumaged individual found at the top of the Blanchisseuse Rd. on 23 October (MK) is likely to be of the race *barbadensis*. Finally, an individual seen and photographed on Little Tobago island on 18 May, 2007 (RJ) is just the third record for Tobago.

An adult male **Caribbean Martin, *Progne dominicensis*** accompanied Gray-breasted Martins perched on utility wires along Edwards Trace, Trinity Hills on 22 February, 2006 (MK, GGo). This is the first documented record for south Trinidad.

A **Bank Swallow, *Riparia riparia*** was found feeding with a party of Barn Swallows over Bon Accord sewage ponds on 23 April, 2006 (MK *et al.*). This is the second record for Tobago.

An adult **Cliff Swallow, *Petrochelidon pyrrhonota*** was found at Bon Accord sewage ponds, Tobago on 29 December, 2006 - 1 January, 2007 (NS). This was followed by an unprecedented passage with up to seven, an adult and six immatures, hunting over the freshwater marshes at Sudama Steps between 1 - 6 March, 2007 (MK, BM) and a further adult again at Bon Accord sewage ponds on 18 March, 2007 (MK, GJ).

A group of 33 **Lined Seedeaters, *Sporophila lineola*** including five adult males, were found beside an area of freshwater marsh west of Sudama Steps on 27 September, 2007 (MK). This is the first record of this species for

T&T. At least 30 were still present and photographed the following day (GW) and a lone male was found nearby on 18 October, (MK, HK).

An adult male **Yellow-bellied Seedeater, *Sporophila nigricollis*** was found at Surrey Village, Lopinot Rd. on 14 May, 2006 (GW). This is just the third recorded away from the Bocas Is. in the last 12 years.

Two **Rose-breasted Grosbeaks, *Pheucticus ludovicianus*** were found at Asa Wright Nature Centre during the review period; an adult male on 22 April, 2006 (AMcG) and an adult female on 11 April, 2007 (RAt). Of the nine records of this rare migrant during the last 12 years, all but two have been seen between 7 March - 22 April.

An immature male **Summer Tanager, *Piranga rubra*** was found along the upper Blanchisseuse Rd. on 26 April, 2007 (MK *et al.*) and an adult male at Las Lapas on 3 December, 2007 (GW).

An adult male **Scarlet Tanager, *Piranga olivacea*** was photographed at Asa Wright Nature Centre on 16 April, 2006 (MK, WP). All eight spring records of this rare migrant have been between 8 - 28 April.

A **Black-and-white Warbler, *Mniotilta varia*** was found along the upper Blanchisseuse Rd. on 10 October, 2006 (MK) and a second bird lingered in the mangrove at Lowlands from 10 November - 2 December, 2007 at least (NG, MK).

An immature female **Hooded Warbler, *Wilsonia citrina*** seen at San Francique on 6 - 7 January, 2006 (HK) is just the second record for Trinidad.

A **Canada Warbler, *Wilsonia canadensis*** was found and photographed at Asa Wright Nature Centre in December, 1993 (RN). This is the first record for T&T.

An adult male **Orchard Oriole, *Icterus spurious*** found and photographed at Kernaham Settlement, Nariva on 13 December, 2006 (AB) is the first record for T&T.

INCONCLUSIVE RECORDS

Records considered inconclusive were of Sooty Shearwater, *Puffinus griseus;* Mallard*, Anas platyrhynchos*; Lesser Yellow-headed Vulture, *Cathartes burrovianus;* Black Hawk-Eagle, *Spizaetus tyrannus;* Caribbean Coot, *Fulica caribaea;* Variegated Flycatcher, *Empidonomus varius;* Long-billed Gnatwren, *Ramphocaenus melanurus* and Slate colored Seedeater*, Sporophila schistacea*. Additionally, records of Chestnut-bellied Seedfinch*, Oryzoborus angolensis* and Common Waxbill, *Estrilda astrild* from Tobago, whilst correctly identified, were considered of suspect origin.

