LIVING WORLD

Journal of The Trinidad and Tobago Field Naturalists' Club

2004

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 on natural history and to encourage and promote activities that would lead to an appreciation, preservation and conservation of our natural heritage.

Enquires

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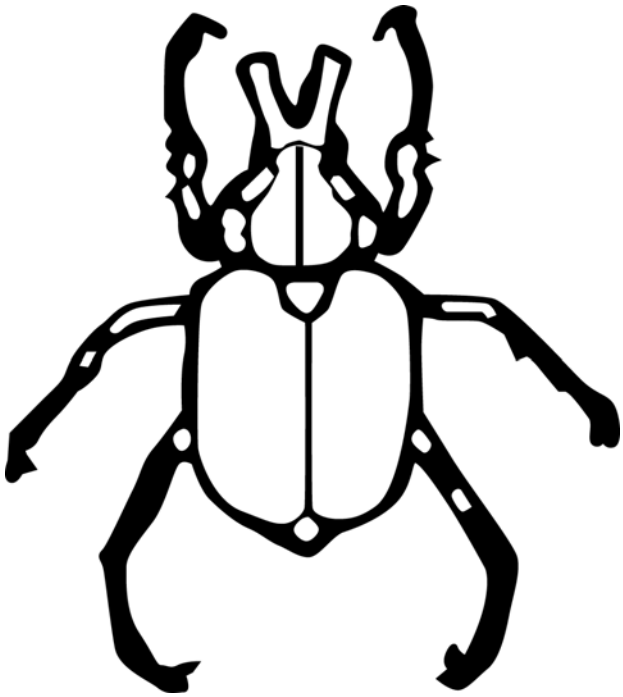

Natura Maxime Miranda in Minimis

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Cover photos of bromeliads

Top left: *Hohenbergia stellata*
Top right: *Aechmea fendleri*
Bottom right: *Vriesea splendens*
Bottom left: *Aechmea aquilega*

(All photos by Paul Comeau except *Ae. fendleri* which was taken by Hans Boos)

The bromeliads, which are monocots, include 46 genera and 2110 tropical American species. One species occurs in West tropical Africa. There are a few that are found in the American subtropics. Bromeliads grow as terrestrial xeromorphic pachycauls (having a thick stem) or as stemless epiphytic herbs. The bromeliad most people are familiar with is the pineapple *(Ananas comosus)* a native of South America. The fruit is a multiple organ, formed by the coalescence of the fruits of a hundred or more individual flowers. The most important pineapple producing area is Hawaii.

Acknowledgement

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

Editorial

During 2003 our Club lost three of its stalwart members: Professor Peter R. Bacon, Sylvia Kacal and T. Francis "Frankie" Farrell.

Professor Bacon lost a long battle with cancer. He was a former President of the Trinidad and Tobago Field Naturalists' Club and an Editor of the Club's Journal. As noted by Starr and Lambie on p.l. Dr. Bacon was the prime mover in the formulating of Trinidad and Tobago's legislation for the protection of turtles as well as his involvement in preventing a commercial enterprise from intruding into the Caroni Swamp. This issue of Living World is affectionately dedicated to Professor Peter R. Bacon.

"Frankie" Farrell died 10 days short of his 96th birthday.and was probably our longest-lived member. Like Professor Bacon he was also a President of the Club. His interest was in botany and was a co-author with Victor Quesnel and Paul Comeau of the book "Native Trees of Trinidad and Tobago." The 1987-1988 issue of Living World was dedicated to him. A tribute to"Frankie" is written by Victor Quesnel on page 49.

Sylvia Kacal succumbed to malaria while working on a project in Malawi. Sylvia Kacal was an active Club Member, a conservation activist and played a leading role in the formation of the Caribbean Forestry Conservation Association, one of many off-shoot organisations of the Club. Detta van Aard-Buch provides us with a tribute to Sylvia on page 48.

I welcome to our Editorial Committee for this issue, Dr. Christopher Starr who wrote the tribute to Prof. Bacon. Along with others, Dr. Starr also reviewed and edited the papers dedicated to Bacon. These papers include two on birds, two on frogs and one on insects. Floyd Hayes *et al.* mention seasonal variation of gull populations on the west coast of Trinidad with the Laughing Gull being the dominant of seven species observed. Graham White and M. Kenefick discusses the species of birds using the mudflats at Brickfield. Roger Downie and his group from Glasgow University have been visiting this Country for many years. We welcome them to our pages as they discuss the comparative ecology of two species of frogs and he joins with M. Jowers to discuss the distribution of the frog *Mannophryne trinitatis* in central Trinidad. The last of the dedication papers is by Christopher Starr and Jo-Anne Sewlal describing their observations on nest and colony structure of *Dolichoderus attelaboides*.

Other papers in the latter half of this issue include the continuing series of papers on the skipper butterflies by Matthew Cock. He also reproduces excerpts from the diary of an early 20th century butterfly collector, Margaret Fountaine, in Trinidad. David Bass records 86 species of macroinvertebrates from streams in Grenada. Also working in streams, Azad Mohammed records four species of cladocerans (water fleas) new to the fauna of Trinidad. Hans Boos summarizes data on the Water Coral Snake and describes an unusual colour form of the species. Some people have to climb high to get a "high" out of research, so Howard Griffiths describes some of his experiences in collecting, studying and describing the research results he has obtained on bromeliads in Trinidad.

Nigel Gains, a member of our Editorial Committee, has had to resign through illness. He was a keen member of our Committee and we want to thank him for his assistance and the many suggestions he has made for the improvement of the Journal.

EST

In Memoriam

As we went to press, we learnt of the death of
NIGEL GAINS
(23 January, 1944 - 30 July, 2004)

Nigel served as President of our Club
and more recently served on the
Editorial Committee of Living World.
We extend our sympathy to his wife and children.

Peter Bacon (1938-2003) — Consummate Naturalist

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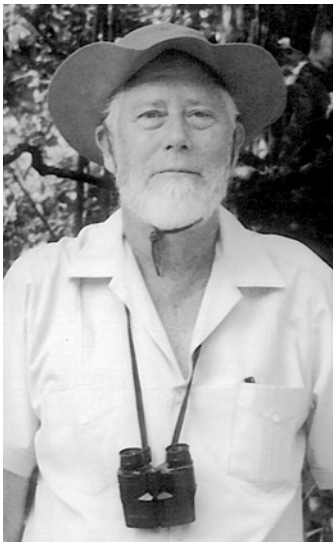
The Caribbean natural-history community lost one of its stalwarts in February 2003 with the passing of Peter R. Bacon at the age of 64. At the time of his death, he was Professor of Zoology at the Trinidad campus of the University of the West Indies (UWI). Originally from England, he spent most of his adult life in the Caribbean. His time in Trinidad was divided into two periods, an early one (1963-1980) in which he did his PhD at UWI and then taught there for many years, and a later period (1993-2003) as Professor. In between, he spent 11 years at the Jamaica campus of UWI.

To characterize Peter as an academic scientist would be correct, but perhaps misleading. To be sure, he had become a widely respected expert on the ecology of wetlands and the coastal zone, adept at both the pure science of the subject and its applications, so that his expertise was much sought after both in the region and abroad. He was also regarded as a powerhouse in the classroom. At the same time, he was by no means narrowly specialized, nor had he left behind the enthusiasms of his early years. In his maturity, Peter remained what he had always been, a keen, infinitely curious —and by now very experienced and knowledgeable — naturalist.



Peter Bacon

It was always a pleasure to show Peter curious specimens that one had encountered in the wild, and one learned not to be surprised if he could readily identify a particular plant or animal and knew the key points of its natural history, whether it lived on land or in the water. A walk in the field with him was always an education. We have often had the experience of pointing out something curious and finding that he, too, had noticed and thought about it. As a naturalist he was an all-rounder, personally familiar with organisms across a broad taxonomic and habitat range.

Peter was not only a long-time member of the Trinidad and Tobago Field Naturalists' Club but a firm believer in its mission. He joined in 1964, soon after his arrival in Trinidad. The following year he was brought onto the Management Committee, where he remained for several years, including three years (the statutary maximum) as President.

Nor did he stand apart from the public aspects of biology and the environment. On the contrary, Peter was very much engaged in promoting the conservation of habitats, species and natural resources. Two examples, from his early Trinidad period will serve to illustrate this fact.

The first of these relates to the protection of the Caroni Swamp. The following account is condensed from the 1990-91 issue of this journal (pp 9-10). Up to 1973, the Trinidad and Tobago Field Naturalists' Club was known as a very conservative organization. It was forced out of this stance and into political activism by a move to allow the Shell oil company to transport one of its products by barge from a refinery to the bottling plant by way of Canal no. 9 in the swamp. This came to the attention of the conservation community when the canal was widened and deepened through cutting of mangrove trees and dredging.

The community was not just concerned but outraged at such an attack on an important habitat. The Club, with Peter in key roles, took the leadership in forming the Blue River Action Committee (BRAC) to oppose this deal between the government and the multinational company. The BRAC's vigorous protest campaign included leafletting, public meetings, a motorcade around the Red House, representations to the prime minister and other public officials, and a boycott of Shell products. In time, the government gave in to public pressure, and the plan to use Caroni as a shipping route was withdrawn. It is fair to say that in this case Peter had a large hand in changing the nature of the Club and the future of the Caroni Swamp.

During this time Peter first showed a special concern for sea turtles, which in time came to transform the conservation status of these charismatic beasts within Trinidad and Tobago. It was in his capacity as an officer of the Club that Peter became an activist in sea-turtle conservation. During the 1960s and 1970s, the Club's sea-turtle group undertook both data gathering and protective patrols of the beaches. This combination of theory and practice strengthened our hand in presenting recommendations to the government for the protection of sea turtles, recommendations that were accepted, implemented and have produced the much improved situation that we have come to take for granted a generation later. Peter wrote the document that resulted in the Turtle and Turtle Eggs Regulations of 1975. As far as we are aware, all of the Club's recommendations contained in this document were enacted into law.

At the same time, he had the sense to know that a legislative measure without backing in public opinion would have little force, so that he and other activists engaged in a campaign to raise general awareness of the question. The existence today of effective local organizations in the communities around nesting beaches in Trinidad is a tribute to the rightness of this approach.

The Trinidad and Tobago Field Naturalists' Club is pleased to dedicate this issue of the *Living World* journal to the memory of our past President, Peter R. Bacon.

Peter Bacon (at right) with students in Caroni mangrove for est. Photo: Terry Sampson

Dedicated to the memory of Professor Peter R. Bacon

Seasonal Variation in Gull Populations along Trinidad's West Coast, Trinidad and Tobago

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ABSTRACT

Seven species of gulls were recorded during a six-year study (1997-2003) of gull populations along the west coast of Trinidad. An estimated 4000-5000 Laughing Gulls (*Larus atricilla*) wintered annually in western Trinidad, with the population peaking in February and less than 10% remaining during the northern summer. Up to 13 Lesser Black-backed Gulls (*L. fuscus graellsii*) wintered in Trinidad, with a few lingering during summer. Very small numbers of the remaining species were recorded: Black-headed Gull (*L. ridibundus*), Franklinís Gull (*L. pipixcan*), Kelp Gull (*L. dominicanus*), Ring-billed Gull (*L. delawarensis*) and Sabineís Gull (*Xema sabini*). Trinidadís west coast provides crucial habitat for many waterbirds and is perhaps the most important locality in northern South America for wintering gulls, which are attracted by the fishing industry.

INTRODUCTION

The coasts of northern South America and offshore islands provide a plethora of critical sites hosting large concentrations of coastal waterbirds. Although many of these sites have been identified during aerial surveys documenting shorebird populations (Morrison and Ross 1989), little is known about the populations of other coastal waterbird taxa, such as gulls of the family Laridae.

The Gulf of Paria is a highly productive estuary (e.g., Kenny and Bacon 1981) that borders the west coast of Trinidad. Large concentrations of gulls, including several rare species (Hayes *et al.* 2002a, b, McNair *et al.* 2002), roost along Trinidad's west coast and forage offshore among large fleets of fishing vessels. In this paper we report survey data gathered from several sites during a six-year period to assess seasonal and long-term trends in the abundance of gulls.

STUDY AREA AND METHODS

Trinidad is a large island located on the continental shelf of South America just north of the Orinoco River Delta. The relatively shallow Gulf of Paria separates Trinidad from the continental mainland and borders Trinidad's west coast, where several major ports, along with several extensive tidal mudflats, are located. Along the Chaguaramas Peninsula to the north, the coast is characterized by rocky shores, sandy beaches, several marinas, small patches of mangroves and minor mudflats at the mouths of streams. A large commercial port at Port of Spain is bordered to the south by extensive mangroves of Caroni Swamp. From the southern edge of Caroni Swamp, the coast is characterized by extensive tidal mudflats and patches of mangroves from Waterloo to Pointe-a-Pierre. Small fishing ports occur at Waterloo, Orange Valley, Carli Bay and Claxton Bay. Large shipping docks occur at Point Lisas and Pointe-a-Pierre. Farther south, small fishing ports are located at San Fernando and Horqueta, and less extensive mudflats occur from La Romaine to Horqueta. To the west and south of Horqueta, the coast is characterized by scattered mangroves, rocky coasts and a few sandy beaches, with a major commercial port at Point Fortin and a minor fishing port at Cedros.

From December 1997 to September 2003, we periodically censussed gull populations at selected sites along the west coast of Trinidad (Fig. 1). Census data were obtained primarily from readily accessible sites where large concentrations of larids could be observed, especially at Waterloo, Orange Valley and San Fernando. Fewer counts were conducted at Carli Bay, La Romaine, Mosquito Creek and Horqueta. Birds were counted individually when possible, but when large flocks were present we estimated the number of birds based on clusters of 10, 25 or 50 individuals. Due to frequent turnover of arriving and departing birds at a given locality, precise counts were difficult to obtain. Counts at coastal mudflat sites (Waterloo, Orange Valley and La Romaine) were generally conducted when mudflats were exposed at low or intermediate tides. Counts at San Fernando were usually conducted at high tide, when concentrations of gulls roosting on the water, boats and piers were greatest. Elsewhere counts were conducted opportunistically.

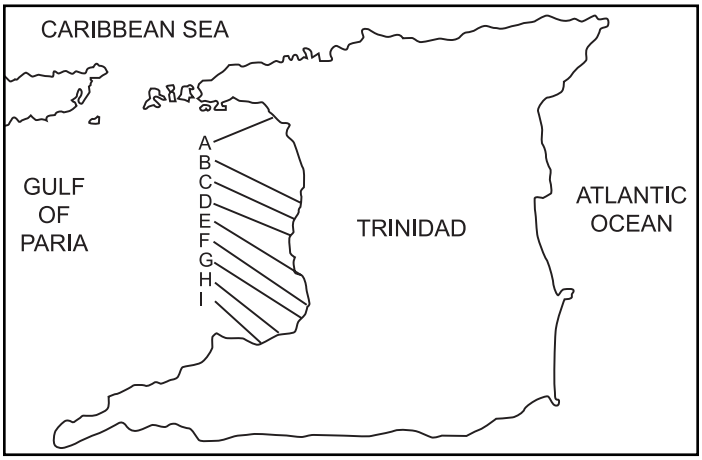

Fig. 1. Sites in western Trinidad where gull populations concentrate. A = Port of Spain; B = Waterloo; C = Orange Valley; D = Carli Bay; E = Pointe-a-Pierre; F = San Fernando; G = La Romaine; H = Mosquito Creek; I = Otaheite.

Table 1. Monthly variation in Laughing Gull populations along the west coast of Trinidad.

Locality	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Waterloo												
$\bar{x}$	1269	1949	1901	934	122	94	59	217	298	302	465	792
SD	541	1203	562	749	101	60	35	124	194	218	352	541
Min	310	325	1372	15	11	35	1	10	120	140	150	150
Max	2000	4000	2675	2300	250	170	85	420	600	550	950	1800
n	12	12	12	7	5	6	5	8	8	3	4	12
Orange Valley												
$\bar{x}$	420	774	695	81	15	46	11	130	101	288	147	351
SD	281	712	794	83	17	53	6	140	80	271	21	180
Min	58	50	22	5	1	0	7	2	3	107	130	77
Max	780	1635	2000	210	40	120	17	420	200	600	175	660
n	6	5	6	5	4	4	3	7	5	3	4	13
San Fernando												
$\bar{x}$	441	1056	369	426	294	104	113	25	100	475	680	573
SD	333	713	125	554	148	90	18	ñ	ñ	35	387	191
Min	0	300	250	7	150	30	100	25	100	450	220	400
Max	1000	2000	500	1200	500	225	125	25	100	500	1000	1000
n	7	9	4	4	4	4	2	1	1	2	4	12

RESULTS AND DISCUSSION

Laughing Gull (*Larus atricilla*) was by far the most abundant species. Populations fluctuated wildly at the three major sites, but were highest during winter, peaking in February (Table 1). Populations declined precipitously during May and June, when breeding occurs in Tobago and elsewhere in the Caribbean and eastern USA (Burger 1996, Chardine *et al*. 2000) and were lowest during July, when mean counts were only a small fraction of those in February (3.0% at Waterloo, 1.4% at Orange Valley, 10.7% at San Fernando; Table 1). Juveniles first arrived in August, when populations began to increase. Laughing Gulls were most common at Waterloo, with a maximum count of 4000. Elsewhere, up to 2000 were recorded at Orange Valley and San Fernando (Table 1), up to 1000 at Carli Bay ($n = 11$), 600 at Otaheite ($n = 3$), 300 at La Romaine ($n = 3$) and 300 at Mosquito Creek ($n = 2$). From San Fernando we could see large numbers congregating on the mudflats of Pointe-a-Pierre during low tide, but were unable to access the site. Scattered smaller flocks were occasionally encountered in the northern Gulf of Paria between Port of Spain and the Bocas Islands, but were not counted.

ffrench (1973, 1991) reported that Laughing Gull was most common along the west coast from March to November, when up to 1000 (ffrench 1973) or 2000 (ffrench 1991) were recorded at Pointe-a-Pierre. ffrench (1973, 1991) reported high counts of only 500 at Pointe-a-Pierre during December and February, and 200 at Port of Spain in January. Our data suggest that numbers have increased in recent decades, especially during the northern winter. Because large flocks of Laughing Gull routinely follow fishing ships at sea and not all can be viewed within a single day from a few vantage points along the coast, obtaining an accurate estimate of Laughing Gull numbers along the entire coast was not possible. Nevertheless, we believe that our estimate of 4000-5000 wintering along the west coast of Trinidad is fairly accurate. Trinidad's west coast may be its most important winter habitat in South America. Lesser Black-backed Gull (*L. fuscus graellsii*) is an Old World species whose numbers have increased dramatically in the New World, where breeding remains undocumented (Post and Lewis 1995). It was the second most common species, occurring in small numbers that peaked in February-March, with a few recorded during summer (Table 2). Hayes *et al*. (2002b) reported 31 records of an estimated 45 individuals (mostly immatures) in western Trinidad from August 1978 through June 2002. In contrast with Laughing Gull, Lesser Black-backed Gull numbers were highest at San Fernando, with a maximum count of six birds; up to five were recorded at Waterloo

Table 2. Monthly variation in Lesser Black-backed Gull populations along the west coast of Trinidad. Sample sizes (*n*) are as in Table 1.

Locality	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Waterloo												
$\bar{x}$	1.2	0.9	0.5	0.3	0	0.5	0.6	0.4	1.3	1.0	0.5	0.8
SD	1.3	1.1	0.8	0.5	0	0.8	1.3	0.7	1.0	1.0	1.0	1.5
Min	0	0	0	0	ñ	0	0	0	0	0	0	0
Max	4	3	2	1	ñ	2	3	2	3	2	2	5
Orange Valley												
$\bar{x}$	0.3	0.8	0.2	0	0	0	0	0.6	0	0.3	0	0.1
SD	0.5	1.3	0.4	0	0	0	0	1.0	0	0.6	0	0.3
Min	0	0	0	0	0	0	0	0	0	0	0	0
Max	1	3	1	0	0	0	0	2	0	1	0	1
San Fernando												
$\bar{x}$	2.4	3.2	3.8	0.8	1.5	0	0	0	0	0	1.8	1.2
SD	1.8	2.3	2.5	1.5	1.0	0	0	0	0	0	0.8	1.5
Min	0	0	0	0	0	0	0	0	0	0	1	0
Max	5	6	5	3	2	0	0	ñ	ñ	0	3	3

and three at Orange Valley (Table 2). The ratio of Lesser Black-backed Gulls to Laughing Gulls ranged from one to 310 at San Fernando, 1280 at Waterloo and 1436 at Orange Valley. Up to 13 different individuals were recorded along the west coast during the winter of 2000-2001, with a maximum daily count of eight on 10 February 2001 (Hayes *et al.* 2002b).

Five other species of gulls were recorded during these surveys, but numbers were too small for statistical analyses. Of these, Black-headed Gull (*L. ridibundus*) is a Eurasian vagrant with several previous records from Trinidad (ffrench 1991). Two immatures and an adult were at Waterloo and Orange Valley from 11 February to 18 May 2000 (M. Kenefick *et al*.); an adult at Waterloo from 3-17 February 2001 (N. Lallsingh *et al*.); and an adult at Waterloo from 17 January to 1 March 2002 (N. Lallsingh *et al*.).

Franklin's Gull (*L. pipixcan*) is a North American migrant that was previously unrecorded from Trinidad (ffrench 1991). Up to two immatures and one adult were seen at Port of Spain and Waterloo during 5 January to 20 March 1999; up to two immatures were seen (one photographed) at Waterloo and San Fernando from 3 December 2000 to 22 April 2001; and an adult was photographed at San Fernando from 10-17 November 2001 (McNair *et al.* 2002).

Kelp Gull (*L. dominicanus*) is a recent colonist from the southern hemisphere to the Gulf of Mexico that was previously unrecorded from Trinidad (ffrench 1991). Two adults were photographed at Waterloo and San Fernando from 8 July 2000 to 10 February 2001, providing the first record for the Caribbean (Hayes *et al.* 2002a).

Ring-billed Gull (*L. delawarensis*) is a North American migrant with several previous records from Trinidad (ffrench 1991). An immature was photographed at Carli Bay on 14 December 1997 and possibly the same individual was seen at Waterloo on 1 March 1998 (White and Hayes 2002); an immature was photographed at San Fernando and also seen at Waterloo from 21 January to 22 April 2001 (F. E. Hayes *et al*.); an immature was photographed at San Fernando and also seen in the Columbus Channel (south coast) from 17 November 2001 to 24 March 2002 (F. E. Hayes *et al*.).

Sabine's Gull (*Xema sabini*) is a North American migrant with a highly pelagic winter distribution that had been recorded only once previously along the Atlantic Coast of South America off eastern Trinidad (ffrench 1991). An immature was photographed at Waterloo from from 27 January to 1 February 2002 (Nigel Hacking *et al*.), and was probably seen at San Fernando on 9 February 2002 (H. Kilpatrick).

In conclusion, the west coast of Trinidad may be the most important wintering site for gulls in northern South America, with an estimated 4000-5000 Laughing Gulls and up to 13 Lesser Black-backed Gulls. Small numbers of Franklin's Gull and Ring-billed Gull winter sporadically. Kelp Gull and Sabine's Gull are probably accidental visitors. The robust fishing industry is probably the major attraction to gulls, facilitated by the presence of tidal mudflats and sheltered bays for roosting.

ACKNOWLEDGEMENTS

This paper is dedicated to Professor Bacon, whose concern for the environmental integrity of Trinidad's coastal habitats stimulated our research. We thank various colleagues, students and our own families, too many individuals to name, who have either assisted or patiently tolerated us while scanning gull flocks. For commenting on various photographs of gulls, we thank A. Adcock, L. Atherton, P. Buckley, D. Dittmann, H. Hussey, A. Jaramillo, B-J. Luijendijk, B. Mactavish, C. Marantz, R. Millington, D. Newell, M. Reid, N. Rossiter and R. Winters.

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Dedicated to the memory of Professor Peter R. Bacon

Avifauna of the Brickfield Mudflats, Trinidad and Tobago

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ABSTRACT

The coastal mudflats at the southern end of Caroni Swamp, Trinidad, provide feeding and roosting areas for large congregations of resident and migrant seabirds, shorebirds and waders. The birds using the mudflats and their relative abundance are presented, together with bird lists for the surrounding habitats. The species composition on the mudflats is influenced by the habitat, location, and surrounding economic activities. The site meets the criteria for designation as an *Environmentally Sensitive Area*.

INTRODUCTION

The western coast of Trinidad, West Indies, from Port of Spain to San Fernando is characterised by shallow seas and coastal mudflats. These mudflats provide feeding and roosting habitats for large congregations of resident and migrant shorebirds (Morrison and Ross 1989; Chandool 1999) seabirds (Hayes *et al.* 2004), and waders. The area accounts for over 90% of the shorebird population in Trinidad and over 60% of the shorebirds on the shores of the Gulf of Paria (Morrison and Ross 1989). Hayes *et al.* (2004) conclude that the western coast of Trinidad may be the most important over-wintering site for gulls in northern South America. Barrancones Bay at Brickfield is particularly rich in birds and easily accessible. It has become an important stop for visiting birders.

The major wetlands in Trinidad are legally protected, but are threatened by encroaching development, squatting and changes in land use. Illegal hunting persists in both protected and unprotected areas. The Brickfield Village community have initiated plans to protect the birdlife in their area and facilitate birdwatchers. This study was motivated, in part by their efforts. We hope to support their initiative by documenting the bird species inhabiting the area and determining their relative abundance. We studied the avifauna of the coastal mudflats from Barrancones Bay to the mouth of the Couva River, and explored its relationship with the surrounding habitat and land use.

Description of site

The location of the study area and major features are illustrated in Fig.1. At low tide extensive mudflats are exposed from Barrancones Bay to the Couva River. At high tide the mudflats are generally covered save for the north end of Barrancones Bay. Three sandbars between Waterloo and Orange Valley remain exposed until the tide has reached its peak. These exposed areas serve as roosting sites for seabirds and roosting and feeding sites for shorebirds. The remains of an old jetty (the piles) at Waterloo are favoured by roosting terns. The causeway of the Waterloo Temple and a pier at Orange Valley provide a rocky-shore habitat. There are extensive

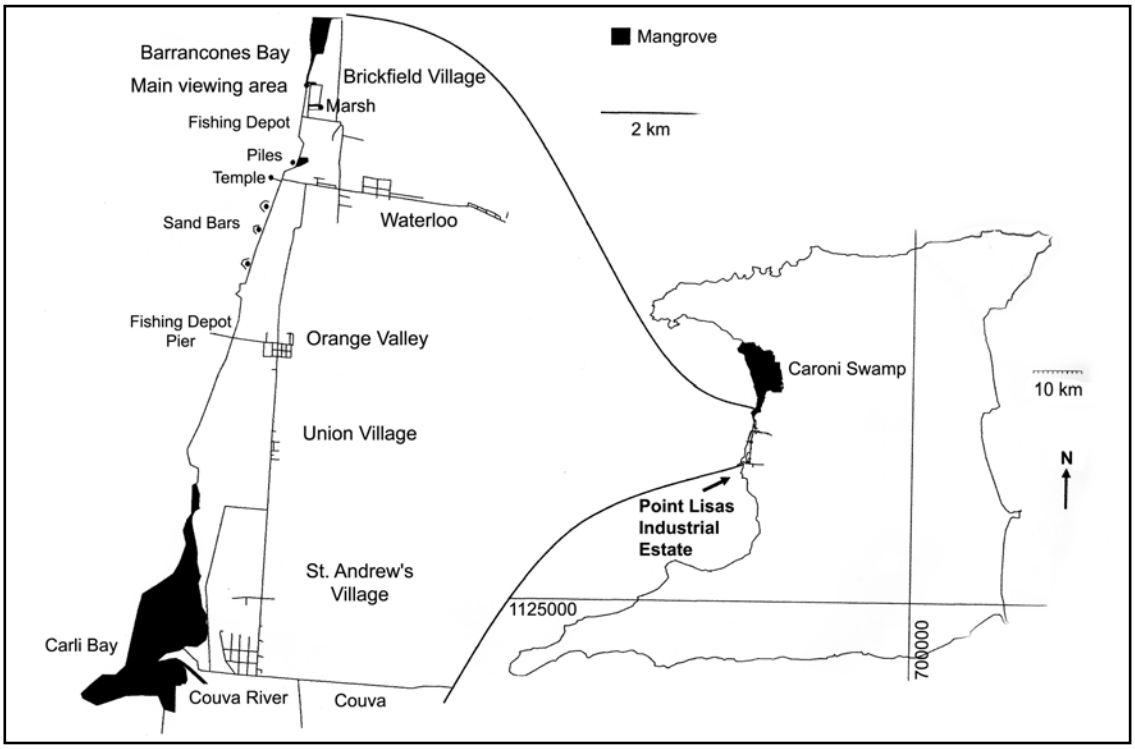

Fig. 1. Map of study area

mangroves surrounding the Couva River mouth and north of Barrancones Bay, which is the southern end of the Caroni Swamp Mangrove. Smaller patches of mangrove occur at Waterloo and Union Village. An abandoned shrimp farming facility at Brickfield serves as a small freshwater marsh. Areas of grass, scrub and small trees occur along ditches, around industrial development, in abandoned sugarcane fields and along the road to Carli Bay. Adding to the diversity of habitat are residential areas with fruit bearing trees.

Economic activity in the area includes fishing and sugarcane cultivation and there is a major industrial park at Point Lisas to the south. There are fishing depots at Brickfield and Orange Valley and small congregations of boats at Waterloo and Carli Bay. Sugarcane production is declined after 2003.

METHODS

The Brickfield mudflats were visited on 48 occasions from 1990-2003 by GW and on 57 occasions between 1999-2002 by MK. Visits were of variable duration from 10 minutes to two hours. Longer visits were usually at low tide, 07.00 -09.00 h or 16.00-18.00 h. During visits by GW an attempt was made to record all species present on the mudflats, shoreline or perched on boats. Both observers recorded any unusual species or particularly large numbers of individuals. Visits by MK usually included a visit to the freshwater marsh. Telescopes and binoculars were used for species identification and counting (GW- Nikon Fieldscope and Celestron 8x42 binoculars, MK- Kowa 32x scope and Leica 10x42 Binoculars). In addition, shorther visits were made to the Couva River mouth, Orange Valley, the sandbars south of the temple and the piles at Waterloo to observe seabirds. During this period, all species observed in the Waterloo residential area were recorded. Nomenclature follows that of the American Ornithologists Union (1998).

