LIVING WORLD

Journal of The Trinidad and Tobago Field Naturalists' Club

2003

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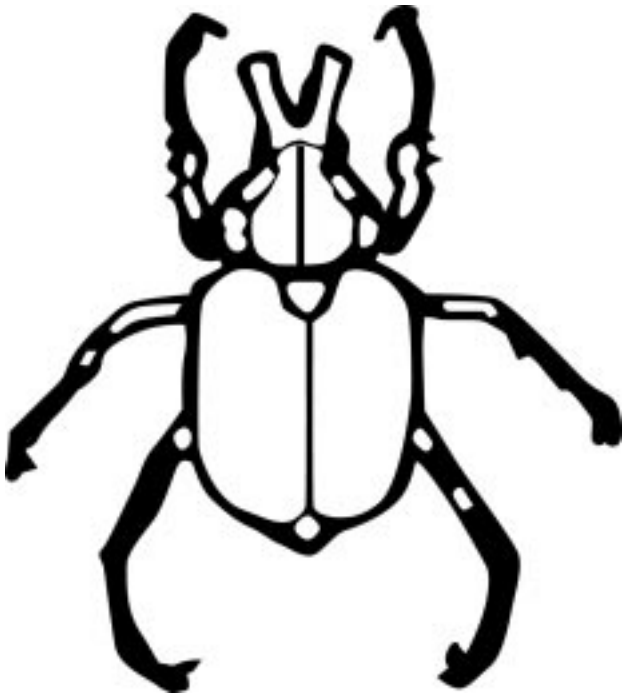

Natura Maxime Miranda in Minimis

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Cover Photograph

Anolis wattsi wattsi Boulenger 1894. Adult male.

Photograph by G. White

The exotic lizard *Anolis wattsi wattsi* Boulenger 1894 (Det. Greg Mayer) was discovered on Trinidad in November, 1992 by G. White on the grounds of the Caroni Research Station in Waterloo (Hans Boos 1996. Living World: 17-19). The species is native to Antigua, and includes in its range the neighbouring islands of Barbuda, Anguilla, St. Martin, St. Eustatius, St. Christopher, Nevis and St. Lucia.

A. wattsi is more terrestrial in habits than the familiar garden anole *Anolis aeneus*, often foraging on the ground, but scampering back to a bush if disturbed. Since 1992, the population has expanded south to Couva and east to Carapichaima. It is well established and likely to spread throughout urban areas of Trinidad. Please report any sightings of this lizard to G. White at his E-mail address: *g-white@tstt.net.tt*

Editorial

Matthew Cock has been a regular contributor to Living World since 1981 with his articles on the Lepidoptera, particularly the skipper butterflies and moths. His research has greatly added to our knowledge on the diversity of our fauna. In this issue, we continue his series on the Hesperiidae and he also provides us with an interesting article giving an estimation of the number of moths in Trinidad and Tobago. His research has shown a doubling of the number of species of moths known from Trinidad and he is now working on the first list of moths from Tobago. We look forward to the completion of these projects, which would give a huge boost to our knowledge and understanding of this important, but poorly documented, part of the nation's biodiversity particularly as so few people are working in this field.

Elisha Tikasingh's article on the history of zoological collections shows that most of the collecting was done by local people who were interested in the environment. The article also shows that most of the collections went to overseas' museums, and he also provides a preliminary list of specimens housed in local and overseas' museums. There is an urgent need for a properly constituted, adequately staffed and funded Biodiversity Centre.

Very little is known about our spider fauna. Jo–Anne Sewlal and Bruce Cutler provide us with an annotated list of the spider families that are found in Trinidad and Tobago. The authors include some families found in the neighbouring mainland and which might also be found here.

There are seven articles on ornithology: one by Victor Quesnel on the Screech owl and two short articles by Richard ffrench on his observations on the Ruddy Turnstones in Tobago and the other on a retrospective view of our Club's ornithologists in the 19th century. The remaining bird articles are found in the Nature Notes Section, of which three are taken from the Trinidad and Tobago Birders' Journal, which never got off the ground. The remaining articles from this "Journal" will be published in our 2004 issue. There is also an article by Nigel Gains on the predation of a lizard by a Mockingbird, an observation not previously recorded for Trinidad and Tobago.

There are two articles, other than ornithology, in Nature Notes: one by Graham White on the temporary beaching of a whale at Waterloo, and the other, a report on a giant silk cotton tree by John Lum Young and others.

Information on fauna in our streams is generally lacking and it has been 13 years since we have had a paper on freshwater species of animals, so we welcome Professor David Bass (University of Central Oklahoma) to our pages with his article on macroinvertebrates in Tobago.

Our Editorial Committee continues to make changes, however slight, to the format of Living World, all in an effort to make it a more professional journal. In this regard we intend to follow as much as possible, recommendations given in the Council of Biological Editors Style Manual.

EST

Acknowledgements

We thank Michael E. Tikasingh for the design and layout of the front and back covers. Thanks are also due to Calista Pierre and Rupert Mends for assistance in proof reading.

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The History of Zoological Collections in Trinidad and Tobago*

Elisha S. Tikasingh
12 Newbury Hill, Glencoe, Trinidad and Tobago
E-mail: *elisha@rave-tt.net*

ABSTRACT

This history of collections of zoological specimens for museum and study purposes is presented in three periods: 1800 to 1899, 1900 to 1949, and 1950 to 2000. The history shows that most of the significant collections were made by local residents and are now located abroad. The most collected and studied groups are the birds, mammals, reptiles, amphibians, fishes, butterflies, moths and other insects of medical, veterinary and agricultural importance. Preserved specimens of our fauna in local institutions are now so considerable that a national data base should be considered.

INTRODUCTION

The 1800's saw heightened worldwide activity in biological explorations. This interest, no doubt, was fuelled by reports from sailors and others of unique and beautiful animals in other countries. Charles Darwin on his voyage on HMS Beagle (1831-1836) was one of the early biological explorers and collectors (Darwin 1845). Others who also came to the New World were Alfred Russel Wallace and Henry W. Bates, both of whom sailed up the Amazon River in 1848 (Bates 1864). Wallace returned to England four years later but Bates remained collecting for 11 years. He collected 14,712 species of animals of which some 8,000 proved to be new to science. It was the heyday of the morphological taxonomist. Alas! This is a dying breed of scientist.

Collections are of three basic types: specimens are collected for display, teaching and reference. The first two are self-explanatory. Reference collections however, should carry at least the following minimum information:

1. Date (and sometimes time).
2. Place of collection, as accurately as possible.
3. Collector's name.
4. Identification, if known when the specimen was collected.

In the laboratory or museum, if the specimen was not identified at the time of collection, another label can be added carrying the identification information including the name of the person who made the identification. A field label can also be rewritten, but the original field label must always remain with the specimen. One must always be careful of place names. For example, in many museums today there are specimens labelled simply as originating from "Trinidad". Now there are at least five places named Trinidad, and some specimens now in museums, just do not fit with what is known of the fauna of our island. There are other problems as well. In the late 19th century, many colourful bird specimens were collected from South America, sent to Trinidad and then transhipped to Europe for the millinery trade. Many of these trade skins were labelled "Trinidad" as the country of origin even when they were not from the island, causing great confusion (Chapman 1894).

1800-1899

There were not many biological expeditions to Trinidad and Tobago in this period. Ledru visited in 1810 (cited in Thomas 1893) and produced a list of ten species of mammals from Trinidad. However, most of the information on our fauna came from local people who were interested in the environment. They collected and sent the occasional specimen to museums in metropolitan countries, particularly towards the end of the 19th century and mainly to the British Museum (Natural History). This is documented in articles found in The Journal of The Trinidad Field Naturalists' Club (1892-1896 in two volumes). The first effort in trying to present a list of our fauna came from Joseph (1838). His list was compiled from what he had observed or from anecdotes. There is no evidence to suggest that he knew of Ledru's visit in 1810. Although Joseph's list was useful it was certainly not scientific. Later, the noted English author, Charles Kingsley, visited Trinidad and wrote about the natural history of Trinidad, but he did not collect specimens (Kingsley 1871). However, the first systematic collection of animals by a local person, was made by a physician Dr. Jules Francois Court, who produced a catalogue of snakes which was published in de Verteuil's (1858) handbook of the island. Court presented his collection to the Royal Victoria Institute (RVI), now the National Museum and Art Gallery. The RVI was destroyed in a fire in 1920 and all specimens were lost (Mavrogordato 1977).

Between December 1862 and March 1863, E. C. Taylor visited Trinidad and made a collection of 118 species of birds which were probably deposited in the British Museum (Taylor 1864). At about this time, a local resident, Dr. A. Léotaud, was slowly and patiently collecting birds and studying them. He had developed such a reputation for himself, that his book on "The Birds of Trinidad" written in French (Léotaud 1866) was financed through public subscription. He listed 297 species of birds for Trinidad. His specimens too, were deposited in the RVI and lost in the fire of 1920 (Mavrogordato 1977). And yet another small collection of birds was made by O. Finsch (1873), but Chapman (1894) was uncertain that all the specimens were collected in Trinidad.

Fifty six years after the first collection of mammals by Ledru, Dr. D. Huggins in San Fernando sent several specimens of bats to Professor Peters (cited in Thomas 1893) in London from which Peters (1866) listed nine species. Huggins was the first collector of bats on the island. Also, in 1866, a fish collected by R. J.

** Based on a lecture presented on 14 October, 2002 at the 115th Anniversary Celebrations of the National Herbarium of the University of the West Indies, St. Augustine, Trinidad & Tobago.*

Lechmere Guppy, a geologist, in 1859 was described and named *Girardinus guppyi* after Guppy (Gunther 1866). The fish is now known scientifically as *Poecilia reticulata*, but known world-wide as the guppy.

Occasionally collections of specimens were forwarded to the British Museum and listed by Boulenger in a series of catalogues on reptiles (cited in Murphy 1997; Boos 2001).

Mammals were of special interest to Oldfield Thomas of the British Museum and he was interested in receiving specimens from Trinidad. He received a collection of bats from Henry Caracciolo from which he described a new species and named it *Vampyrops caracciolae* (now *Vampyrodes caraccioloi caraccioloi*) after its collector (Thomas 1889). Later, Thomas (1892) received another collection of bats, this time from J. H. Hart who was then Superintendent of the Botanic Gardens. Among this collection was a new species which he named *Artibeus hartii* (now *Enchistenes hartii*) in honour of Hart. These were the main collections from Trinidad up to 1891.

Caracciolo along with R. R. Mole, Alfred Taitt, W. E. Broadway, F. W. Urich, T. I. Potter, G. W. Hewlett and P. L.Guppy co-founded The Trinidad Field Naturalists' Club in 1891. The formation of this Club gave a big boost to the collecting of biological specimens. Thomas (1893) wrote to Club Members encouraging them to send specimens to the British Museum, particularly as he had earlier described two new species of bats. He stated that "there can be no question that every collection made at the present is sure to contain species new to the island, even if not, as in the case of two of the bats I recently received from the island, altogether new to science". Thomas increased the list of bats from nine to 27 species, including the two new to science. Further, he listed another 25 species of mammals in his paper. And in a footnote in his paper he mentioned that "The Trinidad Field Naturalists' Club has kindly offered to receive and forward specimens intended for the Museum."

By 1894, two members of the Club, R. R. Mole and F. W. Urich had collected enough specimens to make "A preliminary list of the reptiles and batrachians of the island of Trinidad". They listed six species of tortoises (*sic*) 25 species of lizards, 33 species of snakes and 12 species of batrachians (amphibians) (Mole and Urich 1894). In the same paper by Mole and Urich (1894), Boettger described a new species of gecko, *Sphaerodactylus molei* (p. 80) and a new species of amphibian *Hylodes urichi* (p. 88) now known as *Eleutherodactylus urichi*. In 1893 and again in 1894 Frank Chapman of the American Museum of Natural History (AMNH) made zoological expeditions to Trinidad. During his trips he met members of the Club as noted in the remarks while describing the advantages in visiting Trinidad ".....and a Naturalists' Field Club whose members, as we know from pleasant experiences, will cordially receive brother naturalists" (Brewster and Chapman 1895). Chapman made extensive collections of birds and mammals. In his first trip he collected 200 mammal specimens which included bats. With J. A. Allen, as senior author they described one new species of bats. In addition, they raised the number of known species of rodents from seven to 19, of which six were described as new (Allen and Chapman 1893). During his second visit in 1894, Chapman collected 323 specimens of mammals. Again with Allen, they added two new species of bats and four new species of rodents including a new species, *Akodon urichi* named after F. W. Urich, Secretary of The Trinidad Field Naturalists' Club. The total mammalian faunal list at that time was given as 65 (Allen and Chapman 1897).

Chapman, during his first visit, made an extensive collection of birds and listed 151 species. His was a thorough study and brought up to date the taxonomy of Trinidadian birds (Chapman 1894). In a second paper he described a new species of *Synallaxis* (Chapman 1895).

Butterflies are colourful and conspicuous invertebrates and like the birds, people are easily drawn to them. E. L. Joseph (1838) could only say that "the variety and beauty of our Butterflies is extraordinary and dazzling". In 1889, W. E. Broadway sent a collection of butterflies to the British Museum and from these W. F. Kirby described a new species, *Tithorea Flavescens*. The species was quite common in the country and known as "sweet oil." A few years later, Dr. W. M. Crowfoot, prepared a list of 199 species based on collections made by another physician, Dr. Bevan Rake, who was a member of the Publications Committee of The Trinidad Field Naturalists' Club, and the Honourable S. H. Gatty (Crowfoot 1892). During a walk from San Juan to Maraval over "The Saddle" H. F. Wilson collected butterflies and forwarded these to W. F. Kirby of the British Museum. Specimens forwarded included moths collected by Lady Broome , wife of the then governor of Trinidad Sir Napier Broome, at her home in St Ann's. He listed 36 species of butterflies and moths (Wilson 1894). Serious systematic collecting of butterflies, however, started in 1896 by William James Kaye's brother, S. J. Kaye, and C. W. Ellacombe. It should be noted that Ellacombe's collection is now in the Natural History Museum (NHM), London - the labels give St. George's as the collection locality, but Trinidad is not mentioned - a lapse that has caused some confusion in the past. (Matthew Cock, pers. comm.). W. J. Kaye (1904) himself visited in 1898 and collected extensively.

Up until 1897, Tobago was administered separately from Trinidad and consequently collections from Tobago went directly to museums abroad. These collections, made by James Kirk and reported by Jardine (1846, 1847) included birds. Later, in 1883, other collections of birds were made by W. W. Brown and reported by Cory in 1893. A collection made and reported by de Dalmas (1900) was sent to France and according to ffrench (pers. comm.) is virtually "lost." A Mr. Albrecht Seitz made a collection of four snakes and one toad from Tobago and these were reported by Boettger (1894) in our Club's Journal.

1900-1949

Kaye visited and collected again in 1901, and in 1920 at the invitation of Sir Norman Lamont, who had collected butterflies extensively in south Trinidad. Kaye (1921), in his monograph "A Catalogue of the Trinidad Lepidoptera Rhopalocera (Butterflies)," listed 462 species and stated that "At last we can claim to know pretty well what butterflies are to be found in the island". Yet, in 1940 when he reviewed other collections, the most prominent of which were those made by Robert Dick, F. W. Jackson, and A. Hall in the 1920's and 1930's, the list went up to 582 species (Kaye 1940). Matthew Cock (pers. comm.) stated that the Lamont Collection is divided fairly evenly between the University of the West Indies (UWI), St. Augustine and the NHM (Edinburgh). Kaye had a personal collection, but some specimens are in the NHM and some are probably housed at the British Museum. Kaye's personal collection was sold after his death and is now in the Allyn Museum of Entomology, Sarasota, Florida. Cock further noted that Robert Dick's collection is incorporated into the Malcolm Barcant

collection; F. W. Jackson's is divided between the Oxford University Museum, UK, and the NHM, London; Arthur Hall's collection is in the Booth Museum, Brighton, UK, although many specimens are in the NHM.

In addition to butterflies, Kaye also collected moths and listed 242 species (Kaye 1901). F. Birch made an important collection at Caparo in 1904. S. M. Klages also collected many specimens at Caparo, October 1905-March 1906; this material is considerably more extensive, at least for smaller species, than that collected by either Kaye or Lamont. These specimens were incorporated into Lord Rothschild Museum at Tring, UK, and subsequently incorporated into the NHM when the two collections were amalgamated. It would appear that Kaye never saw these collections. Together with Lamont they published a list of 1016 moths (Kaye and Lamont 1927).

The establishment of the Imperial College of Tropical Agriculture (ICTA) was another boost to the collecting of animals in Trinidad and Tobago. Since ICTA was devoted to studies on agriculture in the tropics, many of the animal species collected were insects of agricultural importance. These collections are now housed at UWI, the successor to ICTA. Apart from ICTA, the West Indian Station of the Commonwealth International Institute of Biological Control (CIBC), was established in 1946 at ICTA, and subsequently in its own buildings at Curepe. The staff of this Station made extensive collections of insects, particularly those dealing with biological control notably coccinellid beetles and parasitic flies and wasps. The Commonwealth Agricultural Bureaux International (CABI) Bioscience, the successor to CIBC, now maintains a collection of over 40,000 insect specimens. The majority of these neotropical specimens are from Trinidad.

Between 1900 and 1949, there were a few collections of vertebrates. It would appear that R. J. Lechmere's son, Plantagenet L. Guppy, also became interested in freshwater fish for he made a collection which was the object of a study by Regan (1906) who recorded 41 species of freshwater and brackish water fish. Guppy (1910) produced another list and included three species from Tobago. Under the auspices of the Barber Asphalt Company, a collection of fish was made by L. Wehekind which was reported by Fowler (1931).

The amphibia was collected by Kugler, was studied by J. Roux (1926) who listed 14 species. And one year later Lutz (1927), a Brazilian also collected 14 species. Through extensive collecting by F. W. Urich and D. Vesey-Fitzgerald, Parker (1933, 1934) of the British Museum, was able to study and update the list and provided a key to 24 species, one of which was new and was named *Gastrotheca fitzgeraldi* (now *Nototheca fitzgeraldi*) after FitzGerald. Parker's work was the most complete study of the amphibians up to that time.

Although Vesey-Fitzgerald (1936) did not collect bats, he listed 34 species in his paper on "Trinidad Mammals." Around this time too, between 1936 and 1938, I. T. Sanderson made his trip to the Caribbean and collected some mammal specimens from Trinidad and elsewhere in the Caribbean for the British Museum (Natural History). These specimens were studied by Laurie (1953), but nothing new was added to the known mammalian fauna of Trinidad.

Small collections of birds in this period were made by Cherrie (1906, 1908) from the Heights of Aripo. Around this time other collections were made by Andre and Dr. P. Rendall, reported by Hellmayr (1906) while collections by Carriker (1909) went to the Carnegie Museum. Williams (1922) studied the food and habits of Trinidadian birds and shot some to study their stomach contents. Skins were prepared from some of these birds, but he did not state if he had placed them in a museum. Likewise, Vesey-Fitzgerald (1936) further noted the food habits of birds particularly those found in the cane fields, but again of those he collected he did not state where his specimens were deposited. In 1931, R. Roberts, W. Wedgwood Bowen and George R. Clarke collected 734 bird specimens for the Academy of Natural Sciences in Philadelphia from which 167 species were listed (Roberts 1934). Belcher and Smooker (1934-1937) made important collections of birds' eggs and recorded their studies of nidification in a series of papers.

1950-2000

The avifauna, as expected, received a lot of attention in this period. Suddenly, between 1950 and 1956, five individuals interested in the study of birds arrived in Trinidad. In 1950-51 Plowden-Wardlaw collected extensively, swamp and savannah, species for the Peabody Museum at Yale University. Unfortunately, the data on the collections were not published. Then G. F. Mees, from Holland, visited from June 1953 to February 1954 for the sole purpose of collecting bird specimens for the Rijksmuseum in Leiden . He collected 835 specimens representing 178 species from Trinidad and 100 bird specimens from Tobago. These collections as well as specimens from other museums were studied by Junge and formed the basis for a paper by Junge and Mees (1958) titled "The Avifauna of Trinidad and Tobago". They reported 344 species in Trinidad and 144 species in Tobago. They also described a new subspecies *(Pipra erthrocephala flavissima*) and added six new forms to the list of birds of Trinidad and Tobago.

About the same time as Mees, Dr. G. A. C. Herklots arrived in Trinidad to take up an appointment as Principal of the ICTA. He noted that within 100 days he had identified 100 species of birds (Herklots 1961). He eventually wrote a book "The Birds of Trinidad and Tobago", but his descriptions were based on his field notes and from shot birds. However, he did not indicate where he had deposited his specimens, so these are, unfortunately, not available for further study, which is the rationale for depositing specimens in a museum.