ACKNOWLEDGEMENTS

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Photograph credits:

1. Aplomado Falcon, Caroni Rice Project - G. White
2. Canada Warbler, Asa Wright Nature Centre - R. Neckles
3. Buff-breasted Sandiper, Bon Accord - G. Hilton
4. Striped Owl, Runnemede - P. Elia
5. Double-striped Thicknee, Hilton Golf Course - D. Ascanio
6. Dark-billed Cuckoo, Blue Range, Diego Martin - B. D'Almadas
7. Lined Seedeater, Oropouche Lagoon - G. White
8. Blue Ground Dove, Lopinot - G. White
9. Variegated Flycatcher, Lower Blanchisseuse Rd. - B. Hanson
10. Summer Tanager, Las Lapas Trace - G. White
11. Orchard Oriole, Nariva Swamp - J. Binns
12. Scarlet Tanager, Asa Wright Nature Centre - W. Powel
13. Small-billed Elaenia, Lopinot - G. White
14. Rufous Crab-Hawk, Carli Bay - G. White


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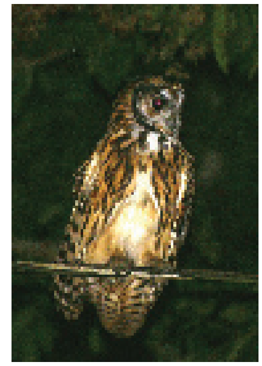
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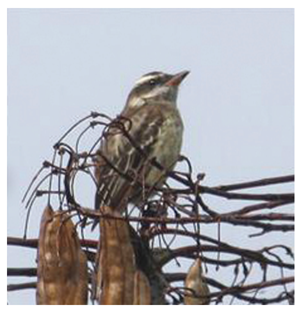
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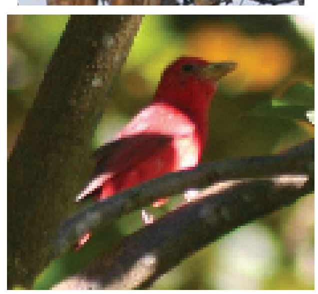
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Nature Notes

Record of Bites from Pit-Vipers (Mapepires) from Trinidad, West Indies

When I was researching the occurrence of snake bites for my book "The Snakes of Trinidad and Tobago" (Boos 2001), I interviewed several people who had been warded at the two main hospitals in Trinidad that handle these injuries. Almost all of the bites were from one of the two pit-vipers found in Trinidad - the Mapepire Balsain (*Bothrops atrox)*.

Though the Mapepire Zanana, *Lachesis muta*, is reputed to be such a dangerous snake, I could find no living person in Trinidad who had been bitten by a snake that had been *reliably* identified as a Mapepire Zanana. Allan Rodriguez, from Sangre Grande, who handles snakes has reported being bitten by this species, although these incidents resulted from accidents while cleaning cages of snakes in captivity.

On 16 February, 2007, at about 1720 h, HH from Denmark, one of the guests staying at the Asa Wright Nature Centre in the Blanchisseuse/Arima Valley, was running along the road that joins the Centre to the main road. This access road runs through heavy jungle and secondary forest and bush.

When I interviewed HH about two days later at the Sangre Grande Hospital, she explained that she had been exercising by running approximately a half mile along this narrow roadway, and was sprinting the last two hundred yards back towards the Centre, when, on passing some low bushes at the side of the road, she felt something hit her on the outside of her left knee. She stopped, and looking back, saw a fairly "large" snake lying coiled in the afternoon dappled shade at the side of the road. She saw that she was bleeding from the spot where she had felt the blow.

She continued on to the Centre, where she reported that she had been bitten by a snake, and some members of the staff went immediately to the place where she said she had seen the snake. There they saw and captured a Mapepire Zanana, about 1.5 m long. HH was swiftly taken to the Sangre Grande Hospital, where she was attended to by the staff there, who are quite experienced in handling snake bite victims. She was given several ampoules of polyvalent anti-venin, which is effective against both pit-vipers found in Trinidad

When I saw HH, she had been in hospital several days; the doctors were having a great deal of difficulty stabilizing her blood clotting factor. The doctors were going on the assumption that there had been more than one bite, as the site on her leg showed multiple puncture wounds.