RESULTS

Species found associated with the coastal mudflats in the study area are listed in Table 1, together with two indicators of relative abundance – frequency of observation and highest numbers recorded. Sixty-nine species were associated with this habitat, the major families being Ardeidae, 8 species; Charadriidae, 7 species; Scolopacidae, 19 species and Laridae, 14 species. With respect to status, 37 species are non-breeding migrants, 33 of which breed in continental North America. Rare migrants and vagrants number 11 species. The tally of 69 includes 38 common or abundant species, 13 uncommon, 2 local, 5 scarce and 11 rare or accidental.

Several shorebirds appear to favour the areas of mud at the mangrove edge, either because of availability of food, or for protection from the sun or predators. The raptors observed, Yellow-

Table 1. Birds associated with tidal mudflats from Orange Valley- Brickfield 1996-2003: their relative abundance and status in Trinidad.

Family	Species	Days seen /48	Highest count	Status and abundance	
Pelicanidae	Brown Pelican, *Pelicanus occidentalis*	32	592	**R**	**A**
Phalacrocoracidae	Neotropic Cormorant, *Phalacrocorax brasilianus*	17	100s	VS	C
Fregatidae	Magnificent Frigatebird, *Fregata magnificens*	48	10	R	C
Ardeidae	Great Blue Heron, *Ardea herodias*	17	6	VN	U
	Great Egret, *Ardea alba*	32	30	BD	C
	Snowy Egret, *Egretta thula*	42	87	BV	A
	Little Blue Heron, *Egretta caerulea*	42	253	BV	A
	Tricoloured Heron, *Egretta tricolor*	18	20	BV	C
	Striated Heron, *Butorides striatus*	9	1	BV	A
	Black-crowned Night-heron, *Nycticorax nycticorax*	10	13	R	C
	Yellow-crowned Night-heron, *Nyctanassa violacea*	21	77	R	C
Threskiornithidae	Scarlet Ibis, *Eudocimus ruber*	31	106	BV	L
Ciconiidae	Wood Stork, *Mycteria americana*	1	1	M	R
	Maguari Stork, *Ciconia maguari*	1	1	M	R
Cathartidae	Black Vulture, *Coragyps atratus*	15	50	R	A
Phoenicopteridae	Greater Flamingo, *Phoenicopterus ruber*	4	4	M	R
Anatidae	Blue-winged Teal, *Anas discors*	3	8	VN	C
Pandionidae	Osprey, *Pandion haliaetus*	20	6	VN	C
Accipitridae	Long-winged Harrier, *Circus biffoni*	2	2	R	Sc
	Rufous Crab-hawk, *Buteogallus aequinoctialis*	1	1	R	Sc
	Common Black Hawk, *Buteogallus anthracinus*	2	2	R	U
Falconidae	Yellow-headed Caracara, *Milvago chimachima*	4	2	R	C
	Merlin, *Falco columbarius*	1	1	VN	U
	Peregrine Falcon, *Falco peregrinus*	1	1	VN	U
Rallidae	Clapper Rail, *Rallus longirostris*	5	2	R	L
	Common Moorhen, *Gallinula chloropus*	1	4	R	C
Charadriidae	Southern Lapwing, *Vanellus chilensis*	25	100	R	C
	Black-bellied Plover, *Pluvialis squatarola*	29	50	VN	C
	American Golden Plover, *Pluvialis dominica*	3	10	VN	U
	Collared Plover, *Charadrius collaris*	22	37	BD	C
	Wilsonís Plover, *Charadrius wilsonia*	7	4	VN	U
	Semipalmated Plover, *Charadrius semipalmatus*	34	109	VN	C
Hematopodidae	American Oystercatcher, *Haematopus palliatus*	4	2	M	R
Recurvirostridae	Black-necked Stilt, *Himantopus mexicanus*	12	31	BD	C
Scolopacidae	Greater Yellowlegs, *Tringa melanoleuca*	15	22	VN	C
	Lesser Yellowlegs, *Tringa flavipes*	22	65	VN	A
	Solitary Sandpiper, *Tringa solitaria*	2	1	VN	C

Table 1. (Continued). Birds associated with tidal mudflats from Orange Valley- Brockfield 1996-2003: their relative abundance and status in Trinidad.

Family	Species	Days seen /48	Highest count	Status and abundance	
	Willet, *Catoptrophorus semipalmatus*	38	70	VN	C
	Spotted Sandpiper, *Actitis macularia*	28	5	VN	C
	Terek Sandpiper, *Xenus cinereus*	1*	1	M	R
	Whimbrel, *Numenius phaeopus*	43	115	VN	C
	Black-tailed Godwit, *Limosa limosa*	1	1	M	R
	Marbled Godwit, *Limosa fedoa*	9	2	VN	R
	Ruddy Turnstone, *Arenaria interpres*	28	9	VN	C
	Red Knot, *Calidris canutus*	19	51	VN	U
	Sanderling, *Calidris alba*	1	1	VN	U
	Semipalmated Sandpiper, *Calidris pusilla*	30	(1000	VN	A
	Western Sandpiper, *Calidris mauri*	31	combined)	VN	A
	Least Sandpiper, *Calidris minutilla*	8	10	VN	A
	White-rumped Sandpiper, *Calidris fuscicollis*	4	10	VN	U
	Pectoral Sandpiper, *Calidris melanotos*	3	6	VN	U
	Stilt Sandpiper, *Calidris himantopus*	6	2	VN	C
	Short-billed Dowitcher, *Limnodromus griseus*	28	394	VN	C
Stercorariidae	Parasitic Jaeger, *Stercorcarius parasiticus*	5	1	VN?	Sc
Laridae	Laughing Gull, *Larus atricilla*	44	3000	BD	A
	Franklinís Gull, *Larus pipixcan*	1	2	M	R
	Common Black-headed Gull, *Larus ridibundus*	1	2	M	R
	Lesser Black-backed Gull, *Larus fuscus*	12	5	VN	U
	Kelp Gull, *Larus dominicanus*	1	1	M	R
	Sabineís Gull, *Xema sabini*	1	1	M	R
	Gull-billed Tern, *Sterna nilotica*	15	14	VN	U
	Royal Tern, *Sterna maxima*	11	150	VN	C
	Sandwich Tern, *Sterna sadvicensis*	5	1	VN?	U
	Common Tern, *Sterna hirundo*	15	143	VN	C
	Least Tern, *Sterna albifrons*	2	11	VN	Sc
	Yellow-billed Tern, *Sterna superciliaris*	30	149	VS	C
	Large-billed Tern, *Phaetusa simplex*	35	103	VS	C
	Black Tern, *Chlidonias niger*	1	2	M	Sc
Rynchopidae	Black Skimmer, *Rynchops niger*	41	860	VS	C

Status - Adapted from ffrench (1991).

R	Resident species without significant movement
BD	Species that breed locally and migrate or disperse to the mainland (sometimes only partially)
BV	Resident breeding species whose numbers are augmented by migrants from continental N & S America
V N/S	Non-breeding visitor from continental North or South America
M	Rare migrants and vagrants

Abundance - field experience of authors.

A	*Abundant; widespread and usually in some numbers in suitable habitat.*
C	*Common, usually seen in suitable habitat.*
L	Locally distributed in restricted habitat; but may be not uncommon there.
U	Uncommon; occasionally seen in suitable habitat in small numbers or singly.
Sc	Scarce; very few records in a year.
R	Rare or accidental.

headed Caracara, Peregrine Falcon and Merlin and have been seen hunting over the mudflats, and the Long-winged Harrier, Common Black Hawk and Rufous Crab Hawk, have spooked the mudflat birds as they fly over.

A roost of Snowy, Great and Cattle Egrets occurs between Brickfield and Waterloo. In May 2003 this roost included 831 Cattle Egrets, 44 Snowy Egrets and 14 Great Egrets. Roosts of Brown Pelicans occur in the mangrove north of Brickfield, south of Orange Valley and at Carli Bay.

A further 95 species, not associated with mudflats, were observed within the immediate area. The predominant habitat in which the species were observed is shown in Table 2. The distinction between "residential" and "open trees, scrub and grasses" is subtle but important. The open scrub along canals and in abandoned sugarcane land provides little food for nectivorous or frugivorous birds. Such species rely on residential gardens. Species common in both habitats are classed with the open trees, scrubs and grasses. Of the 95 species observed 34 were found in the open trees, scrub and grasses and 29 associated with the residential areas. Ten species were associated with mangrove, mainly at the northern end of Brickfield. The small marsh at the shrimp farm, together with a few drainage canals, provide habitat for nine marsh birds and five species are associated with open waterways. The presence of such species as White-necked Jacobin, Long-billed Starthroat and Red-legged Honeycreeper, well outside of their normal habitat, reflects possible migration to Venezuela (ffrench 2000). The Red-bellied Macaws were observed on five occasions in 1994, 1997 and 1999 with 75 birds seen on one occasion. The birds were presumably attracted to the Royal Palms, *Roystonia oleracea*, but they are well outside of their normal range.

Table 2 Birds observed around Brickfield to Orange Valley not associated with coastal mudflats, 1996-2003.

Family	Species	Predominant habitat in which observed
Podicipedidae	Least Grebe, *Tachybaptus dominicus*	Freshwater marsh
Pelicaniformes	Brown Booby, *Sula leucogaster*	Marine
Ardeidae	Pinnated Bittern, *Botarus pinnatus*	Freshwater marsh
	Stripe-backed Bittern, *Ixobrychus involucris*	Freshwater marsh
	Cocoi Heron, *Ardea cocoi*	Freshwater marsh
	Cattle Egret, *Bubulcus ibis*	Open trees, scrub & grasses
Accipitridae	Grey-headed Kite, *Leptodon cayanensis*	Open trees, scrub & grasses
	Pearl Kite, *Gampsonyx swainsonii*	Residential
	Grey Hawk, *Asturina nitida*	Residential
	Short-tailed Hawk, *Buteo brachyurus*	Open trees, scrub & grasses
	Zone-tailed Hawk, *Buteo albonotatus*	Open trees, scrub & grasses
Rallidae	Grey-necked Wood-rail, *Aramides cajanea*	Mangrove
	Sora, *Porzana carolina*	Freshwater marsh
	Yellow-breasted Crake, *Porzana flaviventer*	Freshwater marsh
	Purple Gallinule, *Porphyula martinica*	Freshwater marsh
	Common Moorhen, *Gallinula chloropus*	Freshwater marsh
Aramidae	Limpkin, *Aramus guarauna*	Open trees, scrub & grasses
Jacanidae	Wattled Jacana, *Jacana jacana*	Freshwater marsh
Scolopacidae	Common Snipe, *Gallinago gallinago*	Open trees, scrub & grasses
Columbidae	Pale-vented Pigeon, *Columba cayennensis*	Open trees, scrub & grasses
	Eared Dove, *Zenaida auriculata*	Open trees, scrub & grasses
	Common Grounddove, *Columbina passerina*	Open trees, scrub & grasses
	Ruddy Grounddove, *Columbina talpacoti*	Open trees, scrub & grasses
Psittacidae	Red-bellied Macaw, *Ara manilata*	Residential
	Green-rumped Parrotlet, *Forpus passerinus*	Open trees, scrub & grasses
	Yellow-crowned Parrot, *Amazona ochrocephala*	Residential
Cuculidae	Striped Cuckoo, *Tapera naevia*	Open trees, scrub & grasses
	Greater Ani, *Crotophaga major*	Mangrove
	Smooth-billed Ani, *Crotophaga ani*	Open trees, scrub & grasses
Tytonidae	Barn owl, *Tyto alba*	Open trees, scrub & grasses
Strigidae	Tropical Screech-owl, *Otus choliba*	Residential
	Ferruginous Pygmy-owl, *Glaucidium brasilianum*	Residential
Caprimulgidae	Lesser Nighthawk, *Chordeiles acutipennis*	Open trees, scrub & grasses
	Nacunda Nighthawk, *Podager nacunda*	Open trees, scrub & grasses
Apodidae	Short-tailed Swift, *Chaetura brachyura*	Arial forager
	Fork-tailed Palm-swift, *Reinarda squamata*	Open trees, scrub & grasses
Trochilidae	White-necked Jacobin, *Florisuga mellivora*	Residential
	Green-throated Mango, *Anthracothorax viridigula*	Residential
	Black-throated Mango, *Anthracothorax nigricollis*	Residential
	Ruby-topaz Hummingbird, *Chrysolampis mosquitus*	Residential
	Blue-chinned Sapphire, *Chlorestes notatus*	Residential
	White-chested Emerald, *Amazilia chionopectus*	Residential
	Copper-rumped Hummingbird, *Amazilia tobaci*	Residential
	Long-billed Starthroat, *Heliomaster longirostris*	Residential
Alcedinidae	Ringed Kingfisher, *Ceryle torquata*	Waterways
	Green Kingfisher, *Chloroceryle americana*	Waterways
Galbulidae	Rufous-tailed Jacamar, *Gulbula ruficauda*	Residential
Furnariidae	Pale-breasted Spinetail, *Synallaxis albescens*	Open trees, scrub & grasses
	Yellow-chinned Spinetail, *Certhiaxis cinnamomea*	Open trees, scrub & grasses
	Black-crested Antshrike, *Sakesphorus canadensis*	Mangrove
	Barred Antshrike, *Thamnophilus doliatus*	Open trees, scrub & grasses
Tyrannidae	Southern-beardless Tyrannulet, *Camptostoma obsoletum*	Residential
	Yellow-bellied Elaenia, *Elaenia flavogaster*	Open trees, scrub & grasses
	Northern Scrub Flycatcher, *Sublegatus arenarum*	Mangrove
	Yellow-breasted Flycatcher, *Tolmonyias flaviventris*	Mangrove
	Brown-crested Flycatcher, *Myiarchus tyrannulus*	Mangrove
	Pied Water-tyrant, *Fluvicola pica*	Waterways
	White-headed Marsh-tyrant, *Arundinicola leucocephala*	Waterways
	Great Kiskadee, *Pitangus sulphuratus*	Open trees, scrub & grasses
	Boat-billed Flycatcher, *Megarynchus pitangua*	Residential
	Tropical Kingbird, *Tyrannus melancholicus*	Open trees, scrub & grasses
	Grey Kingbird, *Tyrannus dominicensis*	Open trees, scrub & grasses
	Fork-tailed Flycatcher, *Tyrannus savana*	Open trees, scrub & grasses
Vireonidae	Rufous-browed Peppershrike, *Cyclarhis gujanensis*	Open trees, scrub & grasses
Hirundinidae	Grey-breasted Martin, *Progne chalybea*	Arial forager
	White-winged Swallow, *Tachycineta albiventer*	Waterways
	Blue and White Swallow, *Pygochelidon cyanoleuca*	Arial forager
	Bank Swallow, *Riparia riparia*	Arial forager

Table 2 (Continued). Birds observed around Brickfield to Orange Valley not associated with coastal mudflats, 1996-2003.

Family	Species	Predominant habitat in which observed
	Barn Swallow, *Hirundo rustica*	Arial forager
Troglodytidae	House Wren, *Troglodytes aedon*	Residential
Mimidae	Tropical Mockingbird, *Mimus gilvus*	Open trees, scrub & grasses
Parulidae	Yellow Warbler, *Dendroica petechia*	Mangrove and residential
	American Redstart, *Setophaga ruticilla*	Mangrove
	Northern Waterthrush, *Seiurus noveboracensis*	Mangrove
	Masked Yellowthroat, *Geothlypis aequinoctialis*	Open trees, scrub & grasses
Coerebidae	Bananaquit, *Coereba flaveola*	Residential
Thraupidae	Bicoloured Conebill, *Conirostrum bicolor*	Mangrove
	White-lined Tanager, *Tachyphonus rufus*	Residential
	Summer Tanager, *Piranga rubra*	Residential
	Blue-grey Tanager, *Thraupis episcopus*	Residential
	Palm Tanager, *Thraupis palmarum*	Residential
	Trinidad Euphonia, *Euphonia trinitatis*	Residential
	Red-legged Honeycreeper, *Cyanerpes cyaneus*	Residential
Fringillidae	Blue-black Grassquit, *Volatinia jacarina*	Open trees, scrub & grasses
	Saffron Finch, *Sicalis flaveola*	Residential
	Red-capped Cardinal, *Paroaria gularis*	Open trees, scrub & grasses
	Greyish Saltator, *Saltator coerulescens*	Open trees, scrub & grasses
	Dickcissel, *Spiza americana*	Residential
Icteridae	Red-breasted Blackbird, *Sturnella militaris*	Open trees, scrub & grasses
	Yellow-hooded Blackbird, *Agelaius icterocephalus*	Open trees, scrub & grasses
	Carib Grackle, *Quiscalus lugubris*	Open trees, scrub & grasses
	Shiny Cowbird, *Molothrus bonariensis*	Open trees, scrub & grasses
	Giant Cowbird, *Molothrus oryzivora*	Residential
	Yellow Oriole, *Icterus nigrogularis*	Residential
	Crested Oropendola, *Psarocolius decumanus*	Residential

DISCUSSION

This study provides a quantitative assessment of the birds on the tidal mudflats at Brickfield and a list of birds observed in the surrounding areas. This study reaffirms the importance of the area to the shorebirds and seabirds of Trinidad. The presence of species apparently *en route* to Venezuela (ffrench 2000) demonstrate that residential areas can provide valuable habitat and food plants for far ranging species.

The diversity of shorebirds, waders and seabirds in the study area appears to be influenced by the nature of the habitat, its location and by fishing activities. Shorebirds feed and roost on the extensive mudflats, herons feed on the mudflats and roost in the mangrove. The mangroves of the adjacent Caroni Swamp serve as a habitat for mangrove-dependent passerines. Small shrimp trawlers (stone drags) operate in this area and discard the by-catch at sea. These trawlers are usually accompanied by gulls, terns and pelicans. The seabirds roost on the mudflats and contribute nutrients via their faeces.

The bird community observed in this study is comparable to that of the Port of Spain Sewage Ponds (White 2000) but without the freshwater species. Other studies, for which comparable data are available (Cuffy 2002; Gochfeld 2002; White *et al*. Unpublished) are inland and include freshwater marsh and scrub inhabiting species. Black-bellied Plover, Willet, Whimbrel and Western Sandpiper, appear to prefer saline conditions. They are abundant at Brickfield but rare at the Caroni Rice Project (White *et al*. unpublished). At the Port of Spain Sewage Ponds they were restricted to brackish areas along canal edges (White 2000). In contrast, American Golden Plover, Upland Sandpiper, Least Sandpiper, Stilt Sandpiper and Buff-breasted Sandpiper, are better represented in the freshwater conditions at the Caroni Rice Project (White *et al*. unpublished) than at Brickfield.

The area from Orange Valley to Brickfield is particularly important to local populations of Whimbrel, Western Sandpiper, Laughing Gull, Royal Tern, Yellow-billed Tern, Large-billed Tern and Black Skimmer. The concentration of birds and their accessibility make it attractive to birdwatchers. Consequently many rare species have been observed, including Wood Stork, Maguari Stork, Caribbean Flamingo, American Oystercatcher, Terek Sandpiper, Black-tailed Godwit, Franklin's Gull, Kelp Gull and Sabines Gull. Indeed the Maguari Stork (Trinidad and Tobago Rare Bird Committee, unpublished record), Franklin's Gull (McNair *et al.* 2002) and Kelp Gull (Hayes *et al.* 2000) were all first records for Trinidad and the Terek Sandpiper (Taylor 2001), and Black-tailed Godwit (Hayes and Kenefick 2002) were first records for South America.

Of the mudflat species recorded in this study, none are considered *Endangered,* and only one species, the Scarlet Ibis, is listed as V*ulnerable* in Trinidad as defined in Schedule 4 of the Conservation of Wildlife Act of 1999 (Anon. 1999). However, the site meets many of the criteria set out under the *Environmentally Sensitive Areas Rules 2001* (Schedule II). It is a good representation of a naturally occurring system. It is regarded by the scientific community as having significant value in non-destructive research. It has high potential for fostering environmental awareness, appreciation or education. It is high in aesthetic value. It performs an integral role in the functioning of a wider ecosystem, and is of specific value as a habitat for animals at a critical stage of their biological cycle. Designation of the site as an *Environmentally Sensitive Area* will assist efforts to keep the area attractive for birds and persons who enjoy watching them.

ACKNOWLEDGEMENTS

This paper is dedicated to Peter Bacon who will be remembered with affection and gratitude, especially by G. White. His tremendous influence is reflected in this paper. He often stressed the need to collect empirical data on common species, not only rare or exciting

ones. He advocated active management of habitats, whether natural or not, and he encouraged the integration of surrounding communities into these efforts.

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NATURE NOTE

An Observation of Nest Relocation in the Ant *Cephalotes atratus*

Colonies of most ants, like other social insects, tend to inhabit fixed nests. However, movement from one nest site to another is known to occur at least occasionally in many species. Based on a systematic study of four north-american species, Smallwood (1982) concluded that nest relocation is much commoner in forest ants than had been supposed.

One of the more conspicuous ants in Trinidad forests is *Cephalotes atratus*, the giant turtle ant. This relatively large, all-black ant has a very broad, flattened head. It nests arboreally and is often seen walking in loose columns on tree trunks, fallen logs and across the forest floor. Despite its commonness and striking appearance, it has been the subject of just one substantial behavioural-ecological study (Corn 1980).

On 15 July, 2003, we came upon a fairly strong column of *Cephalotes* workers crossing a broad trail in the Arena Forest Reserve, central Trinidad. Movement was almost entirely in one direction. The ants descended one tree trunk and ascended another trunk about seven metres away. Aside from its nearly one-directional nature, the notable feature of this column was that a large minority of the larger workers carried smaller workers in their mandibles. Carried workers had the body curled and were plainly alive, their antennae and tarsi twitching. Closer examination showed that a small minority of workers carried larvae in their mandibles.

Although we were unable to see either the old or new nest of this *Cephalotes* colony, it was plain that a relocation was underway. The queen presumably walked to the new nest either before or after our observation period. Corn (1980) described workers carrying dead nest-mates out of the nest, but she made no mention of carrying live nest-mates or brood. This appears to be the first report of nest relocation in this species.

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Dedicated to the memory of Professor Peter R. Bacon

Comparative Breeding Ecology of the Frogs *Leptodactylus fuscus* and *Physalaemus pustulosus* in Trinidad, West Indies

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ABSTRACT

Foam nest numbers deposited by two leptodactylid frogs *Leptodactylus fuscus* and *Physalaemus pustulosus* were monitored at five ephemeral ponds in the village of Lopinot over a 40 day period in the rainy season. *L. fuscus* laid more nests after dry or light rainfall days, and none after very wet days; *P. pustulosus* tended to lay more nests after wet days, and fewer after light rainfall days. *L.fuscus* nest burrows were positioned so as to be inundated by water only after very wet days. Water levels in the ponds fluctuated markedly, with one pond drying out on four separate occasions during the study. Although many more *P. pustulosus* nests and total egg numbers were deposited than *L. fuscus* (228,300 *pustulosus* eggs estimated compared to 6300 *fuscus*), numbers of tadpoles of the two species found in the ponds were fairly similar. The different reproductive strategies of the two frogs, and their suitability for ephemeral pond breeding, are discussed in the light of these results.

INTRODUCTION

Leptodactylus fuscus and *Physalaemus pustulosus* are two of Trinidad and Tobago's commonest frogs, with widespread distributions on both islands (Murphy 1997; Kenny, 1969 named these frogs *L. sibilatrix* and *Eupemphix pustulosus*). *L. fuscus* (the whistling frog) and *P. pustulosus* (the pung-la-la frog) both owe their local names to their calls and are found predominantly at lower elevations on agricultural land and urban fringes, whenever choked ditches, deep tyre-ruts and temporary pools occur.

Both species are foam-nesting leptodactylids: *L.fuscus* nests are made in burrows in the banks of ditches and pools and are hard to locate, because the parent frogs seal the burrows after completing the foam nest. Each nest contains around 100 large (2.0 mm diameter) pigmentless eggs which hatch after about 2 days incubation and then remain in the foam nest from a few days to several weeks, depending on the occurrence of heavy rain to flood the burrow, allowing the larvae to enter the pool as feeding stage tadpoles (Downie 1994). *P. pustulosus* nests are made on the surface of water, usually at the edges of pools and ditches. They are conspicuous and white, containing about 300 small (1.5 mm diameter) pigmentless eggs which hatch after about two days incubation and soon drop from the nest into the water below; after 2 days further development, they are feeding stage tadpoles (Downie 1988 and 1993).

L. fuscus and *P. pustulosus* commonly breed in the same pools in Trinidad. The aim of this study was to compare the success of their different breeding strategies in relation to the characteristics of their habitat.

STUDY SITE AND METHODS

The study site was a set of five temporary pools in and around the grave yard at Lopinot Village in Trinidad's Nothern Range. We visited the site 20 times, at two day intervals, between 1100 and 1500 h each time, between 12 July and 22 August, 1999, and have also made observations at this site in earlier years and since then. The pools are rain-fed and serve to water cattle which graze the graveyard: in 2003, the pools were mainly filled in, possibly to reduce mosquito breeding. Figure 1 illustrates the lay-out of the site as it was in 1999. At the first visit, pond dimensions and basic characteristics were assessed. At each visit, the following were noted:

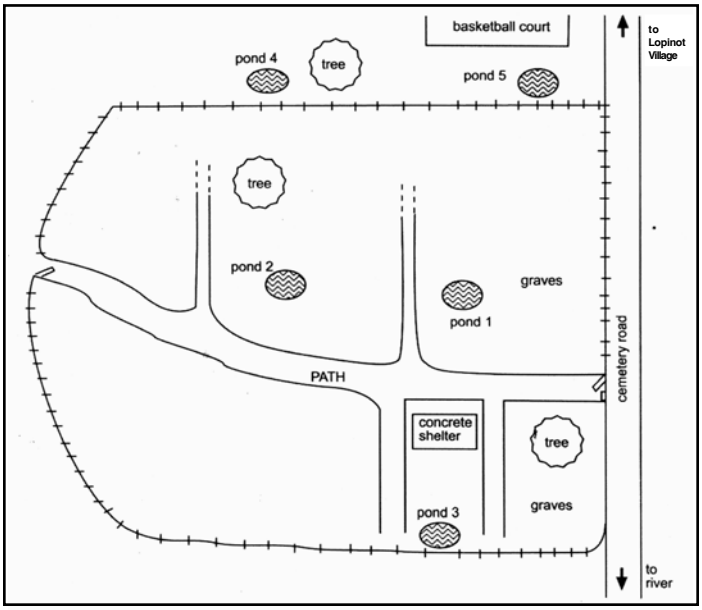

Fig. 1. Map of the graveyard site at Lopinot (not scaled)

- Pond depth at the deepest point, to 0.5 cm using a metre stick.
- Rainfall at the site since the previous visit, using a rain gauge left in an open but secluded position.
- Water temperature to 0.1 °C using a digital thermometer placed at the centre of the pond.
- Water pH using pH paper.
- Freshly made *P. pustulosus* and *L. fuscus* nests.

It was straightforward to count *P. pustulosus* nests, except that mating pairs are sometimes so close together that their nests fuse: we estimated the number of individual nests in a fused foam mass from size and shape. We located *L. fuscus* nests by systematically inserting the handle of a tablespoon into the mud surrounding each pond to a distance of about 30 cm from the outer edge: this method located empty frog holes, hatched nests containing larvae and fresh foam nests. The height of each nest above the water level was recorded by means of a metre stick and spirit level. A combination of this measurement and pool depth at

the same time allowed calculation of the position of each nest relative to the bottom of the pool.

In addition, every second visit (10 in total), we used a small aquarium net to sample the relative proportions of the two tadpole species and any predators; the length of each pool was swept twice, close to the bottom, and all tadpoles and insect larvae caught were returned to our laboratory for identification and counting.

During this study, a large tethered water buffalo was moved around the site to graze the grass, and it often spent time sitting in the nearest pond. We did not think it advisable to disturb this animal: this led to lack of data from each of the ponds on 1-2 occasions during the study.

RESULTS

Nest numbers and rainfall

Table 1 shows the number of nests recorded for each species related to the rainfall recorded for the period since the previous visit. A Spearman's rank correlation showed a significant positive relationship between number of *P. pustulosus* nests and rainfall (r_s = 0.715, P <0.05) but a significant negative relationship between *L. fuscus* nests and rainfall (r_s = -0.803, P <0.05). The most anomalous result in this pattern was the large number of *P. pustulosus* nests for the 0.0 mm rainfall record. This was our first sample and, although no rainfall was recorded on the previous days, it followed a period of very heavy rainfall which had filled the pools. Given the concealed nature of *L. fuscus* nests, it is likely that we underestimated their numbers, but we feel that our technique was systematic enough to ensure that under-counting was not serious. Since we sampled every second day, and hatching occurs after two days, any discovery of nests that were later than two days post-hatching indicated nests missed on previous sample days: their numbers were low.

Table 1. Numbers of nests of *Physalaemus pustulosus* and *Leptodactylus fuscus* found on each sample day, arranged according to rainfall during the previous two days.

Rainfall (mm)	Number of nests	
	P. pustulosus	*L. fuscus*
0.0	61	14
0.5	25	2
2.5	26	5
4.0	17	4
8.0	26	12
9.0	46	3
12.0	31	4
13.0	35	3
13.5	39	5
14.5	36	5
18.0	52	0
20.0	55	3
21.0	52	1
24.0	68	2
49.0	43	0
60.0	51	0
66.0	53	0
109.0	49	0

Pond choice and characteristics

Table 2 shows the characteristics of each pond, and the number of nests of each species recorded during the study period. Ponds 1-3 showed good numbers of both species nests, with *P. pustulosus* predominant; pond 4, the coolest pond with least temperature variation, due to shading by a large tree, contained the smallest numbers of nests; pond 5 had the largest number of *P. pustulosus* nests, but no *L. fuscus* at all (a result supported by finding no *L. fuscus* tadpoles). There was no obvious relationship between nest numbers and pond dimensions or temperature, other than that the only cool pond had fewer nests than the others. The lack of relationship with pond dimensions may not be surprising, given that the ponds were quite similar in size. There was also no relationship with water pH, consistently recorded as around pH 5.5.

Table 2. Characteristics and nest numbers of the different ponds.