In November, 1952, eight months prior to the arrival of Herklots, Dr. Wilbur G. Downs, who was also interested in birds arrived in the country to establish The Trinidad Regional Virus Laboratory (TRVL) and to study insect, tick and mite-transmitted viruses. Many of the viruses were known to have wild vertebrates as hosts, and birds were an important group in this study. By 1955, when the laboratory was running smoothly, he turned his attention to birds. He collected initially, by shooting and then by the use of mist nets. Downs amassed a large collection of bird specimens which is now housed in the museum at The Caribbean Epidemiology Centre (CAREC), successor to the TRVL (ffrench 1980; Tikasingh 2000). The CAREC bird collection seems to be the only one that is properly housed and maintained and available for reference in Trinidad and Tobago.

Richard ffrench was the last of the quintet to arrive in Trinidad. He visited in 1956 and then took up residence in 1958 in order to teach English, Latin, History and Music at St. Peter's School, Pointe-a-Pierre. ffrench studied bird life extensively in the field and with the help of previous studies and examination of the museum specimens at CAREC and abroad, he produced his book

"A Guide to the Birds of Trinidad and Tobago" which was later revised (ffrench 1980). In his second edition (1991) he lists 433 species for Trinidad and Tobago: 411 species from Trinidad and 210 from Tobago, of which some are dubious. Later he produced a checklist of 416 species for Trinidad (ffrench 1996a) and 224 species for Tobago (ffrench 1996b). His book is now standard reference and suggests that the resident avifauna of Trinidad and Tobago is well known. Thus, the chance of seeing a new resident species would be extremely low. Nevertheless, we have the Trinidad and Tobago Rare Bird Committee which receives reports of unusual sightings, analyzes them for credibility and produces occasional reports in the Club's Journal.

The next large collection of vertebrates made during this period was of mammals and this was made by Dr. Downs and his group at TRVL. It seemed that their intention was to catch anything that moved. They also collected some things that did not move, like plants. Their collection of plants, properly mounted and documented, was subsequently donated to the National Herbarium at UWI. From some of the mammals collected, skins were prepared and sent to the AMNH for identifications. The Museum subsequently sent back some of the specimens for reference purposes and included some specimens collected by Chapman in the 1890's. These specimens are now housed at the CAREC Museum. It is interesting to note that although CAREC collected mammals from many parts of Trinidad and from different habitats, they were able to add only one subspecies to Chapman's list.

Here I will give one example as to why it is essential to have well-preserved and documented specimens. While working on Soldado Rock, staff members of TRVL, Thomas H. G. Aitken and Elisha Tikasingh, caught a rat that was tentatively identified as the cane rat, *Zygodontomys brevicauda brevicauda*. The rat did not look like a typical *Z. brevicauda brevicauda* and the specimen was sent to the AMNH where Goodwin compared it with their specimens and concluded that it was a new subspecies. He named it *Z. brevicauda soldadoensis* (Goodwin 1965).

Earlier, Goodwin (1962), described two new subspecies of rodents (the spiny rat *Echimys armatus handleyi* and the grass mouse *Akodon urichi tobagoensis*) as well as *Zygodontomys brevicauda tobagi* from Tobago.

Although some bats were collected earlier, systematic collecting of this group of mammals did not start until the arrival of Arthur M. Greenhall in 1953. He was appointed Government Zoologist, Curator of the Emperor Valley Zoo, Curator of the RVI and Consultant to TRVL. As zoologist of the bat catching programme in the Government's anti-rabies drive, he visited all parts of Trinidad and Tobago collecting bats. Greenhall (1956) in his preliminary paper on "Bats of Trinidad" listed 52 species. His collection was submitted to the AMNH where G. Goodwin studied the specimens. Goodwin and Greenhall (1961) wrote a comprehensive monograph on the bats of Trinidad and Tobago. They described 58 varieties of bats and they carefully noted the point that 27% "(16) of the 58, were described originally from so small an area as Trinidad" and they went on to state that "With more intensive and improved collecting techniques there will be additional records and possibly new forms, especially among the rarer solitary tree or free-living bats." One year later, these authors described two new bats in the Genus *Mesophylla* (Goodwin and Greenhall 1962) and later, Carter *et al.* (1981) updated Goodwin and Greenhall's monograph and listed an additional four species. Voucher specimens from the Goodwin and Greenhall study were returned to TRVL and the Veterinary Public Health Unit. The species count of mammals now stands at 64 bats and 40 other terrestrial species (Goodwin and Greenhall 1961; Goodwin and Greenhall 1962; Alkins 1979; Boos 1986; Tikasingh 1991).

Professor Julian Kenny made an extensive collection of amphibians during the period 1955-1961 and 1963-1965 and reported 25 species in his monograph (1969). His specimens were deposited at the Royal Ontario Museum. More recently, at various times between 1982 and 1994, John Murphy has visited the twin islands and made extensive collections of our herpetofauna. His collections were deposited in the Field Museum of Natural History (Chicago). Murphy (1997) made a thorough study of the group and listed 128 species, of which 36 were amphibian and 45 snake species.

The remaining group of vertebrates studied during this period was the freshwater fishes. Although the guppy became internationally known, it is surprising that a more thorough study of this group was not undertaken until the 1950's. Then, Jack Price (1955) conducted a survey and identified 51 species which included ten new records for Trinidad. Later Walter King-Webster and J. Kenny also conducted surveys of the freshwater fish. These collections were deposited in the Rijksmuseum of Leiden and studied by Boeseman (1960). In addition, Kenny (1995) also studied these collections and listed 46 species in his Memoir which have been described by Phillip and Ramnarine (2001).

With reference to the invertebrates, two groups received extensive attention during this period - the Lepidoptera (butterflies and moths) and arthropods of medical and veterinary importance. Malcolm Barcant started collecting butterflies shortly after Kaye published his monograph in 1921. Eventually, Barcant (1970) listed 605 species in his book which included 229 species of skipper butterflies. Earlier, Robert Dick had died in 1943 and his collection went to his nephew Percy Rodriguez. On Rodriguez's death in 1961, Barcant acquired the collection. Barcant as well as Dick's collections are now owned by Angostura Holdings and held at their Laventille facilities. Then in the early 1980's, Floyd Preston, who was on an attachment at the Faculty of Engineering, U.W.I. made extensive collections of the Lepidoptera. Preston's collections were personal, but he left a selection of duplicates at CABI Bioscience Museum at Curepe. Matthew Cock who was attached to CABI Bioscience, has been studying the Lepidoptera, particularly the skipper butterflies (Hesperiidae) of Trinidad and Tobago since 1981. In a series of articles in "Living World, Journal of the Trinidad and Tobago Field Naturalists' Club", he listed 272 species for Trinidad and Tobago (see Cock 2003b for a list of references) based on his own collections or those made by others. Cock has also made a collection of moths. He lists 2,275 species of moths for Trinidad and 259 species recorded in Tobago. He estimates the species of moths to be 3,500 for Trinidad and 640 for Tobago (Cock 2003). Cock's specimens are lodged at CABI Bioscience at Curepe, Natural History Museum (London) and in his personal collection.

Arthropods of medical importance, particularly the diptera received a great deal of attention with the establishment of the TRVL. When malaria was a problem in Trinidad and Tobago, it was quickly learnt that there were 11 species of *Anopheles.* But the rest of the mosquito fauna was practically unknown. It took the staff of TRVL, particularly Dr. T. H. G. Aitken, to painstakingly collect and identify the species of mosquitoes present in the country.

I can report that there are 160 species plus or minus. I say "plus or minus", because there are some species we collected and have not been able to identify. Aitken, who was the prime collector, merely gave these unknown specimens numbers so that he and his staff were able to work with them. The numbering system for the unknowns reached 28, but some of these have now been identified. Here is a job for a graduate student interested in taxonomy to complete the task.

Staff of TRVL also collected and have a fair idea of the other arthropods of medical and veterinary importance, as some 300 to 400 species have been collected. These collections, including some paratypes (specimens other than the type specimen which were examined by an author when the original description was made and so designated by him) are housed in the CAREC's museum.

CONCLUSION

What we can conclude from these historical data is: that for a country as small as Trinidad and Tobago, our fauna may be considered rich and varied; that the vertebrate fauna and certain groups of arthropods are fairly well known; that more taxonomic work is needed for some invertebrate groups; and that we have a fair amount of collected material which is scattered in many institutions.

It should be noted that most of the collected material went to museums in metropolitan countries. Even local scientists sent their specimens to foreign institutions and this was probably due to the fact that the few local institutions which cater for collections are not well funded nor have adequate staff and hence curators have a difficult time in maintaining their collections. In any proposal for a Biodiversity Centre, it is essential that supporting technical staff should be well-trained in the art of collecting, preserving and maintaining specimens.

Prof. Kenny, in an unpublished paper titled "Proposal for a National Information Centre for Biological Diversity", noted that "our terrestrial fauna is roughly estimated to number something in excess of 10,000, the bulk of this being arthropods, particularly insects and spiders". He further noted that "the volume of material both in the form of preserved specimens and publications is now so considerable that it is necessary to consider means of putting it into some order, making access more readily available to the planning process, and to determine further needs". I heartily endorse his view.

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Appendix

Significant Collections of Zoological Specimens of Trinidad and Tobago in Local and Overseas' Museums: A Preliminary Listing.

Trinidad and Tobago

(Some of the collections are uneven in form, size and may lack full collecting data).

1. **Angostura Ltd.,** Laventille.
   Butterflies - Malcolm Barcant.

2. **CAB International Bioscience** (formerly **Commonwealth Institute of Biological Control**), Gordon St., Curepe.
   Insects, mainly include pest species and biological control agents - Collections by staff.
   Termites - J. P. E. C. Darlington.

3. **Caribbean Epidemiology Centre** (formerly **Trinidad Regional Virus Laboratory**), Federation Park.
   Bird skins.
   Mammal skins and bats preserved in spirits.
   Snakes, lizards, frogs.
   Arthropod specimens of medical and veterinary importance, including the following: scorpions, spiders, bed bugs, assassin reduviid bugs, sucking lice (pediculids), biting lice (mallophagans), black flies (simuliids) *Culicoides* sand flies, *Lutzomyia* sand flies, mosquitoes, horse flies (tabanids), louse flies (hippoboscids), biting bat flies (nycteribiids and streblids), house fly and its allies, stable flies, flesh and blow flies, bot flies, mites including chiggers and nasal mites of birds, ticks, fleas - Collections by staff members, particularly T. H. G. Aitken, W. G. Downs, and E. S. Tikasingh.

4. **Coast Guard Museum,** Chaguaramas.
   Fish - Collections by staff.
   Marine invertebrates - Collections by staff.

5. **Fisheries Division, Ministry of Agriculture, Lands and Marine Resources.**
   Marine fishes - Collections by staff.
   Some invertebrate material - Collections by staff.

6. **Institute of Marine Affairs,** Chaguaramas.
   Marine invertebrates - Collections by staff.

7. **Pointe-a-Pierre Wildfowl Trust,** Pointe-a-Pierre.
   Molluscs - Peter Perchade.

8. **University of the West Indies,** Department of Life Sciences, St. Augustine.
   Insects, general - Adamson, and others.
   Aquatic hemiptera, trichoptera and other invertebrate - Mary Alkins-Koo.
   Cirripedes, molluscs, plankton, turtles - Peter Bacon.
   Trinidad fossils - Kennedy.
   Scleractinian corals - Julian Kenny.
   Freshwater fishes - J. L. Price, Webster-King, J., Kenny, D. Phillip.
   Marine fish and invertebrates - MV Oregon.
   Marine invertebrates - MV Discoverer.
   Butterflies and moths - Sir N. Lamont.
   Brachyuran crabs - Stonley.
   Sphingid moths - Stradling and Bennett.
   Freshwater fishes - J. L. Price, Webster-King, J. Kenny.
   Octocorals - D. Ramsaroop.
   Marine molluscs - Texaco collection.
   Caribbean reptiles - G. Underwood.
   Bats - Various collectors and Clarke.
   Reptiles - Various collectors.
   Amphibia - Various collectors.
   Marines fishes - Various collectors.
   Echinodermata - Various collectors.
   Mollusca - Sybil Atteck, Adamson, Bacon, Ash and various collectors.
   Fresh water decapods - W. Rostant.

Overseas' Museums

Canada

Royal Ontario Museum, Toronto, Canada.
Amphibians - J. Kenny.

Germany

Berlin
Reptiles?
Museum der Senckenbergischen Naturforschenden, Frankfurt am Main
Reptiles - Albrecht Seitz

Holland

Institute of Taxonomic Zoology, Univ. Amsterdam, Amsterdam.
Trichoptera - L. Botosaneanu.
Rikjsmuseum**.** Leiden.
Freshwater fishes - J. L. Price, King-Webster, J. Kenny.
Birds - G. F. Mees.
Thiel, Amsterdam
Aquatic and semi-aquatic hemiptera - N. Nieser, pers. coll.

United Kingdom

Booth Museum, Brighton.
Butterflies and moths - Arthur Hall.
Natural History Museum, London, (formerly **British Museum (Natural History),** London.
(There are probably far more specimens of various grouping deposited in this museum than are listed here).

Birds - E. C. Taylor.
Reptiles
Mammals
Butterflies and moths - F. W. Jackson, S. M. Klages, J. H. Hart, H. Caaracciolo, Dr. Rendall, W. J. Kate, F. Birch, Sir N. Lamont, C. L. Withycombe, F. W. Urich, F. D. Bennett and others.
National Museums, Edinburgh, Glasgow. (Formerly **Royal Scottish Museum)**.
Butterflies and moths - Sir N. Lamont, F. W. Jackson and A. Hall.
Oxford University Museum, Oxford.
Butterflies, moths - F. W. Jackson, and others.

U. S. A.

Academy of Natural Sciences, Philadelphia.
Birds - R. Roberts.
Fishes
Allyn Museum of Entomology, Sarasota, Florida.
Butterflies and moths - Kaye's personal coll.
American Museum of Natural History, New York.
Termites - A. M. Adamson.
Mammals, including bats - F. Chapman.
Bats - A. Greenhall.
Birds - André, F. Chapman.
Brooklyn Museum, New York.
Birds
Carnegie Museum, Pittsburgh.
Birds - Carriker.
Field Museum, Chicago.
Frogs, toads, lizards, snakes - J. C. Murphy.
Geological Museum, Cornell University, Ithaca.
Ahermatypic corals - J. Kenny.
Museum of Comparative Zoology, Cambridge.
Reptiles
Museum of Texas Technological University, Lubbock.
Bats - R. J. Baker, C. H. Carter.
National Museum of Natural History (Smithsonian Inst.), Washington, D.C.
Mosquitoes - Belkin Collection.
Trichoptera - O. Flint.
Yale Peabody Museum, New Haven.
Birds - Plowden-Wardlaw.
University of Florida, Fort Lauderdale.
Termites - R. H. Scheffrahn.

Note: *This is an incomplete listing of significant collections of Trinidad and Tobago's fauna in museums. In order to improve the list, I welcome comments on it with the possibility that an updated list can be published in a future issue of our Journal.*

NATURE NOTE

Problems to be Solved in Trinidad and Tobago's Ornithology.

a. Are there still any quail-doves living on Tobago?

b. Find a nest of either Gray-rumped or Band-rumped Swift on Trinidad.

c. What is the status of the Purple Honeycreeper on Tobago?

d. Keep a look-out (and listen!) for Scarlet-shouldered Parrotlet on Trinidad.

e. Find out **anything** about Striped Owl on Tobago.

f. Check for nesting records on Trinidad of Neotropic Cormorant.

g. Find nests of **any** crake, especially Yellow-breasted or Ash-throated.

h. Find conclusive evidence of **nesting** Rufous Nightjar or Yellow Warbler on Tobago.

i. Separate (and record) the calls/songs of the four or five *Myiarchus* flycatchers that occur on Trinidad and Tobago (and Bocas islands).

j. Survey the bird populations of the summits of El Tucuche and Cerro del Aripo.

Richard ffrench
Toftingal
Laurieston Rd., Gatehouse of Fleet
Scotland, DG7 2BE
E-mail: *Richardffrench@aol.com*

Annotated List of Spider Families (Araneida) of Trinidad and Tobago

Jo-Anne Nina Sewlal[1] and Bruce Cutler[2]
1. Department of Life Sciences,
University of the West Indies, St. Augustine, Trinidad and Tobago.
E-mail: *jo-annesewlal@tstt.net.tt*
2. Department of Ecology and Evolutionary Biology,
University of Kansas, Lawrence, Kansas 66045 USA.
E-mail: *bcutler@ku.edu*

ABSTRACT
The spider families of the neotropical islands of Trinidad and Tobago are reviewed. Forty one families are definitely recorded, while an additional 12 families are considered as likely, based on their presence in the nearby South American mainland. Biological and recognition characters are noted for most of the families.

INTRODUCTION

The Araneida, or spiders, are an order within the class Arachnida (arachnids), and number about 38,000 known species. They are diverse, adaptable and found on all the continents except Antarctica.

There are two suborders of spiders, Mesothelae and Opistothelae. The first is a small group found only in southeast Asia. The Opistothelae are further divided into two infraorders, Mygalomorphae and Araneomorphae. The most obvious distinction between these two is the orientation of the chelicerae, or jaws. Mygalomorphs have the chelicerae oriented so that the fangs are parallel to each other. Whereas the Araneomorphs, which make up the great bulk of spider species worldwide, have the chelicerae oriented so that the fangs oppose each other.

The popular image of a spider is an orb weaver sitting in the middle of its web waiting for prey to fly into the snare. But this only applies to a very few families. The tangled webs of some other spiders are much less ornate. Moreover, there are many spiders that do not call a web home or rely on it to catch prey. Members of the families Salticidae and Lycosidae use strength and speed to catch food. Some mygalomorphs, for example Theraphosidae, construct burrows, while some build silken retreats in leaf litter or in crevices of rocks. Most species of spiders are solitary. However, there are about 25 known social species, in several families, for instance *Anelosimus eximus* (Keyserling) which is found in Trinidad and Tobago.

This list aims to act as a guide to the distinguishing features, with some natural history notes, of the spider families found in Trinidad and Tobago. The intention of this paper is to act as an introductory guide and to provide some insight to the little known spider fauna of Trinidad and Tobago. Family determinations often require the examination of structures that are only visible with considerable magnification, consequently this paper is not intended to serve for family identification. A few families (Salticidae) have very obvious characteristics so that they can be determined easily. Family descriptions are based on the literature, and presence in Trinidad and Tobago in some cases confirmed by consulting a catalogue of species names (Platnick 2002). The inclusion of some families in this list is tentative since no specimens confirming their presence have been collected in this country. The assumption that these families are present is based on the fact that Trinidad and Tobago was separated from South America. Therefore the biota North of the Amazon and East of the Andes would be similar to that found in Trinidad and Tobago.

The worldwide spider fauna is still incompletely known. Furthermore, the scientific literature is very scattered, and new species can be found even with the most cursory surveys. Despite these problems there is fair taxonomic literature. As an example, the numerous papers of Levi that revised the taxonomy of the Araneidae, Tetragnathidae and Theridiidae include many examples of Trinidad and Tobago species. There is one recent publication that presents a key to the families of the neotropical country, Panama (Nentwig 1993). This key works fairly well for the spiders of Trinidad and Tobago. The hosting of the 23rd annual meeting of the American Arachnology Society in Trinidad and Tobago, in 1999, encouraged collecting efforts and further research on Trinidad and Tobago spiders. A good inexpensive field guide is Levi and Levi (1968). It should be used with the awareness that many spiders will be found which cannot be accurately determined. Body lengths in the family descriptions refer to adults: minute <3mm; small 3-6 mm; medium 6 - 12 mm; large 12 - 25 mm; very large >25 mm. A 10X hand lens is usually sufficient to view most features, whereas claws and some other features require a microscope of at least 40X magnification.

FAMILY DESCRIPTIONS

Families marked with asterisks have not been recorded from Trinidad and Tobago but have been recorded from biotically similar areas of the northern South American mainland, so that it is expected that at least some of them occur here. All species named in the text, unless specifically stated are found in Trinidad and Tobago.

MYGALOMORPHAE

Actinopodidae (mouse spiders) - Large with a glossy carapace with a high and broad cephalic region and very large, bulbous jaws. Eyes are widespread across the front of the head. Spinnerets short and blunt. They live in burrows, often made in the banks of rivers, creeks and other waterways. These burrows can have single or double trapdoors and an oval entrance.

***Barychelidae** - Large, two clawed with claw tufts, short

maxillary lobe or lobe absent. Burrowing spiders although the burrows are very variable in structure. Some are simple silk retreats others more elaborate with trapdoors.

***Ctenizidae** - Large, very robust, with a distinct dorsal excavation on third tibia. The classic trapdoor spiders, build vertical burrows with a well hinged thick door resembling a short cork.

Cyrtaucheniidae - Large, eyes in a central group near anterior edge of carapace, spinnerets long. Construct silk-lined burrows often beneath stones or fallen timber.