I examined the site of the bite and saw that in fact there had been only one bite, but the snake must have hit her with full force, its jaws opened perhaps to almost 180 degrees, for the imprint of almost all the teeth of both the upper and lower jaws was clearly to be seen, as well as what appeared to be only one main puncture wound from the left fang of the snake. It was difficult to judge if the right fang had made contact with or punctured the skin. So powerful was the strike that even the palatine rows of teeth from inside the upper jaw were clearly imprinted in her flesh. There was massive bruising running up the underside of her thigh; this black and blue area seemed to extend well onto her buttocks.

About three weeks later HH was sent to Martinique, where she was given several transfusions to stabilize her blood clotting. I heard from her when she got back home to Denmark, thanking me for my concern and advice, and praising the good work of the hospital staff, for she said she was told by the doctors in Martinique that few people survive such a highly envenomed bite.

In my book (p.176) I describe the Zanana's reputed habit of "biting high". HH's bite seems to bear this out, as the bite was delivered in an upward arc, making contact with her knee, which must have been approximately two feet off the ground and passing swiftly by as she sprinted those last few yards.

Coincidentally, while I was with HH on the day I visited her, I was informed that there was another snake bite victim, SC, in the nearby male ward, who had been bitten on 20 February, 2007. I went over to this ward and met and interviewed SC. He reported that he had not seen the snake that bit him as he was wading barefoot through ankle-deep water in the Valencia River. He felt a stinging sensation, and there was immediate pain, and swelling of the foot close to a set of small punctures on the side of his foot near the big toe. He felt faint and disoriented within minutes of the bite. These symptoms are also typical of the bite from the Mapepire Balsain.

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Collections of Freshwater Mussel Shells of *Anodontites* sp. and *Mycetopoda* sp. in Rivers of South-Central Trinidad, West Indies

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Freshwater mussels belong to the family Unionidae (Order Paleoheterodonta, Suborder Unionidea). This family also includes some brackish water species. Their substrate requirements are quite varied and range from soft clays to pebbles and cobble. The family has a worldwide distribution.

Members of the Unionidae family are filter feeders and this makes them quite susceptible to bio-accumulation of many residual compounds such as heavy metals. Pathogenic bacteria also form pools of infections in these filter feeders. Nonetheless, they are very important to the ecology of a river for several reasons. Firstly, the overall filtering effect of colonies decreases turbidity in the river. Secondly, because of their high sensitivity to pollution, they are used worldwide as bio-indicators. Finally, their life cycles are complex and some species rely on host fish to support the newly hatched larvae (Cummings *et al*. 1997).

The shells of freshwater mussels were found during May, 2007 at three separate sites in south-central Trinidad. The sites were: on the bank of the Poole River, (GPS, 1136363 695727); tributary of the Ortoire River, (GPS, 1130116 691795); and the Ortoire River, (GPS, 1131269 699133). At all sites, both valves of an individual were found, (Plate 1: A, B and D). At Poole River and Ortoire tributary, the shell was cracked open, and was collected on the river bank, whilst at the Ortoire River an intact (but dead) specimen was collected from the river bed. The lengths of all specimens were 7.5 cm, 8.0 cm and 7.0 cm respectively.

From the remains collected, two species have been determined. At Poole River and Ortoire tributary, *Anodontites cf. irisans* (Marshall 1926) was collected and at Ortoire River, another species, possibly *Mycetopoda* sp. was collected. Identifications were made by consulting the publication by Simone (2006). Both species have distributions in Venezuela.

Determination of species in this family is somewhat difficult. Very little has been written about the two species in Trinidad. Guppy (1866) described a new species of bivalve, *Anodon leotaudi* collected from south of the Caroni plain. The specimen was described as oval-oblong and covered with a shining dark, olive-brown epidermis. The shell was measured at 8.3 cm in length. Nothing more was heard about *A. leotaudi* until its re-discovery by Bacon *et al*. (1979) in Cuche River, near Plum Mitan, Nariva during May, 1978. In this publication it was noted that the species was found in slow moving, silted channels and rivers, partially buried in soft sediments. Bacon *et al*. (1979) also noted that they were 'unexpectedly' common. Based on their communications with fishermen from that region, it was reported that the abundance was so high that it was collected then as food. Errol Jaikaransingh (personal communication), the only surviving author of the Bacon *et al*. (1979) publication, stated several hundred were exposed during dredging of the Canque River, Plum Mitan in 1979 and the mussels were quite prevalent in the 'dasheen' fields of Plum Mitan.