Pond	Temperature ∞ C mean ± SD	Mean dimensions (m: length x width x depth	Total *P. pustulosus* nests	Total L. fuscus nests
1	32.0 ± 4.5	2.9 x 2.3 x 0.19	133	18
2	32.0 ± 4.4	2.4 x 2.3 x 0.17	151	24
3	34.7 ± 4.6	2.1 x 1.3 x 0.13	108	14
4	26.2 ± 1.3	1.7 x 1.4 x 0.14	92	7
5	32.4 ± 4.0	2.6 x 2.5 x 0.19	277	0

Pond drying and community composition

Water depth profiles for the five ponds are shown in Figure 2. Broadly, these followed the same pattern, related to rainfall, but the

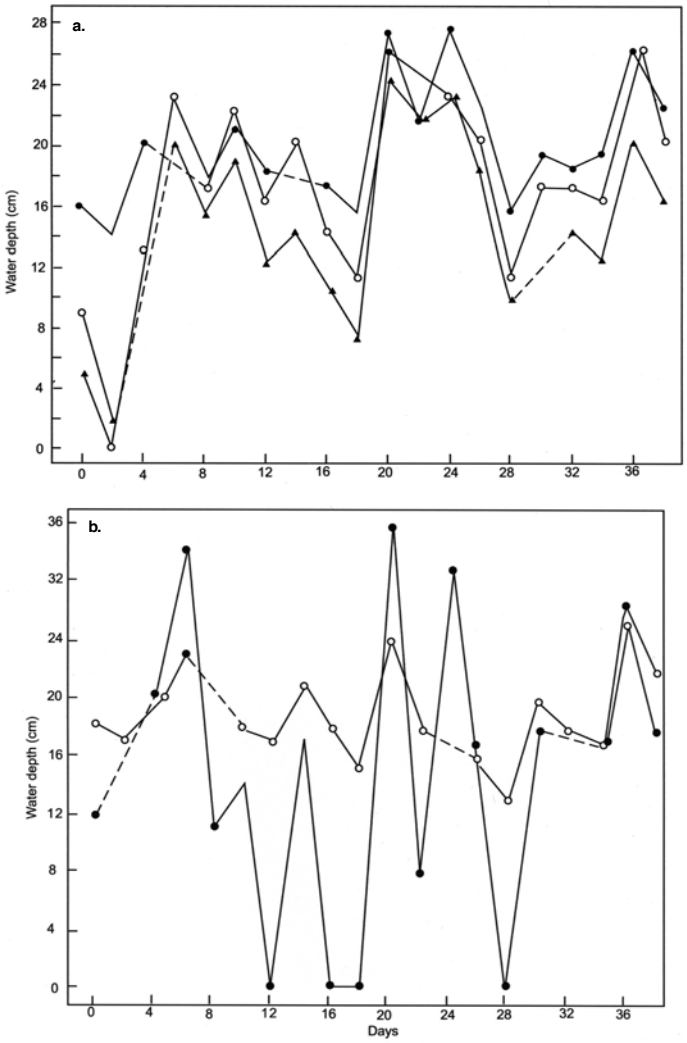

Fig. 2. Water depth changes in the five Lopinot ponds a) ponds 1-3; b) ponds 4-5.

different physical characteristics of different ponds did lead to important consequences for tadpoles. Pond 4 was less basin shaped than the others and dried up most often (dry on four occasions). There was also most probably a relationship between pond depth and water temperature (likely since a small depth of water heats up faster than deep water), though we did not have enough data to discount complicating effects like degree of cloud cover: however on two days when water depth was zero in the shaded pond 4 and low in the others, water temperature was close to or in excess of 40°C.

Table 3 shows the mean numbers of *L. fuscus* and *P. pustulosus* tadpoles captured from the different ponds. The data support the earlier result of a lack of *L. fuscus* in pond 5. Notice that despite their being many more *P. pustulosus* nests overall than *L. fuscus*

Table 3. Mean numbers of tadpoles taken from the different ponds (9-10 samples through the study).

Pond	*P. pustulosus*	*L. fuscus*
1	31.0	21.0
2	26.9	22.4
3	14.2	16.4
4	7.9	16.0
5	51.3	0

(Table 2) and the fact that each *P. pustulosus* nest contains three times as many eggs as an *L. fuscus* nest, the numbers of tadpoles of the two species were surprisingly similar. The sampling nets we used had a mesh size of about 1mm^2 since finer nets would have taken too much of the sediment from near the bottom of the ponds. Recently hatched *P. pustulosus* located at the surface of the mud would not be taken by this method. Our sampling therefore estimated only tadpoles that had succeeded in growing well past the start of feeding stage. Another feature is that the only pond where the recorded numbers of *L. fuscus* tadpole clearly exceeded *P. pustulosus* was pond 4, the only pond to dry up more than once during the study.

The number of predators, nearly all odonate nymphs, that we captured was quite small, only three for every hundred tadpoles. However, this was certainly an underestimate of actual numbers since most of the nymphs sit in the mud at the bottom of the pond.

At pond 2, we found six foam nests of *L. validus*, another of Trinidad's leptodactylids, on one occasion, but did not see tadpoles of this species during later visits. Other frog species have been known to breed at the site in other years, including *Hyla crepitans*, *Phyllomedusa trinitatis* and *Bufo marinus*, but they did not occur in 1999: we are therefore essentially dealing with a two species comparison.

L. fuscus nest distribution

Table 4 shows the height distribution of *L. fuscus* nests at each pond, in comparison with water depth variation and the measured high water mark. Nests occurred over quite a narrow range of heights, well up the sides of the pools, but within high water mark.

Table 4. Position of *L. fuscus* nests in relation to pond depth and high water mark in the different ponds (no *L. fuscus* in Pond 5).

Pond	Number of nests found	Nest height (cm: mean ± SD)	Pond depth (cm: mean ± SD)	High water mark (cm)
1	18	20.7 ± 1.7	19.7 ± 4.1	27.5
2	24	21.1 ± 4.3	16.8 ± 6.3	26.0
3	14	19.6 ± 2.2	14.5 ± 6.3	24.0
4	7	21.7 ± 2.2	14.8 ± 10.8	32.0

DISCUSSION

The results presented here compare reproduction in two tropical leptodactylid frogs at one location in Trinidad. The study was carried out in July and August, in the midst of Trinidad's rainy season (May-December approximately) and, although we have sampled only a part of the season, it is clear that reproduction in these frogs is very different from the pattern characteristic of temperate region species, which tend to breed only once in early spring. Breeding in the tropics tends to occur throughout the rainy season, whenever conditions are suitable. Several factors may be responsible for this difference: higher temperatures in the tropics may allow the tadpole phase to be relatively short, providing time for several successive batches of young to complete metamorphosis in a season; another factor may be the unpredictability of the rains: if temporary pools have a significant risk of drying out before tadpoles can reach metamorphosis, a bet-hedging strategy where individuals reproduce several times over the season is likely to be more successful than a single reproductive event (Philippi and Seger 1989).

We do not know how often individuals mate over the season. This could be established in *P. pustulosus* by marking the frogs in a population and following a breeding season. Previous work on this species (Ryan 1985; Green 1990) has concentrated on reproductive activity in males, but the number of foam nests produced by a population over a season must be related to the ability of females to produce multiple batches of eggs. We know of no relevant field study, but Davidson and Hough (1969) found that females of *Physalaemus* (= *Engystomops*) *pustulosus* in a laboratory population kept under rainy season conditions were able to ovulate every 4-5 weeks. *L. fuscus* would be harder to study because of the secretive nature of these frogs: males call from their burrows and become silent when observers come close; finding and marking a population would be very difficult.

We also do not know how long it takes for a newly fertilised egg to grow into a tadpole at the start of metamorphosis: in all amphibians, development time is affected by temperature, but also by environmental factors such as nutrient availability and competition, both intra- and inter-specific. In a laboratory study (Downie, Miller and Langhorne, unpublished data) we have found that at 28°C, well fed *P. pustulosus* and *L. fuscus* at low density can reach metamorphosis after 17 and 14 days respectively, compared to Kenny's (1969) report of 6 weeks for both species. Kenny did not give details of rearing conditions but we suspect his tadpoles were kept at high density. Increases in density and growing the two species together both lead to increases in development time in our experience. Laboratory data of this sort can only provide a general indication of what may be happening in the field, where the situation is complicated by diurnal temperature fluctuations, alterations in density due to water volume changes, the entry of new batches of tadpoles and the effects of predation and food availability. However, they can establish the minimum time needed to complete development, since other factors lead to increases.

Of the ponds in our study, pond 4 dried out three times and pond 2 once during the 38 day period we observed them. Given that we only visited every second day, it is also possible that other ponds may have dried temporarily, especially pond 3 (Figure 2a). This shows that drying out within the period of development from egg to metamorphosis (minimum 14-17 days at 28°C in the

laboratory: all our ponds except the shaded pond 4 had higher mean temperatures, but they were all measured when at their hottest, around the middle of the day) is a likely occurrence. If this happens, *L. fuscus* tadpoles have a chance of survival for some time: Downie (1984) and Downie and Smith (2003) have shown that *L. fuscus* tadpoles can survive several days out of water on a damp substrate (they may hide under leaves at the bottom of a dried up pond), but *P. pustulosus* die very quickly in these conditions. Previous work on pond drying in relation to tadpole growth has often demonstrated a speeding up of tadpole maturation (e.g. Crump 1989), but these studies have generally started with single egg clutches and a simulation of drying as the tadpoles near metamorphosis. The multiple ovipositions and unpredictable filling and drying of the ponds seen in our study clearly provide a much more complex situation.

The positions of *L. fuscus* nest burrows, all 20-22 cm above the pond bottom, suggest that they are situated so as to be inundated (allowing the tadpoles to emerge) only after very heavy rainfall. During our study, this occurred only at days 6, 20, 24 and 36. As noted earlier, *L. fuscus* hatchlings are able to survive several weeks in their foam nests, when they are in a state of suspended development (Downie 1994). The advantages of this strategy are twofold: emerging into the pool only after very heavy rain increases the likelihood that there will be enough water to complete development; also, being already at the feeding tadpole stage shortens overall development time and allows these tadpoles to prey on the eggs of frogs which reproduce only after rain, such as *P. pustulosus* (Downie 1990). Our data on nesting in relation to rainfall shows that *L. fuscus* did not breed on very wet days, whereas lowest numbers of *P. pustulosus* nests occurred after dry days: our results were not able to make this entirely clear partly because we sampled every second day, not daily, and because our study period was generally quite wet. Lack of breeding by *L. fuscus* on very wet days could be for two reasons: inundated mud may be unsuitable for making burrows; and it may be disadvantageous for *L. fuscus* nests to open before the larvae have got to the feeding stage. We suspect that nest burrow position may be related to the characteristics of the pond. In a previous study (Downie and Barron, unpublished data) of a ditch at Lopinot, *L. fuscus* nests were mainly about 10 cm above the ditch bottom, but this was a shallow ditch along which water could flow quickly: again, it only reached nest inundation depth occasionally. How *L. fuscus* can assess the best place to make burrows is not clear.

So far, the breeding strategy of *L. fuscus* seems much better suited to the characteristics of the site than *P. pustulosus*, yet *P. pustulosus* is present breeding in large numbers. How can this be explained? An extra factor is the frogflies whose maggots can destroy whole batches of *L. fuscus* eggs (Downie *et al.* 1995) though their frequency of occurrence is not high enough to be a serious limitation. In Trinidad, frogflies do not seem to attack *P. pustulosus* nests, though *Physalaemus* species are attacked in South America (Menin and Giaretta 2003). It is possible that *P. pustulosus* has some advantageous features that we have been unable to assess, such as better predator avoidance. In a study of tadpole distribution and competition in ephemeral ponds in Texas, Dayton and Fitzgerald (2001) concluded that pond duration and tadpole predator avoidance behaviour helped explain the differential distribution of species. Another factor may be differences in pollution toleration: we did notice that pond 5 where *P. pustulosus* bred abundantly and *L. fuscus* not at all, seemed to suffer more than the others from organic pollution from the water buffalo. The other obvious feature is the sheer difference in numbers of eggs produced by the two species: at an average of 300 eggs per nest, 228,300 *P. pustulosus* eggs were deposited over our study period, compared to only 6300 for *L. fuscus*. This disparity came down to very little difference in tadpole numbers sampled: broadly, therefore, *P. pustulosus* is an r-selected species, reproducing often, with large numbers of small eggs; *L. fuscus* is more k-selected, with smaller numbers of eggs, each of which is larger.

Previous work on these species has emphasised a number of other factors affecting breeding success. *P. pustulosus*, in particular, is a much studied species, *L. fuscus* much less so. Marsh *et al.* (1999, 2000) found that *P. pustulosus* males range between ponds at a scale of 200m apart but that females can only exercise mate choice (by assessing male call quality) at a scale of about 10m. The further apart ponds are, the higher the degree of site fidelity shown by males. Our ponds were about 20m apart and it would be of interest to assess levels of migration and site fidelity.

In another foam-nesting species, *Pleurodema borelli*, Halloy and Fiano (2000) found that oviposition was inhibited by existing high densities of conspecific tadpoles: late stage tadpoles ate new eggs and recent hatchings. We saw no evidence of such an intra-specific effect, though, as noted above, *L. fuscus* tadpoles have been observed to feed on *P. pustulosus* eggs (Downie 1990).

ACKNOWLEDGEMENTS

We wish to acknowledge the assistance provided by the late Peter Bacon to successive University of Glasgow expeditions to Trinidad and dedicate this paper to his memory. Also, the Wildlife Section of the Forestry Division have been very helpful in providing approval and permits for our work. This study was carried out as part of a series of University of Glasgow expeditions, funded by a number of agencies, principally the University of Glasgow Court and the Carnegie Trust.

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NATURE NOTE

Changes in the Number of Lesser Nighthawks at Caroni Sanctuary Car Park

On the night of 11 August, 1989 on the way home to Talparo from Port of Spain, I decided to pass through the parking lot of the Caroni Sanctuary to look for nighthawks. On that night, two days after first quarter, I saw four or five of them, and encouraged by this observation, passed in again on 12 August and 18 August (one day after full moon), saw three of them on the second visit and two on the third. They all seemed to be the same species, and after careful scrutiny and checking of descriptions and illustrations, I came to the conclusion that the species was the Lesser Nighthawk, *Chordeiles acutipennis*. Over the next five years I made it a habit to return home via the Caroni Savannah Road once per month at or near full moon, and on the way simply drive slowly through the carpark in the same circular route looking for these birds. The time of visit varied from about 2000 h to 2300 h, though I did not always take note of it; but the carpark was always vacant, so disturbance is not a factor to be considered. From December to July I saw no nighthawks. For August to November the results are in the table below. I visited the area three times in August 1989 and saw 9–10 birds. I have entered three in the table as the average for one visit.

Table. Number of birds sitting on the carpark.

	Year				
Month	1989	1990	1991	1992	1993
Aug.	3		0		
Sept	2	4	1	1	0
Oct	1	1	0	0	0
Nov	0	1	0	0	0

Belcher and Smooker (1936) noted that "its present status in Trinidad is that of a rare resident", and a little later "as in Leotaud's day [1866], in the off season it haunts at dusk the wet savannahs in little flocks of five or six". ffrench (1991) calls it "a common species, especially in August to October, occurring on savannahs …….breeding but probably also migrant." Later, however (1997), ffrench expressed doubts about the breeding reports, and suggested that the species visits Trinidad (and Tobago) only as a migrant.

Presumably then, what I saw at the Caroni Sanctuary in 1989 – 1990 were "little flocks". But why did they disappear by 1993? Are these observations evidence for a decline in numbers in recent years, or for migration, or for a change of habits? Perhaps the observations support the conclusion made by ffrench (1997) that the species is a migrant and not a rare resident, but further observations are needed to warrant definite conclusions.

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Distribution of the Frog *Mannophryne trinitatis* (Anura – Dendrobatidae) in Trinidad, West Indies

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ABSTRACT

Mannophryne trinitatis populations are found throughout most of Trinidad¥s Northern Range. The only previously reported *M. trinitatis* population found elsewhere other than the Northern Range is at Mount Tamana (Kenny 1969). We report here three new *M. trinitatis* localities in the central region; at Mount Harris (10 km northeast from Mount Tamana), and in the vicinities of Pepper Village and Gran Couva (16 and 20 km southwest from Mount Tamana respectively). No *M. trinitatis* have been found in the Southern Range. On several occasions, tadpoles were found in still pools distant from streams, made from plant material (phytotelmata).

INTRODUCTION

Mannophryne trinitatis (Garman) (see Murphy, 1997 for naming history of this species) is a small (25-28 mm snout-vent length), dark coloured diurnal and terrestrial dendrobatid frog that inhabits the humid coastal mountain forests of Northern Venezuela and the Northern and Central Ranges of Trinidad, West Indies. These frogs are found in Trinidad from sea level to the highest elevations (Kenny 1969) in and around rocky streams. The mostly slow-running clear-water streams that they inhabit are generally quite narrow and shallow; deeper pools within the streams are used for deposition and growth of tadpoles.

Kenny (1969) stated that *M. trinitatis* is present throughout the Northern Range, but did not list localities. He noted that deforestation of the southern slopes west of St. Joseph had restricted the species to "isolated pockets". Murphy (1997) listed previously published localities in the Northern Range (all on the southern slopes, other than Toco) and also noted localities he had checked himself. The Northern Range is an extension of Venezuela's Paria Peninsula, where *M. trinitatis* is also found (Murphy 1997 and personal observations) and consists of a series of ridges running northwest-southeast, up to 16 km wide and 88 km long. Most of the range lies between 150-456 m in elevation, although isolated peaks reach greater altitudes. The ridges are split by a large number of steep valleys and streams, descending on the southern side to Trinidad's central plain, but on the north side reaching the sea (Murphy 1997).

The only *M. trinitatis* locality recorded outside the Northern Range by Kenny (1969) and Murphy (1997) is Tamana Cave, located in Mount Tamana, the highest hill of the Central Range. The Central Range has an average elevation of 60 to 300 m with Tamana Cave at 240 m. The Central Range is separated from the Northern Range by about 20 km of relatively flat low elevation terrain (Fig. 1).

M. trinitatis distribution

M. trinitatis is found throughout most of Trinidad´s Northern Range. This range was once an extension of the Venezuelan mountain range currently known as the Paria Peninsula. The Northern Range consists of a series of ridges running northwest-southeast, up to 16 km wide and 88 km long. Most of the range lies between 150-456 m in elevation although peaks reach greater altitudes (Murphy 1997). The ridges are split by a large number of steep valleys and streams where *M. trinitatis* is found.

The Central Range is 60 km long, 5-8 km wide and is orientated northeast to southwest. The Central Range is lower than the Northern Range, with an average elevation between 60 and 300 m (Murphy 1997). The only previously recorded population of *M. trinitatis* in the Central Range is found in a cave system at an altitude of 240 m. This cave, Tamana Cave, is in the highest hill of the Central Range, Mount Tamana (Kenny 1979), and is separated from the Northern Range by 20 km of relatively flat low elevation terrain (See Fig. 1).

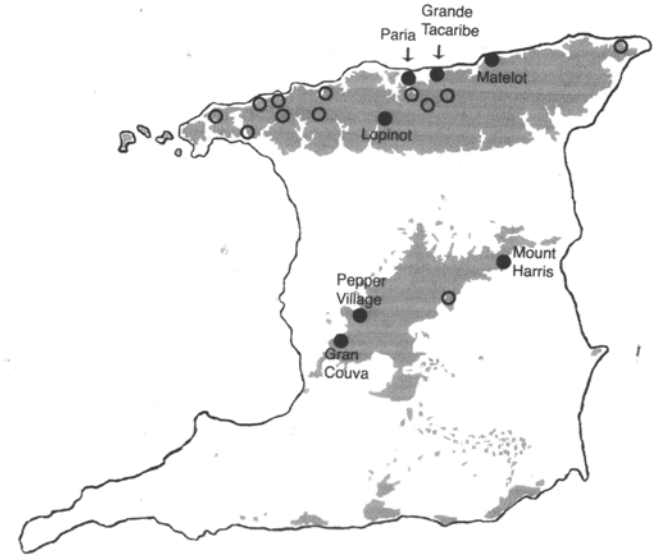

Fig. 1. Distribution of *Mannophryne trinitatis* populations in Trinidad. (Shaded areas: hill and mountain ranges; open circles: previously described populations; black circles: new populations).

The aim of the survey reported here was to check previously reported localities and to search for and establish whether any other populations of *M. trinitatis* exist within Trinidad´s Central Range, and to understand the distribution and habitat requirements of this species within Trinidad.

METHODS

The surveys were carried out in Trinidad during June to August (early in the rainy season) from 1996 to 2004 but most intensively 2002 to 2004. We searched at locations or sites where these frogs were likely to be found; near streams with surrounding dense vegetation, leaf litter or in muddy and humid valleys with thick vegetation cover. Three methods were used to survey the sites: (1) an auditory survey (males frequently call between 1600 and 1730 h,

or after rain), (2) tadpole sampling in pools and (3) looking for adult and juvenile frogs.

RESULTS

Northern Range

Some of the Northern Range *M. trinitatis* sites that we inspected have been well documented before; approaching and a few km beyond Maracas Bay (north coast road sites), Mount Saint Benedict and Lopinot (Downie *et al.* 2001; Cummins and Swan 1995). Other less well known populations were found at Blue Basin, Maracas Waterfall, El Tucuche, Simla, Paria, Matelot and Grande Tacaribe. Several other populations that we did not inspect have been reported previously in Arima Valley, Caura Valley, Maraval Valley, Morne Bleu Ridge, Toco, and St. Ann´s Valley (Murphy 1997).

All Northern Range populations inspected showed similar ecological and environmental characteristics. All *M. trinitatis* sites were in valleys or mountain slopes with rocky streams flowing downhill for several kilometers. With the exception of Mount Saint Benedict, all sites were surrounded by dense vegetation and were difficult to access. On the southern side of the Northern Range, *M. trinitatis* sites were first found at moderately high altitudes; but on the northern side at the coast, *M. trinitatis* could be found at sea level, in and beside forest streams opening on to beaches.

Adult frogs were found in large numbers at Mount Saint Benedict, north coast road, and at El Tucuche and Matelot. These frogs could be seen all day and, unlike in other populations, the males called for most of the day.

As well as adult frogs, tadpoles were present in large numbers at Mount Saint Benedict and in the streams close to the north coast road west of Las Cuevas. Tadpoles at Mount Saint Benedict (more than 400 tadpoles, July-August) were only found in a predator-free pond (diameter; 1.30 m, depth; 20 cm): lack of tadpoles elsewhere was likely due to the large number of a tadpole predator, the fish *Rivulus hartii*, found in the stream and other ponds (Downie *et al*. 2001). Large numbers of tadpoles were seen in the stream pools close to the north coast road and Lopinot sites, where *R. hartii* was absent. *Rivulus hartii* was found in large numbers in El Tucuche, Blue Basin and in one Lopinot site, and no tadpoles were seen in the streams at these sites, presumably because of male selection of deposition sites lacking predators (Downie *et al*. 2001). However, tadpoles were found on the slopes of El Tucuche in water-filled tree-stump holes and seed pods. Few tadpoles were caught at Paria and no tadpoles were ever seen at Matelot and Grande Tacaribe possibly because of the presence of freshwater prawns of the genus *Macrobrachium* (Downie *et al.* 2001).

M. trinitatis were also heard calling at Maracas River, at Cerro del Aripo, Morne Bleu and Toco, but these sites were not inspected. We were unable to access possible Northern Range sites west of Blue Basin.

Eastern Central Range

Tamana Hill (Tamana Caves)

Tamana Cave is located in the northern face of Mount Tamana (lat. 61°12´W – long. 10° 28´N) at 240 m. Between 1996 and 2001, tadpole and frog numbers fluctuated very markedly and we decided to assess the population more systematically in future years. Seven inspections of the site were carried out during the summer of 2002. Tadpoles were found at very high density in a small section of the stream (11 m) in almost complete darkness in 25 small rocky limestone pools (none exceeding 50 cm in diameter). This stream led to an open section of the cave, the chimney area (5.30 m x 7 m, 4 m high) where the sunlight entered the cave and froglets were extremely abundant, possibly reaching several hundred individuals at a given time. In addition to normally coloured individuals we also found six albino froglets and eight albino tadpoles in the pools by the chimney area.

Adult frogs were rarely seen in the cave: occasionally some males with attached tadpoles could be seen near the cave stream but adults did not appear to inhabit the cave: they only entered through the chimney to deposit tadpoles in the cave ponds. These pools may be suitable for tadpole development for two reasons: (1) a downstream flow of bat guano effluent enriches the ponds with nutrients, and (2) the stream is free of the predators found in the Northern Range streams. Given that clutch size in this species is 10-12, the very large numbers of tadpoles represent the breeding activity of a large number of frogs.

During the summer of 2003 the cave was visited on three occasions. Only one male frog and 12 tadpoles were seen in the cave. In 2004 the cave was visited once. No adult frogs or tadpoles were found in the cave, merely one juvenile frog. In the summer of 2002, males were seen outside the chimney entrance to the cave and at the bottom of the north side of Mount Tamana where the stream exited the cave to a banana plantation. In 2003, many frogs were heard all around Mount Tamana; by the path that ascends to the cave entrance and by the banana plantation; at the bottom of the hill and 500 m down the path by a very small stream that runs through the banana and cocoa plantation. The unusually low numbers of tadpoles in the cave and the abundance of frogs outside the cave may be an indication that the population had changed breeding grounds. However, no tadpoles or suitable ponds were found in the vicinity of Mount Tamana to support this idea. However, in 2001 tadpoles were found in a water-filled tree root hole on the side of the hill.

Mount Harris

Mount Harris (61°06´ W – 10°30´N) is located 10 km northeast from Mount Tamana. Nine male frogs calling by a small stream were seen during three site inspections in 2003: this is the first time that *M. trinitatis* has been reported at this location. The site differed from the Northern Range sites in that it was formed primarily by broken forest, with hardly any low vegetation cover. Frogs were found at both sides of Cunapo Southern Road. At the top of the road (up a slight slope) the small stream was only a trickle, and at the other side of the road, down a slope, the stream increased in size and carried more water; the ground was covered in bamboo leaf litter and the ground was almost dry. The males were very elusive and difficult to catch. A batch of six tadpoles was found in a very small pool by the stream.

Western Central Range

Pepper Village

About 16 km southwest from Mount Tamana (61°21´W – 10°25´N), near Pepper Village, several males calling by a small stream were seen at both sides of Couva Main Road in 2003. The site above the road (up a small slope) was drier and covered in dry bamboo leaves. At the other side of the road (down a slope), access was difficult and the stream opened to several small effluents that flowed through very muddy terrain. The vegetation throughout was dense and led to a cultivated area several dozen meters down stream. Only two tadpoles were found in a small pond at the upper side of the road.

Gran Couva

Three kilometers southwest (61°22´W – 10°23´N) from Pepper Village (south from Gran Couva, Corosal Road) *M. trinitatis* were located in 2003 by a small stream that flowed through a very dry site with hardly any vegetation other than a few bamboo trees growing by the stream banks. For the first 50-70 m from the road the stream had few rocks and flowed slowly to a small descent with several dark rocks and stream pools. Adult males and females were found in larger numbers in this part of the stream. Fourteen tadpoles belonging to three different batches were found in three separate pools.

When disturbed, these frogs jumped into the pools and remained submerged for about a minute, swimming underwater to rock crevices within the ponds. This is the first time this behaviour has been observed for *M. trinitatis* in Trinidad. This escape response has only been observed before in some of the *M. trinitatis* Venezuelan coastal populations (Jowers, personal observation).

During a second visit in 2004 larger numbers of adults and tadpoles were found at this site.

Southern Range

Several sites and streams were surveyed at Moruga during a visit in 2003 (Lune Road and Moreau Road) and at Trinity Hills in 2004. Even though some sites seemed to be suitable for *M. trinitatis*, no frogs were found.

DISCUSSION

The results presented here add several points to previous reports on *M. trinitatis* in Trinidad.

First, *M. trinitatis* is more widely distributed in the central region than previously reported. It is not clear whether the populations at Mount Harris, Pepper Village and Gran Couva are recent expansions from the well-known population in Tamana Cave or whether previous workers have not searched for *M. trinitatis* in these areas. Since the habitat in these new localities is rather different from *M. trinitatis* habitat in the Northern Range, the latter explanation is possible. Genetic analysis should reveal how closely related the new populations are to the Tamana population.

Next, it is clear that the Tamana population is subject to dramatic fluctuations. Kenny (1969) reported tadpole densities of "several thousand per square meter" in the stream and as recently as 2002, we found high numbers. However, in the two years since, the population has drastically reduced. It is not clear what has caused these fluctuations, but the degree of severity of the dry season in a limestone-based terrain may be a factor.

Finally, Kenny (1969) stated that "under natural conditions, tadpoles dwell always in running water". However, Downie *et al*. (2001) found that tadpoles were rarely if ever found in streams containing predators, even when there were plentifull adult *M. trinitatis* close to the streams. They suspected that males carrying tadpoles migrated some distance in search of predator-free pools. Our findings here show that these pools can include phytotelmata i.e. not running water. Other dendrobatid species are obligate users of phytotelmata, such as bromeliad tanks, but in *M. trinitatis,* tadpole deposition in these pools seems to be opportunistic.

The apparent absence of *M. trinitatis* from the Southern Range is a puzzle. The habitat is very similar to the lower elevation hills of the Northern Range, where *M. trinitatis* is so common and widely distributed. It is possible that *M. trinitatis* is present, but not in large numbers and that previous searches including our own have been on unsuitably dry days. Neither Kenny (1969) nor Murphy (1997) report having searched the Trinity Hills, the most likely habitat, and our few visits have not coincided with the best weather for locating *M. trinitatis*. A genuine absence of this frog may reflect the pattern of its colonization of Trinidad, presumably from the Northern Range.

ACKNOWLEDGEMENTS

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NATURE NOTE

Cooperative Inter-specific Behaviour Warning of Danger

I was looking out from the Asa Wright verandah at the usual peaceful scene of birds feeding on plants and artificial feeders. Below me a Great Kiskadee was perched prominently on one of the posts provided for birds approaching the feeders, and various other birds including at least one Crested Oropendola were foraging nearby.

Suddenly the oropendola uttered a loud, urgent call - kak-kak-kak. In a split second the kiskadee dived for cover into the bushes, and all the other, smaller birds disappeared too. Within a few seconds I saw not far above the house an Ornate Hawk-Eagle circling around, and it seems certain that it was the sight of this predator that had prompted the oropendola's warning. Clearly the other birds got the message.