Dipluridae - Minute to very large, easily recognizable by their long spinnerets which may be more than half the length of the abdomen. These spiders are web builders and entangle their prey in a sheet of silk, with the spider hiding in a tube in one corner of the sheet. This tube may be positioned among rock crevices, wood or at the base of a tree. The thick webs of *Ischnothele caudata* (Ausserer) are a common sight on rock walls and poorly maintained structures. Females of this species care for their young after hatching by providing food.

***Idiopidae** - Large, either anterior lateral eyes set well in advance of other eyes or eye group occupying more than half the carapace width. Build trapdoor burrows of various types.

***Microstigmatidae** - Minute to small, booklung covers small and round, scaly cuticle, two spinnerets. Natural history details not known, probably cryptic in leaf litter and on the ground.

***Paratropididae** - Medium to large, scaly cuticle, abdomen with strong coarse setae. Body normally soil encrusted. Natural history poorly known, cryptic in ground litter.

Theraphosidae (tarantulas, bird spiders) - These are the largest of all spiders, with claw tufts and a distinct maxillary lobe, possess a heavy coat of hair on all parts of their body, eyes are closely grouped together. The females lay 40 to 500 eggs depending on the species (West 1983). Many theraphosids live on the ground, some live in trees while others burrow. As their common name suggests they prey occasionally on nestling birds, lizards or small snakes, but mainly on arthropods. A common member of this family is *Avicularia avicularia* (Linnaeus) also known as "pinktoes", because each of its legs has a prominent pink tip against the general black colouration in adults. These arboreal spiders live in large silken tubes (West 1983) commonly found in trees, low plants, lightpoles and buildings, and are often kept as pets due to their docile nature but caging more than one together is not advised. This species is quite widespread with collections being made in Chacachacare, Monos Island, Maracas, as well as Talparo, and Rio Claro (West 1983).

ARANEOMORPHAE

Agelenidae (funnel weavers) - Medium to large, have long posterior spinnerets. They have three leg claws and lack a cribellum. Some make flat funnel-shaped webs on grass, with the spider hiding at the narrow end of the funnel. The spider picks up the vibration of a prey on the web, attacks it, bites it and carries it back to the funnel.

***Amaurobiidae** - Small to medium, cribellate spiders, pale eyes in two rows. Almost nothing is known about the biology of neotropical amaurobiids. If they occupy similar habitats as those in the northern hemisphere they will be found under debris and rocks in moist forest habitats, with an irregular web of thick, non-adhesive cribellate silk produced by the cribellum and used to ensnare flying prey.

Anapidae - Minute, usually armour-plated spiders. The pedipalps of the females have been lost. They build modified sticky silk orb webs. Most species live in leaf litter and low, moist vegetation.

Anyphaenidae - Medium, similar to clubionids in size and colour, but have tracheal opening well forward of the anterior spinnerets. Active hunters that forage on vegetation, leaf litter and trees. They also construct silken retreats on the undersides of leaves.

Araneidae (orb-web spiders) - Small to very large, identified by their characteristic orb webs, where they are often found in the centre. The structure of the web consists of a lattice of silken threads held together with spiral threads coated with sticky webbing, used to catch prey. A few genera do not spin orb webs. They are sedentary predators waiting in webs which intercept flying, and jumping prey. Once caught the prey is immobilised by wrapping in silk and killed with a bite. There are diurnal and nocturnal species. The diurnal groups continually repair their webs. A conspicuous example of a diurnal species is *Argiope argentata* (Fabricius), whose web is identified by heavy zigzag bands of silk which make an x-shaped mark in the centre of the web. The nocturnal groups construct a new web every night, consuming the old web as a valuable source of protein.

Caponiidae - Small to medium, majority have only the anterior median (front central) pair of eyes, rarely some have eight in one group. Their oval abdomen lacks book lungs but has four tracheal slits. Usually with characteristic colouration, carapace and legs orange, abdomen bluish grey. Found in leaf litter, under stones and in low vegetation. They are active hunters that rely on strength and speed to subdue their prey, believed to feed primarily on other spiders, some may feed on termites.

Clubionidae (sac spiders) - Medium, resemble gnaphosids but have a less flattened abdomen, longer legs and closely spaced, conical front spinnerets. Eyes are uniform in size and are arranged in two rows of four. The first and fourth pairs of legs are the longest and are almost equal in length. Construct a resting tube in a rolled leaf, or under bark or stones, and do not use webs to trap their prey. Nocturnal in activity.

Corinnidae - Medium to large, legs are relatively long and slender, possess two leg claws. Most live in leaf litter or on the dry bark of trees, some in vegetation. Many species resemble ants and multillid wasps.

Ctenidae (wandering spiders, tropical wolf spiders) - Medium to very large, the largest araneomorph spiders belong to this family. Eye arrangement is diagnostic with two rows of eyes. The top row consists of four large eyes, two closely spaced in front and one on either side of the face. The same arrangement is mirrored with a bottom row of four smaller eyes. Possess two to three leg claws. Fast terrestrial and arboreal hunters, nocturnal, do not make webs and rely on speed and strength to capture prey.

Deinopidae (net-casting spiders) - Medium to large, cryptically coloured in grays and browns. There are three main genera. Our genus, *Deinopis* (Ogre Face Spiders), so called because of their pair of huge posterior median (back central) eyes. These spiders live on vegetation and hide during the day with their legs stretched like some tetragnathids to resemble sticks. At night they hunt by building a highly modified cribellate orb web that comprises of a small, expandable square which it holds in its first and second pairs of legs. This is then flung over prey as one would cast a net.

***Dictynidae** - Small to medium, cribellate or ecribellate

spiders. The genera likely to be found in Trinidad and Tobago build small space webs with dense cribellate silk. They are found on vegetation often in drier habitats.

***Drymusidae** - Medium, resemble *Loxosceles*, but with longer and more slender three clawed legs. Found in forested areas where they make tube or sheet webs under fallen tree branches and rocks.

Gnaphosidae - Small to large, the long abdomen is slightly flattened and the front spinnerets are cylindrical and separated. Legs have only two claws. They have posterior median oval eyes at an angle and the endites are concave and slightly constricted in the middle. Mostly nocturnal hunters, rest in the daytime under stones or loose bark. The egg sac is a papery disc usually attached to the underside of a stone. Guarded by the female in some species.

***Hersiliidae** - Medium to large, three clawed very flat spiders with extremely long, tapering posterior spinnerets. On tree trunks, move rapidly towards prey, turn so spinnerets face and enswathe prey with silk bands affixing it to substrate.

Linyphiidae - Minute to small, have at least femoral spines. They construct sheet webs amongst vegetation or across indentations in the ground and hang beneath them waiting for prey. Other members of this family live in leaf litter.

Lycosidae (wolf spiders) - Small to large, have a row of four small eyes below four larger eyes, and three tarsal claws. Legs are moderately long and robust. Commonly found running on the ground or over stones. Some dig short tunnels or deep burrows. A few build agelenid like sheet webs. Some genera are diurnal and others nocturnal. Males wave their pedipalps in a rhythmic pattern when approaching potential mates. Female attaches the egg sac to her spinnerets and as the young spiderlings emerge she allows them to climb on her back.

Mimetidae (pirate spiders) - Small to medium, are easily recognised by a row of strongly, curved setae on the front margins of the lower segments of the first pair of legs. As their name suggests, they invade the webs of other spiders. Slow moving spiders that prey on the web owners, while some sit with outstretched legs under leaves and ambush passing spiders. A species has been observed to pluck the prey's web like a courting male to gain entrance.

Miturgidae - Medium, first pair of legs is longer than the fourth and used for detecting and capturing prey. Fast, aggressive, free ranging nocturnal hunters. Construct silk-like retreats in curled leaves. In some agricultural settings they have been reported to be important insect pest control agents.

Mysmenidae - Minute, males with a large spur on the metatarsus, females with a sclerotised subdistal, ventral spot on first femur. Most build highly modified sticky silk orb webs, some with 3-dimensional orbs, while other species of this family are known to build small irregular webs. Most live in dark moist places in leaf litter and low vegetation.

Nesticidae (cave spiders) - Small to medium, fourth leg has a comb on its last segment. Similar to theridiids, rear margin of cheliceral fang furrow, that is, the groove in which the fang lies when at rest (Gertsch 1979), with many denticles. Occupy moist caves and cellars thus their common name. Make an irregular cobweb, female carries her egg sac attached to her spinnerets. Subdue prey by flinging large globs of sticky silk with the comb on the fourth tarsus.

Ochyroceratidae - Minute to small pale spiders very similar to pholcids. Often have a mottled purple coloration. Live in leaf litter where they construct spacewebs.

Oecobiidae - Minute with a cribellum and a large, hairy anal tubercle. Make small, flat webs over crevices in walls and on leaves. Some feed on ants, and some species are known to be social.

Oonopidae - Minute, short-legged with six tiny eyes closely grouped on the front of the carapace. Many have orange plates on the abdomen. Live under stones or in leaf litter, and can run rapidly. Nocturnal hunting predators.

Oxyopidae - Small to large, possess six large eyes in a hexagon arrangement with two Smaller ones below. Their legs are three clawed, covered with many long, strong setae. The abdomen is pointed behind. Diurnal hunting spiders that chase their prey over vegetation or lie in wait and ambush them. Use their silk as draglines for jumping and for anchoring the egg sac to vegetation, not for catching prey. Some species rest at night suspended from a dragline.

Palpimanidae - Small to medium, eight-eyed spiders that resemble zodariids but only have two visible spinnerets. First pair of legs is much thicker than the rest, elevated when walking, have modified setae on the inner surface which may aid in holding prey in place. Sternum surrounds the first segments (coxae) of the legs. Biology poorly known. A few make irregular webs under stones and debris. Others are slow moving terrestrial and arboreal predators of other spiders.

Philodromidae - Small to medium, laterigrade legs, legs I, III, IV subequal in length, leg II longer than the others. Active, very fast runners, most hunt on vegetation, some on ground.

Pholcidae (daddy long leg spiders, cellar spiders) - Minute to large, fragile appearing spiders with very thin legs that are usually many times the body length. Their eyes are always close together. This appears to be true for native Trinidad and Tobago species, however, pholcids from other areas may have eyes that are arranged in two triads. Based on the accounts of the most researched pholcid species *Pholcus phalangioides* (Fuesslin) which is cosmopolitan in temperate regions, many general texts state that pholcids make a messy, irregular tangled web, that is non-adhesive. However the irregular mesh of web lines over which the spider moves easily impedes insects and makes escape difficult. After which the spider quickly wraps its prey in silk and inflicts a fatal bite. These webs are found in caves, under rocks and loose bark, abandoned animal burrows and undisturbed areas in buildings and cellars, hence its other common name, cellar spiders. Tropical species, however, show a diversity of web forms (Eberhard 1992), for example *Mesabolivar aurantiacus* which constructs a domed aerial sheet (Sewlal, unpublished observations). Huber (2000) records six species (in the genera *Canaima*, *Coryssocnemis*, *Mecolesthus* and *Mesabolivar*), and has found one additional genus, *Priscula*, in buildings. An example of a common species found in this country is the red pholcid, *M. aurantiacus* (Mello-Leitão) which is plentiful between the buttresses of forest trees.

Pisauridae (nursery web spiders) - Medium to large with eight eyes of approximately equal size, three tarsal claws. They can walk on water by spreading their legs radially. They resemble the related lycosids but many are found on vegetation. They sit quietly for hours on vegetation or actively hunt in vegetation. The female carries her huge egg sac in her jaws and suspends it among the leaves with silk when it comes near to hatching time, and stands guard nearby (Levi and Levi 1968). The young spiders leave the nursery after about a week.

Prodidomidae - Medium with eight eyes arranged in a semi-

circle at the front of the carapace, and with long spread chelicerae. These ground spiders are related to gnaphosids, and are found under stones.

Salticidae (jumping spiders, sometimes called money spiders in Trinidad) - Minute to large, members of this family are easily identified by two very large anterior median (front central) eyes which form high resolution images. The lateral anterior eyes are smaller, but still large, and play a major role in hunting behaviour (Cutler and Edwards 2002). These simple image forming eyes allow the spider to focus on an object providing information on both colour and size. The posterior eyes are smaller. They generally have squat bodies with short legs, but some species are slender. Some resemble ants, mutillid wasps or small beetles. Have two claws plus a scopulae pad (tuft of hair), which enables them to adhere to various surfaces. This is the largest spider family with 4,500 species currently known, 117 of which are found in this country (Cutler and Edwards 2002). They are found in most terrestrial ecosystems; arctic and alpine tundra, deserts, forests, grasslands, crops and manmade structures, but the greatest diversity is found in tropical forests. Construct silken retreats which they use to moult and produce eggs. Daytime running or ambushing hunters, they stalk and attack walking prey. To catch flying prey, they attach a thread of silk to a substrate and leap at the prey and haul themselves to the substrate with their catch. The males perform ritualised movements during courtship like the Lycosidae.

Scytodidae (spitting spiders) - Small to medium, possess smoothly domed high carapaces underneath which is a pair of large glands. The legs are slender and the spider uses them to stand high off the surface it is resting on. Long lived, active hunters, use the large glands underneath its carapace to squirt sticky threads combined with venom at prospective prey and hold it in place. Females carry the egg sac in their jaws. Several species are common on manmade structures and debris hanging in flimsy webs.

***Segestriidae** - Medium to large, easily recognized as they are the only spiders in which the third legs project forward with the first two pairs, body tubular. Build tube webs in narrow cracks and under stones. Webs have radial lines around the circular entrance.

Selenopidae (wall crab spiders, flatties) - Medium to large, two clawed, easily recognised by the flatness of their bodies as well as their eye arrangement, that is, six eyes in a single row in the front, and one eye towards the rear on each side. Commonly found in houses and under rocks or loose bark. Also their flattened bodies allow them to retreat sideways into cracks and crevices when disturbed. Nocturnal, well camouflaged, free ranging spiders, found on flattish surfaces such as rock faces, tree trunks and walls.

Senoculidae - Medium to large, possess three tarsal claws. Eyes with an anterior pair on the front edge, and the other six in a recurved semi-circle further back. Natural history poorly known, hunt on plants with the female guarding her egg sac.

Sicariidae (members of the genus *Loxosceles* are called violin spiders) - Medium to large, legs two clawed, six eyes arranged in three diads (contiguous groups of two) in a recurved row (the outer ends of the row are behind the central part). All members of this family possess venom capable of causing necrotic lesions in humans. Some live concealed under the surface of sand and hunt by grabbing prey with their front legs. Members of the genus *Loxosceles* are found under stones and debris on the ground and in houses.

Sparassidae (giant crab spiders) - Medium to very large, hold their two-clawed legs in a crab-like fashion. The trilobed membrane at the end of the metatarsus is diagnostic. Mostly nocturnal and occur on the soil surface, vegetation, tree trunks and in buildings. They do not build webs and rely on speed and strength to subdue their prey.

Symphytognathidae - Minute, pale spiders with fused chelicerae and four or six eyes, female pedipalp absent or with just a basal segment. They build horizontal, finely woven sticky silk orb webs. They mostly live in forest litter.

Tetragnathidae - Small to very large, many with elongate bodies, legs long and thin, chelicerae are strong with large teeth, often with spines. Female genital plate often poorly sclerotised. Most spin orb webs often at an angle between vertical and horizontal, orb usually has 12 to 20 radii and widely spaced spirals. Spider hangs in the centre or on a stalk somewhere near web, both diurnal and nocturnal species. A well known member of this family which occurs in Trinidad and Tobago is *Nephila clavipes* (Linnaeus) which is highly sexually dimorphic and constructs a large web of golden silk reaching up to 1m or more in diameter in relatively open spaces like trail edges and clearings. Webs of adult females are often asymmetrical with the hub being placed high in the web.

Theridiidae (comb-footed spiders) - Minute to medium, with three leg claws, possess a tiny comb of bristles (setae) at the end of the fourth leg. Legs with few spines or none. Rear margin of cheliceral fang furrow with at most three teeth. Most spin an irregular web sometimes on the underside of leaves, stones or loose bark. Some build highly modified webs, a few do not build webs and are wandering hunters. The tarsal comb is used to cast strands of silk over prey once it has become entangled in their web. Members of this family include *Latrodectus geometricus* (Koch) (Brown Widow), an extremely timid spider which is rarely reported to bite and is commonly found in houses. Another common member of this family is *Argyrodes nephilae* (Taczanowski). These tiny angular silver spiders are commonly found in the webs of *Nephila clavipes*. They are kleptoparasites. Two other members of this family, *A. eximus* and *A. rupununi* (Levi) are social spiders, the latter is less common in Trinidad and Tobago. Both species reside in colonies with members cooperating in prey capture, transport, tending of egg sacs and communal feeding. They construct huge communal webs ranging from 88 to over 700cm in length, containing a single adult female to almost 3,000 spiders (Avilés and Salazar 1999)

Thomisidae (crab spiders) - Small to medium, stout with two tarsal claws, first and second pairs of legs noticeably longer and thicker than the other pairs. Eyes are small, nearly uniform in size and arranged in two rows. They are sit-and-wait predators that often rely on camouflage to ambush their prey. They can resemble tree bark, flowers and even bird droppings. Some can change colour to match their background. They get their common name from their tendency to walk sideways rather than forwards.

Theridiosomatidae - Minute spiders with globular abdomens, rear of sternum is short and squared off posteriorly. Some build small, modified orb webs that lack a hub, but have several radii tied together near the centre. The centre of the web is held by the spider with a tight thread to form an inverted umbrella, when a prey item gets caught, the thread is released, causing the web to spring back and entangle the prey. One genus builds a line across tiny watercourses with sticky strands hanging down to float on the

water surface. Prey items floating suspended on a stalk, one tends to see far more egg sacs then spiders or capture webs.

***Titanoecidae** - Medium, with a cribellum and calamistrum, the calamistrum appearing bipartite and less than half the length of the metatarsus. Natural history similar to amaurobiids, build webs with dense cribellate silk under stones and debris on ground. Found in drier habitats than are usually occupied by amaurobiids.

Uloboridae - The first two pairs of legs are longer than the other pairs. They possess a cribellum and construct orb webs. Uloborids lack poison glands. These orb weavers wrap their prey in silk to subdue them. The pantropical *Zosis geniculatus* (Olivier) belongs to this family and builds flimsy orb webs that degenerate with age so that the orb is not readily discernible. This species is often found in colonies in sheltered areas, in and around buildings. Another genus constructs a web consisting of a single line, others construct just a sector of an orb.

Zodariidae - Small to large, stout, eight-eyed spiders with more than two spinnerets although the first ones are much larger in comparison to those at the rear. Legs equally thick and robust. Ground-dwelling, hunting spiders which hide under stones, leaf litter or burrow in sand. Many are specialised predators on ants and termites.

***Zoridae** - Small to medium, eyes in three rows, four in anterior row, followed by two rows of two eyes in each, lack claw tufts, with strong ventral macrosetae on the legs. Fast, nocturnal hunters, on ground and vegetation.

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NATURE NOTES

Predation of a Lizard by a Mockingbird in Trinidad and Tobago

On 7 June, 2003, I saw a Mockingbird (*Mimus gilvus*) "hovering" in front of a stone wall . It then landed in the middle of the road and dropped a small lizard, which managed to run about 50 cm before it was caught again. The mockingbird flew with the lizard into a neighbouring garden where it was no longer in view. The lizard could not be identified (it was about 10 m away), but was the size of a species of *Gonatodes vittatus.* These are common in the neighbourhood. In his book, A Guide to the Birds of Trinidad and Tobago, ffrench (1980) notes that mockingbirds have been reported to take lizards in the Dutch Leeward Islands. If you have made observations on the predation of vertebrates by Mocking birds, please send them to The Editor, so that they can be published as a Nature Note in a later edition of The Living World.

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Nigel Gains
E-mail: *gains@tstt.net.tt*

Display of the White-tailed Sabrewing on Tobago

This display must be one of the most spectacular sights in Trinidad and Tobago, if not the whole neotropical area, and it should be a challenge for any wildlife photographer to capture on film this amazing performance.

This hummingbird, *Campylopterus ensipennis*, like many others is largely green, but the outer three pairs of tail feathers are pure white. When the male bird is performing his display at his familiar perch, he constantly calls a repeated double note "**chee-chink……chee-chink**". Often, while doing this, he fans out his tail feathers, sometimes raising the tail at the same time, so that the white feathers stand out brilliantly against the generally green background of the forest environment. It has reminded me of a miniature peacock. Occasionally the bird also raises its wings, as if about to fly.

I have found this bird displaying at Gilpin Trace on Tobago's Main Ridge, not far from the Bloody Bay Look-out, so it is not too difficult to locate. Every birder should try to share this experience, described to me by a friend as "a cosmic mind-blower".

Ishmael Samad
c/o Pax Guest House,
Mount St. Benedict, Tunapuna.