Later, in August, 1988, ten specimens were collected by I.W. Ramnarine which were identified by P. Greenhall at the Smithsonian National Museum of Natural History. All shells were collected from dried, dredge spoil from the Nariva Swamp. Of these, eight were identified as *Mycetopoda siliquosa* (Spix 1827), (Smithsonian Catalogue Number: 853930) and two were identified as *Anodontites patagonicus leotaudi* (Guppy 1864), (Smithsonian Catalogue Number: 853931). *Anodon leotaudi* and *Anodontites patagonicus leotaudi* are synonyms for *Anodontites cf. irisans*.

Worldwide, the family is severely threatened through habitat destruction and pollution (Bogan 1993). The complexity of Unionids' life cycle compounded by populations being spatially and genetically isolated from each other is largely responsible for its scarcity. Apart from Cuba, Trinidad is the only other Caribbean island where members of this family are present (Bogan 1993).

Unionids form a large part of the diet for raccoons, otters and turtles in North America (Bogan 1993). There are also representatives of these taxa in Trinidad, and they all have distributions in the south-central area. Two specimens of *Anodontites cf. irisans* appeared to have been forced open by cracking, suggesting that they were preyed upon.

It is interesting to note that all specimens collected belonged to the Poole/Ortoire drainage. All specimens appear to have recently died because they did not lose their internal lustre and showed no signs of sedimentation on the inside of the shells, algal growth or weathering on the interior or exterior. Dried connecting tissue was also seen on both specimens of *Anodontites cf. irisans*. These collections suggest that there are pockets of these bivalves in the drainage. The occurrences of these shells however, are good signals for the overall health of the river ecology. The area the river runs through is mostly secondary forest with patches of primary forest in south-central Trinidad. There is very little anthropogenic effect in the regions upstream.

There are two independent pieces of anecdotal evidence from individuals living in the south-central villages of Biche and Rio Claro, who both claim to have collected larger live individuals (locally referred to as 'mok') in the forested regions of the Poole River, (personal communication with local recreational fishermen). With this in mind, investigations were made into former 'mok' habitats in the mangroves around the Oropuche and Ortoire Rivers, but these yielded no additional evidence. Shells of *Anodontites* sp. were collected from the banks of the Caparo River during November 2007 and a second during February 2008. One specimen (of length 7.9 cm) was found in a partially closed position embedded in a steep river wall (GPS, 0681134 1159217), (Plate 1: C). This specimen was apparently buried for many years as it was filled with sediment. It had lost its dark brown outer colour and was similar in colour and texture to chalk. The second specimen (of length 5.6 cm) was found downstream (GPS, 0680682 1159834), (Plate 1: E), on the river's edge. This recently died as well, because the specimen was in a similar condition to those found in the Poole drainage in 2007. Again, upstream of both Caparo sites are not impacted severely by humans and have patches of secondary forest.

Plate 1. (A) *Anodontites cf. irisans* collected on the bank of the Poole River. **(B)** *Anodontites cf. irisans* remains collected on the bank of Ortoire tributary. **(C)** Fossilised *Anodontites* sp. from Caparo River bank. **(D)** *Mycetopoda* sp. remains collected on the river bed of Ortoire River. **(E)** *Anodontites cf. irisans* from Caparo River bank.

Based on the literature reviewed, there are at least two species of freshwater mussels in Trinidad and the range for both *Anodontites* and *Mycetopoda* is very limited. Our collections and the appearance of the shells of these two species suggest that they are still present in our environment, but the current rate of land use for various forms of development is placing these species at risk of extinction in Trinidad. The Poole/Ortoire region lies within the Central Block oil reserve, the Caparo sites are within impacted range of the proposed Caparo/Mamoral dam and the Plum Mitan/Nariva area is presently under oil exploration and heavy agricultural use. With this in mind, further investigations would be undertaken to look at the present distributions of these species before there is a total loss of habitat.