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Dedicated to the memory of Professor Peter R. Bacon

Observations of Nest and Colony Structure of the Neotropical Ant *Dolichoderus attelaboides* (Formicidae: Dolichoderinae)

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ABSTRACT

Two polydomous colonies of *Dolichoderus atellaboides* are described from Trinidad, West Indies at the start of the rainy season. One comprised four nests, the other five nests. Each nest was in a cylinder formed by a dried, rolled *Ischnosiphon arouma* (Marantaceae) leaf plugged at the ends with rough carton. Each colony had several hundred workers and some hundreds of brood. Three out of four nests from one colony had multiple dealate queens, in each case with just one showing developed ovaries. The other colony had no dealate queen in any nest, which may indicate that the colony was in a state of senescence. Each colony had alate adults and pupae, all queens. This finding is consistent with the hypothesis of split sex ratios. In each colony we also found several supposed prey items, as well as *Crematogaster* sp. workers and several limuoid beetles. These latter are presumably specialized myrmecophiles.

INTRODUCTION

Dolichoderus attelaboides (Fabr.) is a relatively large member of the worldwide ant subfamily Dolichoderinae. It is widespread in South America north of the Southern Cone, including the West Indian island of Trinidad (MacKay 1993). MacKay (1993:38) has summarized the sparse published biological information on this ant. It is mainly arboreal, found in forests and plantations, where it builds carton nests on above-ground vegetation. It is known to respond aggressively to disturbances of the nest.

Ischnosiphon arouma (Aubl.) (Marantaceae) is a common understory plant in some Trinidad forests. It has a single spray of large, long-stemmed undivided leaves. As these age and dry out, the petiole and leaf blade come to hang approximately vertical, and the leaf curls to form a durable cylinder that can be more or less closed along its length.

In May-June 2003, near the end of the dry season, we found two apparent polydomous colonies of *D. attelaboides*, each occupying several old *I. arouma* leaves. We describe here the structure of the nest and colony composition in this species.

MATERIALS AND METHODS

All observations are from the Arena Forest Reserve (10E 34N 61E 14W) in Trinidad, West Indies. This is a well-developed lowland secondary forest on well-drained soil.

The nest description is based on nine active and two old nests. To locate active nests, we supplemented visual inspection of dry, rolled *I. arouma* leaves with mechanical disturbance of plants, usually by rapping on stems with a stick. *D. attelaboides* workers tend to rush out of the nest after even a light disturbance. On locating the first nest of each colony, we examined all rolled *I. arouma* leaves in the vicinity, removing all non-nest leaves as we did so, to a radius of at least 5 m, as well as examining other understorey vegetation. We did not search in the ground layer. We then left each nest undisturbed for about 15 min, in order to allow alarmed workers to re-enter the nest, and bagged the nest, and froze it within two hours. All collections took place in the late morning. We later dissected each nest individually. The dealate queens were dissected and their ovaries examined for the presence of mature oocytes.

Callow workers and alate queens are readily distinguishable from mature individuals by their lighter colouration. For present purposes, callows were diagnosed as having the femora and tibiae of the fore-legs yellowish-brown, versus dark red. As a supplementary character, the upper surface of the head, thorax and gaster is partly or entirely pale yellowish-brown in callows, versus uniformly dark in mature individuals.

As in most ants, pupal and adult queens are readily distinguished from workers by the much deeper thorax and the presence of wing buds, wings or wing scales.

Eggs were identified by their size and smooth surface, without apparent segmentation. However, we did not always take the time to definitely distinguish eggs from first-instar larvae, so that these are grouped together as "eggs".

Voucher specimens of *D. attelaboides*, collected by the authors as nest series 2117, are deposited in the Land Arthropod Collection of the University of the West Indies and at the University of Texas at El Paso.

RESULTS AND DISCUSSION

Nest Structure

Each nest in our study occupied a rolled dead leaf of *Ischnosiphon arouma*. The cylindrical space inside the leaf formed the nest cavity. Among active nests, this had a length of 12-14 cm and an estimated inner volume of 24-382 ml in our sample (Table 1).

Each nest cavity was closed below with a sheet of rough, dark

Table 1. Dimensions of nests A-D of colony 1 and nests A-E of colony 2 of *Dolichoderus attelaboides*.

	Nest								
	Colony 1				Colony 2				
	1A	1B	1C	1D	2A	2B	2C	2D	2E
Height (cm)	13.5	14.5	12.0	13.5	22.0	24.0	21.5	12.8	12.0
Inner diameter (cm)	2.0	2.7	3.5	1.5	3.5	4.5	2.5	4.5	6.0
Volume (ml)	42	83	115	24	212	382	106	255	339
Distance leaf base to upper sheet (cm)	0	12	2	10	6	4	1	14	9
Distance lower sheet to leaf tip (cm)	9	8	0	3	1	3	7	7	9

carton, the "lower sheet". It was partly closed above by an "upper sheet" of the same material. This latter always left a broad entrance hole, and in some nests the cylinder was hardly closed at all above. Only relatively neatly rolled leaves served as nest cavities, in our sample. The closure along the side was completed with additional carton joining the exposed leaf margin to the vane near the main vein. This carton formed a variable "side band" up to several mm wide, extending from the lower sheet to the upper sheet. In the one exception to this pattern, nest 1C, the upper sheet was complete, and a break in the side band near the top served as the entrance hole.

Embedded in the carton were abundant coarse fibres and occasional entire leaflets of *Pentaclethra macroloba* (Willd.) (Leguminosae), as well as apparent grains of soil. *P. macroloba* is a dominant tree in the Arena Reserve, where its leaflets form the main nest-closure material of another ant, *Anochetus emarginatus* (Fabr.) (L. Dempewolf, M. Cazabon and A. Roach, pers. comm.).

There was no inner partitioning of the nest cavity except in 1A. In this a dry leaf of another plant was found inside the nest, fixed in place with carton in such a way as to form an incomplete division between about the upper third and lower two-thirds of the cavity. The area above the partition contained mostly workers and brood, suggesting that it was being treated as a sort of fortuitous brood chamber.

Colony Composition

As we interpet it, Colony 1 comprised four nests (1A-1D) in two *I. arouma* plants about 2 m apart, while Colony 2 comprised five nests (2A-2E) in four plants with a maximum separation about 3 m. The close spatial association of nests within each of the two groups, together with a superabundance of apparently suitable, unused *I. arouma* leaves in the area around each group, supports this interpretation. Colony 1 was in an area of sparse *I. arouma*, while Colony 2 was in a broad, dense patch of this plant. The composition of each nest (Table 2) is assumed to be complete for all phena except mature workers. It is likely that some of these were away from their nests at the time of collection.

A striking feature of each colony is the considerable similarity of composition among nests, with each phenon distributed approximately at random among the nests. In addition, the two colonies are similar to each other except in one conspicuous aspect: While Colony 1 had 17 dealate queens distributed among three of its four nests, we found no dealate queen in any part of Colony 2. Nests 1A, 1B and 1C each had one queen with developed ovaries, suggesting decentralized reproduction at the level of the colony. The presence in nest 1D of a badly mauled queen (presumably dead at collection) with wings chewed off is suggestive of reproductive conflict at some level, possibly with worker policing (Ratnieks 1988).

The apparent absence of dealate queens in Colony 2 is something of a puzzle, especially in view of the abundant young brood. The most obvious hypothesis is that we failed to find all nests. However, our search was extensive enough that any additional nest in an *I. arouma* leaf or other understorey vegetation would have had to be at a considerable distance, with plentiful suitable nesting sites much closer at hand. In addition, it is noteworthy that not one of five known nests had any dealate queen, in strong contrast to Colony 1. An alternative hypothesis is that Colony 2 had been rendered queenless and was in a state of very early senescence, possibly with some reproduction by workers.

Each nest of each colony had new reproductive adults and pupae, but these were uniformly queens, with no sign of males. This is consistent with the hypothesis of split sex-ratios among colonies (Bourke and Franks 1995). It is less likely that males are produced later in *D. attelaboides*, both because this runs against the rule in social hymenoptera (Bulmer 1983) and because there were no male pupae in our colonies at a time when most nests already had more alate queens than queen pupae. Our results are also consistent with a burst of colony founding in the early wet season in this species.

Table 2. Composition of insects in nests A-D of colony 1 and nests A-E of colony 2 of *Dolichoderus attelaboides*.

	Nest										
	Colony 1					Colony 2					
	1A	1B	1C	1D	Total	2A	2B	2C	2D	2E	Total
Adults											
Dealate queens	2	8	7	0	17	0	0	0	0	0	0
Alate queens	11	8	4	2	25	3	6	19	5	12	45
Callow	4	7	4	2	17	3	6	14	4	7	34
Mature	7	1	0	0	8	0	0	5	1	5	11
Alate males	0	0	0	0	0	0	0	0	0	0	0
Workers	176	237	243	102	758	665	319	117	158	142	1401
Callow	120	126	92	35	373	251	93	12	16	16	388
Mature	56	111	151	67	385	44	226	105	142	126	643
Brood											
Queen pupae	3	10	0	1	14	4	1	1	0	1	7
Male pupae	0	0	0	0	0	0	0	0	0	0	0
Worker pupae	40	61	64	11	176	232	20	22	0	5	279
Larvae	22	70	35	38	165	72	42	26	20	29	189
ìEggsî	13	13	11	0	37	58	28	9	120	7	222
Total brood	78	154	110	50	392	366	91	58	140	42	697
Presumed nest symbionts											
Crematogaster	6	3	10	23	42	6	9	60	17	1	93
Limuloid beetles	2	0	1	0	3	6	6	0	2	0	14

Although the numbers of mature workers, callow workers and brood vary quite considerably among nests, ratios among mature workers, brood and callows workers are similar between colonies and reasonably uniform between nests of Colony 1. There is, however, no such consistent pattern among nests of Colony 2, which may indicate that it had recently lost (or slaughtered) its queens and was losing social cohesion, as suggested above.

As seen in Table 2, most nests contained small numbers of insects other than *D. attelaboides*. Some of these (omitted from Table 2) were probably or certainly prey, but nests also contained intact insects of two kinds that appeared to be nest symbionts. (Because all nests were frozen before examination, it can only be assumed that these were alive at collection.) It seems most likely that the *Crematogaster* ants were present as kleptoparasites. The term "nest symbiont" is applied loosely with respect to *Crematogaster*, as there was no indication that they nested together with *D. attelaboides*. Most nests also contained beetles with the typical limuloid form of several lineages of obligate myrmecophiles (Kistner 1979, 1982).

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NATURE NOTE

Note on an Unusual Gastrolith in a Prehensile-Tailed Porcupine, *Coendu prehensilis* (Linnacus 1758)

The prehensile-tailed porcupine *Coendu prehensilis* is a Neotropical mammal belonging to the Order Rodentia in the Family known as the Erithezodontidae. It is found throughout the tropical regions of northern South America as well as on the island of Trinidad.

It is almost totally arboreal in its habits as is attested to by the prehensile construction of its tail, which is not unlike the tails of some of the arboreal and prehensile-tailed primates that share its habitat. The porcupine will rarely come to the ground, except when there is no aerial connection of the branches, for it will usually, easily cross from tree to tree where the branches intertwine.

They feed entirely on vegetable matter which they cut up with their large upper incisor teeth. Like the feeding habits of other rodents in the Order — the squirrels (*Sciurus*), rats (*Rattus*), mice (*Mus*), pacas (*Agouti*) and agoutis (*Dasyprocta*) — the porcupine must gnaw on wood to wear down the large chisel-like incisors and must spend a considerable time doing this to keep them at the right size and functionality.

In captivity, this habit is attested to by the wear and tear to the climbing logs and nesting boxes supplied to these animals to make them feel secure and comfortable in their cages or enclosures.

The Emperor Valley Zoo, in Port of Spain has had on display many specimens of the porcupine over the years of the Zoo's existence.

In all zoos or animal menageries, animals whose diet cannot exactly be duplicated, substitute foods near as possible food eaten in the wild, are offered. The porcupines in the Emperor Valley Zoo were fed a mixture of fruits and hard, raw vegetables, which seemed to maintain them in healthy condition. This diet appeared satisfactory as the animals were able to reproduce in captivity.

When an animal dies in captivity and whenever possible, a necropsy was done to ascertain the cause of death. One such death in 1988 indicated a necropsy as a large mass could be seen in the abdominal area which, when palpated, was solid to the touch.

At necropsy, Dr. Charles DeGannes, the zoo's veterinarian, found a large stony mass occupying the entire area in the stomach that would normally be used to process the food eaten. Over the time of its formation the mass must have taken up more and more space until there was little or no room for digestion of the large amount of vegetable matter needed to keep the animal alive. Starvation or injuries sustained by a fall, when it could no longer climb around carrying the excess weight in its body cavity, were the probable causes of death.

This mass was approximately ovoid in shape measuring about 20 cm in its long axis. It felt like a large stone and must have weighed not less than a kilogram (see photo). There was no way that this animal could have ingested such an object and it was therefore formed in the stomach of the porcupine from the materials it had been eating over its lifetime. At present there is no information available to me whether any such gastroliths have ever been found in other Neoptropical porcupines. In other deaths at The Emperor Valley Zoo there was nothing like this that could have caused the death of the animal.

A gastrolith is a stone or stony concretion found in the stomach of mammals and is not uncommon. The most famous are the bezoar stones, found in the digestive tracts of some animals (such as goats) which, at one time and in many countries, were held in great esteem as being an antidote to poison (Tichy 1977). Gastroliths are also found in the crops of some birds and gizzards of crocodilians. However, these are stones that have been purposely ingested to assist in the digestion and grinding up of their food.

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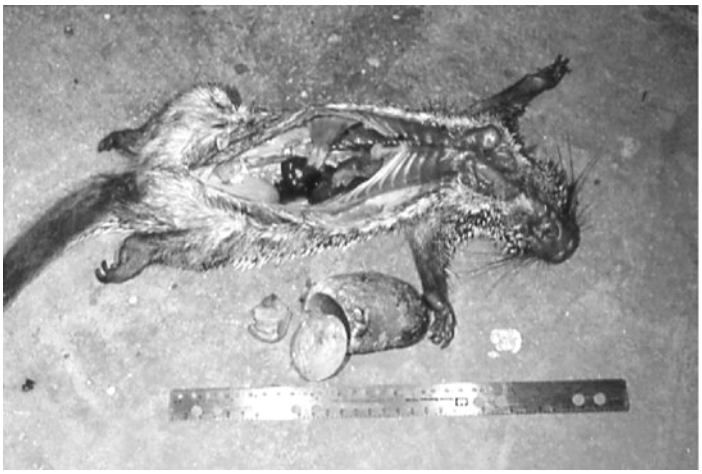

Necropsy of porcupine showing gastrolith and scale in inches and centimeters.

The Skipper Butterflies (Hesperiidae) of Trinidad. Part 12, Heteroptinae Genera Group H and Hesperiinae Genera Group N

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ABSTRACT

Heteroptinae (Genera Group H) are represented in Trinidad by one doubtful record of a *Dalla* sp.: *D. quasca* Bell or near. Because this is such a colourful and distinctive species, it seems strange that there are no other records if it were a true Trinidad species. Furthermore, members of this genus normally occur at relatively high altitude. Hence, this may well prove to be either a vagrant or a mis-labelled specimen, and is unlikely to be a resident Trinidad species. Genera Group N of the Hesperiinae is represented in Trinidad by just one record of a single species, *Lerodea eufala eufala* Edwards, which is widespread in North and South America. The only previous record of *L. eufala* from Trinidad is shown to have been based upon a misidentification. However, a new record is reported, the first and only one for the island to date, so that this species is retained on the Trinidad list. Neither species has been reared in Trinidad. Both species are described and illustrated as adults, and the male genitalia of *L. eufala* are illustrated.

INTRODUCTION

This contribution continues my series on the Hesperiidae of Trinidad and Tobago (see Cock 2003 and earlier papers). Abbreviations and protocols established in earlier papers are continued here.

HETEROPTINAE (GENERA GROUP H)

Evans (1955) treats this genera group as part of Hesperiinae, although he notes that in the New World fauna, it could well stand as a valid subfamily. I follow more recent authors and treat this group as a subfamily here. It is distinguished from Hesperiinae by the porrect hairy palpi (cf. Genera Group E; see Cock (1991)), stout arcuate antennal club, and long hindwing cell. The antennae are not longer than half costa F, the club stout, arcuate, tip blunt or pointed, and the nudum 7-12 segments. The wings are broad, F cell short, H cell much longer than half wing, with vein 1A shorter than vein 8, and the abdomen = or > dorsum H. There are no secondary sexual characters in this subfamily. Palaeartic and African representatives are known to be grass feeders, and it is likely that this is true of the Neotropical representatives as well.

There are six genera represented in this group in the Americas, but one genus dominates: *Dalla* Mabille, with over 80 species. Just one species of *Dalla* is doubtfully recorded from Trinidad; none from Tobago.

[134. H6/33 *Dalla sp. ?quasca* Bell 1947]

D. quasca quasca was described from Colombia, and Evans (1955) lists a male from Venezuela (Merida) in the NHM. A second subspecies, *equatoria* Bell, is found in Ecuador. The inclusion of this species in the Trinidad list is based on a specimen in the Booth Museum, Brighton, UK, collected by A. Hall, and labelled *D. fraternans*. The name *fraternans* is not a valid name in the Hesperiidae (Bridges 1988), and it may be that *D. frater* Mabille (range Panama to Bolivia, TL Peru) was intended. Referring to the same A. Hall specimen, Kaye (1921) lists this species as *Cyclopides caenides* Hewitson, a species now placed in *Dalla* (range Venezuela, Colombia, Ecuador, TL Venezuela); this is a misidentification. My identification is based on Evans' (1955) key and comparison of a photograph of the Hall specimen UPS with the NHM collection curated by Evans. S.R. Steinhauser (pers. comm. 2003) has examined my photograph and suggests it could be one of several species, including *D. quasca*. My identification must be considered provisional pending examination of the genitalia.

The Hall specimen is labelled St. Ann's, x-xi.1920. There is no more information regarding this species in Trinidad, yet it seems unlikely that such a brightly coloured skipper would have been overlooked if resident.

This is a genus of predominantly high altitude butterflies, and the presence of *D. quasca* in Trinidad seems unlikely. It is possible that this specimen is mis-labelled. For example, *Stalachtis susanna* Fabricius is a large and brightly coloured riodinid restricted to central and southern Brazil and perhaps Paraguay (D'Abrera 1994), yet there is an A. Hall specimen in the Booth Museum labelled St. Ann's, xi-xii.1931 which must surely be mis-labelled. On balance, the retention of this species on the Trinidad list does not seem justified.

Fig. 1. *Dalla ? quasca*, St. Ann's, x-xi.1920, A. Hall (specimen in Booth Museum)

Male. UPS dark brown; slightly yellow hyaline spots in spaces 2, 3, 6-8 and cell F; fringes F brown. UPH with a large orange discal spot; fringes brown-orange. F male 14 mm according to Evans (1955).

Life history and food plants unknown.

HESPERIINAE (GENERA GROUP N)

Evans (1955) treats four genera and 52 species from the Americas in this Genera Group. Most are restricted to North America, but *Lerodea* Scudder occurs in tropical South America, and one species, *L. eufala* Edwards, is widespread. This is the only species of the

group known from Trinidad; it has not been reported from Tobago.

This group is not well distinguished from others in the subfamily, lying between Genera Group M (tawny species with short antennae with hardly any apiculus) and Genera Group O (Cock 2003). The length of the nudum on the club of the antenna is equal to the length on the apiculus (reflexed portion); the quadrate palpi resemble those of Genera Group J (which I have yet to treat); the mid tibia are always spined; and there are no secondary male characters (brands, stigma, costal fold etc.)

It seems likely that most members of the group are grass feeders; *Lerodea eufala* almost certainly is.

244a. N3/1 *Lerodea eufala eufala* Edwards 1869

This species occurs from southern USA to Argentina (not the Guianas), Cuba and Jamaica, but appears to be more common in North America; a second subspecies, *concepcionis* Strand, is restricted to Patagonia (Evans 1955).

Kaye (1940) records *Lerodea fusca* Grote and Robinson from Trinidad on the basis of specimen collected by Sir Norman Lamont at Morne Diable, 10.xi.1929; he gives the range of this species as Chile. *Lerodea fusca* Grote & Robinson was described from Georgia and is a synonym of a North America species, *Nastra l'herminieri* Latreille. Probably, Kaye intended to refer to *Lerodea fusca* Reed, described from Chile, which is a homonym of *fusca* Grote & Robinson, and has been subsequently named *concepcionis* Strand, the Patagonian subspecies of *Lerodea eufala*. In Cock (1982) I assumed that Kaye had made a misidentification for *Cymaenes tripunctus theogenis* Capronier, since the two are similar, and Kaye (1921, 1940) did not include this common species. I have since examined Lamont's specimen, which is in the RSM labelled as *Lerodea fusca*, and find that although it is similar to *L. eufala* and C. *tripunctus*, it is actually another species, probably *C. campestris* Mielke. Thus, the published record of this species is based on a misidentification.

However, I am retaining this species on the Trinidad list on the basis of a single male specimen collected by Sir Norman Lamont at Guayaguayare, 29.iii.1922 (specimen in RSM). Lamont had identified this specimen as *Vehilius subplanus* Kaye, which is considered to be a synonym of *V. inca* Scudder, Genera Group J (Evans 1955, Cock 1982). My identification is based on the adult markings and comparison of the male genitalia (Fig. 2) with figures in Evans (1955) and Lindsey *et al.* (1931). There is nothing else known about the occurrence of this species in Trinidad.

Fig. 2. *Lerodea eufala eufala* (male) Guayaguayare, 29.iii.1922, N. Lamont, (specimen in RSM).

Fig. 3. *Lerodea eufala eufala* (male) UNS of plate 3. The darker tone in spaces 6 and 7, and at the tornus UNH are shadows due to the positioning of the camera flash; the UNH is rather uniformly pale brown.

Fig. 4. Male genitalia of *Lerodea eufala eufala,* Guayaguayare, 29.iii.1922, N. Lamont (specimen in RSM). From left: genitalia with valves and aedeagus removed, lateral view; uncus and gnathos, dorsal view**;** left valve, internal view; left valve, ventral view.

Male. UPS brown; sharply bordered white hyaline spots in spaces 2 (just beyond origin of vein 3, inner edge straight, outer edge angled), 3 (just beyond end of cell, slightly quadrate), 6-8 (dots in a straight line, angled slightly towards apex at costa); two indistinct spots in cell, aligned parallel to spots in spaces 6-8; fringes brown, paler at tornus UPH. Evans (1955) states that there may be a spot in space 1B, but that is not present in the Trinidad specimen. UNS light brown, paler towards apex UNF, and over whole of UNH; spots as UPS, except the lower spot in the cell is not visible; space 1 UNF slightly paler in distal half. I have not seen the female. F male 13 mm according to Evans (1955).

Although this species is superficially similar to several others that occur in Trinidad, the combination of the arrangement of spots F, plain UNH, and absence of a stigma or brand in the male seems unique. *Morys compta compta* Butler (genera Group J) is perhaps closest, but there are no cell spots, the apical spots are aligned at right angles to the costa, and the male has strong black brands in spaces 1B and 2.

The life history has been described in California, USA, by Coolidge (1922) and Comstock (1929) based on larvae hatched from ova laid by field-collected females, and reared on grass, i.e. the field host in unknown. There are illustrations of ovum, larva and pupa on the internet (DCLS 2003). Dethier (1939) reports that larvae will feed on sugar-cane in the laboratory in Cuba, and Kendall (1959) obtained ova from field collected females which he reared on St. Augustine grass, *Stenotaphrum secundatum* in Texas. Finally,

Hayward (1926), as cited by Brown and Heineman (1972), states that the larvae will accept *Cyperus* sp. (Cyperaceae) in Argentina, and subsequently (Hayward 1941) lists this as a food plant. Other Poaceae food plant records which I have found on the internet include *Cynodon dactylon*, *Echinochloa crus-galli*, *Sorghum halepense*, *Pennistem ciliare*, *Sorghum bicolor, Setaria verticillata*, *Oryza sativa* and *Zea mays* (DCLS 2003), but it is not stated whether these are field records or rearing hosts. Thus, although it seems clear that the larvae feed on various grasses, the normal field host plants remain unclear.

ACKNOWLEDGEMENTS

I thank Dr Phillip Ackery of the Natural History Museum (NHM) (formerly British Museum (Natural History)), Dr Mark Shaw of the Royal Scottish Museum (RSM), and Dr Gerald Legg (Booth Museum, Brighton, UK) who have very kindly assisted in providing access to the collections in their care. I also thank Dr Steve Steinhauser (Allyn Museum, Florida) for his advice on the photograph of the *Dalla* sp. which I sent to him.

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NATURE NOTE

Feeding the Birds

A slightly longer than usual period of stay during September 1998 at the Asa Wright Nature Centre enabled me to make some more detailed observations at the Centre's feeding station, to which previously I had tended to pay little attention. It is of course an important part of the Centre's attraction for human visitors, and great care (and some expense) is given to seeing that supplies for the birds and other creatures are kept up.

At several platform feeders pieces of fruit, mainly banana and pawpaw, are provided, along with bread and other tit-bits discarded from the kitchen, while there are nearly a dozen "hummingbird" feeders dispensing sugar-water for hummingbirds, Bananaquits and various honeycreepers. The mixture is five parts of water to one of brown sugar, and although I have been concerned that the lack of protein in this might adversely affect hummingbird nestlings fed directly with this food collected by their mothers, the fact that the population appears to have remained stable over the years indicates that any such harm must be minimal.

It is interesting to see which species visit the feeders and which do not. Among honeycreepers the most numerous species to visit the nectar-feeders are Bananaquits, Purple Honeycreepers and Green Honeycreepers. Blue Dacnis and Red-legged Honeycreepers are infrequent, preferring insects and berries, while most of the latter species appear to leave the area for a few months during August to November.

Hummingbird visitors are mainly White-chested Emerald, Copper-rumped, White-necked Jacobin, along with Blue-chinned Sapphire, Black-throated Mango and Ruby-topaz occurring in much smaller numbers, the latter two absent usually from August to November. The Tufted Coquette and Long-billed Starthroat are attracted by the vegetation (and maybe by the presence of other birds), but I have never seen them feed at the feeders. Among the hermits the Green seems to be the only one to use the feeders regularly, even though both Little and Rufous-breasted are seen nearby feeding at flowers, mainly of Sanchezia.

Among tanagers the most prevalent at the feeders are Blue-gray, Palm, White-lined and Silver-beaked, but although others, such as Bay-headed and Turquoise, and Violaceous Euphonia, are present nearby, they don't seem to go to the feeders. The Yellow Oriole mostly feeds on fruit, whilst a heterogeneous collection of other birds mostly go for the bread. They include Ruddy Ground-Dove, Cocoa and Bare-eyed Thrush, Tropical Mockingbird, Shiny Cowbird and Grayish Saltator; while a few others seem omnivorous (and greediest), such as Crested Oropendola, Great Kiskadee and Blue-crowned Motmot.

Perhaps the most unexpected visitors are the Chestnut Woodpecker (a great favourite with bird-watchers) and both Barred and Great Antshrikes. Although these species are known mostly as feeders on invertebrates, they follow the motmot in having a preference for larger animal prey (even including sometimes the nestlings of other birds). Certainly I have never known such a concentration of Great Antshrikes as can be found at the Nature Centre, very likely as a result of this bonanza at the feeding tables.

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A Survey of Freshwater Macroinvertebrates on Grenada, West Indies

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ABSTRACT

A survey of macroinvertebrates inhabiting the freshwater habitats of Grenada was conducted during May and June of 1996. Qualitative collections were made by sweeping a dip net through the water column and by hand examination of rocks, plants, and other debris submerged in both flowing and standing bodies of fresh water across the island. These collections yielded at least 32 species previously unknown from Grenada. When my collections were combined with those made by previous investigators, the total number of species recorded from the island is expanded to total at least 86. Dominant taxa collected included a few species of gastropods, decapod crustaceans, ephemeropterans, odonates, and hemipterans. Generally this macroinvertebrate fauna is sparse, most likely due to the oceanic origin of Grenada and periodic disturbance of freshwater environments across the island.

INTRODUCTION

Grenada is the southernmost island in the Windward Islands of the Lesser Antilles. It is volcanic in origin, rising 827 meters above sea level and comprising approximately 346 square kilometers. Grenada is estimated to have emerged in the eastern Caribbean 20-25 millions years ago, although much volcanic activity has occurred across the island since that time (Briden *et al.* 1979).

The freshwater habitats on Grenada are typical of other small volcanic islands of the Lesser Antilles (Bass 2003a). Numerous small, steep streams originate in upper elevations where water flows rapidly over a substrate that consists mostly of boulders, rocks, and cobble. Some of these streams merge together to form larger rivers whereas others remain small as they flow short distances toward the sea. Because these streams flow mostly through forested areas, leaf packs form on the upstream side of rocks and leaf debris accumulates in pools. A deep freshwater lake exists in a dormant volcanic crater near Mount Sinai and several small ponds, having varying salinities and muddy substrates, occur at lower elevations near the coast.

A limited amount of information regarding the freshwater invertebrates of the Lesser Antilles and other small Caribbean islands is available. Biodiversity surveys have been conducted on certain islands including Barbados (Bass 2003b), St. Vincent (Harrison and Rankin 1975, 1976a, 1976b; McKillop and Harrison 1980), Nevis (Bass 2000), Tobago (Nieser and Alkins-Koo 1991, Bass 2003c), and Trinidad (Hynes 1971; Alkins *et al.* 1981; Alkins-Koo 1990, Nieser and Alkins-Koo 1991), but similar published investigations are generally lacking for Grenada. While some invertebrate groups in the region have been studied, such as decapod crustaceans (Chace and Hobbs 1969; Hart 1980), odonates (Donnelly 1970), and trichopterans (Flint 1968, 1996; Botosaneanu and Alkins-Koo 1993), many others have yet to be surveyed. Previous efforts in Grenada have been limited to certain taxa (e.g., Trichoptera: Flint and Sykora 1993). Furthermore, additional collections may yield previously unknown populations or species (Bass and Volkmer-Ribeiro 1998; Bass 2003a).

The objectives of this investigation include: 1) to determine the species of aquatic macroinvertebrates inhabiting fresh waters of Grenada; 2) to note microhabitat preferences of each species; 3) to determine the relative abundance of each species; and 4) to compare the Grenada macroinvertebrate fauna with that of other small Caribbean islands.

METHODS

Sixteen sampling sites were established in various freshwater habitats across Grenada. Collections were made during May and June of 1996. Water temperature was also recorded from each site at the time of collection.