The Skipper Butterflies (Hesperiidae) of Trinidad. Part 11, Hesperiinae, Genera group O

Matthew J. W. Cock
CABI Bioscience Switzerland Centre,
Rue des Grillons 1, CH-2800 Delémont, Switzerland.
E-mail: m.cock@cabi-bioscience.ch

ABSTRACT

Details are given on the taxonomy, history, description, identification and biology of the Trinidad and Tobago species of genera Group O of the Hesperiidae (Lepidoptera). This is a predominantly Neotropical group of which 12 genera and 32 species occur in Trinidad and five genera and seven species occur in Tobago. *Xeniades orchamus orchamus* Cramer is a new record for Trinidad. *Panoquina panoquinoides* Skinner occurs in distinct island races on both Trinidad and Tobago; these are described, but treated as below the subspecies level. All 32 species are illustrated as adults, and the early stages are illustrated for *Nyctelius nyctelius nyctelius* Latreille, *Niconiades xanthaphes* Hübner, *Aides aegita* Hewitson, *Saliana antoninus* Latreille, *S. longirostris* Sepp, *S. salius* Cramer, *S. saladin culta* Evans, *Thracides cleanthes binota* Evans and *T. phidon* Cramer.

INTRODUCTION

In part 10 of this series (Cock 2000) I completed my treatment of the subfamily Pyrginae, i.e. roughly half the known Hesperiidae from Trinidad. The remaining species belong in the subfamily Hesperiinae. Many of these are small, predominantly brown species whose biology is little known (especially Evans' genera groups I, J, L, M, and N). In contrast, genera groups K and O include larger species, for a proportion of which the biology is now known from Trinidad. Accordingly I have decided to treat these groups first before returning to the other genera groups, by which time, hopefully more information will have accumulated on these.

Most authors now agree that Evans' classification of the Hesperiinae into genera groups is seriously flawed (e.g. Burns 1990), but for the moment no better arrangement has been proposed. Accordingly I do not propose to characterize the genera groups in any detail - at least not at this stage. Evans (1955) characterises his group O as "generally brown species with the antennal club constricted before the apiculus: the length of the nudum on the club = apiculus. The palpi are flattened against the head: third segment short and stout. The termen of the hindwing is straight or excavate". This is a predominantly Neotropical group for which Evans (1955) lists 20 genera and 133 species; of these 12 genera and 32 species occur in Trinidad and five genera and seven species occur in Tobago. *Xeniades orchamus orchamus* Cramer is a new record for Trinidad.

The known larval food plants include grasses and bamboos (Poaceae), palms (Arecaceae) and members of the Epigynae group, including Cannaceae, Marantaceae, Bromeliaceae and Costaceae.

In the treatments of *Panoquina lucas* Fabricius and *Nyctelius nyctelius* I quote the work of Dethier (1942) who reared these species from the ovum, through seven larval instars to pupation. I have reared relatively few species of Hesperiidae from the ovum, and these have always taken five instars. Hence, I should point out that in my treatments of field collected larvae, I have always assumed that the final instar is the fifth, the penultimate instar is the fourth, the one before that the third, and so on. It would probably be more accurate, although clumsier, to refer instead to final instar (n), n-1, n-2, etc., where n is the unknown number of standard instars (e.g. Holloway, Cock and Desmier de Chenon 1987).

Several references, notably Moss (1949), refer to relevant host plants by their common or local names; in some cases, I have located the probable scientific names of these based on internet searches, and inserted these in square brackets without source.

I reiterate my thanks to Dr. C. Dennis Adams, Yasmin Comeau, Bhorai Kalloo and Winston Johnson of the National Herbarium who identified the plants from which I reared Hesperiidae in Trinidad. The following have very kindly assisted in providing access to the collections in their care: Dr. George McGavin of the Hope Entomological Collections, Oxford University Museum (HEC), Dr. Phillip Ackery of the Natural History Museum (NHM) (formerly British Museum (Natural History)), Dr. Mark Shaw of the Royal Scottish Museum (RSM), Mr. Scott Alston-Smith to his private collection (SAS), Professor Julian Kenny and Dr. Gene Pollard of the University of the West Indies, St. Augustine (UWI), Dr. Gerald Legg of the Booth Museum, Brighton, Drs. Lee and Jacqueline Miller of the Allyn Museum of Entomology, Sarasota, Florida (AME).

Once again, I especially thank Scott Alston-Smith who has read and commented on this paper, and provided additional records from his collecting, and observations and food plant records which have not previously been published (indicated as SAS in text).

245. O1 *Calpodes ethlius* Stoll 1782

Calpodes ethlius, the only species in its genus, was described from Suriname, but is found from southern USA to Argentina (Evans 1955), all through the Caribbean (Smith *et al*. 1994), colonised Bermuda some time before 1910 (Cock 1985), and recently colonised the Galapagos Islands (Onore and Mielke 1988).

It was first recorded from Trinidad by Kaye (1904), who considered it a common species, at least around cannas. He later qualified this, stating that it is less common in Trinidad than in Jamaica or Dominica (Kaye 1921). Sheldon (1936) records a Tobago specimen reared from a larva collected on *Canna* sp. at Bacolet by W.J. Kaye; there are two Kaye specimens from Tobago in the AME. There is also a Tobago specimen from the Sheldon collection in the NHM, a male collected i. 1937 at Roxborough by F. d'A. (i.e. Frank d'Abadie).

Plate 1. *Calpodes ethlius* (female), in cop. on canna, Curepe, 14.ix.1979. Scale in mm.

Sexes similar. UPS brown with white hyaline spots; overlay of light brown setae base UPF, base UPH and spaces 1A-1C UPH. UNF dark brown basally, light brown on costa, apical area and along margin to vein 1. UNH light brown. F (male) 24mm; (female) 25-27mm. Illustration of UPS in Lewis (1973, plate 21.24); of (male) in Riley (1975, plate 24.9).

Plate 2. *Calpodes ethlius* (female) UNS, collected as larva on ornamental canna, 20.i.1982 (ref. 82/37B). Scale in mm.

The recorded food plants of this species include several species of Marantaceae and the introduced ornamental canna, *Canna* sp. hybrids (Cannaceae). It is well known as a pest of ornamental cannas (Moss 1949; Reinert *et al*. 1983), *Canna edulis* (Young 1982) and arrowroot, *Maranta arundinacea* (Urich 1932; Myers 1935; Cock 1985). Reinert *et al*. (1983) compared 39 cultivars of cannas for resistance to *Calpodes ethlius* in Florida. Plants with red leaf colour were preferred for oviposition to those with green leaves, and cultivars with red, orange, or scarlet flowers were the most preferred for oviposition, while those with yellow, rose red, yellow-red, or pink flowers were least preferred. Scott (1986) includes *Thallia dealbata* amongst the food plants, and Janzen and Hallwachs (2001) have reared it from *Thallia geniculata*, *Calathea macrosepaia*, both of which occur in Trinidad (Simmonds 1967), and at least one other Marantaceae.

In the 1980s, specimens were submitted to the International Institute of Entomology from Guyana, where they were reported to be causing defoliation of sugar cane (J.D. Holloway, pers. com.). This seems to be the only record of *C. ethlius* as a sugar cane pest (Box 1953).

Moss (1949) illustrates the larva. I have recorded the life history on *Canna indica* in Nevis (Cock 2001). Although I have reared this skipper several times in Trinidad, I did not record the life history in any detail, but I do not think it differs significantly from that which I described from Nevis. Eggs, larvae and pupae are quite easy to find on ornamental canna, and at times this skipper is a pest causing defoliation of this garden flower. Outbreaks usually collapse in a generation or two, probably due to the action of parasitoids.

Calpodes ethlius is a significant pest of arrowroot in St. Vincent, and of ornamental cannas in Bermuda. Natural enemies were studied in Trinidad, as part of a biological control programme against *C. ethlius* in these islands (Urich 1932; Myers 1935; Cock 1985). In Trinidad, the eggs are attacked by two trichogrammatid wasps, *Trichogramma* sp. sometimes incorrectly referred to as *T. minutum* Riley (Bare 1935) and *Xenufens ruskini* Girault, and an encyrtid, *Ooencyrtus calpodei* Noyes (Noyes 1985). The larvae are attacked by a gregarius braconid, *Apanteles talidicida* Wilkinson (the cocoons of which may in turn be hyperparsitised by a *Spilochalcis* sp.), a *Microbracon* sp., two tachinids, *Achaetoneura nigripalpis* Aldrich and *Exoristoides urichi* Aldrich, and a eulophid, *Ardalus scutellatus* Howard (= *Elachertus meridionalis* J.C. Crawford). Although no pupal parasitoids were recorded at the time of this biological control work, a pupa which I collected at the Pax Guest House (14.xi.1995, ref. 95/70) was parasitised by a gregarious *Aprostocetus* sp. (Eulophidae). Some hundreds of male and female adult wasps emerged from this one pupa and immediately started mating.

Xenufens ruskini was originally described from USA (Girault 1916) as an egg parasitoid of *Urbanus proteus* (see Cock 1986). Ainslie (1922) records it from Florida parasitising ova of *Lerema accius* Smith and Abbott, a species recorded from Trinidad but in error for *L. ancillaris ancillaris* Butler (Cock 1982). A *Xenufens* sp. is also recorded to attack the ova of *Caligo* spp.: Malo (1961) record *X.* sp. nr. *ruskini* attacking *Caligo eurilochus* in Ecuador, and Harrison (1963) records *X. ruskini* attacking *C. memnon* in Costa Rica. These authors are likely to be referring to the same parasitoid species, but whether it is *X. ruskini* or a close relative is not clear. Malo and Willis (1961) record an interesting case of phoresy with regard to the latter record. The adult female *X. ruskini* are carried on the termen of the hindwing of the adult female *C. memnon.* When the female alights to oviposit, the wasp moves onto the ovum as it is laid, parasitises it and then returns to the butterfly wing. Perhaps not surprisingly, the ova are heavily parasitised. This behaviour has not been reported for *Calpodes ethlius*, and considering the slow flapping flight of *Caligo* spp. compared to the rapid beating of skipper wings in flight, it may well be impossible to duplicate this behaviour on *Calpodes ethlius*.

Adults of *C. ethlius* can be seen around the food plant, especially when there is an outbreak (e.g. Curepe, 14.ix.1979; Petit Valley, SAS; Ellersie Park, SAS), but otherwise, this skipper is seldom encountered, and not common in Trinidad collections. Smith *et al*. (1994) point out that its flight times are early morning and late afternoon into the early evening. Doubtless linked with this crepuscular flight period, adults are occasionally attracted to light, and I have two specimens caught this way, a male attracted

to a fluorescent light in Toco (3.vi.1978) and a female from my mercury vapour light moth trap in Curepe (4-10.vi.1981). In general, however, the early stages are much easier to find.

Although *C. ethlius* has not been reported to migrate in Trinidad, Williams (1920) describes a mass movement in Panama which may have been migratory, and attributes the sudden mass appearance of this species in North America and in some Caribbean islands to mass migratory movements. The relatively infrequent incidence of canna and Marantaceae suggests they are unlikely food plants to generate the enormous numbers necessary to be noticed in mass movements, but the record of outbreaks on sugar cane (above) makes such population outbreaks much more plausible.

Larvae and adults have been used as model insects in many studies on insect physiology and biochemistry, e.g. Barrett (1984), Delhanty and Locke (1990), Griffith and Lai Fook (1986), Lai Fook (1984), Locke *et al*. (1991), Nichol and Locke (1989), Reisner *et al*. (1989), etc.

***Panoquina* Hemming**

The species of this genus have a similar UPS appearance, brown with white or yellow hyaline spots, and F pointed. The UNH has spots or a discal line of varying clarity and thickness. *Panoquina evadnes* is the only species with a male secondary brand. All species have a distinctive indentation on F margin at vein 2, which is also found in the next genus, *Zenis*. These species are all able to fold down the fore wing in a double fold so that the wing profile is much narrower, as can be seen in the plates of living adults of *P. fusina* (Plate 21) and *Zenis jebus* (Plate 25).

All species for which the biology is known feed on grasses (Poaceae). *Panoquina panoquinoides* seems to be a specialist on a grass from brackish conditions, but whether the other species show ecological preferences is not clear. Several species are minor pests of sugar cane and maize.

245a. O2/2 *Panoquina panoquinoides* Skinner

This is a group of species, subspecies, and forms which I treat here under the general name of *P. panoquinoides*. These are small brown skippers associated with coastal habitats. On the eastern side of the Americas, they have been treated as at least four subspecies, while closely related populations from California and Peru have been treated either as additional subspecies or as distinct species.

Evans (1955) lists material of *P. panoquinoides* from Florida and Texas (type localities), Cayman Is., Tobago and Pernambuco (E. Brazil). Smith *et al.* (1994) specify the non-USA distribution as Yucatan, Belize, the Bahamas, Cuba, Hispaniola, Mona Is., Puerto Rico, Virgin Is., St. Martin, St. Bartholomew and Antigua. However, Mielke (1980) refers to this subspecies extending as far south as Rio de Janeiro and Rio Grande do Sol in southern Brazil.

Godman and Salvin (1896) described *eugeon* as a distinct species from Union Island (Grenadines) and Grenada, mentioning that one Grenada specimen was captured on the seashore. Evans (1955) treats *eugeon* as a subspecies of *panoquinoides*, although Riley (1975) suggests that *eugeon* and *panoquinoides* may be distinct species. Smith *et al*. (1994) add records from other Grenadines, and suggest this taxon is likely to occur on other Lesser Antillean islands. This is confirmed by Corke (1995) who records *eugeon* from Maria Island off St. Lucia and Milligan Cay off St. Vincent.

The Suriname population was described by de Jong (1983) as ssp. *minima*. Mielke (1980) describes and illustrates ssp. *albistria* from a single female from a coastal site in Rio Grande de Sol, Brazil. This subspecies differs from others in that the UNH has a distinctive white stripe UNH, from the base to spaces 3 and 4, and no hind wing spots. Evans (1955) described *calna* as a subspecies of *panoquinoides*, based on two males and a female from Callao, coastal Peru; Brown and Turner (1966) suggest this may prove to be a distinct species.

Panoquina errans was described from California, and is restricted to the marine shoreline of California, USA, and Baja California, Mexico (IUCN 1983). Evans (1955) lists two males in the NHM apparently from South Brazil (Rio Novo Friborgo) which he attributes to this subspecies, but suggests they may be mislabelled. In view of Mielke's (1980) comments on the range of *panoquinoides*, i.e. extending to South Brazil, these two specimens need to be re-assessed. Evans (1955) treated *errans* as a subspecies of *P. panoquinoides*, but Brown and Turner (1966) reinstated it as a distinct species on the basis of differences in the larvae and male genitalia.

Although it is widespread and localised along the eastern coast of the Americas and Caribbean islands from the southern USA to Brazil, *P. panoquinoides* is likely to be overlooked, since brackish habitats are relatively under-collected. There is additional material from Peru, Ecuador, Venezuela and French Guiana in the USNM, and further populations in Trinidad and in Tobago as reported here. The populations from Venezuela, from Trinidad and French Guiana, and from Tobago could easily be considered to represent three additional subspecies, and other populations are likely to appear distinct. Because of the restricted habitat of this species, individual populations are relatively isolated, and so have evolved in isolation. Until more material is available from suitable areas where this species is as yet unrecorded, and someone undertakes a careful study and comparison of the different populations, adding more names to the literature at this time does not seem justified. Accordingly, although I describe the Trinidad and Tobago populations in some detail, I do not name them as new subspecies.

Riley (1975) includes *P. panoquinoides* from Trinidad in his table of butterfly distributions in the West Indies, but this is almost certainly based upon the Tobago specimen in the NHM listed by Evans (1955), since Tobago is not included in the table. Corke (1995) repeats the Trinidad record citing Riley (1975). *Panoquina panoquinoides* was first recorded from Trinidad by Cock (1984), when I pointed out that the species which I had recorded from Nariva Swamp as *Phlebodes* sp. (Cock 1981a, 1982) was actually *P. panoquinoides* and referable to either the nominate subspecies or an undescribed subspecies. Sheldon (1936, 1938) did not know *P. panoquinoides* from Tobago, and the first record from the island is that of Evans (1955) who lists a female in the NHM as ssp. *panoquinoides*.

***Panoquina panoquinoides* Trinidad population**

Male. UPF brown, with a few scattered tawny scales UPH, and diffuse tawny areas in space 12, costal ½ of cell, and an area distal and costal to end cell, space 1B against cell, and on either side of vein 1 for the middle $^1/_3$ of the wing. There is a sharply defined yellowish white spot in space 2, under the origin of vein 3, running from vein 2 to vein 3, and showing individual variation in

thickness from about 0.3-0.7 mm. A similar small spot at base of space 3 at end of cell, and distal to spot in space 2. One apical spot at the base of space 6 may be present in heavily marked specimens, and one specimen also has a dot in space 7. These more heavily marked specimens also have a diffuse yellowish white spot in space 1B on vein 1 in line with the inner margin of the spot in space 2. F 12.3-13.2 mm. UPH brown, unmarked.

Plate 3. *Panoquina panoquinoides* Trinidad population, (male) UPS, Nariva Swamp, milestone 46 1/4 track, 19.viii.1981. Bar = 1 cm.

Plate 4. *Panoquina panoquinoides* Trinidad population, (male) UPS, Caroni Swamp, Cacandee Sluice, 20.ii.1982. Bar = 1 cm.

UNF lighter brown than UPS with scattered tawny scales in distal half of cell, space 12 and the distal ½ to ⅓ of spaces 11 to 3; basal ½ of cell, space 1B to origin of vein 2 and space 1A basal ½ blackish. Veins yellowish, especially vein 3 and the distal ½ of veins 3-7. Spots in spaces 2 and 3 are distinctly larger and whiter than UPF; apical spots may be absent, or may be present in spaces 6 and 7; a quadrate whitish area at beyond ½ in the lower half of space 1B, diffuse on basal and distal margins. UNH lighter brown than UPS with a few scattered tawny scales; veins are pale and yellowish, apart from vein 1B which is whitish; no spots. Fringes yellowish brown, brown from space 2 to apex F.

Plate 5. *Panoquina panoquinoides* Trinidad population, (male) UNS of Plate 3.

Plate 6. *Panoquina panoquinoides* Trinidad population, (male) UNS of Plate 4.

Male genitalia. The male genitalia are shown in Figure 1. They, like those of ssp. *minima*, do not seem to differ significantly from those of ssp. *panoquinoides*, although I have not been able to compare the two. In terms of the characters which Brown and Turner (1966) use to distinguish the male genitalia of *P. errans* and *P. panoquinoides*, the genitalia match those of *panoquinoides.*

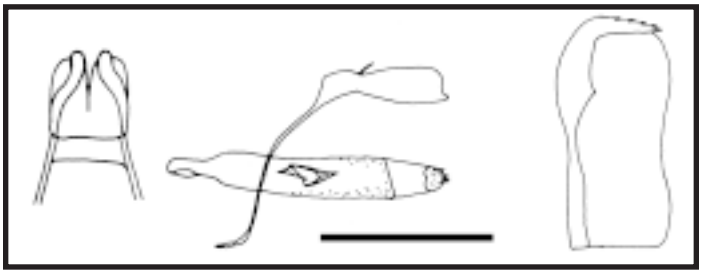

Figure 1. Male genitalia, *Panoquina panoquinoides* from Trinidad. *Left*, uncus and gnathos, dorsal view; *centre*, uncus, gnathos and aedaeagus, lateral view; *right*, left valve, internal view. Bar = 1 mm.

Female. UPF brown with tawny scales in basal ⅓ of wing. White hyaline spots F: quadrate spot in space 2 from origin of vein 3, elongate (basal-distal) spot at base of vein 3; apical spots in spaces 6 and 7, that in space 7 slightly distal to that in space 6. A quadrate white spot in space 1B on vein 1, overlapping with the basal margin of the spot in space 2. F 14.2 mm. UPH brown, with just a trace of spots in spaces 3 and 4.

Plate 7. *Panoquina panoquinoides* Trinidad population, (female) UPS, Oropouche South Lagoon, by Southern Main Road, 23.xii.1981. Bar = 1 cm.

UNF paler brown than UPS; costa and costal half of cell tawny, otherwise basal 1/3 of F blackish. UNF hyaline spots similar the UPS but slightly larger; spot in space 1B clearly larger, whiter and more diffuse. UNH brown as UNF, with veins yellowish brown, except vein 1B whiter; inconspicuous whitish spots at 1/3 in spaces 3 and 4.

Plate 8. *Panoquina panoquinoides* Trinidad population, (female) UNS of Plate 7.