We would like to acknowledge Dr. Mary Alkins-Koo for assisting with the search for local literature and overall guidance and Mr. Errol Jaikaransingh for enlightening us about his past sampling experiences in the Nariva region. Ms. Rhoda Bharath assisted with the formatting of this document.

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New Records of Daddy-Longlegs Spiders (Pholcidae) from the Lesser Antilles, West Indies

Pholcidae are a worldwide family of about 1000 described species (Platnick 2007), commonly known as daddy-longlegs spiders. Most species are characterized by very long, thin legs, globular abdomens, and loose tangle webs. Four species are presently recorded from the Lesser Antilles (Huber 2000, 2007). *Physocyclus globosus* (Tacznowski) is very commonly found in buildings in the New World tropics; it is recorded from St. Vincent, and one of us (CKS) has found it abundant in Dominica. *Mecolaesthus* is a genus of 13 described species, likewise widespread in the New World tropics. In the Lesser Antilles, three species are known from Dominica, Guadeloupe and St. Vincent. In addition, Simon (1894) recorded *Modisimus glaucus* (Simon) from St. Vincent; however, this is probably either a mistaken identification or a locality error (B. Huber, pers. comm.). Our purpose here is to extend the known pholcid fauna of the Lesser Antilles arising out of collections on the islands of Anguilla (JNS and CKS), Grenada (JNS), St. Kitts (JNS) and Nevis (JNS and CKS) during 2006 and 2007.

We found *P. globosus* on all three islands, and it is very likely found in most of the inhabited Lesser Antilles.

Like *P. globosus*, *Smeringopus pallidus* (Blackwall) is an anthropophilic spider widespread in the New World tropics and subtropics (Huber 2007). It is relatively large for the family, with a body length of 7 to 9 mm, a circular carapace and an elongate, light brown abdomen with a distinctive pattern consisting of three longitudinal bands of brown dots. We found *S. pallidus* in Anguilla in caves and abandoned buildings, consistent with its known preference for dark areas.

Modisimus is a genus of 57 described extant ranging from the western USA to Panama and all of the Greater Antilles (B. Huber, pers. comm.). In this genus the eye region is distinctly elevated above the carapace to form an eye turret. Specimens were collected in St. Kitts in secondary forest and rainforest along the Crater Trail, in evergreen dry forest at West Farm, and in coastal vegetation between Cayon and Keys, Grenada in riparian vegetation around Grand Etang Lake and in montane forest along the trail on Mt. Qua Qua, and in Anguilla in gardens and around caves at Katouche Bay. Two species of *Modisimus* were found, the first on Anguilla and the second on both St. Kitts and Grenada. Given this variety of habitats, it is notable that we did not find any *Modisimus* sp. on the island of Nevis, very close to St. Kitts (Sewlal and Starr 2007).

It is also noteworthy that, while *Smeringopus* and *Modisimus* are widely distributed on the neotropical mainland, the Greater Antilles, and now the Lesser Antilles, we have not yet found any member of either genus in Trinidad and Tobago. The other genera known from the Lesser Antilles, *Mecolaesthus* and *Physocyclus*, are present in Trinidad.

Voucher specimens are deposited in the Land Arthropod Collection at the University of the West Indies, St. Augustine, Trinidad.

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Homing Ability of Harvestmen Nymphs (Opiliones, Cranaidae)