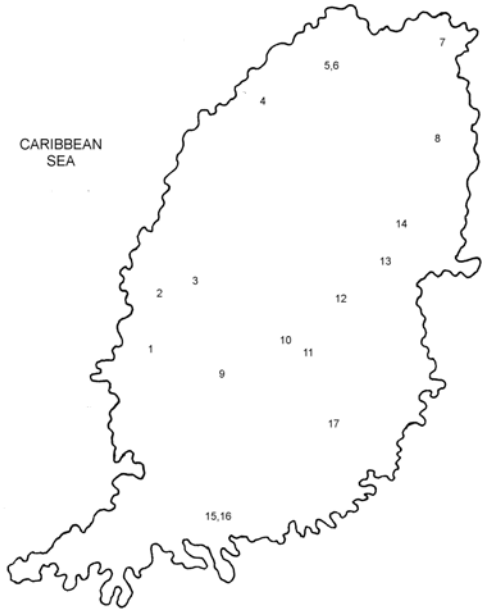

Fig. 1. Map indicating location of collecting sites in Grenada. Specific locations, dates, and approximate elevations of collections are listed below Table 1.

Because data in this investigation was to be compared with that from other small Caribbean islands, it was important that collecting methods were consistent in application from island to island. Several methods of collecting were employed to ensure as many species as possible were captured. Submerged debris, such as stones, leaves, and wood, was carefully examined and inhabitants were picked from the substrate using forceps. A dip net was swept through aquatic vegetation and the water column to capture macroinvertebrates occupying those microhabitats. The microhabitat from which each specimen occurred was noted. A drift net was used at two sites to capture organisms carried in the current during the night. All 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 and the taxonomic name to which they could be identified was used. A list of taxa known from Grenada, including those previously reported by other researchers, was composed. Sorenson's index of similarity (1948) was used to compare my collections in Grenada with similar endeavors on other small Caribbean islands.

RESULTS AND DISCUSSION

Water temperatures measured during this investigation ranged from 23°C in the outflow of Grand Etang to 31°C in Levera Pond. Generally, cooler temperatures were measured in small, shaded streams at higher elevations whereas warmer temperatures occurred in exposed, lowland streams and ponds. A similar thermal pattern was observed in waters of Tobago (Bass 2003c).

At least 52 species were collected during this study, bringing the total number of freshwater macroinvertebrates known from Grenada to a minimum of 86 taxa (Table 1). Although more taxa are listed on Table 1, several of those may actually be listed multiple times. For example, *Potimirim* sp. from sites 1 and 2 may actually be *P. glabra*, but because all specimens collected from those sites were small juveniles, their identity cannot be confirmed. Therefore, both taxa are listed, but only *P. glabra* is included in the final count of taxa known from Grenada. At least 32 taxa in my collections are being reported from this island for the first time.

Table 1. List of freshwater macroinvertebrates, including collecting sites, life cycle stages present, relative occurrence, microhabitats, and proposed trophic relationships in Grenada during May and June 1996. Life cycle: A, adult; J, juvenile; L, larva; N, nymph. Occurrence: +++ abundant, ++ common, + uncommon.

Taxa	Collections	Life Cycle	Occurrence	Microhabitat	Trophic Relationship**
Platyhelminthes					
Girardia sp.*	4	J	+	Rock	Predator
Oligochaeta					
*Limnodrilus undekemianus**	1, 4-5, 6	A	++	Sediment	Deposit
Gastropoda					
Ampullaria glauca	18	A			
Gundlachia radiata	18	A			
*Melanoides tuberculata**	1-5, 8-10, 12-14, 17	J, A	+++	Detritus	
*Neritina clenchi**	1, 3	A	++	Rock	Algivore
*Neritina punctulata**	2-4, 9	J, A	++	Rock	Algivore
Neritina virginia	3, 18	A	++	Rock	Algivore
*Physella cubensis cubensis**	9	J, A	+	Detritus	Detritivore
Physella marmorata	18	A		Detritivore	
Potamopyrgus coronatus	18	A			
*Tropicorbis pallidus**	10	A	+	Detritus	
Amphipoda					
*Hyalella azteca**	10	A	+	Detritus	Detritivore
Quadrivisio sp.*	16	A	+	Detritus	
Decapoda					
*Atya innocous**	9	J, A	+	Detritus	Omnivore, Collector
Atya poss. *innocuous/scabra*	4, 5	J	++	Detritus	Omnivore, Collector
*Jonga serrei**	15-16	J, A	++	Detritus	
*Macrobrachium faustinum**	1-2, 4-5, 8-9, 12-13, 15-16	J, A	+++	Detritus	Omnivore, Predator
Macrobrachium heterochirus	18	A			Omnivore, Predator
*Macrobrachium jelskii**	7	A	+	Detritus	Omnivore, Predator
Macrobrachium sp.	1	J	+	Detritus	Omnivore, Predator
*Micratya poeyi**	3, 5, 9, 12, 13	J, A	+++	Detritus	Omnivore, Collector
*Potimirim glabra**	3, 8, 9	J, A	++	Detritus	
Potimirim sp.	1, 2	J	++	Detritus	
*Xiphocaris elongata**	1, 2	J, A	++	Detritus	
Ephemeroptera					
Baetidae	4, 8, 12, 13, 15, 16-17	N	+++	Detritus	Collector
Baetodes sp.	18	A		Scraper	
Cleodes sp.	18	A			
Farrodes grenadae	18	A			
Farrodes sp.	1, 4, 8, 12, 13, 16	N	+++	Detritus	Collector?
Farrodes sp. 2	14-15	N	+	Detritus	Collector?
*Leptohyphes zalope**	4, 9, 12-14, 16-17	N	+++	Detritus	Collector?
Leptohyphes sp.	18	A			
Odonata					
Argia concinna	5, 8, 14, 18	N	++	Detritus, rock	Predator
Brachymesia sp.*	1, 9, 15	N	++	Detritus	Predator
Brechmorhoga praecox grenadensis	12, 18	N, A	+	Detritus	Predator

Table 1. (Continued).

Taxa	Collections	Life Cycle	Occurrence	Microhabitat	Trophic Relationship**
Dythemis multipunctata	18	A		Predator	
Erythrodiplax fusca	18	A		Predator	
Erythrodiplax/Micranthyria	9	N	+	Detritus	Predator
*Ischnura ramburii**	1, 10, 15	N	++	Detritus, rock	Predator
Lestes spumarius	18	A			
Hemiptera					
*Belostoma subspinosum**	10	N, A	+	Detritus	Predator
Brachymetra albinervis	1-3, 5, 8-9, 11, 14-15, 18	A	+++	Neuston	Predator
Brachymetra unca	18	A		Predator	
Buenoa gracilis	18	A		Predator	
Buenoa sp.	2	A	+	Detritus	Predator
Hebrus consolidus	18	A		Predator	
Limnogonus francisanus	2, 18	A	+	Neuston	Predator
Mesovelia amoena	18	A		Predator	
*Mesovelia mulsanti**	1	A	+	Neuston	Predator
Microvelia leptotmena	18	A		Predator	
Microvelia pulchella	18	A		Predator	
Nerthra raptoria	18	A		Predator	
Paraplea puella	18	A		Predator	
*Rhagovelia angustipes**	1-3, 5, 8-9, 11-16	A	+++	Neuston	Predator
Rhagovelia elegans	1-3, 5, 8, 9, 11-16, 18	N, A	+++	Neuston	Predator
Trochopus plumeus	18	A		Predator	
Trichoptera					
Bredinia appendiculata	18	A			
Cerasmatrichia sp.	18	A			
Chimarra caribea	18	A			
Chimarra sp.	12	L	+	Detritus	Collector
Helicopsyche grenadensis	18	A			
Helicopsyche margaritensis	18	A			
Hydroptila antilliarum	18	A			
Leptonema albovirens	1, 4, 8-9, 12-18	L	+++	Detritus, rock	Collector
Leucotrichia sarita	18	A			
Neotrichia nesiotes	18	A			
Neotrichia tauricornis	18	A			
Ochrotrichia ponta	18	A			
Oecetis pratti	18	A			
Oxyethira azteca	18	A			
Oxyethira janella	18	A			
Polyplectropus bredini	18	A			
Polycentropus insularis	18	A			
Smicridea astarte	18	A			
Smicridea grenadensis	18	A			
Smicridea palifera	18	A			
Wormaldia planae	18	A			
Xiphocentron lobiferum	18	A			
Zumatrichia anomaloptera	4, 18	L	+	Rock	Scraper
Zumatrichia antilliensis	4, 18	L	+	Rock	Scraper
Lepidoptera					
Petrophila sp.	4, 18	L	++	Rock	Scraper
Coleoptera					
*Copelatus posticus**	5, 6	A	+	Detritus	Predator
Heterelmis sp.	18	A		Collector?	
Hexacylloepus smithi	1, 18	A	+	Rock	Collector?
Phanocerus congener	18	A		Collector?	
*Psephenops smithi**	3, 9, 12-14, 17	L, A	+++	Rock	Scraper
Psephenops sp.	18	A		Scraper	
*Thermonectes basillaris**	7	A	+	Detritus	Predator
Diptera					
Aedes sp.*	6	L	++	Water column	Collector
Anopheles sp.*	3	L	+	Water column	Collector
Chironomidae	18				
Culex sp.*	6	L	+	Water column	Collector
Ephydridae*	6	L	+	Detritus	

Table 1. (Continued)

Taxa	Collections	Life Cycle	Occurrence	Microhabitat	Trophic Relationship**
Fittkauimyia sp.*	16	L	+	Sediment	Predator?
Psychoda ? sp.*	6	L		Detritus	Collector
Psychodidae	18				
Orthocladius sp.*	5	L	+	Sediment	Collector
Tipulidae	18				

* Indicates specimen from this collection is first report of this taxon from Grenada.
** Determined for non-insects from Thorp and Covich (2001) and for insects from Merritt and Cummins (1996). Note this information is based on North American taxa and may not be applicable to Neotropical species.

Collections:

1. Beausejour River, West Coast Road, Grenada, 1 May 1996, elev. 35 m
2. Douce River, West Coast Road, Woodford Estate, Grenada, 1 May 1996, elev. 25 m
3. Black Bay River, Concord Valley Road, Davidall Estate, Grenada, 1 May 1996, elev. 170 m
4. St. Mark's River, Bocage Estate near Bonair Government School, Grenada, 1 May 1996, elev. 190 m
5. Samaritan River, Samaritan Estate, Grenada, 1 May 1996, elev. 220 m
6. Boiling Pot along bank of Samaritan River, Samaritan Estate, Grenada, 1 May 1996, 220 elev. m
7. Levera Pond, Levera Pond National Park, Grenada, 1 May 1996, elev. 5 m
8. Antoine River, Poyntzfield Estate, Grenada, 1 May 1996, elev. 110 m
9. Annadale Waterfall (Beausejour River), Willis Grenada, 2 May 1996, elev. 210 m
10. Grand Etang Lake, Grand Etang Forest Reserve, Grenada, 2 May 1996, elev. 580 m
11. Outflow-Grand Etang Lake, Grand Etang Forest Reserve, Grenada, 2 May 1996, elev. 575 m
12. Great River, Birch Grove, Grenada, 2 May 1996, elev. 190 m
13. Great River, Balthazer Estate, Grenada, 2 May 1996, elev. 130 m
14. Grand Bras River, Mount Horne Estate, Grenada, 2 May 1996, elev. 125 m
15. Chemin River, CARDI Field Station, Grenada, 2 May 1996, elev. 30 m
16. Drift Sample-Chemin River, CARDI Field Station, Grenada, 2-3 May 1996, elev. 30 m
17. Drift Sample-Crochu River, St. Andrews, Grenada, June 1996 (collected by CARDI staff), elev. 160 m
18. Reported by other researchers.

Platyhelminthes

Only one species of flatworm, *Girardia* sp., was collected and this came from submerged rocks in St. Mark's River. Unfortunately, only juveniles were present so a species name cannot be determined.

Oligochaeta

Limnodrilus undekemianus was the only species of oligochaete collected. It was found in shallow sediments of several small streams on the leeward side of Grenada and among the organic debris in a boiling pot, presumably abandoned and filled by rainwater.

Gastropoda

Ten aquatic snails are now known from Grenada. Of these, six were collected in this study, with five of them being found in Grenada for the first time. The introduced species, *Melanoides tuberculata*, was the most abundant and widespread freshwater snail in aquatic habitats of the island, often occurring among detritus. It seems once this species is introduced to these small Caribbean islands, it is able to rapidly spread and develop large populations (Bass 2003a). Although two species of the widespread pulmonate *Physella* have been reported from Grenada, only one, *P. cubensis*, was present in my collections.

Amphipoda

Two species of amphipods were collected from Grenada. The eurytolerant and widespread *Hyalella azteca* was found among bottom debris in shallow water near the shore of Grand Etang. *Quadrivisio* sp. was collected in a drift sample taken during the night in the Chemin River. Both species are negatively phototaxic and hide among submerged detritus during the daylight hours.

Decapoda

Ten of the 11 species listed on Table 1 were found in my collections. These shrimps were primarily associated with detritus. Three of those taxa, *Atya* poss. *innocuous/scabra*, *Macrobrachium* sp., and *Potimirim* sp., are likely to belong to species already reported, but the immature condition of those specimens prevents precise identification. The omnivorous predatory shrimp, *Macrobrachium faustinum*, was found at over half the collection sites. Another widespread shrimp occurring across Grenada is the atyid *Micratya poeyi*. *Macrobrachium jelskii* was possibly the most noteworthy species of shrimp collected in Grenada. It has been found previously on the South American mainland, but there are no records of this species occurring on West Indian islands (Hurlbert and Villalobos-Figueroa 1982). Unlike many species of *Macrobrachium*, *M. jelskii* lacks a marine planktonic stage, and that presumably limited its ability to disburse to oceanic islands. Although it remains unknown how this species arrived on Grenada, possible mechanisms include transport by humans or migrating waterfowl.

Ephemeroptera

Several species of mayflies are known from Grenada. *Leptohyphes zalope* was abundant in my collection and further studies by Baumgardner *et al.* (2003) indicated it to be a new record on Grenada and Tobago. Equally abundant were mayflies of the genus *Farrodes* and the family Baetidae. All of these mayfly nymphs were found living among submerged leaf debris.

Odonata

At least seven species of odonates are reported from Grenada: three are damselflies and four are dragonflies. Populations of the former appear to be considerably more widespread and abundant than the latter. Based on the microhabitat from where the nymphs were collected, they seem to have a preference for areas of the stream where flow is reduced and detritus accumulates among the rocky substrate. Both the aquatic nymph and the aerial adult stages of odonates are predators.

Hemiptera

Hemipterans are common at collecting sites across Grenada and at least 15 species are known from the island. Three species of water striders, *Brachymetra albinervis*, *Rhagovelia angustipes*, and *R. elegans*, were abundant, being found in collections from most sites. Both nymphs and adults are predators in the aquatic environment.

Several populations of water striders exhibited wing polymorphism and flightlessness. The loss of wings is a widespread phenomenon that has been well documented in water striders living in isolated habitats (Roff 1990; Schuh and Shlater 1995; Thorp and Covich 2001; Bass 2003a). Because these collections in Grenada took place only near the end of the dry season, it is unknown if this polymorphism occurs throughout the year or if it is simply a seasonal phenomenon.

Trichoptera

Twenty-two species of caddisflies are known from Grenada with four having been reported only from this island (Flint and Sykora 1993, Flint *et al.* 1999, Botosaneanu 2002). Based on my collections and those of Flint and Sykora (1993), it appears *Leptonema albovirens*, *Chimarra caribea*, *Zumatrichia antilliensis*, and *Z. anomaloptera* are the most common trichopterans on Grenada. *Leptonema albovirens* is a widespread species, ranging from the USA (Texas) and Mexico across Central America, Colombia, and Venezuela and northward into the Lesser Antilles (Flint and Sykora 1993, Flint *et al.* 1999). *Chimarra caribea* is known only from the southeastern Caribbean islands of Grenada, Mustique, Tobago, Trinidad, and Margarita (Botosaneanu and Alkins-Koo 1993, Flint *et al.* 1999, Botosaneanu 2002) whereas *Zumatrichia antilliensis* and *Z. anomaloptera* are known from numerous islands of the Lesser Antilles and the nearby region (Flint and Sykora 1993, Flint *et al*. 1999, Botosaneanu 2002).

Lepidoptera

Petrophila was the only aquatic lepidopteran found on Grenada. Larvae were collected from their small, self-spun silken retreats covering indentations of rocks in shallow stream environments. These larvae scrape algae and other organic material from the surface of submerged rocks, probably during hours of darkness (Bass 2003a, 2003c). *Petrophila* appears to be widespread across the Lesser Antilles.

Coleoptera

Three of the four species of aquatic beetles found in my collections were previously unknown from Grenada. When studies from Darlington (1936) and Hinton (1971) are included, a total of six species of aquatic beetles may be reported from Grenada. *Psephenops smithi* seems to be the most widespread aquatic beetle in mountain streams of this island, usually observed inhabiting the underside of rocks.

Diptera

Ten taxa of aquatic dipterans may be found in the species list. However, two of the families listed, the Chironomidae and Psychodidae, were reported from Grenada by earlier researchers using only those family names. More recent collections have yielded genus names for some specimens belonging to those families. Over half of the dipterans now known from Grenada are mosquitoes and midges.

Taxa richness varied between the sites sampled. As in Tobago (Bass 2003c), sites in Grenada having the greatest number of taxa generally were those of streams having stable cobble substrates and flowing through forested land where human impact appeared minimal. Such sites occurred in the Beausejour River, Black Bay River, St. Mark's River, Samaritan River, Annadale Waterfall area, and Great River. Taxa richness was lowest in Levera Pond, probably due to salt water intrusion.

Hynes (1971) concluded that the zonation of stream macroinvertebrates in the Arima River system of Trinidad was based largely on elevational differences. However, Bass (2003c), based on the results of macroinvertebrate samples from seventeen different sites at varying elevations on nearby Tobago, found it is difficult to conclude which, if any, of the parameters of elevation, water temperature, suitable microhabitat, or some other environmental factor was more important in determining whether a species could exist at a site. Alkins-Koo (personal communication) suggested this lack of distinct elevational zonation is because these small islands have steep slopes along much of their lengths and a very short lower reach near the sea. Results of this study in Grenada more resemble those from Tobago with few species seeming to have little, if any, elevation preference. Many taxa, including representatives of gastropods, shrimps, ephemeropterans, hemipterans, and trichopterans were collected at several elevations (Table 1).

Generally faunal similarity is reduced as distance between islands increases (Table 2). Of the 13 other islands listed in Table 2 for which similar collections were made by the author, Grenada shares the greatest faunal similarity with Tobago and St. Lucia.

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

Island	Approximate Distance (km)	Approximate Size (km^2)	Similarity Value
Tobago	125	300	0.22
St. Lucia	175	616	0.22
Barbados	230	430	0.16
Dominica	335	751	0.17
Montserrat	505	83	0.08
Antigua	540	402	0.08
Nevis	560	93	0.09
St. Kitts	575	176	0.10
Saba	610	13	0.03
Cayman Brac	2,075	37	0.00
Little Cayman	2,100	26	0.01
Grand Cayman	2,180	197	0.00
Guanaja	2,595	69	0.03

These are the two islands sampled in this study nearest Grenada and all three islands possess a similar terrain. Grenada showed no species in common with Cayman Brac and Grand Cayman. Both of these are small, low-lying distant islands that possess fewer and very different freshwater habitats. It appears that distance between these small islands is the most critical factor determining faunal similarity, but other factors such as prevailing winds and currents,

island area, island elevation, and habitat similarity should also be considered (Bass 2003a, 2003c).

Grenada is an oceanic island and has never been connected to any other landmass (Briden *et al*. 1979) so all species present must have come from elsewhere or have evolved on the island. Species that colonized the island may have done so by either actively flying (e.g., winged insect adults) or being passively carried by wind or water currents (e.g., larvae of nerites and shrimps). Those species that were carried by water currents must have been tolerant of seawater during the period of dispersal. Due to its close proximity to South America, it seems likely that much of the fauna of Grenada would be dominated by species tracing their ancestral origins to the freshwaters on the South American mainland, as suggested by the distributions of shrimps (Hart 1980) and trichopterans (Hamilton 1988; Flint 1996). Upon arrival, it appears some groups, such as the caddisflies (Flint and Sykora 1993), have evolved and further speciated in isolation on this island. Further studies of macroinvertebrates in fresh waters of Grenada are likely to find additional species, including some that may be endemic.

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New Records of Cladocera (Crustacea) for Trinidad, West Indies

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ABSTRACT
Four cladoceran species, *Latonopsis occidentalis*, *Diaphanosoma brachyurum*, *Ceriodaphnia ridaugii* and *Moinodaphnia macleayi*, are recorded from Trinidad for the first time. All four are known from other areas of the Caribbean and South America. However, some show modest morphological differences when compared to those described elsewhere. These new records increase the known geographic distribution of the order, Cladocera.
Key Words: Cladocera, Water-fleas, Trinidad and Tobago.

INTRODUCTION

Cladocerans (water-fleas) are a group of small crustaceans, with a wide geographic distribution. The majority of species are eurythermal, but the distribution of some is limited by temperature. Among these latter, at least three species are cold stenothermal (*Latona*, *Holopedium gibberum* and *Daphnia longiremis*), while *Pseudosida bidentata*, *Ceriodaphnia rigaudii* and *Euryalona occidentalis* are restricted to warm waters (Pennak 1998).

The morphology and distribution of these organisms have been well documented (Goulden 1968; Delome 1991; Pennak 1998). The majority of species live in freshwater, but a few marine species belonging to the family Polyphemidae have been reported (Delorme 1991). Because of their wide distribution and variation within species, the systematics of this group remains problematic. With the exception of Cuba, Puerto Rico and Haiti, faunistic knowledge of Caribbean cladocerans is very limited. To date, no species is recorded from Trinidad. Extensive studies have been done in some mainland Latin American countries, such as Mexico, Panama, Brazil and Venezuela, which lie west of Trinidad (Frey 1982).

Zoppi de Roa and Vasquez (1991) were able to identify 24 species in Mantecal (Apure state, Venezuela) in Venezuela. Of these, 18 belonging to 6 families (Sididae, Daphniidae, Moinidae, Macrothricidae, Chydroidae and Aloninae) were new records for Mantecal and nine were new records for Venezuela. In a review of cladoceran records for the wider Caribbean region by Frey (1981) species belonging to several families, including Sididae, Daphniidae, Moinidae, Bosminidae, Macrothricidae and Chydoridae were identified. Four species of the genus *Daphnia (D. laevis, D. pulicaria, D. parvula* and *D. ambigua)*, and three *Ceriodaphnia* (*C. cornuta, C. dubia* and *C. rigaudii*) were reported for the Greater Antilles. Four members of the family Sididae (*Diaphanosoma brachyurum, D. brevireme, Latonopsis occidentalis* and *L. fasciculate*) have also been identified, and *Moina micrura, M. affinis* and *Moinodaphnia macleayi* from the family Moinidae appeared to be most widely distributed (Frey 1981).

Trinidad and Tobago sits on the continental shelf of South America and is only 12 kilometers from Venezuela. Geological evidence suggests that Trinidad had a dry-land connection to the mainland as recent as about 11,000-15,000 years ago (EMA 2001). The flora and fauna of Trinidad is therefore a natural extension of South American populations. This paper identifies four new cladocera records for Trinidad, but species, which were identified in Venezuela.

METHODS

Water samples (40 l) were collected from ten isolated pools in an isolated forest stand at Valencia in northern Trinidad. A 500 ml beaker was used to collect water from the pools and was then transferred to a large 20 l bucket. Organisms were also collected using a 50 mm mesh plankton net. These samples were aerated and maintained as cultures at the Department of Life Sciences, University of the West Indies at St. Augustine. The invertebrate fauna was then sampled and examined using a compound light microscope. Species identification was done using different taxonomic keys (Goulden 1968; Pennak 1898; Delorme 1991). A minimum of 50 organisms was examined for each of the taxonomic groups and measurements made of standard body length and lengths of the antennae.

RESULTS

In most of the pools sampled, natural populations of cladocerans were present. Ambient temperatures of the pools ranged between 26-28°C and the relative humidity of the area was above 90%. From the samples collected, four cladoceran species belonging to three families (Sididae, Daphniidae and Moinidae) were identified.

Description of Species

Sididae: *Latonopsis occidentalis* Birge

An ocellus is markedly absent, as was described for species from Mantecal, Venezuela (Zoppi de Roa and Vasquez 1991). The head appears triangular, with the eye in the apex of the triangle (Fig. 1). Body length was about 1.7 – 2.0 mm, body width about 0.6 - 0.8 mm. The carapace has numerous pyramidal surface reticulations (Fig. 2). The posterior end of the carapace appears indented on the dorsal rim (Fig. 3). At the point of indentation, there are six long setae and eight shorter marginal spines. Along the ventral rim, just posterior to the head, there are 14 setae (Fig. 4). The abdominal claw has three basal spines, instead of two as reported species from Mantecal. There are also about 4-6 denticles present, the last two of which are very prominent (Fig. 5). The first antennae measures about 0.26 ± 0.003 mm and has one long spine and 4-6 short filamentous setae. The basal segment of the second antennae is about 0.53 ± 0.03 mm long and 0.2 ± 0.03 mm wide. The distal end has two short spines and a long seta. The dorsal ramus is approximately twice as long as the ventral one. The first segment of the dorsal ramus is about 0.21 ± 0.02 mm long and 0.1 ± 0.009 mm wide with eight feathery setae and two spines on the distal end. The second segment is approximately twice as long as the first (0.43 ± 0.03 mm) but only about half as wide (0.05 ± 0.004 mm), and has eleven setae and two spines on the distal end (Fig. 6). The ventral ramus has three segments, the first (0.03 ± 0.001 mm) and

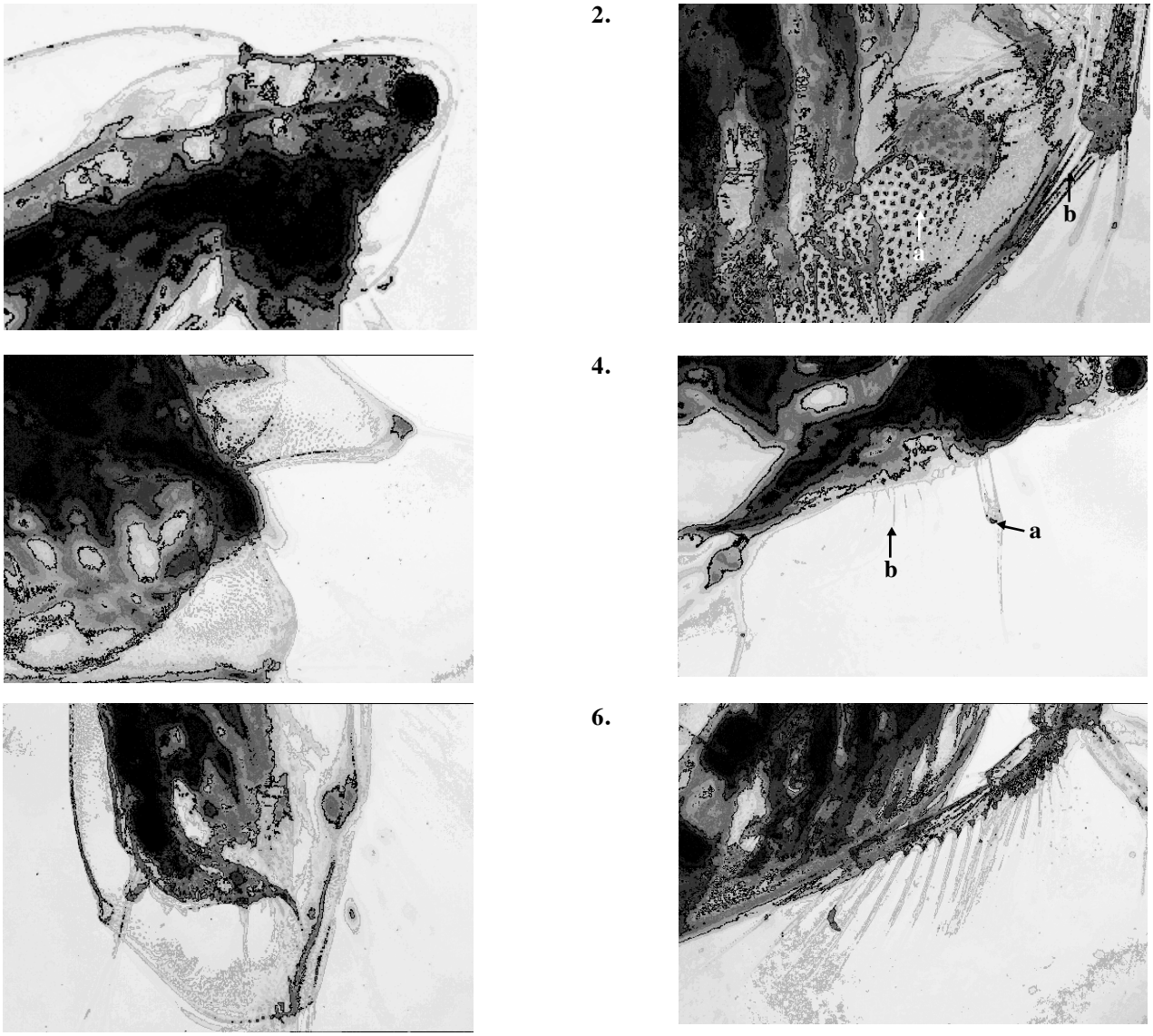


Plate I: Figs. 1- 6.
Latonopsis occidentalis: **1**. Head with eye, ocellus absent (x63); **2.** (a) Surface reticulations, (b) Second ramus of the first antenna (x63); **3.** Posterior end of the carapace (x63); **4.** (a) First antenna (x63), (b) Setae along the ventral margin of the carapace (x63); **5.** Abdominal claw with three basal spines (x63); **6.** Dorsal ramus of the second antenna with setation (x63).

third (0.05 ± 0.001mm) are much smaller that the second (0.21 ± 0.01 mm). There is one seta on the second segment, and four on the third segment. Three of the setae are apical and one about half way along its length (Fig. 2). The setation formula for this species is 8-11/0-1-4.