Panoquina panoquinoides Tobago population

Male. UPS brown, with diffuse tawny areas in space 12, basal ½ of cell, space 1B against cell, and on either side of vein 1 for the middle 1/3 of the wing. There is an inconspicuous, diffuse spot of tawny scales in space two, under the origin of vein 3, and just a trace of a spot in space 3, slightly distal to the spot in space 2; no apical spots. F (male) 11.3 mm. UPH brown, with scattered tawny scales.

Plate 9. *Panoquina panoquinoides*, Tobago population, (male) UPS, Speyside, 15.v.1982. Bar = 1 cm.

UNF lighter brown than UPS and extensively overlaid with tawny scales in distal half of cell, space 12 and the distal ½ to 1/3 of spaces 11 to 3; basal ½ of cell, space 1B to origin of vein 2 and space 1A basal ½ blackish. Veins yellowish, especially vein 2 and the distal ½ of veins 3-6. The spot in space 2 is slightly larger and whiter than UPF, but the spot in space 3 is not evident; a broad diffuse whitish area at about ½ in the lower half of space 1B UNH lighter brown than UPH and extensively overlaid with tawny scales, except spaces 1A, 1B and 1C; veins yellowish, apart from veins 1A and 1B which are whitish; no spots. Fringes yellowish brown, brown from space 2 to apex F.

Plate 10. *Panoquina panoquinoides* Tobago population, (male) UNS of Plate 9.

Female. UPF brown with scattered tawny scales in basal 1/3 UPF; weak, diffuse yellow-brown spots in spaces 1B on vein 1 at 2/3, space 2 under origin vein 3, and near base of space 3. UPH brown, unmarked.

Plate 11. *Panoquina panoquinoides* Tobago population, (female) UPS, Tobago, 8.ii.1931, Capt. A.K. Totton (specimen in NHM).

UNF paler brown than UPF, with scattered tawny scales, similarly, but less densely, arranged as in the male. The spots in spaces 2 and 3 are slightly larger than on UPF and the spot in space 1B is distinctly larger, whiter and more diffuse than that on UPF; no apical spots. UNH with veins marked as in male; no spots.

Plate 12. *Panoquina panoquinoides* Tobago population, (female) UNS of Plate 11 (specimen in NHM).

Panoquina panoquinoides is consistently associated with coastal habitats in Trinidad and Tobago. I have now seen this species from four scattered localities in Trinidad, always in or near mangrove swamps. It is quite common along the edges of Nariva Swamp, where accessible from the Cocal and in the accessible parts of the eastern side of Caroni Swamp, such as Cacandee Sluice (ffrench and Bacon 1982). I have also found it beside Southern Main Road at Oropouche South Lagoon and in a patch of mangrove swamp at the base of Point Gourde. SAS has had a similar experience, only finding this species in swamp habitats. It can be expected to occur elsewhere around the coast where brackish conditions occur. I have collected Tobago specimens from Speyside and Military Hill (on flowers by the coast road).

Brown and Turner (1966) and Brown and Heineman (1972) describe the life history of ssp. *panoquinoides* from Jamaica, based on material which Turner found as eggs on *Mimosa pudica*, but reared on *Cynodon dactylon*. The normal food plant of *P. p. panoquinoides* in Jamaica does not, therefore, seem to have been recorded. Brown and Heineman (1972) suggest *P. p. panoquinoides* may have been a recent import in the Cayman Islands and Jamaica on sugar cane plants, however the information now available suggests that sugar cane would not be a natural food plant for this skipper, and so it is more likely that it is a long-term resident that was overlooked by early collectors.

Oviposition has been observed in Trinidad on *Paspalum vaginatum*, a grass only found in brackish conditions near the coast (Cock 1984). The life history of sspp. *eugeon*, *calna*, *minima* and *albistriga* have not been described as yet, but given the consistency of habitat choice, it seems rather likely that *Paspalum vaginatum*, and perhaps other salt grasses, are used by all subspecies throughout the range of *P. panoquinoides*.

The life history of *P. errans* was described from California, USA, by Comstock (1930). This information is summarised by Brown and Turner (1966) and behavioural observations are quoted in Brown and Heineman (1972). They consider the larvae to be sufficiently distinct from those of *P. p. panoquinoides* which they describe from Jamaica, that they are convinced that the two are distinct species. Brown and Heineman (1972), referring to Comstock's work, give the food plant as "salt grass", which Smith *et al.* (1994) refer to as *Sporobolus virginicus*. However, other sources, e.g. IUCN (1983) and Scott (1986), give the food plant as *Distichlis spicata* (Poaceae) which is also known as salt grass. *D. spicata* var. *stolonifera* is the form found locally frequent along the coast in California, and is probably the food plant actually used by *P. errans*, since IUCN (1983), for example, specifically states that the food plants used, grow in moist soil which is at least wetted by high tides.

246. O2/4 *Panoquina ocola ocola* Edwards 1863

This species is widespread, from southern USA (TL Texas) to Argentina (Evans 1955), and the Greater Antilles where it is not a common species (Smith *et al*. 1994). *Panoquina ocola distipuncta* Johnson and Matusik was recently described from a xeric pine forest at 1500-1600m in SW Dominican Republic; it differs from the nominate subspecies by having a yellowish white spot in the cell F (Smith *et al*. 1994).

Panoquina ocola was first recorded from Trinidad by Kaye (1914), from a Trinidad specimen in the Godman collection. Sheldon (1936) includes this species in his Tobago list on the basis of a Speyside record by A. Hall and a specimen which he collected himself. However, there are no specimens of this species from Tobago in the NHM, where the Sheldon collection and many of Hall's Hesperiidae are deposited, nor in the Booth Museum, where the remainder of Hall's collection is held, so *P. ocola* needs confirmation as a Tobago species.

Plate 13. *Panoquina ocola* (male), Andrews Trace, 8.x.1994. Scale in mm.

Plate 14. *Panoquina ocola* (male) UNS, St. Benedict, 16.x.1993. Scale in mm.

Sexes similar. UPS brown with white hyaline spots. UNF dark brown basally, light brown on costa, and distal half. UNH light brown; veins may or may not be darker; paler streak on vein 2; indistinct diffuse row of pale or mauve spots in spaces 3 to 7, usually distinct in 3,4 and 7 but may be absent altogether. Evans (1955) describes the normal form as not having any spots UNH, but most Trinidad material has at least a trace of spots. One exceptional male specimen (St. Benedict, 26.ii.1994, MJWC) has no trace of the UNH line of spots, but the cell and spaces 2-7 are dusted with light blue. F (male) 16-17 mm; (female) 17-18 mm. Illustration of (male) UPS in Lewis (1973, plate 22.22); (male) in Riley (1975, plate 24.14). The absence of a cell spot (rarely present as a dot over the spot in space 2, more evident UNF than UPF) distinguishes *P. ocola* from other members of the genus except *P. panoquinoides*, which is much smaller.

Plate 15. *Panoquina ocola* (male), "sunbathing", St. Benedict, 16.x.1993.

This is a common and widespread species, found throughout Trinidad in open disturbed areas and forest and swamp margins. Adults come readily to flowers, such as *Bidens pilosa* and *Eupatorium* (s.l.) spp. I have one specimen taken at light (Curepe, xii.1981). Although I have records of nearly 30 Trinidad specimens, I found only one in Lamont's collection and four in the NHM. Could it have become more common in recent years?

Wolcott (1951) records the observations of T.H. Jones who reared this species from sugarcane and *Hymenachne amplexicaulis* (Poaceae) but failed to distinguish the larvae from those of *P. lucas*, the commonest skipper on sugar cane in Puerto Rico. It has been noted once as a pest of rice in Mexico (Bell 1942).

247. O2/5 *Panoquina hecebolus* Scudder 1872

In Mexico this species seems quite common, and can be found from there south to Paraguay (Evans 1955). Kaye (1921, 1940) did not record this species from Trinidad. Since there is a male collected in Maraval in ix.1891, presumably by S.J. Kaye, then W.J. Kaye must have seen this specimen, but may well have confused it with the last species. There are no specimens from the W.J. Kaye collection in the AME. The first record from Trinidad is in Box's (1953, 1954) lists of sugar cane insects.

Plate 16. *Panoquina hecebolus* (male) UNS, Curepe, 7.x.1979. Scale in mm.

Sexes similar, but male with more pointed forewings, and F markings less pronounced and slightly yellow. UPS dark brown with yellow-white hyaline markings in space 2, 3, lower cell (against base of space 2), 6-7 (absent in male), and white spot in space 1B. UNS brown with UPS markings repeated. F (male), (female) 18 mm. The plain brown UNS distinguishes this species from other members of the genus. *Panoquina ocola* is similar and some specimens have the UNS unmarked, but *P. hecebolus* has a cell spot not normally present in *P. ocola*. Critical male specimens can be checked by brushing off the scales from the genitalia to show the uncus arms, which are blunt in *P. ocola* and pointed in *P. hecebolus*.

Although not as common as *P. ocola*, this species is widespread and regularly encountered in open disturbed situations and forest margins. Adults come readily to flowers. I have taken one female at light (Curepe, x.1979, IIBC).

Box (1953, 1954) lists this species from sugar cane in Trinidad, and in the NHM there are three females reared from sugar cane by him (ix.1952).

248. O2/8 *Panoquina lucas* Fabricius 1793

This species appears in the literature, including Evans (1955), Cock (1982), Smith *et al*. (1994) as *Panoquina sylvicola* Herrich-Schäffer 1865, which is now considered a synonym of *P. lucas* (Robbins *et al*. 1996; Mielke and Casagrande 2002). This wide-ranging species is found from USA to Argentina (Evans 1955), and throughout the Caribbean except the Bahamas (Smith *et al*. 1994). Strangely, Kaye (1921, 1940) does not record this species from Trinidad, even though there are S.J. Kaye specimens from 1891 in the NHM, and there is a specimen from the W.J. Kaye collection in the AME ((male), Trinidad, 17.x.1920), which Kaye labelled as *Prenes ocola*. Thus, Evans' (1955) listing of three males and a female from Trinidad in the NHM is the first published record from the island. Sheldon (1936) records this species from Tobago on the basis of a specimen collected at Speyside by A. Hall; this specimen, a male collected ii.1932, is in the NHM, along with a pair from Roxborough collected by "F.d'A." (i.e. Frank d'Abadie) from Sheldon's collection.

Plate 17. *Panoquina lucas* (male) UNS, Textel Road, 11.x.1979. Scale in mm.

Plate 18. *Panoquina lucas* (female) UNS, St. Augustine, 27.ix.1981. Scale in mm.

Sexes similar, except with regards to the cell spot F. The male has a distinctive lower cell spot, very elongate and distally overlapping the base of the spot on space 2. In the female the cell spot is small and round, and overlaps the spot in space 2. UPS dark brown with white hyaline markings in cell, spaces 2 (elongate towards margin on lower angle), 3, 6 and sometimes 7; elongate white marking in lower space 1B. UNS brown; the spot in space 1B UNF slightly larger than on UPS. UNH brown, with a purple flush of varying intensity except in space 1A-1C, usually stronger in female, and sometimes also on distal portion of UNF. A distinctive line of small pale spots, usually with a blue or purple tint, runs from space 2 to space 7, in a straight line directed towards the costa just before apex. F (male) 19 mm, (female) 18-19 mm. Illustration of (male) in Riley (1975, plate 24.10).

Like *P. hecebolus*, this species is regularly encountered in open disturbed situations, and comes readily to flowers, such as *Eupatorium* spp.

Jones and Wolcott (1922) treat this species as *Prenes nero* Fabricius due to a mis-identification (Wolcott 1951). Jones and Wolcott (1922) provide a detailed description of the life history and illustrate the larva and pupa with line drawings. This illustration of the larva is reproduced in Wolcott (1951). Dethier (1939, 1942) describes the ovum, seven larval instars and the pupa of this species which he reared in Cuba (as *Prenes nero sylvicola*). The larval food plants noted in Puerto Rico are "sugar cane, bamboo, malojillo grass [*Brachiaria mutica*] and Johnson grass [*Sorghum halepense*]", and in Costa Rica, Janzen and Hallwachs (2001) record larvae from *Oryza latifolia* and *Panicum maximum*. Brown and Heineman (1972) reproduce the description from Jones and Wolcott (1922) although they attribute it to Jones' notes. They note that this description differs only in minor details from notes on the life history in Jamaica which T. Turner provided to them. Turner reared his material on pimento grass, *Axinopus compressus*, but it is not clear whether this is a natural host plant, or only a host plant used to rear ova laid by a captive female.

Jones and Wolcott (1922) note that this is the most common hesperiid larva attacking sugar cane in Puerto Rico, yet it is heavily attacked by parasitoids, to the extent that it is not a pest. The commonest of these is an egg parasitoid, *Trichogramma minutum* Riley (Trichogrammatidae), although it should be noted that *T. minutum* is a species complex (e.g. Bare 1935). This was the only egg parasitoid observed by T.H. Jones in 1912-14, but subsequently *Ooencyrtus prenidis* Gahan (Encyrtidae) has been recorded (Gahan 1946; Wolcott 1951). Jones and Wolcott (1922) also record an eulophid, *Ardalus antillarum* Gahan, noting that the larvae "issue from the caterpillars and form naked black pupae nearby, 16 individuals having been observed to come from one large larva". From what is now known of this group of parasitoids, it would be expected that the larvae actually develop as external parasitoids on the paralysed host, and do not emerge from within the host. The larvae are also attacked by *Cotesia prenidis* Muesebeck, which the wording in Jones and Wolcott (1922) implies to be a gregarious species, and one of the social wasps, *Polistes crinitus* Felton, was recorded to attack a pupa. This species is also recorded to attack *P. lucas* (mis-identified as *P. nero*) in Jamaica (Gowdey 1924).

I have reared this species from larvae collected on maize (Golden Grove, vi.1982) but did not record details. However, the description in Cock (2001) of larvae collected and reared on *Panicum maximum* in Nevis, may help to recognise this species in Trinidad.

249. O2/12 *Panoquina fusina fusina* Hewitson

This variable species is treated as five subspecies by Evans (1955), but there is no clear geographical division of four of these suggesting that more than one species may be involved. Thus, ssp. *jumbo* Evans is restricted to Jamaica but (see below), while the other four ssp. are widespread on the mainland of the Americas: ssp. *evansi* from Texas (TL) and Guatemala, ssp. *sonta* from Panama (TL) and Colombia, ssp. *fusina* Hewitson from Colombia, Guyana, Peru, Bolivia, Upper and Lower Amazon (TL Santarem), ssp. *viola* Evans from Honduras, Colombia, Bolivia, Brazil (TL Rio Grande) and Paraguay.

In Cock (1982) I treated this species as the two subspecies: *P. f. evansi* Freeman and *P. f. sonta* Evans. I have now reviewed Evans (1955) treatment against the types and collection of the NHM. I conclude that based on Evans' treatment, there is just one subspecies in Trinidad, *Panoquina fusina fusina*, which occurs in two different forms: *fusina* Hewitson (which I treated as ssp. *evansi*) and *fufidia* Hewitson (which I treated as ssp. *sonta*). Form *fusina* has the UNH line narrow, c. 1mm, maculate, pale purple apart from the section in space 1C which is white; this line is faint, wider and more diffuse in some specimens. The Trinidad specimen in the NHM (ex. J.J. Joicey coll.) which Evans treated as *evansi* is an extreme of this

type, with the UNH bar broad, c. 2 mm, but very diffuse, indistinct purple; there is nothing comparable in the NHM series of *fusina*, but some of my Trinidad specimens of f. *fusina* approach it. Form *fufidia* has a broad, white line UNH, interrupted by the veins which are brown, and tapered in space 1C. Evans states that the two forms occur together and that they intergrade. While I agree with the former, the Trinidad material before me does not obviously support the latter - the two forms seem discrete, yet I can see no clear difference in the genitalia, and so follow Evans' treatment. Rearing from known parentage would help to elucidate the relationship of the two forms.

Plate 19. *Panoquina fusina* f. *fusina* (male) UNS, Grande Ravine, 13.ix.1980. Scale in mm.

Subspecies *viola* and *jumbo* both have a strong purple flush UNH and apex UNF, which is not seen in Trinidad specimens. Subspecies *sonta* has a solid, white line UNH from vein 1B to costa, wider at vein 2 (3mm) than costa (2 mm). Brown and Heineman (1972), Riley (1975) and Smith *et al*. (1994) note that although Evans described ssp. *jumbo* from Jamaica on the basis of two females in the NHM (Evans 1955; Riley 1975, plate 24.12), this does not appear to be a Jamaican species. Brown and Heineman (1972) suggest the specimens may actually have come from Trinidad or north-east South America, but given the strong purple flush UNS in the two specimens of *jumbo*, Trinidad seems an unlikely provenance. Riley (1975) suggests that the specimens fall within the range of ssp. *fusina*, matching specimens from Brazil, and Smith *et al*. (1994) agree. Evans (1955) considered *jumbo* a modification of *viola*, and the purple flush UNS in common would seem to support this view.

Plate 20. *Panoquina fusina* f. *fufidia* (female) UNS, Cat's Hill, 19.ix.1982. Scale in mm.

This species might be confused with *P. lucas* and possibly with *P. evadnes*. *Panoquina lucas* has a line of purplish spots UNH similar to some specimens of f. *fusina*. However, *P. lucas* is a smaller species, and the male has a very distinctive F cell spot, elongate and basal to the spot in space 2; the female has a normal cell spot over the base of the spot in space 2, whereas that of *P. fusina* is slightly basal to the spot in space 2. *Panoquina evadnes* is larger than *P. fusina*, the UNH white line is broader, and the cell spot fills the width of the cell, whereas that of *P. fusina* is only in the lower half of the cell. F f. *fusina* (male) 21-22 mm, (female) 24 mm; f. *fufidia* (male) 21-22 mm, (female) 23 mm.

Plate 21. *Panoquina fusina* f. *fufidia* (male) at rest, Bush Bush Island, 7.v.1995.

Form *fusina* is commoner than *fufidia* in Trinidad (15 records to 9), and while *fusina* is found in both the north and south of the island, I have records of *fufidia* from the south only. They do occur together, e.g. on 19.ix.1982, I captured two male *fusina* and a male and female *fufidia* at flowers of *Austroeupatorium inulaefolium* in Cat's Hill. This species is much more closely associated with forest situations than others of the genus in Trinidad, and seems to be significantly commoner in the South (Morne Diable, Moreau, Rock, Parrylands, Grande Ravine, Cat's Hill, Bush Bush Island) than the north (Morne Bleu, El Tucuche). Males are collected more frequently than females (21 males to 3 females), and most captures are made at flowers, usually eupatorium.

Moss (1949) illustrates a striped larva, but left no notes about the life history or food plants, and there are no preserved early stages associated with this name in the NHM. Riley (1975) provides notes based on Moss's original figure. He describes a grey-green larva, "with a pair of subdorsal yellowish stripes on either side and grey beneath; head large, grey, rimmed black with a vertical black frontal stripe and a curved black stripe on each cheek."

250. O2/15 *Panoquina evadnes* Stoll 1781

This large and distinctive species is widespread from Guatemala to Argentina (Evans 1955). It was recorded from Trinidad first by Crowfoot (1893) as *Proteides evadnes*.

Plate 22. *Panoquina evadnes* (male) UNS, Waller Field, 2.xii.1980. Scale in mm.

Sexes similar; male has a grey three part brand in lower 1B, upper 1B and 2 forming a slightly interrupted line. UPS dark brown with UPF hyaline white spots in spaces 2, 3, 6, usually 7 and sometimes 8; the hyaline spot in cell extends across the width of the cell and is distinctly yellow; white spot in lower space 1B. UNF brown. UNH chestnut brown, except spaces 1A-1C blackish brown; a sharply marked broad silver-white line from vein 1B to vein 8, across the apex of the cell; the spot in the distal part of the cell is joined to the silver-white line in the male, but slightly separated in the female; a yellow-white mark in space 8 is displaced towards apex. F (male) 22-23 mm, (female) 25 mm. Illustration of UNS in Lewis (1973, plate 84.39).

The male is the only member of the genus with a brand. The chestnut UNH with a broad silver-white line should serve to recognise this species. It is superficially similar to the slightly smaller *P. fusina fusina* f. *fufidia*, but the UNH line of that species is narrow, more diffuse and with dark veins. Furthermore the cell spot of *P. fusina* is only in the lower cell, whereas that of *P. evadnes* fills the width of the cell.

This species is quite uncommon in Trinidad. I have records from scattered localities (Forest Reserve, Manzanilla, Maraval, Palmiste, Port of Spain, St. Augustine, Waller Field) during the months August to January. Most of SAS's 10 specimens are from southern Trinidad. It comes to flowers such as lantana, but not frequently to eupatorium.