For harvestmen, parental care may take several forms including egg guarding, egg carrying, egg covering, and young guarding (Machado and Macías-Ordóñez 2007b). The functional significance of parental behavior has been attributed to warding off potential conspecific predators, protecting eggs from fungal infections, or preventing predation by other arthropods (Machado and Macías-Ordóñez 2007b). In particular, young guarding has been inferred generally through field observations of groups of similar size nymphs occurring in loose aggregations (Machado and Macías-Ordóñez 2007a) with one or more adults. In Trinidad, two species from the family Cranaidae, *Santinezia serratotibialis* Roewer 1932 and *Phareicranaus calcariferus* Simon 1879, are known to occur. These species generally use the same microhabitats (decaying logs and palm frond sheaths) and are widely distributed on the island. While both of these species appear to be nocturnal foragers, foraging behavior and diet composition in cranaid harvestmen have not been examined. Although superficially similar, we were able to identify adult male *S. serratotibialis* on the basis of the large coxal spines on leg IV and by the greater armature on the femur and tibia of leg IV (Pinto-da-Rocha and Kury 2003). In contrast, females were more difficult to distinguish, but we were able to identify females of *S. serratotibialis* on the basis of their slightly larger overall body size. Machado and Warfel (2006) provided the first observations of maternal care for this family by reporting two instances of egg guarding by adult female *S. serratotibialis* in the Northern Range. Hunter *et al*. (2006) detailed the first observations of loose aggregations of larvae and nymphs with adult *P. calcariferus*. Relatively little is known, however, about the behavioral interactions of adults and nymphs within aggregations. In this paper, we provide additional insights into the behavioral ecology of *P. calcariferus* by investigating the homing ability of displaced nymphs.

On 22 July, 2006, we located aggregations of nymphs and adults in fallen palm frond sheaths in the lower montane rainforest adjacent to Lalaja Trace in the Northern Range (10°44'47"N, 61°15'54"W; datum: WGS84; elevation: 260 m). The first aggregation consisted of a loose assortment of approximately 20 second stage nymphs and one adult female. Separated by more than 500 m, the second aggregation was composed of 15 third and 15 fourth stage nymphs with one adult female. Four nymphs were arbitrarily selected and removed from each nest and marked with a small spot of model paint on the dorsal scute. These individuals were released into the leaf litter at distances of 1, 3, 5, or 10 m (corresponding to the color of the mark) from the original site of capture. The remaining individuals (nymphs and adults) were not disturbed. After 48 hrs, we returned to the palm frond sheaths, collected all individuals that were present, and preserved them in 70% ethanol. Voucher specimens were deposited into the invertebrate collections at the American Museum of Natural History (AMNH).

Overall, three of the eight marked nymphs returned to the palm frond sheath from which they had been captured. In the case of the first aggregation, a total of 18 nymphs were collected. Only the individual that had been released 5 m from the aggregation site was recaptured. For the second aggregation, nymphs that were displaced 1 m and 10 m were recaptured and a total of 28 nymphs were found. In both instances, virtually all undisturbed individuals initially observed occupying the palm frond sheaths were present.

The results of this field experiment provide the first demonstration of the ability of cranaid nymphs to return to the same aggregation after displacement. This is a remarkable accomplishment for a group with such low vagility (Giribet and Kury 2007). Bishop (1950) proposed that harvestmen may deposit one of two types of secretion on the surface which may be used in intraspecific communication and trail marking. Individuals of *Goniosoma spelaeum* were observed to frequently travel the same route when entering and leaving their diurnal shelter within a cave (Gnaspini 1996). In our study, the ability of the cranaid nymphs to relocate to the same palm frond sheath after displacement of considerable distances (5 or 10 m) indicates the possible use of some form of chemical signal. For example, this may be a chemical trail deposited on the substrate or haphazard wandering aided by the ability to detect an aggregation once in the vicinity. Alternatively, nymphs may possess an ability to navigate based on spatial memory of an area or a detailed topographic knowledge of a home range with a radius of several meters. In-depth field observations and behavioral studies are required to determine the exact mechanism used by harvestmen nymphs to relocate an aggregation following displacement. Although the aggregations used in this study were not in close proximity to one another, we did observe two aggregations that were approximately 2 m apart. Investigating whether displaced nymphs return only to their home aggregation, or whether they will simply relocate to the nearest aggregation, may provide insight into the mechanism involved.

We are grateful to the Wildlife Section of the Forestry Division for granting us permission to conduct field research. We thank Paul Resslar and Stephen Broadbridge for assistance in the field. We are indebted to the Pacheko family for their assistance, kindness, and generosity. This research was supported by a grant from the Virginia Federation of Independent Colleges (DNP) and the Natural Science Undergraduate Research Fund at Virginia Wesleyan College. Specimens were legally collected and returned to the U.S. under export permit number 001284.