Sididae: *Diaphanosoma brachyurum* (Liéven)

An ocellus is conspicuously absent in this species. The head appears rounded, with the eye almost completely filling the anterior region (Fig. 7). The body appears elongated with the length ranging from 0.8 to 1 mm. The surface of the carapace is covered by small, raised hexagonal reticulations. The abdominal claw has three basal spines. The first antennae measures about 0.09 ± 0.02 mm and has one long spine and three short filamentous setae. The basal segment of the second antennae has one small seta close to the point of attachment of the two rami and one on the third formix. The two rami are almost of equal length. The first segment of the dorsal rami

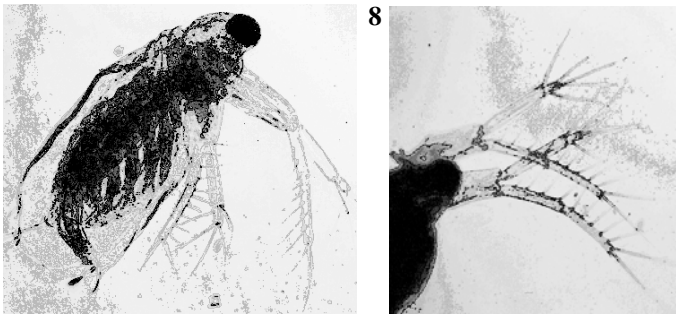
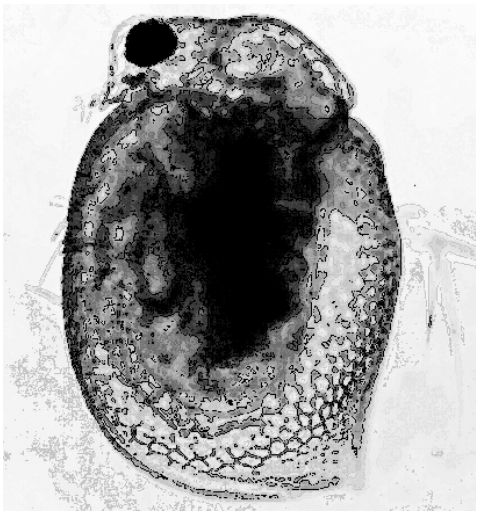
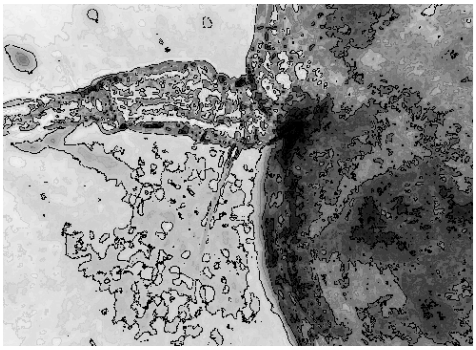
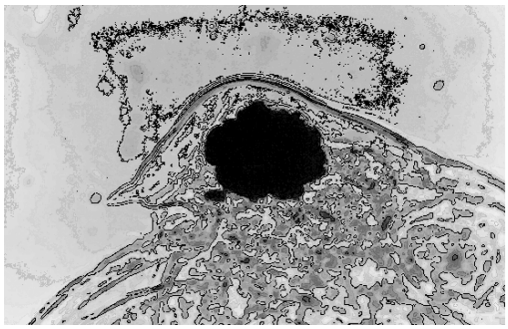


Plate II: Figs. 7- 8.
Diaphanosoma brachyurum. **7.** Whole body showing head and large eye, with no ocellus, second antannae, abdominal claw and post anal setae (x100); **8.** Dorsal and ventral ramus of the second antenna (x100).

is about 0.14 ± 0.03 mm long with four feathery setae and one spine on the distal end. The second segment is about 0.15 ± 0.02 mm and has seven setae, two apical and five along the length and one small distal spine. In some organisms, there may be six setae along the length of the second segment. The ventral rami has three segments, the first (0.02 ± 0.001mm) and third (0.04 ± 0.001mm) are much smaller that the second (0.15 ± 0.03 mm). There is one seta on the second segment, one midway on the third segment and three apical setae (Fig. 8). One short spine is present on the distal end of the second segment. The setation formula for this organism is 4-7/0-1-4.







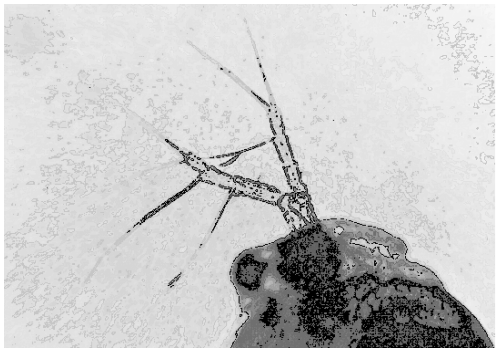


Plate III: Figs. 9 -13.
Ceriodaphnia rigaudii. **9.** Body with surface reticulations (x200); **10.** Head with (a) large eye and (b) ocellus (x400); **11.** Spine on the basal segment of the second antennae (x400);
12. Setation on the second antennae (x200); **13.** Abdominal claw with denticles (x200).

Daphniidae: *Ceriodaphnia rigaudii* Richard

The body is typically oval in shape and is about 0.45 ± 0.03 mm long. A single folded carapace covers the body and opens ventrally, giving the appearance of a bivalve (Fig. 9). The carapace tapers to the posterior and is covered with large hexagonal reticulations. A distinct cervical sinus separates the head from the thoracic region. The head appears very compact with a prominent beak but does not open ventrally. There is a large eye that occupies about two thirds of the headspace. A small ocellus is present ventral to the eye (Fig. 10). The abdominal claws have six pairs of spines associated with them. The stout basal segment is about 0.2 ± 0.003 mm long and has a long spine at the base between the third and fourth formix (Fig 11). The first antenna is short (0.03 ± 0.003 mm) and relatively inconspicuous with many bristle-like spines on the distal end. They are located ventrally on the head, close to the posterior margin. The second antenna is longer and positioned laterally close to the posterior margin. The dorsal ramus has four segments and is about 0.1 ± 0.007 mm long. The first segment (0.01 ± 0.002 mm) is much smaller than the other three. The second (0.028 ± 0.004 mm), third (0.032 ± 0.003 mm) and fourth (0.031 ± 0.003 mm) are almost of the same length. There is one setae on the third segment and three apical ones on the fourth, with no spines on any of the segments (Fig. 12). The ventral ramus (0.12 ± 0.01 mm) has three segments. The first segment (0.06 ± 0.005 mm) is almost twice as long as the second (0.035 ± 0.005 mm) and third (0.03 ± 0.005 mm). There is one setae on each of the first two segments and three setae on the third. The general setation formula for the species is 0-0-1-3/1-1-3 (Fig. 13).

Moinidae: *Moinodaphnia macleayi* (King)

Adults appear bright red in color. The body is typically oval and measures about 0.9 – 1.0 mm in length. The general species description coincides with the description of Goulden (1968). The carapace is rounded with plate-like surface reticulations, but no spines along its margins. There is a clearly defined cervical cleft that marks the separation of the head from the rest of the body (Fig. 14). The head appears triangular in shape with a large eye that

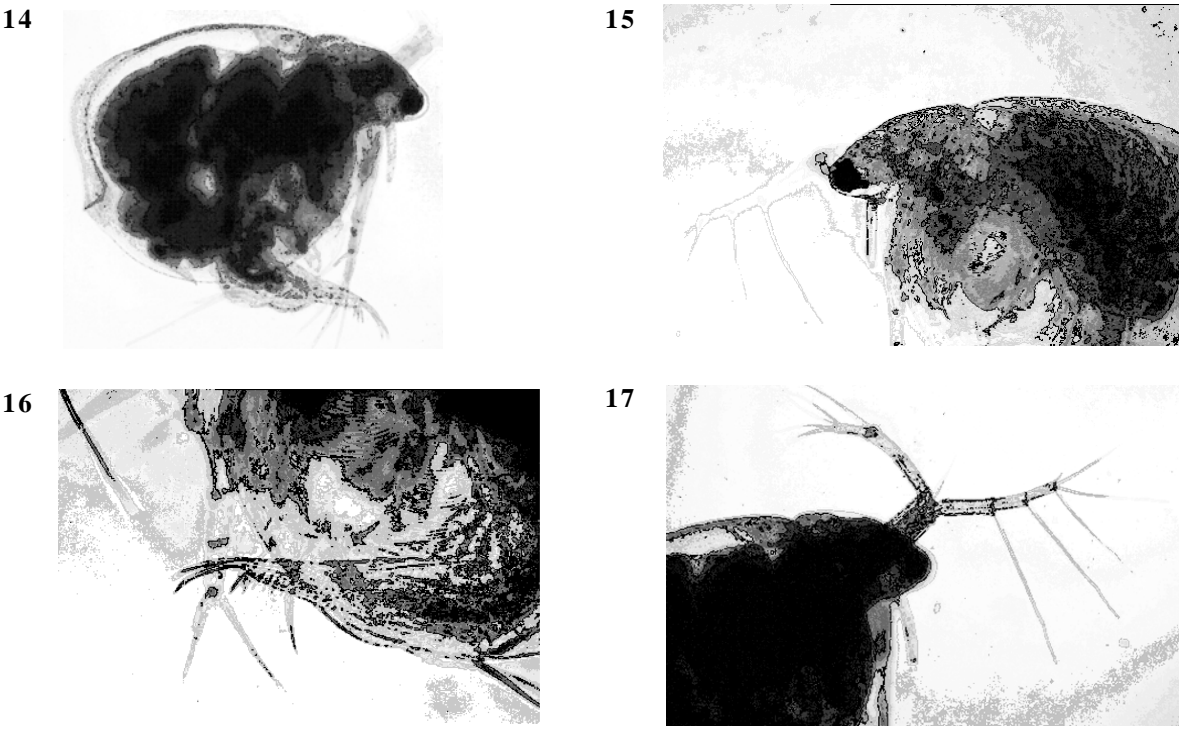


Plate IV: Figs. 14 –17.
Moinodaphnia macleayi. **14.** Shape of body (x100); **15.** Head with large eye and ocellus (x100); **16.** Abdominal claw with denticles (x200); **17.** Setation on the second antennae (x100).

fills the anterior end. An ocellus is visible, posterior to the eye (Fig. 15). The first antenna is positioned ventrally to the eye and is about 0.16 ± 0.02 mm long. It is not segmented and has numerous bristle-like setae on the distal end. The second antenna is positioned laterally on the head and has a stout basal segment and two long rami. A long sensory setae is located on the basal segment between the two ramus. The dorsal ramus has four segments, the first of which is very short. Only the two distal segments have setae. The second segment is relatively longer (0.13 ± 0.01mm) than the others and has no setae or spines. The third segment (0.07 ± 0.01mm) has one long seta and no spines. The last segment (0.06 ± 0.01mm) has three setae and one elongated spine (Fig. 16). These setae appear shorter than those on the ventral ramus. The ventral ramus has only three segments with the first (0.11 ± 0.01mm) and second (0.08 ± 0.01mm) segments bearing a single seta. The distal segment (0.07 ± 0.02 mm) has three setae and one short spine. This gives a setation formula of 0-0-1-3/1-1-3. The abdominal claw has eight pairs of denticles (Fig. 17).

DISCUSSION

Cladocerans have been reported from Brazil, Venezuela, Mexico, Costa Rica in South America, and Cuba, Haiti, and Puerto Rico in the wider Caribbean regions. Studies have thus far reported species belonging to six families: Bosminidae, Chydoridae, Daphniidae, Macrothricidae, Moinidae and Sididae. This study of cladocerans in Trinidad has identified four species, all of which are new records for the country. This extends the known distribution of these species, all of which has previously been recorded in Venezuela. Given the close proximity of Venezuela to Trinidad, with the direct land connection in the Pleistocene period, and the overall biotic similarity between them, this sharing of cladoceran species is not surprising.

The species found in Trinidad are similar in gross morphology to those described in other areas. However, in some cases there are notable differences. *Latonopsis occidentali*s from Trinidad has a larger number of setae on the terminal end of the carapace than was identified for this species from Mantecal, Venezuela. Similarly, whereas those reported by Zoppi de Roa and Vasquez (1991) had only two spines associated with the claw, the ones from Trinidad had three prominent large spines and several smaller ones. Similarly, in *Ceriodaphnia rigaudii* the presence of the elongated spine on the basal segment appears not to have been noted before. While *Moinodaphnia macleayi* coincides with the description given by Goulden (1968), a few modifications were evident. There is no seta along the ventral margin of the carapace and the eight pairs of denticles associated with the abdominal claw. These minor anatomical modifications may have arisen as a result of geographical separation as organisms adapt to exploit new, changing niches.

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The Water Coral Snake *Hydrops triangularis neglectus*, (Serpentes: Colubridae: Xenodontinae) from Trinidad and Tobago: a Review of the Literature with a Note on an Unusual Colour Form

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ABSTRACT

Taxonomic data of the Water Coral Snake, *Hydrops triangularis neglectus* is given and an unusual colour form from the Nariva Swamp in the northeast of Trinidad is described.

The Water Coral Snake *Hydrops triangularis neglectus*, is one of the lesser known snakes found on Trinidad. This species has been known to science since 1824 when Wagler described it as *Elaps triangularis* from specimens collected in Brazil. Later, Gray (1842; 1849) and Boulenger (1894) used the genus *Hydrops* instead of *Elaps*.

Boulenger (1894), based on 13 specimens collected in Guyana (formerly British Guiana) and Suriname (formerly Surinam), distinguished *Hydrops* from other similar looking snakes by the distinctive arrangement of the scales on the top and sides of the head, especially the rhomboidal shaped scale between the nasals and the prefrontals (Photo 5 and Fig. 1). Also important were the diagnostic number of 15 dorsal scale rows, 159-168 ventral and 47-51 pairs of sub-caudal scales, with the anal plate divided. He also described the colour of the specimens.

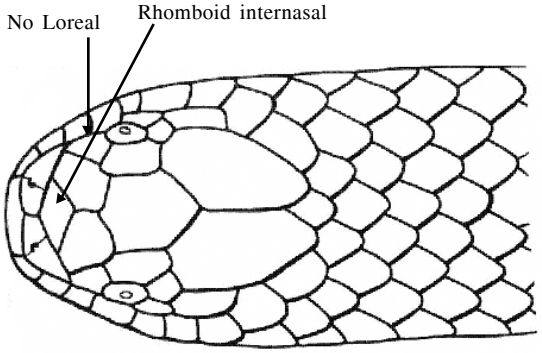


Figure 1. Head scales: *Hydrops triangularis.* (After Emsley 1977)

For the family Colubridae in Trinidad and Tobago, only the genera *Leptophis, Tantilla* and *Hydrops* lack the loreal scale between the eye and the nostril, but the first two genera are not banded and therefore cannot be confused with *Hydrops*. The bands and the absence of a loreal scale are usually diagnostic and distinctive for the venomous Elapids, the coral snakes. But seemingly most important of all was the colour pattern, obvious even in the preserved specimens in the collection: "Purplish brown above, red on the sides, white below; with black annuli, which may be interrupted and alternate on the middle dorsal and ventral lines" (Boulenger 1894 p.187.).

Mole (1914) published his catalogue of "Trinidad Snakes" and mentioned the local name, "Water Coral," for the first time in print. He had been collecting snakes for several years in Trinidad since his arrival here in 1886 (Boos 2001 p.16.), and he obviously had a copy of the Boulenger Catalogue, for his quoted maximum length for this species, 780 mm, its description and distribution is exactly the same as that given by Boulenger.

Mole had been collecting snakes from all over Trinidad and had other collectors bringing him specimens as well. He published his most often- referred-to-work, "The Snakes of Trinidad" (1924, 1926). The first specimen of *Hydrops* that Mole saw was from Arima, and others came from Princes Town and Cunupia. Some snakes were collected in the Four Roads area of Diego Martin. Today there is little habitat that would support a population of *Hydrops* in the Diego Martin Valley. It was noted that it fed on little fish and that, apparently, it did not live very well in captivity. Of greatest importance, was the first publication of a photograph of this species in the 1924 paper by Mole. Fig. 1. of Plate VI shows the distinct banding on the dorsal surface and the blotched underbelly that is characteristic of this species.

However, up to this time the only description of this species was still the original one in Boulenger (above), and, in their general characteristics, all the subsequent specimens collected seemed to conform to this pattern.

In what was then British Guiana, William Beebe, at the tropical station established at Kartabo, noted that the specimens that were being collected there were mostly burrowing in habit, and were common in the rice fields where they were feeding on *Synbranchus* eels. Beebe (1946 p.28-29.) was meticulous in recording the details of the patterns of the three specimens collected by the staff who worked at Kartabo. In all three descriptions one of the distinctive characters was that the snakes were distinctly banded on the head and the body. His descriptions differed little from the one in Boulenger. He designated this species with the common name, the "Red and Black Banded False Coral Snake." It is unfortunate that the plates at the end of the paper do not include an illustration of this species, though there is mention in the text of a Color Plate 88 of the snake number 244a, collected in March of 1919. I have no information if, or where, this plate was going to be, or ever was, published.

However, I had seen a number of beautiful colour paintings and illustrations when I visited the New York Zoological Society field station at Simla in the Arima Valley in the early 1960's. I recognized that the illustrations for many of the later papers and articles written by Beebe and his staff were based upon the originals that I had seen. These drawings and paintings included the ones from British Guiana, and may have included Plate 88. I have been unsuccessful in tracking down these works either locally or from

the New York Zoological Society in the United States of America.

It was noted by Wehekind (1955) that Hydrops also fed on fresh water eels. (*Synbranchus marmoratus*).

Brongersma (1956) listed a specimen collected near Tacarigua in 1953 and, taking into account a work by Amaral (1929), tacked on a nominate subspecies name, *Hydrops triangularis triangularis*.

Roze (1957 p.56.), in his revision of the genus, published a drawing of the head scales of *Hydrops triangularis*, which clearly shows the distinctive, single, rhomboidal internasal scale and the lack of a loreal scale between the preocular and the nasal scales. Using details of scalation for three specimens from Trinidad and four from Guyana, Roze (1957 p.81-83) described a new subspecies, *Hydrops triangularis* neglectus. This subspecies differed from the five other subspecies by having the following scalation characteristics: 47-51 subcaudals, 159-168 ventrals, 43-60 black bands across the body and 10-14 black bands on the tail region. Figure 13 of this paper illustrates the banding on the dorsal surface of H. t. neglectus and shows the banding for three of the other subspecies. Later, Roze (1966) published two drawings of the head scalation and the banding of the subspecies *Hydrops triangularis venezuelensis*, details of which differ little from those of the subspecies neglectus.

Besides those noted above, and the ones I have not seen in Wagler (1824), Schlegel (1837) and Jan et al. (1868), illustrations or photographs of *H. triangularis* are uncommon in the recently published literature.

There is a colour painting on page 112 of Do Amral's "Serpentes do Brasil" (1977) which shows the snake, heavily banded on both dorsal and ventral surfaces, the pink bands fading to a dirty white on the ventrals.

There is a good, three-view, drawing of the head scalation in Emsley. (1977 p. 293 Fig 30)(Fig.No.1).

Moonen *et al.* (1979 p. 26) show a colour photograph of a brightly coloured specimen identified as *H. triangularis*, with the alternating black and pink/red body-banding, and a distinct light collar rimmed with dirty yellow behind a dark head. What can be seen of the ventral surface looks white.

There is a colour photograph in Campbell and Lamar (1989 p.288; Fig.488) which depicts *H. t. venezuelensis*, and which shows the distinct black and white banding on the body and tail. Some parts of the light bands appear to be dirty yellow/pink.

Murphy (1997 Pl. 131.) shows the banded pattern for this species. However in his description (p.177) he states in error, "The only Trinidad snake with….a loreal (distinguishing it from the true coral snakes)… *Hydrops* is fairly unique in the Subfamily Xenodontinae in Trinidad and Tobago, in that it lacks the loreal scale between the preocular and the nasal scales, similar to the true coral snakes. (See above)

There are two illustrations of *H. t. neglectus*, one in black and white and the other in colour, in Boos (2001 p. 97, Plate 14) that show clearly the reported typical banded pattern of this species. The white band across the rostral area of the head is clearly seen, even in the hatchling as it emerges from the egg case.

Due to space and financial restrictions that affected the content of the book "The Snakes of Trinidad and Tobago," there were several more photographs that could not be published, two of which would have confirmed and further illustrated the colour patterns of this snake.

The first shows a very thin and possibly starving individual that was collected by Allan Rodriguez in the lagoon that drains the northern reach of the Nariva Swamp. Here a small estuary crosses the road and seasonally flows to the sea. (Photo 1). Collected in October of 1983, at the height of the rainy season that year, there is a possibility that this snake had traversed the passage between Venezuela and Trinidad during heavy flooding of the Orinoco delta, and had managed to survive. Without any food for several weeks as it floated on the rafts of water hyacinths, it made landfall on the north Manzanilla Beach, to crawl weakly into the inhospitable and polluted, brackish-water lagoon there. If the transmigration of this specimen did occur, it underlines observations that some reptilian fauna from Venezuela are regularly making landfall and continuing the colonization of Trinidad and possibly Tobago. (Boos 1984, 2001 p.74).

The second I collected dead on the road near the bridge that crosses the Cumuto River in the northeast of Trinidad and there was a small, fresh-water eel, *Synbranchus marmoratus*, about 25 cm. long, protruding from the crushed abdomen. (Boos 2001 p.97.) This photograph supports the previous observations of the prey choice of this species (Photo 2).

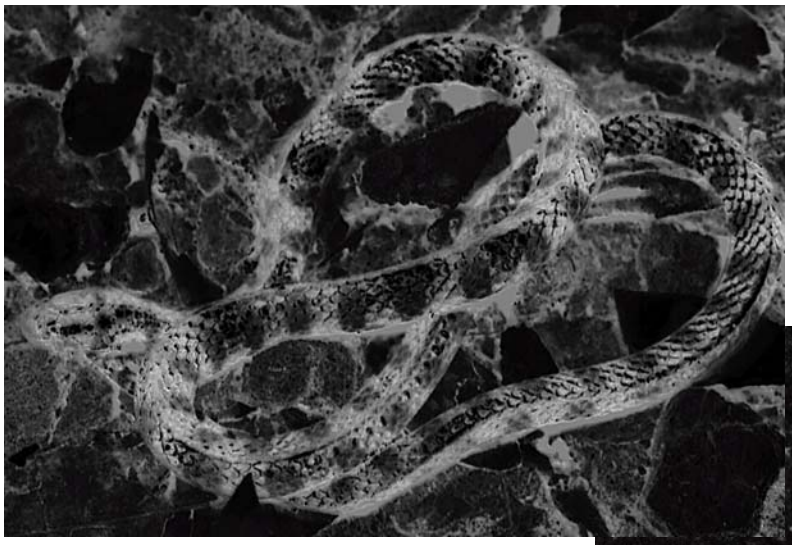
The above was the standard description of, and information about *Hydrops*, and was what I have used over the years to identify the few specimens that I collected or had brought to me for identification.

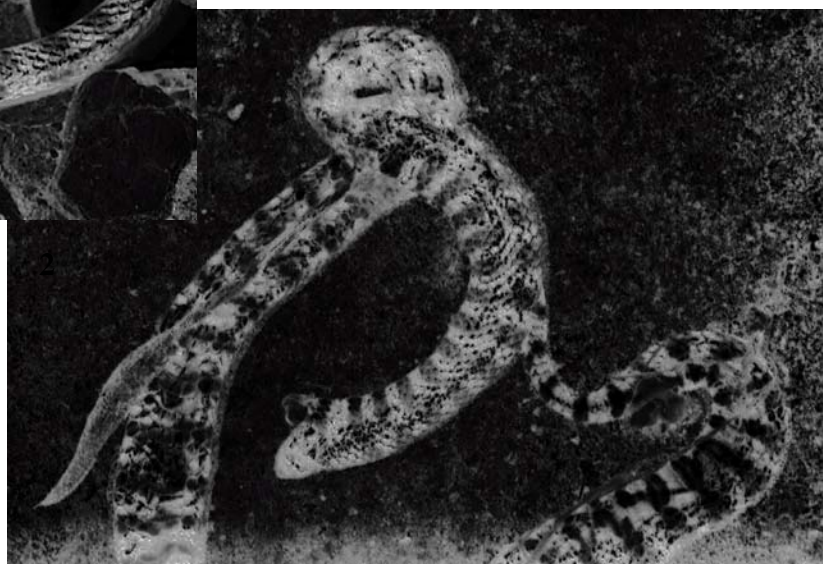
However, there was a surprise to come (Photos 3-5).

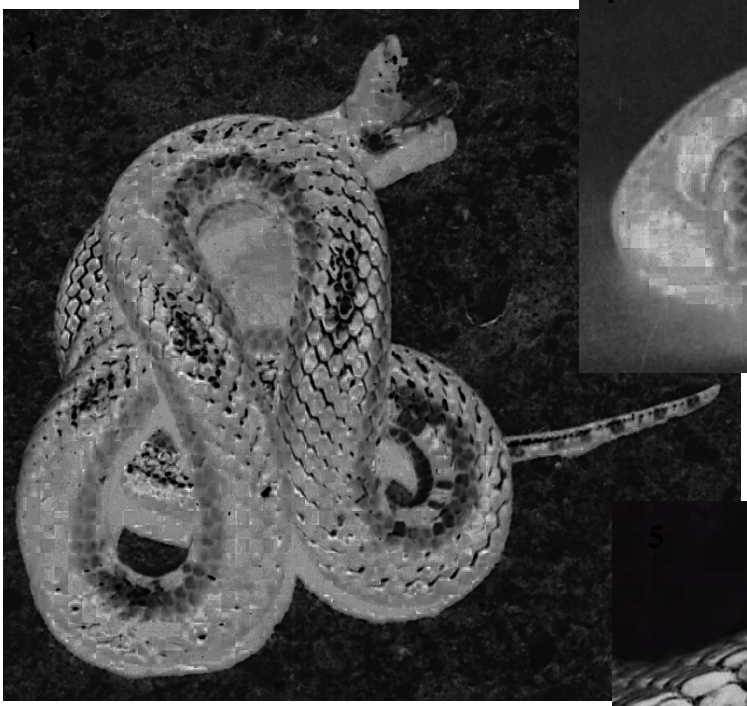
Collecting in the Bush Bush area of the Nariva Swamp, Saiyaad Ali found a small snake that looked nothing like *H. t. neglectus* There was little to no banding on the body, though there was some hint of banding on the tail and on the head and neck. There were the required 15 scale rows throughout the entire body. The 166 ventrals fell within the parameters set by Roze (1957) and the 53 paired subcaudals were two more than the maximum given for *H. t. neglectus*. All other scale characters on the head conformed to the genus Hydrops. Upon examining the head scales, there was the distinctive rhomboidal internasal and there was no loreal. The unusual color pattern was as follows: the ventral scales from the chin to the divided anal plate were a uniform dark gray to black. The first two dorsal scale-rows up from the ventrals were pale gray, creating a distinct, light line running the entire length of the snake. On dorsal scale row 3 was a longitudinal series of blotches and conjoined brown spots, creating a dark line. Above that line, on rows 4 and 5, the scales were light khaki/brown, again creating the effect of a light lateral line along the entire body of the snake. The next 5 rows, from row 6 to 10, spanning the mid-dorsal area of the snake, were a dark blackish green, and this dorsal stripe extended to about three scale rows before the anal area. The both sides of the snake were mirror images. Only on the dorsum of the tail and subcaudals was there some light and dark banding, and there was some hint of pink on the light areas. The head was also flattened as illustrated in the drawings that have been published; (Roze 1957 p.56, 1966 p.148, 149; Emily 1977 p.293) and the eyes and nostrils were dorso/laterally placed. The iris was a brown/orange, with a black round pupil. As there was no discernable dorsal banding those characters could not be used to determine any further the validity of the species identification, but the other characters were enough to allow it to be identified as *H. t. neglectus*.

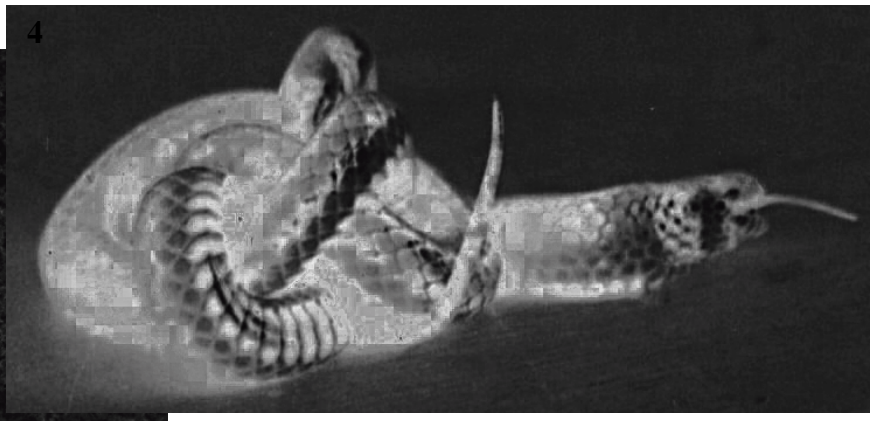
In captivity this snake tended to burrow out of sight into the substrate of the aquarium, supporting the earlier observations of Beebe (1946 p.28). It was feeding on the common Cyprinodontid fish, *Rivulus hartii*, the jumping guabin, and after one of the meals it unfortunately died. The cause of its death was not determined.

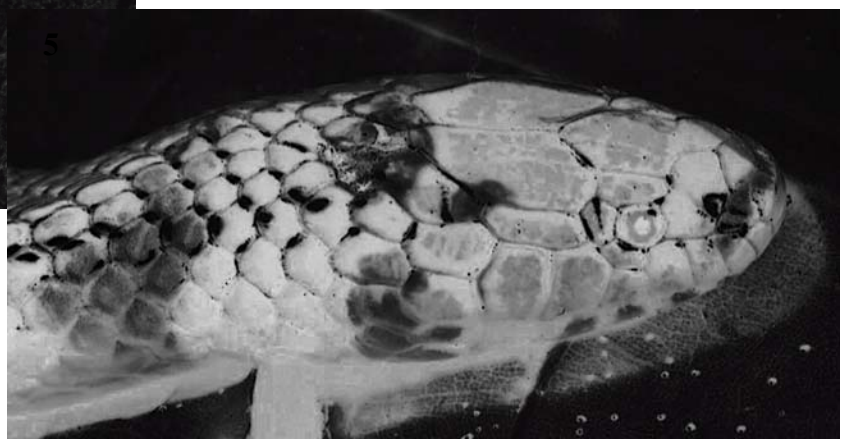
Continued observations and collecting in the immediate area where this unusual colour form of *Hydrops triangularis neglectus*











Figs. 1-5. *Hydrops triangularis neglectus*.
Photos 2 and 3 by S. Ali.
Others by H. Boos.

was found may indicate whether this individual is a single aberration or a colour form that is sometimes found in a fairly widespread and genetically plastic species.