Moss (1949) often reared this species from sugar cane. His notes on the larva and pupa are very brief, but sufficient to suggest the early stages do not differ markedly from other grass feeding species of this group. Some of his preserved early stages are in the NHM. Three cast L5 skins have an almost oval head, wider at the base; light, translucent brown in colour (perhaps green in life), with a faint (or very faint) pair of lines from the apex to the stemmata, one more or less straight, the anterior one convex, running roughly parallel to the clypeal sutures. The anal plate is semicircular, covered with erect pale setae. The emerged pupa is elongate and smooth with a strong frontal spike, slightly upturned at apex; the proboscis sheath extends about 3 mm beyond the wing cases to the second visible abdominal segment; the colour is light translucent brown, and so the pupa was probably plain pale green in life; no associated white waxy powder.

251. O3/2 *Zenis jebus janka* Evans 1955

This is one of two species of *Zenis*, the other, *Z. minos* Latreille, having an apparently disjunct distribution, being recorded from Mexico, Honduras and South Brazil (Evans 1955). *Z. jebus* Plötz occurs in three subspecies: *janka* Evans from central America (TL Panama), south to Peru, the Amazon and the Guianas, *beckeri* Mielke and Casagrande (misidentified as *melaleuca* Plötz by Evans 1955) from Venezuela, Colombia, Ecuador and Brazil, and *jebus* from southern Brazil (TL) and Paraguay. First recorded from Trinidad by Crowfoot (1893) as *Carystus minos* Latreille (a misidentification, prevalent in much of the literature).

Plate 23. *Zenis jebus* (male), Maracas Valley, 10.iii.1982. Scale in mm.

Plate 24. *Zenis jebus* (female) UNS, Textel Road, 5.x.1979. Scale in mm.

Sexes similar. UPS black, with white hyaline markings F in lower cell (elongate, alongside spot in space 2), spaces 2, 3, 4, 6, 8 (usually present in Trinidad material, although according to Evans (1955) this spot is absent in this subspecies) and 9, the last five formed a semi-circle; UPH a white discal band from space 2 to space 6. UNF as UPF, but with a purple flush of varying intensity in apical area, and the veins in this area slightly pale. UNH brown with a purple flush except in spaces 1A-1C; a broad cream-coloured discal band from vein 2 to apex; a pale spot on termen in line with discal band; basal half of vein 1B pale. F (male) 18-19 mm, (female) 18-20 mm. The white/cream discal band UPH and UNH,

arrangement of spots F and colouring make this species very distinctive, so that it can be mistaken for no other Trinidad skipper.

Plate 25. *Zenis jebus janka* (male) at rest on *Lantana camara*, Mt. Tamana, 12.xi.1995.

This conspicuous species is normally not very common, but may be over-represented in collections because it is so distinctive and recognisable in the field. Most of my records are from the Northern Range, where it seems to be associated with forested areas. In October 1979 it was common on the eupatorium flowers along the road to Morne Bleu Textel.

This species has not been reared in Trinidad, but Janzen and Hallwachs (2001) have reared it once from a larva on a bamboo, *Rhipidocladum racemiflorum* (Poaceae), but do not show the early stages.

252. O6/1 *Nyctelius nyctelius nyctelius* Latreille 1824

There are two species in the genus *Nyctelius*, the other being *N. paranensis* Schaus, which is unmarked brown above, and restricted to south-east Brazil (Evans 1955). *N. nyctelius* is much more widespread, from Guatemala to South Brazil and occurring on many of the Caribbean Islands (Evans 1955). Ssp. *agari* Dillon was described from Dominica, and occurs in Dominica and St. Lucia, although it may be an extreme form of the general tendency of Caribbean material to have the pale areas UNH a darker purple (Smith *et al*. 1994; Cock 2002).

Kaye (1914) considered this species not rare when he included it in his "additions and corrections" and also listed a G.B. Longstaff specimen from Maraval, 19.xii.1906. He includes it again as *Prenes ares* Felder (a synonym) in the Addenda to his catalogue (Kaye 1921), noting that it occurs in many localities, and probably everywhere that sugar cane is grown since that is the food plant. Kaye (1940) corrects this pointing out the synonymy. A specimen collected by A. Hall at Speyside is the basis of Sheldon's inclusion of this species in his list of Tobago butterflies (Sheldon 1936); there is also a W.J. Kaye specimen from Tobago in the AME.

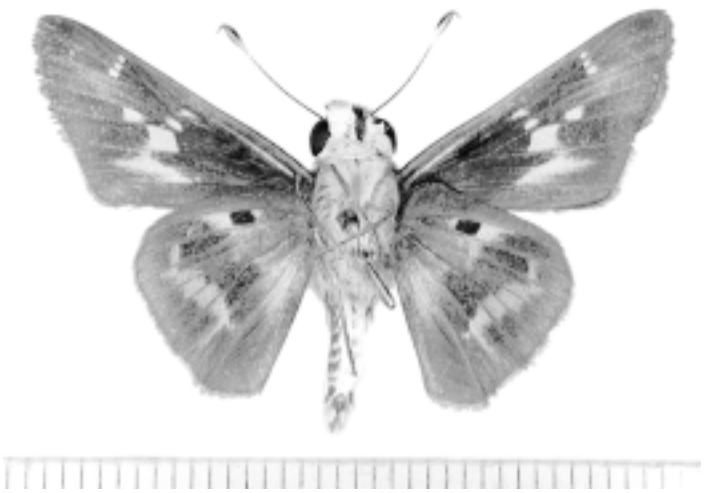

Plate 26. *Nyctelius nyctelius nyctelius* (male) UNS, Textel Road, 7.x.1979. Scale in mm.

Sexes similar; the male has more pointed fore wings, the spot in space 2 F is relatively less broad, and the pale areas UNH have a lilac flush which is almost absent in the female (see also the discussion of this species in Cock (2002). UPS brown with white hyaline spots: 2 (large, quadrate), 3, a row of dots in 6-8, and a double cell spot; white spot in space 1B: a variable, sometimes indistinct triangular spot above vein 1, below inner margin of spot in space 2, and a dot sometimes present against vein 2 before distal margin of spot in space 2. UNF basally brown; costa and distal $^1/_3$ light brown; a large irregular white spot in space 1B. UNH brown with light brown markings: space 1A, basal part of wing, from $^1/_3$ in space 1B to $^2/_3$ in space 7, post-discal band from vein 1B to vein 6 (narrower in spaces 5 and 6, paler in space 1C), and diffuse margin; a dark spot at $^1/_3$ in space 6. F (male) 16-17 mm, (female) 18-20 mm. Illustrations of (male) and (female) UNS in Lewis (1973, plates 84.16 and 84.18); (male) from St. Vincent in Riley (1975, plate 24.16). The double cell spot, dark spot in space 6 UNH and general appearance of markings UNH will serve to distinguish this species.

Plate 27. *Nyctelius nyctelius nyctelius* (male), "sunbathing" on bougainvillea, St. Benedict, 27.ii.1994.

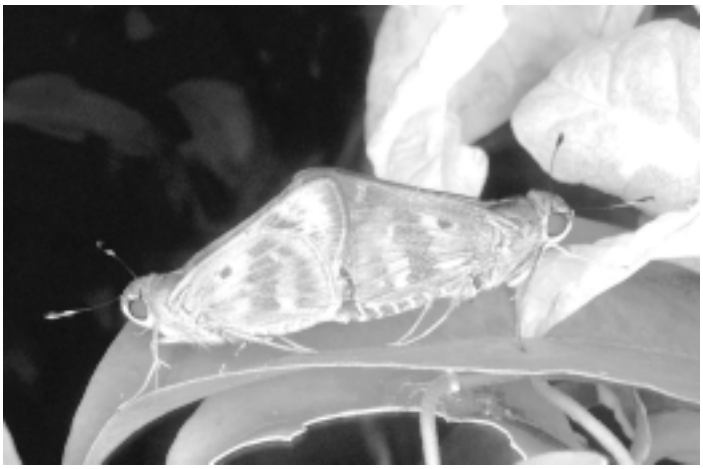

Plate 28. *Nyctelius nyctelius nyctelius* in cop. on bougainvillea, St. Benedict, 27.ii.1994. The male, on the right, has a lilac flush to the pale areas UNH which is absent in the female, on the left.

This is a common and widespread species in Trinidad, coming readily to flowers such as eupatorium.

Dethier (1939, 1942) describes all life history stages, based on material he reared in Cuba from sugar cane, on which it was more common than on native grasses.. He found this species to develop in seven instars (see comments in Introduction). The pattern and colouring of the head is comparable to that which I found in Nevis. Moss (1949) reared this species from sugar cane and a wild cane, and Box (1953, 1954) records it from sugarcane in Trinidad (there are two males and a female reared from sugar cane in Trinidad by H.E. Box (ix.1952) in the NHM). Janzen and Hallwachs (2001) record it from *Panicum maximum* and *Rottboellia cochinchinensis* (Poaceae). I have reared this species from maize, *P. maximum* and *Setaria barbata* in Trinidad and found a larva on *P. maximum* in Nevis (Cock 2001). It probably uses a variety of broad leafed grasses. I have described the larva from Nevis, and also illustrated a Trinidad specimen in Cock (2001).

Dethier (1942) reports that early instar larvae are found near the tips of young leaves, and the larvae cause most damage to small plants, but the older larvae are able to complete development on coarser, more pubescent foliage than other species.

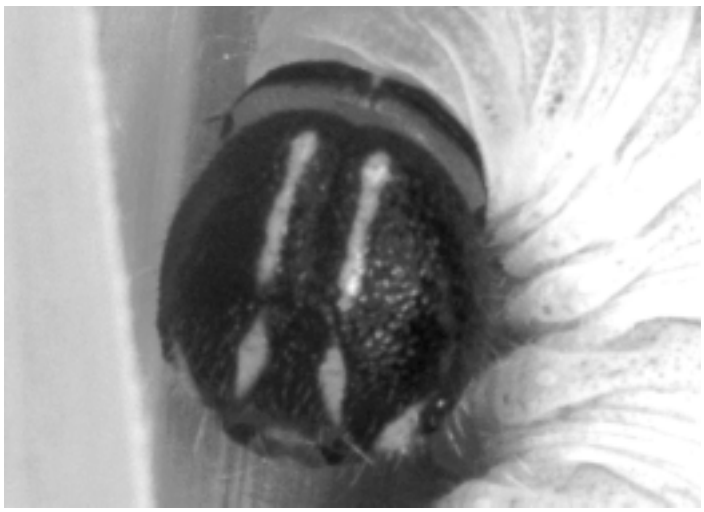

Plate 29. *Nyctelius nyctelius nyctelius* L5 detail of head, collected on *Panicum maximum*, St. Benedict, 11.x.1994 (ref. 93/7).

The fifth instar larva (Plate 21 in Cock 2001) grows to 20 mm or more. Head rounded; predominantly black, narrow yellow lines from near vertex along central suture, continued to labrum apart from a small gap; stemmata in kidney-shaped black marking, within and overlapping the dorsal and ventral margins of a yellow spot; T1 with narrow black dorsal plate and spiracle; legs black; body whitish green, smooth; a few pale setae on the anal plate. More observations from Trinidad and the mainland would be desirable, but it does appear that larvae from Trinidad are distinct from those from the northern Caribbean islands, albeit based on a similar plan of markings. The correlation of larval markings with adult markings and the status of ssp. *agari* need further study (Cock 2002).

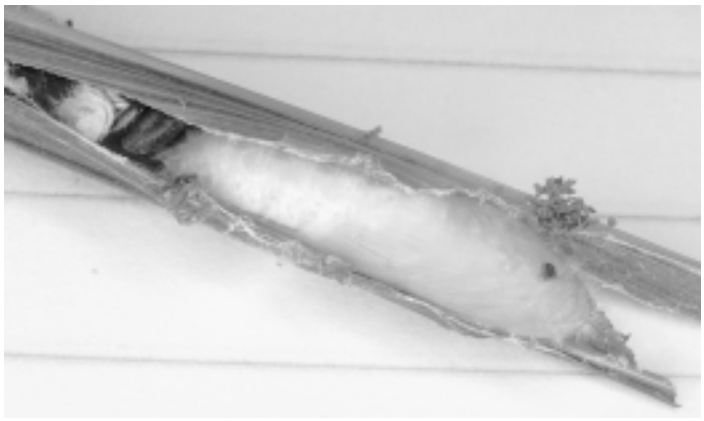

Plate 30. *Nyctelius nyctelius nyctelius* pupa, 22 mm, collected as larva on *Panicum maximum*, St. Benedict, 11.x.1994 (ref. 93/7).

The pupa is translucent; rounded in outline; with long forward-directed pale setae on head; thorax apart from the wing cases and appendages, and abdomen are covered with short, pale erect setae, those on thorax forward directed and those on the abdomen backward directed; proboscis sheath extends 5 mm beyond the wings; spiracle T1 is oval, large and dark brown; other spiracles concolorous. The pupal shelter is formed by rolling a large leaf; the chamber is lined with silk, but no white waxy powder.

There is an emerged pupa from Moss's collection in the NHM. Unlike Trinidad material, there are black markings on the head: a large roughly oval irregular spot filling the frons, a stripe down each eye, a broad band dorsally across the posterior margin of the collar, and a diffuse spot dorso-laterally just posterior to this on T1.

In Puerto Rico, where *N. nyctelius* is a minor pest of sugar cane (Jones and Wolcott 1922), the ova are parasitised by a trichogrammatid referred to as *Trichogramma minutum*, while the larvae are attacked by *Cotesia prenidis* and *Microbracon* sp. (cf. *Panoquina lucas*). In Cuba, Dethier (1942) records parasitism by *Hemiteles* sp. (Ichneumonidae, ?hyperparasitic), *Microgaster* sp. and *Cardiochiles* sp. (Braconidae), disease due to a bacterial "wilt", and that in addition to spiders, ants and lizards, a pentatomid bug *Mormidea pictiventris* Stål and a frog, *Hyla septentrionalis* Bounlingir are important predators. Box (1954) lists *Brachymeria orseis* Walker (Chalcididae) attacking *N. nyctelius* in Trinidad; *Brachymeria* spp. are solitary or gregarious pupal parasitoids.

253. O8/1 *Vacerra bonfilius litana* Hewitson 1866

Only *V. bonfilius* Latreille from this genus of seven species is found in Trinidad and Tobago. Evans (1955) divides it into four subspecies: *aeas* Plötz from Central America to Colombia, *litana* Hewitson from Venezuela, the Guianas and the lower Amazon, *bonta* Evans from Bolivia, and *bonfilius* from Peru to southern Brazil and Paraguay.

This species was first recorded from Trinidad by Kaye (1904), on the basis of a specimen which he captured in July 1901. A. Hall captured this species at Speyside (Sheldon 1936), and this material is in the NHM.

Plate 31. *Vacerra bonfilius litana* (male) UNS, Cumberland Hill summit, 8.viii.1981. Scale in mm.

Sexes similar, but male has inconspicuous grey brands below base of vein 2 and slightly basal to this above vein 1; female larger with wings more rounded. UPS dark brown; with white hyaline spots UPF in cell (across width), 2, 3, 4, 5, 6-8 in a row; white spot in space 1B UPF; UPH a row of white spots in spaces 3-6, of which that in space 5 is relatively large and quadrate, whilst the others are more diffuse; diffuse white spot end cell. UNF dark brown basally, brown discally; the spot in space 1 extends across the width of the space and extends distally. UNH brown in spaces 1A-1C; remainder dark brown with irregular light brown bands across base of wing, along margin, and a narrow discal band in spaces 2-3; diffuse white spot end cell; between the pale marginal band and the dark brown discal area, white spots in spaces 4 (small), 5 (large, as UPS), 6 (narrow); distal to the white spot in space 6 a conspicuous dark brown spot. This combination of white spots and the dark spot in space 6 is distinctive and characteristic, enabling this species to be readily recognised in Trinidad. F (male) 18 mm, (female) 20 mm.

This is an occasional species in Trinidad, particularly associated with less disturbed forest areas. Several captures (e.g. Brigand Hill, Cumberland Hill, Fort George, Mt. Tabor) suggest that the males hill-top. It seems commoner in the north than the south.

The biology of this species seems to be unknown, but Janzen and Hallwachs (2001) have reared two other members of the genus from a bamboo and an unidentified Poaceae, so the food plant of *V. bonfilius litana* is likely to be a bamboo.

***Niconiades* Hübner 1821**

Three members of this neotropical genus of 13 species are found in Trinidad. They form a compact group with a distinctive wing shape and white stripe UNH. Two are common forest species, but the third is rare. The only one for which the food plant is known feeds on *Olyra latifolia*.

254. O11/1 *Niconiades xanthaphes* Hübner 1821

The type locality of this species is unknown; it is found from Mexico to Paraguay, and seems to be particularly common in Trinidad (Evans 1955). It was first recorded from Trinidad by Kaye (1904), on the basis of a specimen which he captured in June 1898. Sheldon (1938) took a specimen at Speyside, which is in the NHM.

Plate 32. *Niconiades xanthaphes* (male), Andrews Trace, 9.iv.1980. Scale in mm.

Plate 33. *Niconiades xanthaphes* (male) UNS, Mt. Tabor, 11.iv.1982. Scale in mm.

Sexes similar, but male has relatively conspicuous grey brands at the base of space 2, immediately under vein 2 and above vein 1. UPS dark brown; white hyaline spots in cell (double, joined in most specimens, but touching in some), and spaces 2, 3, 6, 7 and

sometimes 8; white spot in lower space 1B; overlay of blue-green setae on body UPS and basal quarter UPF, and basal half UPH, extending along vein 1A and termen. UPH with adjacent equal hyaline white spots in spaces 2 and 3. UNF brown; yellow patch on costa next to cell spots and light brown along costa basal to this; extensive white patch across width of space 1B UNF. Strong white line UNH from vein 1B to mid costa and a pale mark in line on vein 1A. The hyaline spot in space 2 is within the white discal line, and that in space 3 is partially within the line. F (male) 17 mm, (female) 17-19 mm. Illustration of (male) UPS in Lewis (1973, plate 84.12). The key features to distinguish *N. xanthaphes* from *N. nikko* are the blue overlay UPS (as opposed to green); white hyaline spots (as opposed to yellow), only two hyaline spots H (as opposed to 3 or 4) which are within or partially within the white discal line (as opposed to partially within or beyond). The separation of *N. xanthaphes* from *N. gladys* is discussed under the latter species.

Plate 34. *Niconiades xanthaphes* adult killed by crab spider, St. Benedict, 16.x.1993.

This is a common and widespread species in forest areas, including disturbed forest, extending to at least 2000 ft. in the Northern Range. It is the commonest and most widespread member of the genus in Trinidad.

I have twice reared this species from larvae collected on *Olyra latifolia* in the forest behind St. Benedict, and SAS has also reared it from this food plant. At least six other Hesperiinae feed on this food plant genus in Trinidad, including *Arita arita* Schaus, *Morys valerius* Möschler, *Orses cynisca* Swainson and *Saturnus saturnus* Fabricius (MJWC unpublished). Janzen and Hallwachs (2001) have recorded *N. xanthaphes* from the same food plant in Costa Rica. The larva which they illustrate has the head uniformly dark brown, shiny rugose, and is not obviously the same as that which I found in Trinidad.

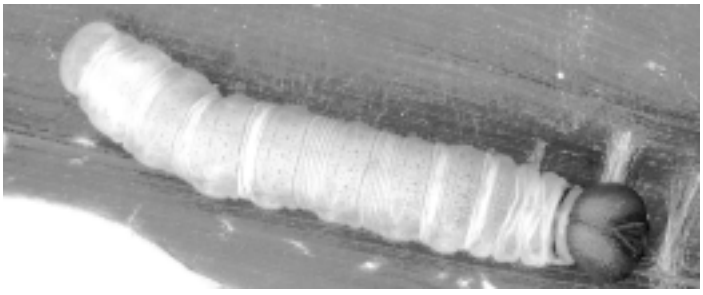

Plate 35. *Niconiades xanthaphes* L5, 20 mm, collected on *Olyra latifolia*, behind St. Benedict, 1.v.1995 (ref. 95/3).

The larvae make a simple leaf roll. The fifth instar larva measures 15 mm when newly moulted and grows to at least 20 mm. The head is rounded triangular in section but relatively narrow, indented at the vertex; mat, rugose, with scattered short setae; brown; slightly darker brown area from the epicranium apex to the stemmata, and along the outside of the clypeal sutures; clypeal sutures narrowly dark brown. In one specimen (ref. 96/2A) the clypeus and adjacent area is dark. T1 shiny, brown plate on posterior margin. Body uniform whitish green. Spiracles pale, inconspicuous. Legs light brown, prolegs concolorous with body.

Plate 36. *Niconiades xanthaphes* L5 detail of head, collected on *Olyra latifolia*, behind St. Benedict, 1.v.1995 (ref. 95/6).