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BOOK REVIEWS

Field Guide to the Birds of Trinidad and Tobago

Martyn Kenefick, Robin Restall and **Floyd Hayes**

London: Christopher Helm/A & C Black, 2007. Octavo, paperback, 256 p.

All ornithologists and birders should try to quickly get hold of a copy of this very useful book. I was fortunate to secure a copy before its release in Trinidad, and it now accompanies my binoculars everywhere.

The dedication is to Richard ffrench, whose seminal work *A Guide to the Birds of Trinidad and Tobago* became a major contribution to neotropical ornithology, and nurtured Trinidad birding from infancy to adulthood. However, this *Field Guide* is a new species evolved to fill a different ecologic niche.

The principal author, Martyn Kenefick, is now the foremost authority on bird identification resident in the country, and this text gives us the opportunity of sharing his tremendous experience and knowledge. Floyd Hayes, a central figure in Trinidadian ornithological research, is now resident and lecturing in the USA. He is a prolific writer, and has published over fifty papers on ornithologic subjects, much of this research done in Trinidad and Tobago. Robin Restall, less well-known to Trinidadians, is the executive director of the Phelps Institute for Ornithological Studies in Caracas, and is co-author of *Birds of Northern South America*.

With such an accomplished group of authors one would have high expectations of this guide. It does not disappoint.

The ideal field guide should be lightweight, portable or even pocket sized, and this book achieves that end without compromising on its purpose. Only 15 pages are allocated for the traditional introductory chapters concerning Trinidad's geography, climate and habitats, and general information on bird taxonomy and identification. Following these are seven valuable pages on "where to watch birds in Trinidad and Tobago", concisely packaged practical information reflecting so many years of the authors' experience.

Then the text quickly gets down to business. Family descriptions are usually limited to three lines. The species descriptions are dispassionate, to-the-point and thorough, directly facing the illustration for reference. The descriptions and transcriptions of the bird vocalizations are equally good, but correspondingly brief. The dimensions are given in centimetres, a challenge for us imperially-hung-over inchers. Particularly useful in each species account is the section on distinguishing the subject species from similar species in the field.

A major strength of the book is the collection of illustrations. There are 107 colour plates. Virtually all birds (almost 470 species) ever recorded from our islands are illustrated, even the accidentals and vagrants. The pictures are large, all in colour, and generally of good to excellent quality. There is a good balance between realistic faithfulness to the subject and diagrammatic utility for identification. Short lines on the illustrations quietly and quickly point out the useful field identification marks for emphasis. Most important for field identification is that several illustrations are given for each species, often showing sexual dimorphism, juvenile and immature plumages, and in the case of migrants, the breeding and non-breeding plumage. The warbler and seedeater illustrations are of particularly high standard, with six images given, for instance, of different stages of the Blackpoll Warbler. For the raptors and flycatchers the body proportions of the images do not always match what I see in the field, but this does not seem to hinder identification from the images. Admittedly the oilbird picture is unfortunate. Don't judge the book on the very simple image of the scarlet ibis, which does no justice to our national bird. Instead, bear in mind that the ibis can hardly be confused with anything else in the field.

In keeping the book lightweight and concise, some sacrifices were necessary. The text font is small (aging birders seldom take reading glasses into the field!). The text does not attempt to carry information concerning species natural history, nesting, diet, "jizz", and relationships in natural systems. There is a single index covering the scientific name and the "formal common name" in English. The local names are not used. Therefore if you wanted to search for a *Palmiste*, you'd either have to know the latin name, or know that it belonged to the *tanager* family, and look up tanager in the index.

A useful checklist is included at the end of the book. Also, there is a brief section from the Rare Birds Committee, listing the birds considered to be "reportable".

This is likely to be the most thorough and comprehensive guide to identification of Trinidad and Tobago's birds for several decades. Although comparisons are inevitable, this book is designed to fill a particular need - field identification. Ideally it should be used in conjunction with the ffrench, with Restall's *Birds of Northern South America*, and with Steven Hilty's monumental work *Birds of Venezuela*, to allow us to find and identify a species, appreciate its place in its Trinidadian habitat, and see how the species has developed in the wider neotropical world. It's a great time to be a birder!