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NATURE NOTE

Post-fledging Dependence of a Young Ornate Hawk-Eagle

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It is difficult to study the post-fledging behaviour of forest hawks, since too often the birds seem to disappear from sight among the trees. On 22 September, 1999 I found an immature Ornate Hawk-Eagle feeding at the forest nest below Asa Wright Nature Centre where adults have for several years raised young. In mid-April I had seen an adult feeding a downy chick in the same nest. It seems likely that the same birds were involved in both sightings, especially as in September I had often heard a young bird calling repeatedly, probably trying to attract the parent's attention; maybe on this occasion it had succeeded. However, I cannot be sure that the parent brought food for the young on this occasion. It seems worthwhile to document the juvenile development in this species, especially as the nesting is so well established in this area, and the security of these birds is likely to remain in good hands.

Note: The managers of the Asa Wright Nature Centre have a unique opportunity to further the knowledge of local natural history, by encouraging some of their naturalists on the staff to compile regular records on the occurrence, numbers, feeding and breeding habits of the resident birds on the grounds of the Nature Centre. Collected over a number of years, such information, if accurately compiled, could be of considerable use for researchers into the local bird life. It is likely that some progress has already been made on this idea. I am sure the T.T.F.N.C. would be interested in publishing some of this material. It would also help the development of research ability for the naturalists themselves.

Rff.

Bromeliads in Trinidad: How to Get a High out of Research

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INTRODUCTION

This commentary is long overdue, as I have been promising my friends and collaborators in Trinidad an account which would explain my continuing fascination for the bromeliads and other epiphytes here for over 20 years. This is a token attempt to give thanks for the extraordinary support that many in the University of the West Indies (UWI) and at Simla have provided over this period, enabling us to develop innovative approaches and show how the physiological ecology of epiphytes can genuinely span field and laboratory experimentation.

Getting started

It all began 1980, when as a postgraduate I had the opportunity of joining an expedition organised by staff at Dundee University. I had set up a mass spectrometer to measure the stable isotopes in carbon (13C/12C), and when Prof Barry Osmond FRS was visiting, I enquired about the possibilities of working on Crassulacean acid metabolism (CAM) and was met with the resounding rejoinder "Bromeliads".

Using stable isotopes, we set about distinguishing the conventional "C3" pathway of photosynthesis from CAM using samples from the field or herbarium. The latter was more normally associated with succulent plants, like cacti, from semi-arid desert regions, since CAM plants open their leaf pores (stomata) at night to allow CO2 uptake when water loss is low. With no sunlight to make sugars at this time, the fixed carbon is stored as malic acid, leading to the simple diagnostic of CAM activity as the dawn to dusk change in titratable acidity of leaf sap.

We were armed with the pioneering work of Colin Pittendrigh , equipped by Prof. Charles McDavid at UWI and aided by the skills of the young curator of the National Herbarium, Yasmin Baksh. We then set out to sample bromeliads day and night-time patterns of water relations under natural conditions over two successive nights in upper and lower montane and seasonal forests in Trinidad at Morne Bleu, Simla and Arena.

Of fevers, feverish activity and fevered speculation

Starting in July-August 1981, the work was undertaken in conjunction with Andrew Smith (now a Professor at Oxford) and an undergraduate, Mary Bassett, ably assisted by my then wife, Nina. Had I not convinced Andy to join us, with his authoritative expertise on plant water relations and CAM, I am sure that the course of my career would not have led me to Cambridge, but then I have always been a great believer in serendipity. In the field, I was the tree climber who scaled two trees at each site to provide bromeliads leaves for determination of daily changes in water deficit using a pressure chamber, and for extraction of leaf-sap acidity to determine CAM activity.

Whilst I had been taken out with a 40 degree fever on the evening that Andy arrived, and carted off to hospital in Port of Spain, four days later we were up surveying sites and building a shelter on the approach to Morne Bleu, where for three nights we scuttled along the ridge for sampling and reprovisioning. Oh, how I remember that royal wedding, when exhausted on the last morning we could find nothing else on the radio when driving back at 5 am! However, we wrote the work up in good time, using the amazing Pittendrigh studies as a framework for showing the distribution of C3 and CAM bromeliads in relation to exposure and rainfall zone across Trinidad. I ended up getting a lectureship at Newcastle, from whence Colin Pittendrigh had originally graduated in Botany, and I had the great thrill of meeting him and showing him his native Northumberland when we awarded him an honorary degree in 1986 (Pittrendrigh C. S. 1993. Temporal organisation: reflections of a Darwinian clock-watcher. Ann. Rev. of Physiology, 55: 17-54).

We then persuaded Andy's collaborator, Professor Ulrich Luettge, that a return to Trinidad in 1983 would be a worthy aim, armed with a combined porometer and infra red gas analyser to measure photosynthetic gas exchange in real time. This second expedition, again based at Simla but sampling bromeliads within forest canopies at six sites from Point Gourde and Tucker Valley to the Morne Bleu Ridge, led to an entire special issue of Plant, Cell and Environment in 1986.

Developments at Newcastle: on bromeliads, strangling figs, world records and tadpoles

Realising that it was time to stamp my own unique organisational skills on an expedition of my own, in 1990 we flew back down to arrive at Simla only to find that my cursory note advising them of our imminent arrival had been sent to the wrong postbag.

With Annie Borland, Mark Broadmeadow and Kate Maxwell, we were armed with the (then) latest equipment for investigating photosynthesis, the Hansatech leaf disc electrode. When hooked up to the Simla water supply, as the dry season progressed, to our amazement a tadpole popped into the sink and down the drain after circulating through the entire water-cooling system. Hoping to study photoinhibition (the loss of photosynthetic activity induced under high light, which we intended to induced artificially), we could not understand why *Guzmania monostachia* was so unresponsive when sampled direct from the field. Answer: it was already severely photoinhibited under the natural high light of the Trinidad dry season!

At that time, David Attenborough was filming his series "Trials of Life" up at Simla. They had specially imported a moth-eaten, stuffed, hummingbird to try to capture the aggressive behaviour of two males defending adjoining territories. Since nothing was happening, I sauntered past and went to check the oil in the old car we were hiring at that time. With a twisted "hood", it made a terrible noise on opening- at the precise moment they finally were about to capture this avian battle sequence on film. The words of the cameraman graphically explained their annoyance, and the two birds did not return- and so no such sequence appeared in the series. Sorry!

Francis Morean had already identified an amazing stand of the

hemiepiphytic strangler *Clusia minor*, growing epilithically around a small quarry on Daleep Singh's land below Simla. This genus was attracting much excitement at the time as the only tree to show CAM. We set about a programme of repeated sampling at dawn and dusk as the dry season progressed, only to determine an astonishing day-night change of leaf-sap titratable acidity of 1500mM (1.5 molar H^+!). Subsequent trips in 1992 and 1995 revealed that in fact *Clusia* leaf sap acidity tends to be maximal not at dawn, as in conventional CAM plants, but by mid-morning, so imagine what we might have found if we had sampled a few hours later! Mark's work with stable isotopes in forest canopies led to subsequent important developments with Kirsty Harwood and Jim Gillon on *Piper aduncum*, whilst Andy Roberts proved himself a star at manipulating *Clusia* under field and laboratory conditions.

Refining the biochemical and molecular approaches

Much of the work we undertook in the laboratory at Newcastle upon Tyne and now Department of Plant Sciences, Cambridge, has set out to investigate the physiology and molecular responses underlying acclimation to changing environmental conditions. Dr. Annie Borland, now a Reader in Newcastle, continues to undertake pioneering work on the metabolic and molecular regulation of the CAM cycle in a range of *Clusia* species. For anyone who has ever tried to wash *Clusia* latex out of clothes (don't even try), imagine the difficulty of refining assays to allow proteins and RNA to be extracted without adulteration. Dr. Kate Maxwell, currently a Royal Society Research Fellow at Cambridge, is now showing the extraordinary restructuring of photosynthetic apparatus which occurs in *Guzmania* at biochemical and molecular levels when the plant is challenged by high light.

Back to the field in 2004

Now old enough to know better, the allure of working in Trinidad still holds, and looking back I recognise what an important stimulus it has been for my well-being throughout- so the highs have been both metaphorical and literal! It was a privilege to bring both Anna and our young lad Jared, then nearly 3, to show them the natural wonders of Trinidad in 1999.

Now, I am trying to initiate new developments, whereby we analyse both 13C and 18O isotopic components in leaf organic material. Over the past 150 years, we have seen a 30% increase in atmospheric CO2 concentrations globally. When allied to global warming and altered rainfall patterns, epiphytes in montane rainforest are in the front line as indicators of environmental conditions. Working with Yasmin, we are now seeking to use both living material and herbarium specimens as markers of changing climatic conditions and evaporative demand. For the third time, I set foot on the summit of Cerro del Aripo in January, this time ably assisted by Dan and a team of Fernatics! Meantime, with my enthusiasm for research in the field undimmed, I am looking forward to renew collaborations with colleagues at UWI. We are now attempting to define geographic ranges and ecological habitat preferences of other groups of epiphytes in a new and exciting chapter of my career, which owes so much to the hospitality and support of friends in Trinidad.

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NATURE NOTE

Salt River Mud Volcano - An "Unrecorded" Mud Volcano

The definitive work on mud volcanoes (mv) in Trinidad was compiled by Higgins and Saunders (1974) making extensive use of the records of the oil companies in the island. However, the Salt River Mud Volcano was not among the 26 mud volcanoes identified and described by the authors. Neither for that matter was the Guayaguayare Mud Volcano noted by Herrara in 1989.

The present authors visited this Salt River mv, located in the Guayaguayare Forest, on April 6th 2003. To get there one can park 1.8 km south of the bridge over the Salt River on the Guayaguayare/Rio Claro Road. To reach the mv from this parking spot it is roughly an hour's walk in a generally southwest direction.

The forest is largely undisturbed apart from the interspersed clearings of itinerant planters. One such clearing was situated on the ridge above the mv. It was a marijuana plot that was destroyed by the Police a few weeks earlier as evidenced by marijuana seedlings that sprung up from mid dry season rains.

The dry mixed forest included *Ficus* sp., *Hura crepitans* (Sandbox) and *Ceiba pentandra* (Silk Cotton). Also present were palms like *Attalea maripa* (Cocorite), *Sabal mauritiiformis* (Carat) and *Bactris major* (Roseau).

The mv, located on a wide bench at the base of the ridge referred to above, had gas and water issuing from a number of vents to form a relatively wide "mouth". The absence of solid footing prevented an accurate measurement of the tassik which we estimated on the bench to be almost circular in shape and about 30m in diameter.

A number of coastal plants grew on the site including a coastal fern (*Acrostichum* sp.), ground bromeliad (*Aechmea aquilega),* Geretout (*Pluchea carolinensis*) and Matapal (*Clusea* sp.)

To the east of the mv and about 3m lower on the slope was an oil-filled depression. The overflow from the mv spilled downhill to the river below. We did not follow the mudflow but P. Nelson who was familiar with the area estimated the distance to the river to be about 800m. From the point where this overflow entered the river, the downstream portion tasted salty and hence the local name Salt River. The official name of the river on the topographic maps, however, is Lizard River.

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Salt River Mud Volcano, Guayaguayare forest

Margaret E. Fountaine, an Early 20th-Century Butterfly Collector in Trinidad

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ABSTRACT

Margaret E. Fountaine (1863-1940) collected and reared butterflies all over the World. She visited the Caribbean island of Trinidad in November 1911 ñ February 1912, February ñ June 1931, and December 1936 ñ June 1937. She died in Trinidad on a fourth visit in 1940 at the age of 78. Her collection from all over the world is preserved as the Fountaine-Neimy Collection in the Norwich Castle Museum, UK. Using extracts from her journal, information is given on her collecting methods and experiences at the Trinidad localities: Fonds Amandes, Hololo Mountain Road and Mt. St. Benedicts. *Sostrata festiva* Erichson, *Pythonides limnaea* Hewitson (Hesperiidae) and *Fountainea ryphea ryphea* Cramer (Nymphalidae) are illustrated from the Fountaine-Neimy collection. A table is provided of the 39 species which she reared in Trinidad.

BACKGROUND

In 1940, an elderly Englishwoman, Margaret E. Fountaine was collecting and rearing butterflies while staying at the Pax Guest House, part of the Mt. St. Benedict's monastery complex on the south-facing slopes of Trinidad's Northern Range. For many years she had travelled the world collecting butterflies and this was her fourth visit to Trinidad, one of her favourite places. She suffered a heart attack while collecting beside the Mt. St. Benedict Road. Here, Father Bruno from the monastery found her. He carried her back to the Pax Guest House, where she died soon afterwards. She was 78 years old.

In her will she left her collection of 22,000 butterflies in ten mahogany cabinets to the Norwich Castle Museum, Norfolk, UK, to be kept in perpetuity as the Fountaine-Neimy Collection (FNC), together with a sealed box of "manuscripts" not to be opened until 1978. When the box was opened, it was found to contain her journals, kept from the age of 15 in 1878. The journals began as a record of one day each year – Miss Fountaine's special day, 15 April. In her family, each daughter had a special day – not her birthday - when the family tried to accommodate her wishes. After the first few years, the journal became a summary of the year, leading into a full account of the special day.

The opening of the box in April 1978 created some interest, and the *Sunday Times* (UK) bid for and secured the rights to publish the diaries. Subsequently, W.F. Cater edited two books of extracts from the diaries covering 1878-1913 (Fountaine 1980) and 1914-1939 (Fountaine 1986). Most of the background material presented here is extracted from these volumes. Much of the interest in the diaries centred on Miss Fountaine's love life. Although the journals are discreet, the impression is given of a series of relationships, of which one dominated: that with Khalil Neimy (also referred to as Charles), a Syrian dragoman (an interpreter or guide in countries where Arabic, Turkish, or Persian is spoken) who travelled and collected butterflies with Miss Fountaine until his death in 1929. They never married, as he already had a family in Syria. While by today's standards, this may not seem exceptional, at the time it was considered outrageous, and so Miss Fountaine has found a place in feminist literature.

Miss Fountaine published very few of her observations in scientific journals, although we know that she reared and recorded the life history of many species, and made water colour paintings of larvae and pupae. Her sketchbooks are held in the Entomology Library of the Natural History Museum, London, and I hope to review the Trinidad observations in these at a later date.

The published volumes (Fountaine 1980, 1986) contain relatively little regarding collecting butterflies and almost nothing about Miss Fountaine's time in Trinidad. Apart from the special day each year, the journals are often vague regarding dates. However, the specimens in the FNC are labelled with their month of capture (or months of rearing), and so we can tell that Miss Fountaine was in Trinidad November 1911 – February 1912, February – June 1931, and December 1936 – June 1937. Thus in 1931 and again in 1937 Miss Fountaine spent her special day in Trinidad and these are described in some detail, both involving butterfly collecting excursions.

Miss Fountaine was buried in an unmarked grave in Woodbrook Cemetery, Port of Spain, at the expense of the city. The grave is still unmarked; it has not been maintained and is now overgrown (Fountaine 1986, C.K. Starr pers. comm. 2004). In the 1980s, following the publication of "Love among the butterflies" (Fountaine 1980), a memorial plaque prepared by local sculptor Ken Morris was mounted at the Pax Guest House overlooking the Caroni Plain (Fountaine 1986). When I enquired in 2003, the plaque had been removed and was in the care of Gerard Ramsarak, the proprietor of the Pax Guest House, following an act of vandalism.

The aim of this contribution is to document Miss Fountaine's experiences in Trinidad from her journals. Although this is of historical interest, the main interest lies in the light it throws on the methods used by butterfly collectors at this time, the areas where she and others collected in Trinidad, and passing comments on other naturalists she met here.

Thus, in editing these passages from Miss Fountaine's journals, I have tried to limit the excerpts to those passages which address the natural history of Trinidad, particularly butterfly collecting, including references to other naturalists. It is clear from reading the Trinidad sections of the journals, that Miss Fountaine had quite strong racist views, which although perhaps acceptable in much of white colonial society at the time, and interesting social history, are not acceptable today. Accordingly, I have edited out phrases and passages which today would give offence, and occasionally added words or phrases in square brackets to improve clarity or flow. Miss Fountaine's original footnotes are included. Explanatory notes are appended, indicated in the text by a roman number in brackets, thus (1), (2), etc.

EXCERPTS FROM THE JOURNAL

1911-1912, pp 2240-2250

"… it did not take … [Khalil and me] long to discover that we were both delighted with Trinidad, the butterflies were a dream, more especially in contrast with the wretched collecting in Jamaica, in fact we soon realised that on this place we had found all we had, at least as far as this trip was concerned, hitherto searched for in

vain, and here our time was more or less to be restricted! A month at the most … After this for some little time, we discovered that the St. Clair direction (1) had more "doing" with the butterflies than any other, and indeed we were getting together a splendid lot of specimens here round Port of Spain including many different species. … Khalil and I very happy and very contented, leading our quiet uneventful life as one day found us wandering over the hill slopes above Belmont (2) another under the shade of the cacao plantations beyond St. Clair (1) where butterflies of the Ithomiidae genus were in abundance notwithstanding that it was so dark beneath the thick foliage of the cacao, that the bats flew at mid-day – huge weird-looking creatures, that some women would have been terrified of, but not I. However we soon discovered that the most beautiful spot of all was the Fonds Amandes Valley (3), also reached from the direction of St. Ann's (4), and here too the rarest species were to be found. I don't think I have ever seen any place quite so lovely before, - ultra tropical and therefore to me intoxicating to a degree in its luscious loveliness, where *Morpho*s flew down in the dark shades in the depths of the forest floating and soaring along the devious course of the stream like blue spirits of light from the blue skies outside, of other worlds more lovely even than this earth of ours. But heavy showers of rain generally came on, especially in this valley, about mid-day, which of course, did not tend to increase our comfort, or success. - …

"… We went to the Agricultural Gardens one day and made acquaintance with Mr. Evans (the Government Botanist) and Mr. Guppy (one of the Government Entomologists) (5). The latter was very pleasant and agreeable, but Mr. Evans, either would not, or could not, give us any help in naming our food-plants, and was most unnecessarily grand and disagreeable, - though this may have been because they were all up to their eye-lids in work, preparing an Agricultural Show that was shortly to take place here in Port of Spain, …

1931, pp. 2951-2960

"I had asked Mons. Réné to be here [Hotel de Paris] at 9 o'clock, and sure enough he arrived to the minute, almost before I had quite got together the nets and other paraphernalia, such as glass-bottomed pill-boxes for ova and small larvae, and the zinc boxes for larger ones. I asked if Fernando was coming, as that would mean also his little white net, and Réné said the boy would join us down-stairs; so we all started off together to catch the next street-car out to St. Ann's. … The Fonds Amandes Valley looked more beautiful than ever, for though, I believe, there has been a spell of dry weather here too, it has rained splendidly the last day or two, and the sky looks as if still more were to come, although I could not help hoping that today it might wait 'til the afternoon, before coming down very heavily. But this was a real tropical valley, hot and steamy and the soft, delicious air was life to me after the dry aridity of Venezuela. There were quite a few butterflies about, and Monsieur Réné and Fernando, were very keen and busy collecting the *Mechanitis* etc., so largely represented on this island, which however I really did not require, having long series of all of them from here years ago with dear Charles. So they all went into Réné's box from whence, I believe they will eventually be sent to Dr. Pollard in the States. The only thing which interested me was a rather small *Caligo*, quite distinct from *eurilochus* (6). I caught one (a female) but she was in such wretched condition, that she was only kept in my box because she was too big to get into theirs; I saw another but failed to catch it. We just wandered on and on …At one time we would be crossing the steam, which was still flowing freely here and the next minute we would again be mounting up amongst the cocoa trees; still far up the valley there was the same solitary dwelling house with the same small piece of cultivated land just in its immediate vicinity; and when the path led once more down to the stream, on the other side of this humble habitation, it stopped abruptly. So we went no further; I having come here specially hoping to get a very beautiful, semi-transparent [1]erycinid I remember we used to catch here 19 years ago. But I saw none of it, and I was beginning to think that it had long since been exterminated by local collectors, so I was all the more pleased when Monsieur Réné brought me a specimen of this very butterfly, which he said had just been caught by Fernando, and the boy seemed delighted to have got something at last that I really wanted. … We had submitted every banana leaf to a careful search for larvae, especially since I caught that *Caligo*, though as a matter of fact, I fancy that it is a species that would give the preference to bamboo, or sugar-cane, as its food plant (6); but our efforts so far had proved in vain, till at last I did find one rather small larva but this being an *Opsiphanes*, not a *Caligo*, I left it undisturbed. We were beginning to retrace our steps now, but the weather which had hitherto on the whole been bright and sunny was now clouding over. A huge land crab which Fernando said was very good to eat, must have heard the remark, and found it little to her liking for she hurried softly across the path in front of us, and the next thing we knew, she was tucking herself most cleverly and expeditiously into her hole, under a good sized rock. We afterwards saw a smaller one which I thought might be the male of the species but Réné said it was a young one not yet fully grown. Nothing of significance happened on the way back. … The tram was standing waiting, so we hurried to catch it. Monsieur Réné and Fernando came back with me to the Hotel de Paris, for one thing to carry the paraphernalia, and also that I should give the former the folded papers, I happened to have ready, so that he should fix up a cocoa tin (à la Newcombe (8)) for his own collecting, as I am sure now that his specimens are by no means improved, by their mode of transport from forest to dwelling house. It was nearly 2 p.m. … Once more upstairs I looked through my captures which were nothing remarkable. However, I set 3 specimens but alas! Fernando's erycinid on closer inspection was damaged near the anal angle of the near hindwing, so I had to paper it for Mme. Fournier. …

"Up on the slopes of one of Trinidad's beautiful mountains is a monastery called St. Benedicts, the order is a strict one, no female is allowed to enter within its sacred precincts … Anyhow Father Maurus one of the priests in this monastery being an entomologist was one of the most pure simple minded men I have ever met, a genuine lover of nature, a true scientist, with the simplicity of a child went far to make him a most congenial companion, and he was allowed to go out with me pretty frequently, perhaps because I was a somewhat antiquated specimen of my sex; but on no account whatever must I set foot in the monastery grounds, much to the regret of Father Maurus as it would have been a real pleasure to him to have shown me all the treasures in his laboratory. But while I enjoyed those rambles over those forest clad mountains immensely, I did not get much of interest, owing to the intense dryness of the season, but we did find a few larvae mostly of *Heliconius* which Father Maurus would look at with beaming eyes, while he remarked with genuine enthusiasm: "Isn't it just the sweetest thing?" He was still young – this man with the mind of a child, not much over 30 years of age and painfully thin, with that hungry eager look on his eyes, so often to be seen in the true religious enthusiast, but his activity on the hillsides and in the ravines must have been somewhat hindered by a long light coloured garment resembling a cassock

that he always wore; but I suppose he was accustomed to it. And we certainly went into some wild places, when maybe I would wade up to my knees in a mountain stream threading my way between the huge rocks and boulders, … while the lean, spare figure in the light coloured cassock would be climbing over the rocks above. There was peace up here in the simple, unpretentious guest house just outside the monastery grounds. … The drought in Trinidad this year was quite exceptional. Forest fires … raged all over those lovely hills, even the Fonds Amandes Valley was burnt black right down into the gorge. But I had made several very nice acquaintances, besides Dr. and Mrs. Myers (9), who had returned from their trip in Venezuela, … Then there was Dr Ulrich (10), who had taken me up to St. Benedict's, also Mr. and Mrs. Wortley, … It was good to go with Dr. Ulrich to see a private collection in the town, and he also took me out to the Agricultural College; it was good to sit in the slumberous heat of those tropical nights on the verandah of the Wortley's house, in the Botanical Gardens, of which he was the chief director and then be driven back to the Hotel de Paris in their car. …

1936-37 pages 3133-3143

"But there is none of these [Caribbean] islands quite equal to Trinidad, possibly I am biased in its favour, because of its really wonderful fauna, there being nearly twice as many species of butterflies on this little island, as in the whole of Europe. I put up at a new hotel kept by a Frenchman some little way up the St. Ann's Valley, where I had a large room, and what was still more important, a very large table, and I was soon busy collecting caterpillars, with the able assistance of a young Indian who was one of Monsieur Sands' gardeners, but who was nevertheless usually available. … I was getting one way or another some pretty good things. … I had not been in Trinidad very long when I discovered to my intense satisfaction that Mr. Sheldon (11) was in Tobago, so I wrote to him at once, receiving an answer to say that he was shortly returning to Trinidad. It is more than 30 years since I first met Mr. Sheldon, when we were both in the prime of life. But were we now any less keen than then? Not a bit, and we climbed the Hololo Mountain (12) together. Though he being several years older even than I am, was not able to go up so rapidly, though he always beat me coming down, but that was because the very first day I went out here in Trinidad, I hurt my left knee, and the steep descent was always rather painful in consequence. Mr. Sheldon seemed to be specialising on *Prepona*s (13), and having already discovered a good locality for these rapid flying forest butterflies, he would paint the trees in that vicinity with a mixture of golden syrup and rum, and by this means succeeded in making several very good captures. I think he was rather vexed at the way I devoted my time and attention almost exclusively to the search for caterpillars. The weather was perfect for our work, quite an unusual amount of rain for the time of year, and rarely enough to cause inconvenience. I missed Mr. Sheldon quite a lot when he left for home on February 1st; and about a fortnight afterwards I left Sands Hotel in spite of being quite aware that the food provided by a French chef would never be equaled anywhere else, and certainly not at the St. Benedicts' Guest House though a new building up there was most comfortable, and the accommodation left little to be desired … Up at St. Benedicts I was at no great distance from the Agricultural College (14), where I had made several friends, and Mr. and Mrs. Pickles (15) usually came to see me on Sunday afternoon, for tea, with their lovely little boy, aged about 2 ½, and then we would go for a walk, up to the forest and over the long wooden bridge (16), where Godfrey had to be carefully watched, as it was in several places very much out of repair. I always felt a scared and squeamish feeling, whenever I crossed this bridge, even on week days with my boy Peter, which as there was no water below, only a deep ravine luxuriant in vegetation, I failed to account for, till we discovered towards the end of my visit up here, that it was the stronghold of snakes, their holes being in the face of the rock just below, and that much dreaded and most poisonous of species, commonly known as "the BushMaster", from its fearless methods of unprovoked attack, was amongst them. One of these brutes, though luckily not a very large one, came up through one of the many cavities in the bridge, after me one day, so that Peter was unable to get past, but I called back to him, to throw a stone at it, and this he did with such good effect, that I believe he killed that one, at any rate he said he did, but doubtless there were others as this was by no means the only BushMaster I had seen on St. Benedicts mountain. This mountain is generally not considered a good locality for collecting, but I found the longer I stayed here, the better results I was getting; for instance, *Catagramma astarte*, considered a rare butterfly in Trinidad, was almost common, and even the females were quite easily met with, also *Prepona*s (13) which at first I had not seen here, were now coming to my baits. All the same, what with the snakes, the wind, and one thing and another, also having had a very satisfactory Letter of Credit from the Midland Bank at home, I was not sorry that I was now able to return to Port of Spain. But Sands' Hotel was full up, so I came here to the Hotel Monaco, …

"… there were several little things to attend to, as usual, and I had ordered Blackman to be here with his taxi at 08.30:a.m. The most important thing I had to do, was to set a fine female specimen of *Zaretes isadora* (17), which emerged yesterday, now leaving my hat box empty of pupae for the first time since I have been on this island, and a most unusual occurrence anywhere. Neither have I much coming out now, two or three *Aristolochia* feeding [2] "Papilios"(?) about a dozen little *Dynamine* larvae from ova laid by captive females in a cage on this table, the residue of some 20 ova, being those which having escaped the cannibalistic tendencies prevalent amongst the young larvae of this species, these survivors no doubt being those who were guilty of disposing of their comrades. I also have two fine [3] larvae feeding on *Casearia*, which I take to be skippers, and hope eventually to confirm as such, especially as the first one I had was parasitized as a pupa producing a lot of disgusting maggots which I handed over together with their pupa shell to Mr. Pickles who informs me that they have produced Diptera which he finds most interesting so of course he too is anxious to identify the host.