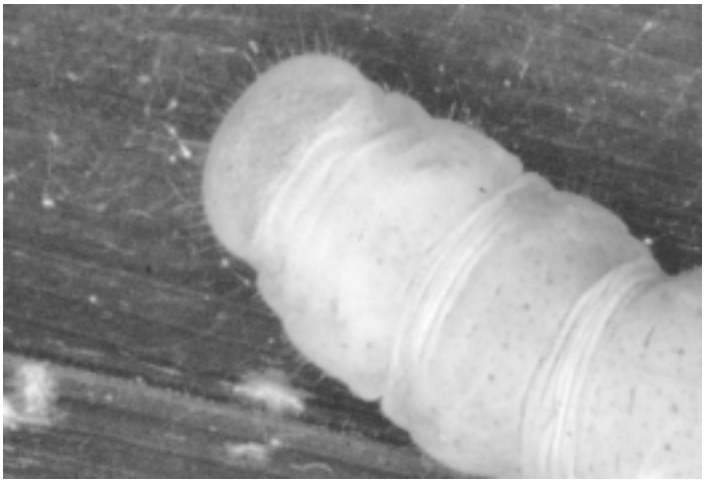

Plate 37. *Niconiades xanthaphes* L5 detail of anal plate, collected on *Olyra latifolia*, 1.v.1995 (ref. 95/3).

A fourth instar larva provisionally associated with this species (ref. 95/6), measured 13 mm. The head was similar in shape to the L5, and plain light brown with a faint shading of darker brown along the epicranial and clypeal sutures, and below apex towards the stemmata which are dark. T1 with shiny black plate on dorsal margin. Body dull translucent green; spiracles pale, quite conspicuous, legs as L5. It moulted to the fifth instar which matched that above, but died before pupating.

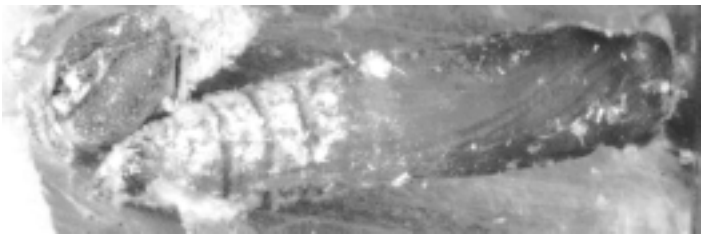

Plate 38. *Niconiades xanthaphes* pupa, 16 mm, collected as larva on *Olyra latifolia*, behind St. Benedict, 1.v.1995 (ref. 95/3).

Pupa 16 (ref. 95/3) to 20 mm (ref. 96/2A). Smoothly contoured, although the bulbous eyes make the head seem flattened; proboscis sheath extends 3-4 segments beyond wing cases. Brown thorax; abdomen green becoming pale brown, with faint dorsal line. White waxy powder on abdomen, in patches on prothorax and eyes; setae along the anterior margin of the eyes and between the eyes accumulate the white waxy powder. Spiracle T1 brown; other spiracles inconspicuous.

255. O11/2 *Niconiades gladys* Evans 1955

Apart from my records from Trinidad (Cock 1982), this species is only recorded from the type locality, Cananche, Cundinamarca, Colombia (Evans 1955).

Plate 39. *Niconiades gladys* (male), Textel Road, 24.x.1979. Scale in mm.

Plate 40. *Niconiades gladys* (male) UNS, Textel Road, 24.x.1979. Scale in mm.

The species is very close in colouring and markings to *N. xanthaphes*, but the two can be clearly separated by the following combination of features: the two cell spots are clearly separate in *N. gladys*, whereas in *N. xanthaphes* they are more or less touching or are joined; the male sex brands are smaller, black and inconspicuous in *N. gladys* whereas those of *N. xanthaphes* are grey and rather conspicuous; the margin H is convex in *N. gladys*, whereas in *N. xanthaphes* it is concave in the male and straight or slightly concave in the female; and the H spots of *N. gladys* are smaller.

I still have just the two records of this species, both from the Morne Bleu Textel Road, a male (24.x.1979) and a female (28.viii.1980). Lacking further records, I suggest this is a species restricted to the higher parts of the Northern Range.

256. O11/6 *Niconiades nikko* Hayward 1948

This widespread species was described from Argentina and occurs from there north to Mexico (Evans 1955); it seems especially common in Trinidad. It was first recorded from Trinidad by Kaye (1904) as *Niconiades caeso* Mabille (a misidentification) without comment.

Plate 41. *Niconiades nikko* (male), Arima-Blanchisseuse Road, milestone 10.5, 5.x.1979. Scale in mm.

Plate 42. *Niconiades nikko* (male) UNS, Arima-Blanchisseuse Road, milestone 10.5, 5.x.1979. Scale in mm.

Sexes similar, but the male has small dark brands at base of space 2 and immediately below vein 2; female is larger, the wings more rounded, the F spots larger and the H spots more pronounced. UPS dark brown with brownish green cilia mostly in basal areas; UPF with pale yellow hyaline spots in cell (double, almost joined in (female)), 2, 3, 6, 7 and usually 8; pale yellow spot in lower space 1B. UPH semi-hyaline pale yellow spots in 2, 3, 4 (in some females) and 5. UNF brown, with a khaki green gloss to the distal half in fresh specimens; the costa yellow-brown adjacent to cell spots, extending to base in some specimens. UNH brown with a green gloss, except in spaces 1B and 1C; a white or pale yellow line from vein 1C to costa just before apex; a white or pale yellow streak in space 1A adjacent to vein 1A, near margin; the yellow semi-hyaline spot in space 2 is either touching or partially within the discal line, that of space 3 is either touching or distal to the discal band. F (male) 18 mm, (female) 20 mm. To distinguish *N. nikko* from *N. xanthaphes* and *N. gladys*, see points under *N. xanthaphes*.

Plate 43. *Niconiades nikko* at *Lantana camara* flowers, Mt. Tamana, 12.xi.1995.

This species is common and widespread in forest areas, including secondary forests. Most records are at quite low altitude, although it certainly extends to over 2,000 ft.

This species has been reared from bamboo in Colombia (AME collection). There is an emerged pupa reared by A.M. Moss in the NHM with an associated L5 larval skin, but no indication of the food plant. The L5 head is oval, but wider ventrally; light brown with two dark stripes, one from the apex, laterally to the stemmata, the other parallel to the epicranial suture, touching the clypeal sutures. The pupa is uniform light brown, smooth, with no frontal spike. There are a few specks of white waxy powder on the posterior part of the abdomen, and more associated with the larval skin.

***Aides* Billberg 1820**

Three of the six species of *Aides* occur in Trinidad, but all are rare, two especially so. These species can be recognised by their large size and the distinctive silvery-white spots UNH.

257. O12/3 *Aides dysoni* Godman 1900

This species is found from Mexico to Ecuador and East to Trinidad (Evans 1955). When Evans (1955) listed a Trinidad male in the NHM, this was the first record from the island.

Plate 44. *Aides dysoni* (male), Trinidad, R. du B. Evans (specimen in NHM).

Male. UPS brown with hyaline white spots; brown brands above vein 1, below vein 2, above vein 2 and along cell in space 2. UNS brown with a chestnut tint to UNH and costa and distal half of UNF; UNS head and a spot on the costa against cell spot yellow-brown; conspicuous silver-white spot covering disc UNH from vein 1B to space 7, with a ground colour inclusion at end cell; small spot above the origin of vein 8.

Plate 45. *Aides dysoni* (female) UNS, Panama (specimen in NHM).

Female. Colouring similar to male, but the UNH is marked with scattered silver-white spots. In both sexes, the silver-white markings UNH are diagnostic.

I have not encountered this species in Trinidad. The male in the NHM has no locality data beyond Trinidad, and no date of collection but the collector was R. du B. Evans. There is no reason to doubt the validity of this record, but confirmation would be desirable. The food plants and life history are unknown.

257a. O12/4 *Aides brino* Stoll 1781

In the NHM collection there are single specimens from Honduras, Colombia, Venezuela, Guyana and French Guiana, together with a series reared in Belem by A. Miles Moss (Evans 1955); obviously it is very rare in collections.

SAS recently added this species to the Trinidad list, having captured a female at Aripo Savannah in February 1986. Since then he has captured a male (Forest Reserve, iv.2000) and two further females (Parrylands, x.1996). All his captures were on forest tracks, where the adults settle on the upper surface of leaves with their wings closed (SAS pers. comm.).

Plate 46. *Aides brino* (male) UNS, Brazil (specimen in NHM).

Male. UPS dark brown; white hyaline spots in spaces 2, 3 and cell (a double spot across width of cell); white opaque spot in space 1B; brands as *A. dysoni*; scattered orange setae across basal half UPF and UPH, densest on costa UPF; small light brown spot UPH middle of space 5, divided by dark sub-vein. UNS head, fore-femora, abdomen light brown. UNF chestnut brown on costa and distal half of wing; termen paler; pale brown spot on costa adjacent to cell spot; white spot in space 1B larger than UPS, extended towards margin. UNH chestnut brown, blackish brown in spaces 1B and 1C; silver-white spots on disc, from space 2 across base of space 3 and end cell, small spot middle of space 5, smaller spot submarginally in space 3.

Plate 47. *Aides brino* (female), Aripo Savannah, ii.1986, S. Alston-Smith (specimen in coll. SAS).

Plate 48. *Aides brino* (female) UNS of Plate 47 (specimen in coll. SAS).

Female. Generally similar to male, but larger and wings more rounded. UPS the orange hairs are more extensive, denser and more conspicuous; UPH spot in space 5 stronger. UNH with silver-white submarginal spots larger, and sometimes linked by a narrow spot in space 4 (not present in the Trinidad specimen).

Moss (1949) reared this species from larvae found on young bushy "bacába" and "pupunha" palms. Interpreting these names in the context of Moss's location in Belem, these species seem most likely to be *Oenocarpus distichus* and *Bactris gasipaes* respectively (Henderson *et al*. 1995). One species of *Oenocarpus* occurs in Trinidad, *O. bataua* v. *interrupta*, and five species of *Bactris* spp., including *B. gasipaes* so these are likely food plants for this species in Trinidad. The elongate white larva has a black spot behind the head, and is covered with white powder. The pupa he describes as being of "a strange unhealthy leaden colour, nearly black; it is elongate, with the proboscis sheath nearly reaching the cremaster, and an upturned hooked frontal spike." There are two empty pupae and associated larval skins from Moss's collection in the NHM. The L5 head is black with a short pale vertical stripe touching the clypeal sutures. One pupa lacks the frontal plate, but that of the other does not have a frontal spike, only a pair of bumps, suggesting there may have been some confusion in Moss's notes or labelling.

258. O12/5 *Aides aegita* Hewitson 1866

This species is found from Panama to Brazil; there is a long series in the NHM reared by A.M. Moss at Belem (the type locality), but otherwise it is quite uncommon (Evans 1955). It was first recorded from Trinidad by Crowfoot (1893) as *Proteides aegita*, and re-recorded by Kaye (1914) as *Paraides anchora* Hewitson (a synonym), from a specimen taken near Port of Spain by H. Caracciolo (now in AME ex W.J. Kaye collection).

Plate 49. *Aides aegita* (male) UNS, collected as larva on coconut palm, 17.ii.1982 (ref. 82/41C). Scale in mm.

Sexes generally similar; female significantly larger with more elongate wings, and male has three very short grey brands above and below vein 2 and above vein 1B; other differences detailed below. UPS dark brown with golden scales and setae on body, head and basal third of wings, much stronger and more extensive in female; basal half of costa UPF as far as cell spot reddish brown, overlaid with golden scales in female. Pale yellow hyaline spots

in spaces 2, 3 and across cell F; opaque pale yellow spots in lower space 1B UPF, and space 5 UPH. UNS head and fore femora yellow-orange, UNS abdomen pale yellow; rest of body UNS reddish brown. UNF black, costa and distal half of wing extending to vein 1 on margin reddish brown, overlaid with yellow-green scales; pale yellow spot in space 1B slightly larger than UPF. UNH matches distal half UNF, spaces 1A and 1C lack the overlay of yellow-green scales; space 1B black with yellow-green scales in basal half; variable silver-white reflective spots UNH: from vein 1B to base of space 3, widest at vein 2, small submarginal spots in spaces 3 and 4, that in space 4 closer to the margin; middle of space 5. Fringes H white from tornus to space 5 in male and to space 7 in female; fringes F white from tornus to space 2. F (male) 22 mm, (female) 26-27 mm. Illustration of (male) and (female) UNS in Lewis (1973, (female) plate 80.16, (female) plate 84.45 as *Paraides anchora*).

The arrangement of silvery-white spots UNH is distinctive. In *A. dysoni*, the discal spot reaches vein 2, not vein 1B as in *A. aegita*, the spots in spaces 3-5 are aligned along their distal margin, and the UNS is clearly reddish-brown, lacking the greenish yellow scales of *A. aegita*. The male of *A. brino* is immediately distinct with the silvery-white spots joined together. The arrangement of silvery-white spots in the female *A. brino* is clearly different: there are spots in cell and usually space 6 and sometimes space 7, which are absent in *A. aegita*; the staggered arrangement of the spots in space 1C - 3 (widest across the width of space 2, the spot in space 1C aligned with the distal end of the spot in space 2 and that in space 3 aligned with the basal end), whereas the corresponding spots in *A. aegita* are in line, and the spot is widest at vein 2.

There is an atypical female specimen in the NHM, taken by A. Hall (Northern Mountains xii.1938-i.1939); this specimen has no silver-white markings UNH, only a small white spot in the middle of space 1C adjacent to vein 2. There is a female in coll. SAS from Mayaro (iii.1993) which is transitional to this, having the white spot larger, and silver-white dots at the base of space 3, submarginally in space 3, and a larger spot in space 5.

Plate 50. *Aides aegita* (female) UNS atypical, Northern Mountains, xii.1938-i.1939, A. Hall (specimen in NHM).

Plate 51. *Aides aegita* (female) UNS atypical, Mayaro, iii.1993, S. Alston-Smith (specimen in coll. S. Alston-Smith).

I have seen Trinidad specimens from Caparo (female), F. Birch, in NHM), Palmiste (female) before 1915, N. Lamont in UWI; (male) 29.iv.1922, N. Lamont in RSM), Port of Spain (female), i.1897, Dr. Rendall, in NHM), St. Augustine (male), Santa Margarita Road, 22.x.1981, J. and F. Preston). SAS considers this species uncommon rather than rare, having scattered records, including one from El Tucuche, showing that this species will occur at all altitudes in Trinidad. There seems no reason for this species not to be widespread in Trinidad wherever coconut or other suitable palms are found. Nevertheless, although I have found larvae several times, I have never encountered adults in the field. June and Floyd Preston's male specimen from Santa Margarita Road was captured at lantana flowers, and I have no other information on the adult biology of this species.

Plate 52. *Aides aegita* adult (female), collected as larva on coconut, Lalaja Ridge, 6.v.1995 (ref. 95/16).

Moss (1949) notes that the larvae, which feed on coconut palm (*Cocos nucifera*), are very long, and surrounded by an abundance of white powder. Moss's L5 head capsules in the NHM are mostly covered with white waxy powder, and beneath this they are pale brown with dark markings of variable extent. Two dead pupae show the exit holes of a *Brachymeria* pupal parasitoid (Chalcididae).

In Trinidad, I have found larvae and pupae on coconut palm several times: Caura Valley, 17.xii.1981, ref. 81/25C; Lalaja Ridge 6.v.1995, ref. 95/16; St. Augustine, 17.ii.1982, ref. 82/41C; St. Benedict, 1.v.1995, ref. 95/5 and 4.v.1995, ref. 95/13), and once on Manila palm, *Veitchia merrillii*: St. Augustine, 2.xi.1981, ref.

81/12B. Apart from ref. 81/41C which was found in the crown of a felled 3m coconut palm, all larvae were collected from fronds of young palms while standing on the ground. SAS has reared this species from another, as yet unidentified palm (Moruga East, ii.1982).

Plate 53. *Aides aegita*, L4 detail of head, collected on coconut palm, St. Benedict, 1.v.1995 (ref. 95/5).

Larger larvae form a shelter from a single leaflet, rolling the edges downwards, held in place by a series of stout silk strands, and lined with white waxy powder. When disturbed, the larva will regurgitate a green liquid, presumably from the fore-gut. The female L5 grows to 57mm; the larva is elongate and covered with white waxy powder, so that the markings are not normally visible. Head 3.5mm wide, 4mm high; almost parallel sided in lower half, rounded over the epicranium, and slightly indent at vertex. The following is based on the dead larva of ref. 95/5 with the white waxy powder removed: head mat rugose, with very inconspicuous short pale setae; ground colour brown; clypeal sutures dark brown; a broad dark brown stripe down each side of the face on the epicranium, parallel to the epicranial suture and running to the outer corner of the clypeus, the stripe diffusely bordered, especially on the posterior margin; in other specimens (refs. 81/12B, 82/41C), the head is paler and the dark stripe not obvious. The body is green, but covered with white waxy powder and the only features evident are a dark lateral spot over the spiracle T1, and a larger dorso-lateral spot on T2; these spots seem to be diagnostic for this species. The anal plate is semi-circular on the posterior margin, flanged and with a fringe of long pale setae. The L4 and L3 larvae are similar, except that the centre of the face is shiny brown, without white waxy powder. L2 lacks the dark stripe on the head, which is light brown.

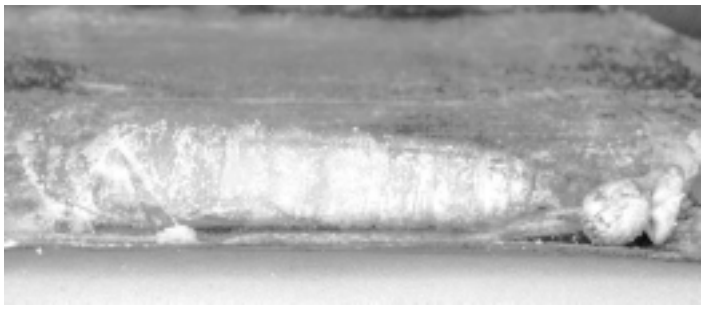

Plate 54. *Aides aegita* pupa, 34 mm, collected as larva on coconut palm, Lalaja Ridge, 6.v.1995 (ref. 95/16).

The pupal shelter is a rolled leaflet; the anterior and posterior ends of the shelter are blocked by a loose flocculence of silk and white waxy powder. The pupa is pale yellow-brown, and measures 34-35 mm. It is elongate and cylindrical, with a 3mm frontal spike, strongly curved upwards so that the apex is vertical; a tuft of erect white setae in front of the eye, and another behind; these setae trap white waxy powder; dorsally on the thorax some eight backward projecting setae and 4 forward projecting setae hold in place the silken girdle which supports the pupa; the proboscis sheath almost reaches or extends slightly beyond the cremaster tip, which is bent downwards. Pupation took 13-14 days.

One 8 mm larva corpse on coconut (St. Benedict, 4.v.1995, ref. 95/13) was associated with a flimsy 4.5 mm parasitoid cocoon, which subsequently emerged. The parasitoid has not been identified.

259. O13/1 *Xeniades chalestra chalestra* Hewitson 1866

Evans (1955) recognises two subspecies of *X. chalestra*: *pteras* Godman from Costa Rica, Panama, Colombia and Venezuela, and *chalestra* which is widespread in South America, as far south as Paraguay. It was first recorded from Trinidad by Kaye (1914), as *X. pteras* Godman, from a specimen taken by J.L. Guppy at Chaguanas, 5.xi.1913 (a female, now in AME ex coll. W.J. Kaye). There is an additional male in the NHM labelled only "Trinidad".

Plate 55. *Xeniades chalestra* (female) UNS, Oropouche South Lagoon, 23.xii.1981. Scale in mm.

Female. UPS dark brown, with green setae on thorax and basal third UPF, and UPH extending along termen; large, well-separated pale yellow hyaline spots in cell and spaces 2, 3, 6-8 F; opaque pale yellow spot in lower 1B UPF, 3, 4, 6 and cell UPH; tip of abdomen russet. UNS head, fore femora and abdomen pale yellow. UNF black basally; reddish brown on costa, and apex, extending to vein 2 on margin; pale yellow spot in space 1B extends into upper space 1B, and along vein 1 to margin; a dusting of pale yellow scales in space 1A and in spaces 4 and 5 between the spots in spaces 3 and 6. UNH reddish brown, except space 1B and 1C blackish; an even 2 mm wide pale yellow line runs from costa at about $^1/_3$ to space 2 where it is acutely angled back to vein 1B; distal $^1/_3$ of space 1A pale yellow; pale yellow, almost white, spots with inconspicuous black margins in spaces 3, 4 and 6. Fringe white H and pale UPF spaces 1A-2, otherwise brown. Evans (1955)

refers to the UNF having a yellow patch on the costa adjacent to the cell spot, but this is no more than a few scales in my Trinidad female. The male is similar, but has more pointed wings and Evans (1955) describes the brands as small, grey or black, at the base of space 2, under and over vein 2 and over vein 1. F (female) 24 mm.