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The Spiders and Their Relatives of St. Vincent and the Grenadines

Mark DeSilva, Giraldo Alayón and **Julia A. Horrocks**

Mayreau: Mayreau Environmental Development Organization. 129 p. 2006. EC$40.

The community of naturalists is always ready to welcome an effective guide to a locally abundant group of plants or animals. This very attractive new guide to the spiders of St. Vincent and the Grenadines (henceforth SVG) aims to fill a very definite need. The authors are a leading lesser-antillean naturalist, a cuban spider specialist, and an academic biologist from Barbados. I should note that the book is classily dedicated to three outstanding local individuals, the recently deceased Conrad DeFreitas and Earle Kirby and the extant Jacques Daudin. It's good to see these luminaries get their props.

The book opens with an introduction to St. Vincent and to spider studies, followed by a chapter on the biology of spiders. These are the weakest parts, not so much for any errors as for missed opportunities. Despite a one-page "biogeographical sketch", there is no real attempt to put St. Vincent and the Lesser Antilles into their proper context. The full-page cladogram of major orders of arthropods is outdated and much too vague. The statement that 35% of the known spider species of SVG are known from nowhere else, if accurate, shows not that endemism is high in these islands -- it is certainly just a fraction of 35% -- but that other islands have been hardly explored in this regard.

The biology chapter will be of little use to beginners, as there is no attempt to say what is really important and interesting about spiders. In particular, there is no focus on the two key general facts about spiders: a) they are all predatory, and b) they all make varied and sophisticated use of silk. One could frame a very good introduction to the group around these two facts. On the other hand, I was pleased to see mention of spider-hunting wasps, with scientific names and information about two prominent species.

The core of the book, and its real strength, is the identification guide, occupying about half of the pages. These are arranged by families, as one would expect, in a standard taxonomic sequence. Three families of mygalomorphs and 28 families of araneomorphs are treated, comprising most of those that have ever been recorded from SVG. Identifying spiders is often not easy, but this guide does a good job of helping even the unaided beginner to learn at least the most commonly encountered families.

Beyond that, there is a wealth of high-quality, informative photographs by Mark DeSilva that permit one to identify many of the common species with confidence. Fifty-three named species (and some others that are not identified to species) are shown in colour, many of them in several different shots. These multiple photos are used to good advantage to show different life stages and sexes, as well as the web in some cases. In some cases, these are even used to show colour variation within the species, as in the widespread *Gasteracantha cancriformis*.

This section is followed by a much briefer treatment of other arachnid orders. The authors have shown a good sense of proportion here, as naturalists interested in spiders will also want to know a thing or two about such creatures as scorpions, mites and daddy-longlegs, but it would not make sense to try to cover everything to the same degree. Again, the other arachnids are well illustrated.

The book ends with four appendices, the most valuable of which, number 3, is a checklist of the 181 known spider species of SVG.

The spider fauna of SVG is better known than that of any other part of the Lesser Antilles. "The Spiders and Their Relatives of St. Vincent and the Grenadines" is an excellent pioneering effort that can profitably be used by anyone interested in these intriguing creatures in a most interesting part of our region.

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Endangered!

The Pawi or Trinidad piping-guan (Pipile pipile) is a bird endemic to Trinidad. It is only found here in our forests.

Its population has been drastically reduced in size and distribution through hunting and the loss of our tropical forests. This species is listed as environmentally sensitive in Trinidad and Tobago, and is globally listed as critically endangered.

An important conservation action is to convince the public not to kill or harass this species or to destroy its forest habitat in the few remaining locations in Trinidad where it is still found. This can only be achieved through a public awareness and education campaign which encourages all users of the forests to protect this species.

The Guardian Life Wildlife Trust, in collaboration with the Asa Wright Nature Centre,is developing such an education programme to include community education, lectures, plays and school-based activities.

Guardians of Our Wildlife

Established by Guardian Life of the Caribbean in 1992 as an independent trust, its mandate is to support projects that seek to preserve and conserve the rich wildlife heritage of Trinidad and Tobago.

By raising public awareness of ecological issues, and by working closely with environmentalists in the field, the Fund aims to help secure the ecological future of our nation for generations to come.

CONTENTS

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