"It was already 8 o'clock when I got down to breakfast, and Blackman arrived with his taxi before I had finished and George (the boy) having also turned up in good time, I had to hurry up a bit. However we were already at the foot of the Hololo Mountain at about 20 to 9, and having ordered Blackman to return for me at 2.30:p.m., I began the very arduous climb, and arduous indeed did I find it, the elasticity of youth with its eager optimism having left me many years ago, and this path is so steep in some places, that I can only compare it to a corkscrew staircase, so that it was indeed a relief to reach more level ground after about 2 hours' steep climb, passing the Chinese people's house where the very nasty tempered dog was not so much in evidence today. But I was not going yet to Mr. Sheldon's *Prepona* place, meaning first to climb to where *Adelpha lara* is said to fly fairly commonly (not far away, but very steep again). I have practically given up all hope of finding any more of its larvae, which feeds on the trumpet tree (*Cecropia peltata*)

(20) so that I have only drawn the chrysalis. There were quite a lot of things on the wing up here, but the sun had gone behind a cloud, so I agreed to go on as far as the Radio Station. George, who is only a young boy, not more than fifteen, had never been there and was keen on going, … Well, to return to the Radio Station, there was the same [man] … He soon informed me that Mr. — (I failed to catch the name) was there today, and as he had heard of me from Mr. Sheldon, would no doubt like to make my acquaintance. I found him most friendly, having apparently known Mr. Sheldon very intimately during his stay in Tobago. … He seemed keen on Entomology, though not working seriously at this most fascinating occupation. He told me that on one occasion he had obtained several posthumously produced ova from a female *Morpho*, and that they had all hatched, but as he had had no idea of what was the food-plant of these larvae, they had all died, so I told him the plant and he said he knew the *Bignonia* (21) quite well, so next time he will, I hope, have better luck. On the way back I caught a beautiful specimen of a female *Catagramma* and further down after wasting some time netting bad specimens of *A. lara* I caught a beautiful [4] erycinid, that transparent one with the long tails, in perfect condition. … We found the bottle of bait, which consists of golden syrup and rum exactly as we had left it behind a large tree, in a cleft between its buttressed roots, nothing human or otherwise having touched it, and the concoction inside it was quite good still, though it is nearly a fortnight since I was last up on this mountain. It is a messy business painting these trees to attract the *Prepona*s, or anything else that may come along. George held the bottle and I manipulated with the long handled brush I have bought for this purpose, leaving my net on the ground until the sticky mess is finished with, and I am able to do my best to wipe my fingers clean, on the broad leaves of the cocoa trees. Not much luck however attended my efforts here, there were still *Prepona*s and *Aganisthos* (22) on the wing, and one or two were already aware of my baits, but they are such shy devils, that however much they seem to be appreciating the feast I have provided for them, they always manage at my approach to get a move on, while I am still at a safe distance. I leave George to rest himself while I plod to and fro, and on one occasion he was quite excited, having secured an egg, but it was only the *Cystineura* (23) and he admitted that it was on "Sootie" that he had seen it deposited. I believe I ought to have kept it just to encourage him, but we just put it back on the plant, as I did not want it. The weather now in the early afternoon, was more glorious than ever, and the sun was shining hot and strong all the way back; I picked up a few things I wanted, including one or two lycaenids, but I found the return journey down that steep path, even more trying than the climb, for though my knee no longer bothers me, I have injured the big toe on my left foot, which has been giving me trouble and as it almost invariably gets a sharp knock or two against a stone every day I go out ever since, it has at present had no chance of getting well though now I am trying to be more careful, but it is still painful, sometimes very much so, even when escaping the usual knocks, so I descended slowly and laboriously, and oh the way was long and tedious; for there was nothing much of interest en route, except to see quite a number of fine specimens of *Aganisthos odius* (22) flying some 20 to 30 feet up in the air and never showing the slightest inclination to descend. A short time before we had at last reached the foot of the mountain, George heard a motor horn which he said was Blackman coming to fetch us; and it was good to find him there waiting, for us after more than 5 hours on foot to sit comfortably on the back seat of Blackman's car, was decidedly pleasant and in less than no time to be back at Monaco Hotel. … I … went up to my room to begin setting at once. Four of the specimens were quite good (I didn't expect more) the female *Catagramma* was fine, though a male I had subsequently caught of that same species, was in wretched condition; the erycinid was perfect, also one *Heliconius ricini*, a species which for some cause or other is very difficult to get in perfect condition, and even among the *lara* (5 in number) there was one good enough to set back view, but the four 4 others were worthless. I papered a big skipper and two lycaenids, for the B.M., and one very perfect *Callicore* (24), which is for George, as he always evinces intense admiration for this lovely little butterfly, so that I had caught this one today specially for him, having myself bred so many of this species that I have practically all I need. I had had nothing to eat all day and was feeling decidedly the worse for wear, so I was not sorry when the knock came on my door to tell me that my tea was ready. …

Notes

(1) St. Clair lies north-west from the Port of Spain Savannah, and leads to Lady Chancellor Road, one of the traditional collecting sites around Point of Spain (Barcant 1970).

(2) Belmont is a suburb of Port Spain, which is occasionally mentioned as a collecting locality in the early literature on Trinidad Lepidoptera.

(3) A classic collecting site to the north of Port of Spain (Barcant 1970), although not an area familiar to me.

(4) St. Ann's lies to the north-east of Port of Spain's savannah; St. Ann's, St. Ann's Valley and St. Ann's Peak are classic Trinidad collecting sites (Barcant 1973).

(5) Plantagenet Lechmere Guppy (1871-1934), one of the founders of the Trinidad and Tobago Field Naturalists' Club (Guppy 1991).

(6) This is likely to be the Cane Mort Bleu, *Caligo illioneus saltus* Fruhstorfer (see Barcant 1970).

(7) The Bee, *Chorinea octavius* Fabricius (*Zeonia faunus* Fabricius in Barcant 1970).

(8) I believe this is correctly transcribed, but do not recognize the term.

(9) John Golding Myers (1897-1942) was at this time working for the Imperial Parasite Service (precursor of CABI Bioscience) on the biological control of sugar cane pests, based in Trinidad but looking for natural enemies in South America (China 1942, Bennett & Cock in prep.). Mrs. I.H. Myers was an anthropologist.

(10) F.W. Urich (Ulrich is a rare lapse by Miss Fountaine) was Government Entomologist for many years (de Verteuil 1996).

(11) A UK-based butterfly collector, who provided the most recent documentation of the Tobago butterflies (Sheldon 1936, 1938). His collection was bequeathed to the Natural History Museum, London.

(12) Hololo Mountain Road climbs a spur of the Northern Range above Port of Spain, and is another classic collecting site (Barcant 1970), although housing now extends far up the spur.

(13) The King Shoemakers of Barcant (1970); now placed in the genera *Prepona* and *Archaeoprepona* (see Papworth 1982).

(14) The Imperial College of Tropical Agriculture, now the St. Augustine Campus of the University of the West Indies.

(15) A. Pickles worked with J.G Myers (9) in the early 1930s and at about this time (1937) became the Government Entomologist until at least 1945.

(16) I assume this refers to what is now an iron and concrete walkway against the cliff on the track from St. Benet's Hall at the top of the St. Benedict's Monastery complex, to the water tanks in the valley behind, en route to Mt. Tabor.

(17) Now referred to as *Zaretis itys itys* Cramer *(Anaea itys* of Barcant 1970).
(18) Currently referred to as *Parides neophilus parianus* Rothschild & Jordan and *Parides anchises cymochles* Doubleday respectively (see Barcant 1970).
(19) The Trinidad subspecies is now referred to as *Mysoria barcastus alta* Evans, although ssp. *venezuelae* occurs on Tobago (Cock 1981). I have reared this species on *Casearia sylvestris*, *C. guianensis* and *C. spinescens* (Flacourtaceae) (M.J.W. Cock unpublished).
(20) Barcant (1970) does not include this food plant record. Around 1980 F.C. Urich (nephew of F.W. Urich (10)) told me that *Cecropia peltata* was the food plant of *Adelpha lara*. At about this time I found a larva on *Cecropia peltata* that I reared through to a pupa, which although it failed to emerge showed the diagnostic black and red wings clearly visible. This was subsequently published in Aiello (1984) as a personal communication.
(21) This is presumably a reference to *Paragonia pyramidata* (Bignoniaceae), which is well known as the food plant of the morpho, *Morpho peliades* insularis in Trinidad (Kaye 1921, Stollmeyer 1932, Barcant 1970; Urich & Emmel 1991).
(22) i.e. *Historis odius orion*, the Grape Shoemaker of Barcant (1970).
(23) i.e. *Mestra cana* Erichson, the Grey Handkerchief of Barcant (1970), who gives the food plant as *Dalechampia pruviens* (i.e. *D. pruriens*, a synonym of *D. tiliaefolia*), the nettle vine.
(24) i.e. *Diaethria clymena aurelia* Guenée, the 89 (*Callicore aurelia*) of Barcant (1970).

THE FOUNTAINE-NEIMY COLLECTION

In 2003, I examined the Fountaine-Neimy Collection at the Norwich Castle Museum, and catalogued the Trinidad material. All specimens in the collection are in excellent condition, many of them having been reared. None have any more specific locality data than "Trinidad". Although the 1911-12 and 1931 collections from Trinidad have been integrated into the main sequence of the collection, that from 1936-37 has not and is found in a group, along with other similar groups at the end of the main sequence. I recorded 880 specimens from Trinidad, representing a mere 140 species out of around 750 currently known from Trinidad (M.J.W. Cock unpublished). It is likely that I did not spot every Trinidad specimen in the day that I spent doing this, e.g. I have no record of *Morpho peliades* in the collection from Trinidad, which seems unlikely, especially since Miss Fountaine implies in her journal that she reared this species. Although there are plenty of good captures amongst the FNC, there are few meriting special comment. However, I take this opportunity to illustrate two species of Hesperiidae Genera Group E, *Sostrata festiva* Erichson (Fig. 1) and *Pythonides limaea limaea* Hewitson (Figs. 2-3) from the FNC as these species were not available to me when I wrote up and illustrated that section of the Trinidad Hesperiidae (Cock 1986).

Part of the reason for this surprisingly low number of species is that Miss Fountaine only accepted perfect specimens, but more important was her taxonomic focus. She specialised in Nymphalidae (sensu lato), of which she collected 70 species (50% of the 141 spp. in Barcant (1970)) and Papilionidae of which she collected 6 species (40% of the 15 spp. in Barcant (1970)). Other families were less well represented: Pieridae 8 (30% of the 27 spp. in Barcant (1970)), Riodinidae 21 (18% of the 119 spp. in Cock & Hall (in prep.)), Lycaenidae 8 (6% of the 136 spp. in Cock (unpublished)) and Hesperiidae 27 (9% of the 307 spp. in Cock (in prep.)).

Fig. 1. Male *Sostrata festiva* Erichson, Trinidad, i.1912, M.E. Fountaine (Fountaine-Neimy Collection, Norwich Castle Museum)

Fig. 2. Male *Pythonides limaea limaea* Hewitson, Trinidad, i.1912, M.E. Fountaine (Fountaine-Neimy Collection, Norwich Castle Museum)

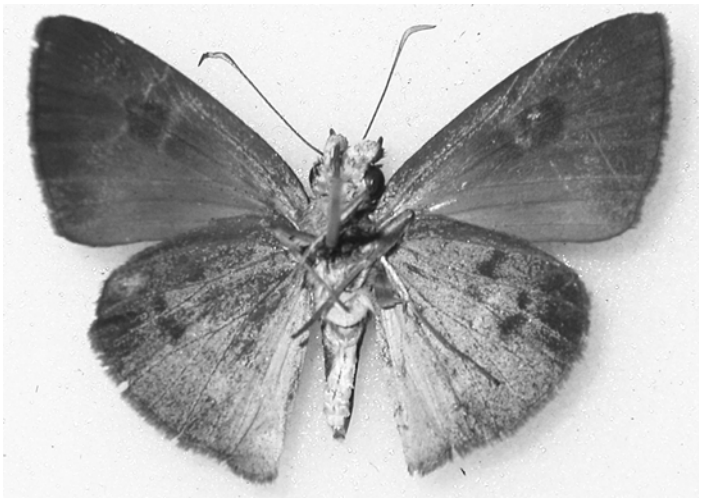

Fig. 3. UNS of Fig. 2.

Of these 140 species, 39 species in the FNC included reared specimens from Trinidad (Table 1). Unfortunately, the specimen labels in the FNC do not include details of the host plants of the reared material; hopefully this information is included in Miss Fountaine's sketchbooks in the Entomology Library of the Natural

History Museum, London. Of the species listed in Table 1, the food plants of most are known to local collectors and were included in Barcant (1970). How much this was due to information exchange between Miss Fountaine and local collectors, or indeed how much she may have learned from them, we do not know. The food plants of the remaining species are now also mostly known (e.g. I have reared all the Hesperiidae that Miss Fountaine reared). However, as yet few of these life histories have been well documented from Trinidad.

DISCUSSION

Apart from the two books published from her journals, Miss Fountaine is not a well-known naturalist. I cannot trace any butterflies named after her, although during her lifetime she refused to allow species to be named after her (A. Irwin, pers. comm. 2004). More recently, Rydon (1971) established the genus *Fountainea* to include several species hitherto placed in the genus *Anaea* Hübner. Since then some authors have recognised *Fountainea*, others have treated it as a synonym of *Anaea* or of *Memphis* Hübner (DeVries 1987). D'Abrera (1988) recognises *Fountainea* and adds several

Table 1. Reared butterflies from Trinidad in the Fountaine - Neimy Collection, Norwich Castle Museum.

Current name	FNC name, if different	Food plant given in Barcant (1970)	Year(s) reared
Nymphalidae			
Adelpha iphicla Linnaeus		*Gonzalea spicata* (1)	1936-7
Adelpha lara lara Hewitson		None	1937
Adelpha pleasure symona Kaye	*Adelpha symona*	None	1937
Colobura dirce dirce Linnaeus	*Gynaecia dirce*	*Cecropia peltata*	1911-12, 1936
Consul fabius ochraceus Butler	*Protogonia hippona ochraceus*	*Piper marginatum*	1912
Diaethria clymena aurelia GuenÈe	*Callicore aurelia*	*Trema micrantha*	1931, 1936-37
Dynamine arene H¸bner		None	1937
Dynamine artemisia Fabricius		None	1937
Dynamine mylitta Cramer		None	1937
Fountainea ryphea ryphea Cramer	*Anaea phidile*	*Casearia ramiflora* (2)	1936-37
Hamadryas februa ferentina Godart	*Ageronia ferentina*	*Tragia volubilis*	1937
Hamadryas feronia ferentulina Fruhstorfer	*Ageronia feronia*	None	1937
Hypanartia lethe Fabricius		*Celtis*	1936-37
Mestra cana Erichson	*Cystineura cana*	*Dalechampia pruriens* (3)	1912, 1937
Siderone marthesia Cramer	*Anaea marthesia*	*Casearia sylvestris*	1936-37
Victorina stelenes Linnaeus		*Blechum brownei*	1936-37
Zaretis itys itys Cramer	*Zaretes isadora*	None	1936-37
Mechanitis isthmia kayei Fox	*Mechanitis polymnia*	*Solanum* spp.	1911-12
Actinote anteas anteas Doubleday	*Actinote anteas*	None	1931
Agraulis vanillae vanillae Linnaeus	*Dione vanillae*	*Passiflora foetida*	1931
Dryas julia julia Fabricius	*Colaenis julia*	*Passiflora tuberosa*	1911-12, 1931
Euides aliphera Godart		*Passiflora lonchiflora*	1931, 1937
Heliconius erato hydara Hewitson	*Heliconius hydara*	*Passiflora edulis*	1911, 1931, 1937
Heliconius melpomene euryades Riffarch		*Passiflora laurifolia*	1911
Papilionidae			
Battus polydamus polydamus Linnaeus	*Iliades polydamus*	*Aristolochia trilobata*	1937
Papilio anchisiades anchisiades Esper	*Priamides anchisiades*	*Citrus sinensis*	1911-12
Papilio androgeus androgeus Cramer	*Iliades androgeus*	*Citrus sinensis*	1937
Papilio thoas nealces Rothschild & Jordan	*Iliades thoas*	*Piper* spp.	1911-12, 1937
Parides anchises cymochles Doubleday	*Meneliades / Iliades cymochles*	*Aristolochia trilobata*	1937
Parides neophilus parianus Rothschild & Jordan	*Meneliades aeneides*	*Aristolochia trilobata*	1937
Pieridae			
Phoebis argante argante Fabricius	*Catopsilia argante*	*Inga laurina*	1912
Riodinidae			
Anteros formosus formosus Stoll		None	1936-37
Lyaenidae			
Denivia hemon Cramer	*Thecla hemon*	*Theobroma cacao*	1937
Hesperiidae			
Chioides catillus catillus Cramer		None (4)	1937
Milanion hemes hemes Cramer		None (4)	1937
Mysoria barcastus alta Evans	*Mysoria venezuelae*	None (4)	1937
Nisoniades bessus Mˆschler	*Nisoniades macarius*	None (4)	1937
Quadrus cerialis Stoll		None (4)	1936
Saliana salius Cramer		None (4)	1936

Notes:
(1) This is in error for *Gonzalagunia spicata*, which is now considered a synonym of *G hirsuta* (Rubiaceae).
(2) I think this is an error of identification; the food plant of *F. ryphea* is *Croton gossypifolius* (Euphorbiaeae).
(3) As noted in the text, this is a synonym of *D. tiliaefolia.*
(4) Barcant (1970) listed the Trinidad and Tobago Hesperiidae, but does not include food plant records.

[1] *Zeonia chorineus* (7)
[2] *Menelades aeneides* and perhaps *M. cymochles* (18)
[3] Identified eventually at the BM as *Mysoria venezuelae* (19).
[4] *Zeonia chorineus* (7)

more species to the genus, including *F. ryphea.* This species occurs in Trinidad, where it is known as the flamingo (Barcant 1970), and is amongst those which Miss Fountaine reared here (Table 1; Figs. 4 and 5).

Fig. 4 Male *Fountainea ryphea ryphea* Cramer, Trinidad, bred i-ii.1936, M.E. Fountaine (Fountaine-Neimy Collection, Norwich Castle Museum).

Fig. 5. Female *Fountainea ryphea ryphea* Cramer, Trinidad, bred i-ii.1936, M.E. Fountaine (Fountaine-Neimy Collection, Norwich Castle Museum).

When Miss Fountaine collected and reared butterflies in Trinidad, much of what she discovered of life histories was doubtless new to science, and although she kept records and painted larvae and pupae, sadly she published very little, and nothing based on her work in Trinidad. Much knowledge was either retained by local collectors, or rediscovered by them. Even now in most cases, little more than the food plant record has been published, e.g. in Barcant (1970) (Table 1), but note the important series of papers by F.C. Urich in *Living World* and *Tropical Lepidoptera* which deal with some of the larger species (e.g. Urich & Emmel 1991).

Norman Riley, for many years Keeper of Entomology of the Natural History Museum, London, wrote "Naturalists, particularly the kind who take a pride in building up valuable collections, are notoriously bad at recording their observations for the benefit of others. Miss Fountaine was one such. Her knowledge of the ways of tropical butterflies was profound, probably unique, but …. recording so little of her work in print or in any systematic form" (Fountaine 1986, pp. 135-136). I repeat this assessment, to support the exhortation of Starr (2003) encouraging Trinidad and Tobago naturalists to share their discoveries in print. If Miss Fountaine had published much of what she discovered, she would be a highly regarded naturalist today, as it is her reputation is that of a good collector.

ACKNOWLEDGEMENTS

I thank the Norfolk Museums and Archaeology Service for permission to use the extracts from Margaret Fountaine's journals, and Dr. Tony Irwin of the Norwich Castle Museum, who kindly hosted my visit to the Fountaine-Neimy Collection, provided me with scanned images of the relevant journal pages relating to Trinidad, and commented on a draft of this paper.

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In Memoriam

Sylvia Kaçal,

April 1940 to October, 2003

Last year the environmental movement of Trinidad and Tobago lost one of its most indefatigable champions in Sylvia Kaçal.

In the weeks following her untimely death in Malawi from malaria, Sylvia's many talents were the subject of numerous articles in the press.

They portrayed a multifaceted personality possessed of singular determination and resolve, a dedicated mother, conservationist and friend.

To the students and staff of St. Andrews School, where she taught for so many years, she was "Miss' and a colleague, always finding some innovative approach to the ordinariness of the syllabus.

To the Art fraternity she was a staunch supporter, critic, and familiar figure at shows and galleries, having run her own many years ago from the Hilton Arcade in the hiatus before Art Galleries enjoyed their present prestige.

She was a Founding Member of the British Women's Club, an outgrowth of her characteristic concern for people. Having arrived in Trinidad as a young bride in the early 60's she readily empathized with the isolation often experienced by the families of ex-patriot personnel on contract in those years. The British Women's Club continues to function as a conference where non-nationals can share experiences as they become familiarized with the complexities of Trinidad's diverse culture and customs, and in turn 'put-something-back' through their fund raisers and charities.

To all of us who tramped hillsides and forest trails with her in the Field Naturalists' Club and informal field trips in pursuit of some new information, she was congenial company with whom we could look forward to intelligent and witty conversations. Her natural history interests were varied. She rarely missed a Bird Count, trudged the Aripo Savannah with the Botany Group, and took an active interest in whatever research was current.

She became an active voice against the destructive practices of some of the less ethical Quarry operators, and assisted in designing the early public education programmes for media, on the detrimental consequences of forest fires.

She was a regular columnist with the *Trinidad Guardian* where her Monday articles under 'Environment', were well balanced, often wry and entertaining, as well as informative.

Believing that a pro-active approach to the urgent issues of environmental neglect was necessary, she became a founding member of the Caribbean Forest Conservation Association (CFCA) and its first President. She was also a founder of the Council of Presidents of the Environment (COPE) the 'umbrella organisation' of Environmental Non Governmental Organisations (ENGOs)

She was an immensely pragmatic and resourceful woman who believed there was a simple and elegant solution to every problem once it was approached with a collective will and sufficient objectivity. Many of the projects she initiated are a testimony to this approach, such as The Tour Guide Training Programme, the Community Based Organisations (CBOs) in Kernahan and Surrey Village among others, and the ENGOs, Nature Seekers in Matura, and the Grand Riviere Environmental Awareness Trust (GREAT) where villagers were trained to care and manage their local natural resources both for conservation and livelihood. These groups, are still actively involved in tour guiding and turtle protection on the nations' beaches.

Her children grown and already in her fifties, she returned to the class room, behind the desk, this time, taking up a scholarship to read for an M.Ph. in Environmental Resource Management at Cave Hill in Barbados. Coming from an academic background in languages this was no mean undertaking, but it gave her the tools to better serve the country of her adoption in an area she perceived both necessary and urgent.

When the CFCA was contracted by the World Bank to develop a plan for National Parks and Protected Areas in Trinidad and Tobago, Sylvia became an important part of the process. Her cumulative experience and reputation for 'getting the job done' later attracted other World Bank assignments in various countries from Vietnam to Malawi where she designed and setup Community Based Organisations in support of Government Environmental initiatives.

In the pauses between contracts and writing new proposals, she would find time to visit the Matura project, or look in on 'the Grand Riviere people', keep in touch with current projects in the Wildlife Section and Forestry Division, attend the Meetings of the Field Naturalists' Club and the CFCA, check out the Art Galleries or the theatre, and spend memorable time with family or friends.

She was no stranger to Carnival and particularly J'ouvert.

Beyond the public face was a loyal and enduring friend, who spoke her mind unequivocally, whose opinion one might get with or without ones leave, and on whose support one could count in any situation. She was an intensely private and unpretentious person who would have been acutely embarrassed by the tributes paid to her at her memorial service. In spite of the many hardships of her own life, she had quietly befriended many, like her longstanding friend, Noel Vaucrosson who she compassionately supported through his terminal illness, and likewise, Jane Boyle from Charlottville.

Most of all Sylvia was an exemplar and left us with a template of constructive action and dedicated service guided by a higher principal than the self-serving model to which we have become accustomed.

Her contribution challenges all of us to move beyond the inertia and procrastination which is at the root of many of the problems influencing declining Environmental health; loss of habitat, and species, and unplanned or uncontrolled development.

A memorial plaque to her work will be placed on the Wall of Remembrance in the Garden of Peace at the Cathedral of the Holy Trinity, Port of Spain, by the Field Naturalists' Club and the Caribbean Forest Conservation Association.

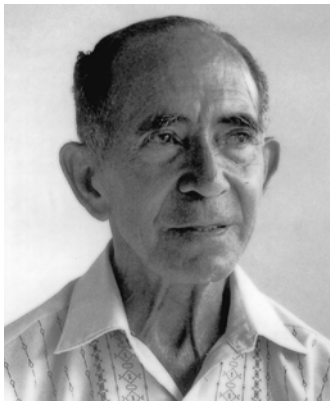
Detta van Aardt-Buch

In Memoriam

Theodore Francis "Frankie" Farrell

29 December, 1907 – 19 December, 2003

Frankie Farrell was born to Charles Farrell and his wife Mary (Brunton) Farrell on 29 December, 1907. He was the last of a family of seven boys, and apparently the smallest. He attributed his small size to the following circumstances. At age two he developed jaundice and was ill for a long time, badly enough to be thought in danger of death. After he recovered, he disliked food and would not eat reasonable amounts until late in his teen-age years. The family lived in Picton Street for some time during his boyhood, but I do not know if they lived there when he went to school at Tranquility Boys Intermediate School. I suspect they did, for it would have been easily possible for him to walk to school from there.



Theodore Francis "Frankie" Farrell

In one of his later years at Tranquility a new boy came to the school, entering as was customary, in the lowest class. After two weeks he was promoted to the class above, and after another two weeks he was again promoted, going on from there to complete his studies with distinction. That schoolboy was Eric Eustace Williams, who graduated from Tranquility to Queen's Royal College (QRC) following in the footsteps of Frankie who had won an exhibition (scholarship) to QRC in 1922. Eric E. Williams later became Prime Minister of Trinidad and Tobago.

At QRC Frankie came under the influence of Dr. B.J. Bedell, the botany teacher. From then to his death he retained his interest in plants, sometimes a little wistfully regretting his almost complete neglect of animals, but most of the time thoroughly enjoying his studies of plants.

He had two chances for winning a scholarship to study at a university abroad, in 1926 and 1927, but failed by just a few marks both times. He was ever to regret this since the family could not afford to pay for studies abroad. After leaving school he worked as a laboratory assistant to Prof. Fred Hardy of the Imperial College of Tropical Agriculture (ICTA) for two years, and enjoyed this tremendously. Hardy complimented him on his work and encouraged him to study science, (which he could have done as an external student of the University of London) but Frankie was very doubtful that as a local person he would be able to find employment as a botanist or soil scientist in the colonial system of the time. He decided to join the Civil Service, and worked his way up the ladder in various departments.

Beginning as a clerk to the judges he was transferred after a few years to the health department as a principal officer, and later to the Colonial Secretariat. He became Supervisor of Elections in 1946, and remained there for the rest of his career in the Civil Service. During this time he made visits to Guyana and the UK on business related to elections, and often recalled those visits in conversations he had with me in later years. In 1951, he was made a Member of the Order of the British Empire (MBE) by King George VI.

All of Frankie's brothers were avid sportsmen, as was he, and played football at various levels. Frankie did not persist with football because of his small size, but he played tennis into his seventies, well enough in the earlier years to win the Queen's Park tennis tournament on one occasion. To my knowledge, he did not play cricket, but he enjoyed watching it at the Oval, having joined the Queen's Park Cricket Club in 1930.

When The Trinidad Field Naturalists' Club was revived in 1954 I met Frankie for the first time, and for the next six years when I was the Hon. Secretary, I met him no more often than any other member. In the 1960s he would visit the Herbarium passing close to my laboratory at UWI in the same building. He seemed to me then a lonely person without close friends. It was only when the Botany Group of the Club was organised in 1977 that I got to know him well. In the beginning the group comprised seven people in addition to Frankie: Anne and John Hilton, Vilma and Judith Lastique, Denise Lee, Luisa Zuniaga and myself. Many people came for one or a few visits, but those eight people formed the core of the group. The Lastiques left after two years and Denise's outings became less regular as the cancer from which she eventually died made its presence felt. A close camaraderie developed between the six (and later five) of us as we studied the orchid *Cyrtopodium broadwayi*, and afterwards when we studied other aspects of the Aripo Savannahs. Frankie and I were drawn closer together by our shared interest in trees, which eventually resulted in the joint authorship of the book "Native Trees of Trinidad and Tobago". We began to organise our own trips, apart from the others. I particularly remember one such trip when we went with a visiting amateur botanist to the Longdenville Forest Reserve. His car gave a lot of trouble, and we had to push it "at least 15 times" as I wrote in my notes later. There were many other trips, including a hike from Brasso Seco to Maracas Bay, one up the Rio Seco, and a fishing trip on the Ortoire River.

As a member of the Club, Frankie was loyal and active. He attended all meetings and field trips. He was Honorary Treasurer for several years in the 1930s. He was Vice-President from 1972 to 1974, was Honorary Auditor from 1975 to 1978, a Committee Member in 1979 and again in 1987-1988. He was Vice-President again in 1980 - 1982 and 1986, and President in 1983 and 1984. When in 1991 we had difficulty in finding a president for our 100th Anniversary Year, Frankie at age 83 loyally undertook the task despite the demands made on him by his wife's declining health. In 1993 at the request of his Excellency President Noor Hassanali he carried a Trinidad and Tobago flag to the top of El Tucuche on Republic Day. He was then 85 years old, and his achievement is a record unlikely to be broken easily. He gave lectures to the Club, wrote articles for its two publications and for other publications such as the Trinidad Naturalist, and occasionally represented the Club at meetings abroad.

He belonged to other societies as well, being a member of the Horticultural Society and Friends of the Botanic Gardens. He was a founding member of the Rhand Credit Union and its President for eight years.

As advancing age began to take its toll on the Botany Group, field trips were fewer, and the botanical work ceased altogether in 2000. After that, the four remaining members would meet at my house in Talparo on the Sunday after the Club's meeting and talk of

"old times" and new concerns. As Frankie's hearing deteriorated and he became less able to follow the conversations, he took to visiting me alone on the following Sunday. He would go by bus to Arima and I would meet him there and drive him to my home. We would talk mainly about current events. Since he read the Express and I the Trinidad Guardian he would bring with him articles cut out from the Express that he wanted to discuss with me.

Frankie had married Elsa Lumsden in 1936, and with her had three children, Maureen, Patricia and Richard. As far as I know, their union of 56 years was one without even a ripple of discontent. Elsa was an Anglican, who practised her religion, but Frankie though baptised an Anglican never practised any religion so far as I know. In all those years of association, and at all those meetings at my home, the topic of religion came up for discussion only three or four times. It was on one of these occasions that Frankie mentioned his belief in reincarnation. I was shocked, to say the least. The idea seemed to be so foreign to the Western World, I wondered if he was serious. My few questions brought answers that indicated he was. He also said he was not afraid of death. Perhaps, these deep-seated convictions were at the root of what I mistook at first to be loneliness, but was really a kind of self-sufficiency that is rare indeed. More than any other man I have known, Frankie has gone placidly amid the noise and the haste of the modern world – and enjoyed his going.

Victor C. Quesnel.

Editor's Note: The 1987-88 issue of Living World was dedicated to Theodore Francis Farrell.

Notes to Contributors

Living World, Journal of the Trinidad and Tobago Field Naturalists' Club, publishes articles on studies and observations on natural history carried out in Trinidad and Tobago, and in countries in the Caribbean Basin. Contributors to Living World are not limited to members of the Club.

Articles are sent to two referees for review.

In general, we follow the Council of Biological Editors Style Manual (latest edition).

All articles, except for the section on Nature Notes, should be accompanied by a short abstract.

Nature Notes is a section allowing contributors to describe unusual observations on our flora and fauna. It should not be longer than one Journal page.

References should follow the Name and Year system. See references cited in recent issues of the Journal.

Some examples:

1. **Journals:**
   Snow, D. W. 1962. A field study of the Black and White Manakin in Trinidad. *Zoologica*, 47: 65-104.
   Quesnel, V., Farrel, T. F., Hilton, A., Hilton, J. and **Zuniaga, L.** 1996. The revegetation of the McClean Monument. *Living World, J. of the Trinidad and Tobago Field Naturalists' Club,* 1995-1996: 9-12.

2. **Foreign Language Journals** should be given in full. e.g. *Tijdschrift Voor Entomologie*.

3. **Books and Monographs:**
   Barcant, M. 1970. Butterflies of Trinidad and Tobago. London: Collins. 314 p.

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

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Deadline for submission of articles for the 2005 issue of Living World 1 February 2005.