The large size and strong pale yellow or white line UNH distinguishes the two Trinidad *Xeniades* spp. from other skippers. *Xeniades chalestra* can be immediately separated from *X. orchamus*, by the arrangement of pale yellow spots UPH in spaces 3, 4, 6 and cell; *X. orchamus* having no cell spot UPH. Also, the setae of the UPS body and wing bases are orange in *X. orchamus*, and the pale line UNH is white, and wider near the tornus.

I have encountered this species just once, when I captured a fresh female beside Southern Main Road, between the sea and Oropouche South Lagoon (23.xii.1981). More recently SAS has collected this species from Santa Flora ((female) vii.1990), and several times from North Post ((male)(male) vi.1999, x.2000; (female)(female) x.99, x.2000 (2), xii.2000) where they can be seen regularly.

The larva is similar to that of the next species, according to Moss (1949), but more maroon coloured. It feeds on dwarf or ground bamboo. Moss's cast L5 skins in the NHM are mostly covered with white waxy powder, but it can be seen that the head and body are covered with pale brown setae up to 3 mm long; the head is dark brown, but I cannot make out any markings. The pupa is formed in a silk lined shelter, which in the anterior part is lined with small bits of loose white flocculence. The pupa is brown with forward pointing light brown setae on the thorax and backward pointing setae on the abdomen. No frontal plates are visible, so the form of the frontal spike (if any) is not known. The proboscis sheath extends to the cremaster.

Based on material in the NHM, H.E. Box reared this species in Guyana (under his reference no.63) but the food plant is not recorded. Box's notebook of reared Hesperiidae in Guyana was in the IIBC library in Curepe in 1982, but I have not been able to locate it on visits since 1988 and it may have been lost.

259a. O13/2 *Xeniades orchamus orchamus* Cramer 1777

This species is widespread in South America, from Panama to Argentina (Evans 1955), but has not previously been recorded from Trinidad.

Plate 56. *Xeniades orchamus* (male) UNS, 20.ix.1994, F.C. Urich (coll. MJWC). Scale in mm.

Male. UPS dark brown; orange brown setae on basal part of both wings and thorax; pale yellow hyaline spots in spaces 2, 3, 4 (dot), 6-8 and cell F; pale yellow opaque spots in space 1B UPF (extending slightly into upper half of space, and the upper edge extended towards margin), and spaces 3, 4 and 6 (dot) UPH. Abdomen black with orange-brown setae on basal segments; white ventrally, and laterally on the posterior margin of the distal five segments, extending almost all the way around the abdomen on the last of these. UNF black basally; reddish brown on costa and apically, extending to vein 2 at the margin; spot in space 1B white, otherwise similar to UPS. UNH reddish brown, black on termen and in spaces 1B and 1C, white in distal part of space 1A; a yellow-white line from mid costa where it is 1.5 mm wide, running to space 2 where it is 2.5 mm wide and completely white; white spots in spaces 3 (joined to white line), 4 (separated from last only by the dark vein 3), 5 (two small staggered spots) and 6 (small). F (male) 24 mm. Illustration of UPS in Lewis (1973, plate 88.31). The identification of this species is discussed under *O. chalestra*.

The first specimen of this species to come to my attention was a male taken at light by Clive Urich at his Sans Souci Estate, Sangre Grande (20.ix.1994), but SAS has specimens he collected at Grand Ravine ((male) iii.1995), Guapo ((male) ix.1981, at light on an oil rig), Inniss Field ((female) x.94, at eupatorium flowers), Sangre Grande ((male) iii.1986, at flowers) and two females collected by Clive Urich (Sangre Grande, vi.1999, at light). Thus, this species is widespread in southern and central Trinidad, and occasionally comes to flowers and to light.

Moss (1949) found larvae of this species mostly on a yellow stemmed bamboo. The larva he describes as "crimson velvet supported laterally by light down", with the extremities brown. The last larval shelter in which the pupa is formed is a bundle of bamboo leaves at the tip of a bough, held by silk, with white powder and flocculence. Some of Moss's material of emerged pupae and cast L5 skins is in the NHM, but the larval skins are covered with white flocculence and indistinguishable from those of *X. chalestra*. The silk lined shelter seems more robust than that of *X. chalestra*, and the white waxy powder is quite heavily spread on the pupa apart from the wing and appendage cases. The emerged pupae are dark brown, with erect brown setae on the head and thorax, and shorter backward pointing brown setae on the abdomen. The proboscis sheath extends to the cremaster. None of the emerged pupae seem to have associated frontal plates, but a dead, parasitised pupa has a short, stout frontal spike with a widened truncate tip with light brown setae on it. Moss's material includes a series of a gregarious *Brachymeria* sp., black with partially yellow legs.

***Saliana* Evans**

This genus has a uniform pattern of spotting, and in most species the UNH is divided into a paler basal area and a darker distal area. F hyaline spots in 1B, 2, 3, 6 and 7, and sometimes in spaces 4, 5 and 8; H with discal spots in spaces 4 and 5 and sometimes 3.

Moss (1949) reared several species of this genus (which at that time was treated as part of *Thracides*), including *S. triangularis*, *S. antoninus*, *S. longirostris* and *S. salius*, as well as some species undescribed at that time. The confusion over the taxonomy of the genus meant that descriptions and illustrations are not included in his paper. The food plants on which he found larvae include *Monotagma contractum*, *M.* sp., *Ischnosiphon ovatus*, *Calathea*

lutea (all Marantaceae), and *Canna coccinea* (Cannaceae). I have reared four species of the genus from *Heliconia* (Heliconiaceae), *Costus* (Costaceae) and *Calathea*; all four species are easily distinguishable as larvae. Janzen and Hallwachs (2001) have also reared several *Saliana* spp. in Costa Rica, for which the taxonomy has not yet been clarified; their recorded food plants include five *Calathea* spp. and arrowroot, *Maranta arundinacea* (Marantaceae), two or three species of *Costus*, *Heliconia latispatha* and a *Renealmia* sp. (Zingiberaceae).

Eight species of this genus occur in Trinidad. Several are confusingly similar, and difficult to identify from individual specimens, especially those in poor condition. *Saliana esperi* is close to *S. antoninus*, which is close to *S. longirostris*, which is close to *S. salius*, which is close to *S. saladin*. Indicative of the difficulties, several of the specimens from the W.J. Kaye collection (in AME) were mis-labelled by Kaye.

Saliana hewitsoni is immediately distinguished by its uniform dull green UNH, but there are similar species known from the mainland which could turn up in Trinidad. The first two species, *S. mathiolus* and *S. triangularis*, are separated from the remainder, as the cell spot F is restricted to the lower half of the cell, whereas in the remaining four species it extends into the upper, costal half of the cell, and their UNH markings are quite distinctive. Of the remaining five species, *S. esperi* is consistently smaller and has a distal streak from spot in space 1B UNH, while the remainder can be separated by a combination of UNS markings, of which those of the apical area UNF seem most clear cut. Thus, *S. antoninus*, is uniformly light chestnut brown (with just a trace of lighter colouring in spaces 4 and 5 in fresh specimens), *S. longirostris* has a quadrate grey-brown area in the basal part of spaces 4 and 5 and the remainder of the apical area dark chestnut brown, *S. salius* has spaces 3-5 purple-brown and spaces 6 to costa dark chestnut brown, and *S. saladin* has the apical area uniformly dark purple-brown.

260. O14/1 *Saliana mathiolus* Herrich-Schäffer 1869

The type locality of this rare species is not known, but there are specimens from Venezuela, Trinidad and South Brazil in the NHM (Evans 1955). Riley (1921) described this species as *Thracides verecundus* from a Trinidad specimen, taken by F.W. Jackson at St. Joseph, but this name is now considered a synonym of *mathiolus*.

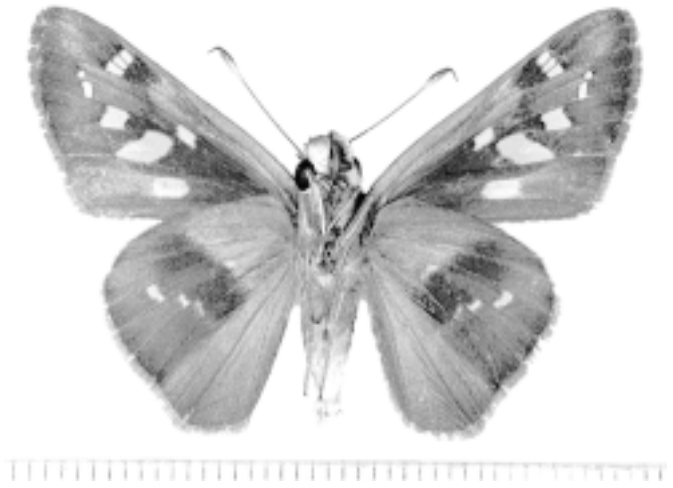

Plate 57. *Saliana mathiolus* (female) UNS, Lower Morne Catherine, 21.v.1982. Scale in mm.

UPS dark brown with white hyaline spots. UNF brown with the following diffuse and not very distinct shading: costa pale brown; pale area on costa covering base of spaces 8-9 and filling most of space 10; similar submarginal area in spaces 6 and 7; distal part of costal half of cell with tawny setae; the area distal to the cell and basal to the spots in spaces 4 and 5 light brown; the submarginal area distal to spots in spaces 2 and 3 similar; a yellow streak from apical angle of spot in space 1B runs towards the tornal angle of the spot in space 2; distal to this light brown with a tint of lilac. UNH with hyaline white spots in 2 and 3-4; basal area light brown with a lilac flush, sharply demarcated across space 2, cell, 6, 7 and costa; distal half of space 1A, and spaces 1B and 1C apart from base tawny brown, shading into basal area; distal to the pale basal area and basal to the H spots, brown; distal to the H spots and along costa to join basal pale area, light brown with a lilac flush and diffuse margins, but not as pale as basal area; margin spaces 2-6 brown shading into the light brown area. The distinct straight margin to the UNH basal pale area, running from vein 2 at right angles to vein 8 is the best feature to distinguish this species from others of the genus in Trinidad. F (male) 19 mm, (female) 21 mm.

This is a rare skipper in Trinidad collections. I have just seven records, from Fort George ((male) ix.1891, in NHM), St. Georges ((male) x.1891, C.W. Ellacombe in NHM), Hololo ((male), 17.xi.1920, W.J. Kaye in AME) Maupertuis (20.iv.1922, N. Lamont in RSM), Caura Valley (female) ii.1930, A. Hall, ex coll. W.J. Kaye - identified as *Thracides triangularis*, in AME), Morne Jean to the west of Diego Martin (12.xii.1978) and from the lower slopes of Morne Catherine ((21.v.1982). 19). SAS has further captures from Andrews Trace ((male) iii.1990), North Post ((male) xii.1998), ((male) x.1999), 2 ((female) ix.2000) and Quinam ((female) viii.1993). The localities suggest this species may be commoner in the north-west of the island than elsewhere.

Life history and food plants unknown.

261. O14/4 *Saliana triangularis* Kaye 1914

This widespread, but not very common species was not described until 1914, having been misidentified by earlier workers, either as *S. salius* Cramer or as *Vacerra hermesia* Hewitson (Evans 1955). It is found from Mexico to Argentina (Evans 1955).

Kaye (1914) described this species from Trinidad, on the basis of a G.E. Tryhane specimen taken in St. Ann's Valley. In his 1921 catalogue, Kaye records a N. Lamont specimen, taken Rock Road Penal, 1.i.1921. Kaye (1921) also records it as occurring in Jamaica, but must have made an error since no *Saliana* spp. are known from Jamaica (Brown and Heineman 1972; Smith *et al*. 1994). Kaye (1940) subsequently incorrectly treats this as a synonym of *S. antoninus*.

Plate 58. *Saliana triangularis* (female) UNS, Mt. Tamana, 13.vii.1997. Scale in mm.

UPS dark brown with yellowish hyaline spots; tawny setae on basal areas, both wings and termen UPF. UNF costa to 2/3 yellow; rest of costa and apical part of wing as far as vein 2 at margin, reddish brown with a purple sheen visible at some angles, especially in the female, and especially around the apical spots; all of spaces 1A and 1B, cell and space 2 basal to the spots black. UNH male: basal half yellowish brown, shading evenly into distal half brown; space 1B with the basal half paler. UNH female: spaces 1A, 1B and 1C light brown, the basal half paler especially in space 1B; basal part of the remainder to end cell and 2/3 on costa lilac, this shades into a distal area of reddish brown, with a strong purple sheen, so that at some angles this part of the wing looks dark purple; costa diffuse yellow to a variable degree, absent in some specimens. The evenly shaded transition from the basal to the distal part of the hind wing is the best character to distinguish *S. triangularis* from other Trinidad *Saliana* spp. F (male) 20-21 mm, (female) 22-23 mm. Illustration of UPS in Lewis (1973, plate 86.38).

This is an occasional species restricted to the forests of Trinidad. I have records from Manzanilla, Morne Catherine, St. Ann's, Las Lappas Trace, Las Lomas, Mt. Tamana, Morne Diable and Parrylands. All specimens were taken beside forest tracks or within the forest.

A.M. Moss reared this species and there are emerged pupae and L5 skins in the NHM, although the food plant cannot now be associated. Jansen and Hallwachs (2001) reared *S. triangularis* regularly from *Maranta arundinacea*, and less frequently from four species of *Calathea*. Larvae are likely to be found on these or related Marantaceae in Trinidad.

The triangular head of Moss's L5 material is indent at the vertex; it is brown, with the face light brown, although the margin between the two areas is diffuse. The larva illustrated by Jansen and Hallwachs (2001) has the head dark brown, with red eye spots in front of the stemmata and a red area at the front of each apex. It may well be that Moss's material curated as *S. triangularis* represents a different species.

Moss's pupae are elongate, smooth, with a short upturned frontal spike; the proboscis sheath extends well beyond the cremaster; no associated white waxy powder; colour translucent white (hence green in life) with a dorso-lateral row of small brown spots on T1-2, and on the anterior margins of T3 and A2-A7. Moss's material includes cocoons of a gregarious *Apanteles* (s.l.) sp. associated with an L5, and a tachinid fly.

262. O14/10 *Saliana hewitsoni* Riley 1926

This uncommon species occurs from Panama to Bolivia, and was described from the Upper Amazons. It was added to the Trinidad list by Cock (1982).

Plate 59. *Saliana hewitsoni* (female) UNS, Textel track, 17.ix.1980. Scale in mm.

UPS brown with white hyaline spots. UNF dark on disc to tornus, with apical area dull green. UNH uniform dull green. F (female) 26 mm. This is the only *Saliana* sp. with a uniform dull green UNH recorded from Trinidad, although in older specimens, such as the only one known from Trinidad, this colour fades to more of a purple-brown tint. Evans (1955) treats three other *Saliana* spp. with a plain green UNH, all of which are recorded from the Guyanas and could turn up in Trinidad. In *S. fischeri* Latreille the cell spot does not reach the upper edge of the cell, and the spot in space 3 UNH is larger than those on either side; *S. nigel* Evans is like *S. fischeri* except the cell spot reaches the upper edge of the cell; and *S. vixen* Evans has the F hyaline spots yellow, not white.

I know of just one Trinidad record, a female in rather poor condition captured on the old track between milestone 10.5 on the Arima-Blanchisseuse Road and Morne Bleu Textel, 17.x.1980 (Cock 1982). The butterfly was flying within the forest when it paused to feed at flowers (I think of *Stromanthe tonkat*) at the forest edge and was caught. This track was completely overgrown when I last visited in the late 1990s. The location suggests that this may be a high altitude species in Trinidad.

A specimen in the AME was reared on "ginger". There is an emerged pupa from the A.M. Moss collection in the NHM labelled as *S. hewitsoni*. It is smooth, elongate, with a short, blunt frontal spike, and the proboscis sheath extends well beyond the cremaster. There are no associated larval remains.

263. O14/12 *Saliana esperi* Evans 1955

Kaye (1940) adds this species to the list as *Thracides telegonus* Esper, an unavailable homonym, subsequently renamed *esperi* by Evans (1955). Evans (1955) described this species from Ecuador, and records a distribution from Mexico to South Brazil. Trinidad material is particularly well represented in the NHM, compared to other areas. Although Sheldon (1936, 1938) does not record this species from Tobago, there are a male and female from his collection in the NHM (see also comments under *S. antoninus*).

Plate 60. *Saliana esperi* (male) UNS, Brasso, 1.x.1994. Scale in mm.

UPS dark brown with slightly yellow hyaline spots, which are paler in the female; tawny setae basally on both wings and on termen UPF. In the female, there are normally two hyaline spots H in

spaces 4 and 5, but the male may also have a smaller spot in space 3. UNF costa yellow-brown to 2/3; apical area to vein 2 at margin reddish brown; disc to tornus dark. UNH space 1A yellowish white basally shading to reddish brown at margin; space 1B and 1C yellow to 2/3, distal 1/3 grey-brown; remainder of UNH dirty white basally and reddish brown distally, the dividing line clear and contrasting, in an arc from about ½ on space 2 to just before apex in space 8, so that the reddish brown area forms a semi-circle on the margin of the wing. F (male) 19-20 mm, (female) 19-20 mm. Illustration of the (male) in Riley (1975, plate 24.18). This species is similar to the next four in markings, but consistently smaller. *S. esperi* also differs from these species in that the spot in space 1B UNF has a pale streak towards the margin, running either from the apical angle or the distal margin.

This is probably the commonest member of the genus in Trinidad, and like the other members of the genus is associated with forested areas. I have relatively few records from the Northern Range, most are from central and south Trinidad.

There is a female specimen in the NHM reared from a "wild plant (Zingiberaceae) in deep jungle" in Guyana by H.E. Box. The rearing records of Jansen and Hallwachs (2001) support this as they have regularly reared this species on *Costus bracteatus* and *C. scaber* (Costaceae, but note earlier authors included this family within Zingiberaceae) in Costa Rica, and most probably *Costus* spp. are also the food plant in Trinidad.

Moss reared this species in Belem, and there are emerged pupae, parasitised pupae, L5 cast skins and associated parasitoids in the NHM, but no indication of the food plant. The L5 has a rounded head, narrower dorsally, and slightly indent at vertex; uniform light brown in colour, the head and body are covered with long, semi-recumbent pale setae. No other members of the genus have setae on the head and body, and neither does the larva illustrated by Jansen and Hallwachs (2001). I conclude that Moss's material is misidentified, and incorrectly associated with the adults which he reared. The larva illustrated by Jansen and Hallwachs (2001) has a plain, shiny, smooth black head.

264. O14/13 *Saliana antoninus* Latreille 1824

This species was described from Brazil, and occurs from Guatemala to South Brazil (Evans 1955). It was first recorded from Trinidad by Crowfoot (1893) as *Thracydes antonius* (a mis-spelling). Kaye (1921) adds a record from St. Joseph (15 Jan, F.W. Jackson). Sheldon (1936) records catching this species at Speyside, but the only *Saliana* spp. from Sheldon's collection in the NHM, are a male and female *S. esperi*, suggesting that Sheldon misidentified his material.

Plate 61. *Saliana antoninus* (male) UNS, collected as larva on *Costus scaber*, Point Gourde, 8.x.1995 (ref. 95/45). Scale in mm.

UPS dark brown with yellow hyaline spots; costa UPF tawny brown and tawny setae on basal portions of both wings. UNF costa yellow to 2/3; apical area distal to upper part of cell spot to margin at vein 2 light chestnut brown; disc, termen and tornus to vein 2 black; in fresh specimens, the quadrate area in spaces 4 and 5 between end cell and the spot (or trace) in space 4 is slightly paler, but this rapidly becomes indistinguishable in older specimens. UNH space 1A dirty white to 2/3, then shading to chestnut brown; spaces 1B and 1C yellow to 2/3 then shading to chestnut brown, with a dark area each side of vein 1B at margin; rest of wing creamy white basally, dark reddish brown distally, slightly paler at apex, the contrasting line running in a weak arc from ½ on vein 2 to just before apex in space 8. F (male) 22-23 mm, (female) 22-24 mm.

Very similar to *S. esperi* in markings but consistently larger, lacking the extension of spot in space 1B UNS, and the brown areas UNS are more of a chestnut colour and not as dark as in *S. esperi*. The basal area UNH is much paler than that in any of the following three species, and the UNF apical area is distinctly lighter in tone.

This is a fairly common and widely distributed species in forested areas of Trinidad.

There is a series in the NHM reared by A.M. Moss, but unfortunately the early stages and food plants are not associated (see comments under *Saliana* above); they may have been confused with the next species.

I have reared this species twice, both times from fourth instar larvae collected on *Costus scaber* (Costaceae), once from near the summit of Morne Catherine (26.ii.1994, ref. 94/17) and once from Point Gourde (8.x.1995, ref. 95/45). In Trinidad, *C. scaber* is also known to be the food plant of *Cyclosemia herennius* (Cock 1991) and *Saliana salius* (below), and it is likely to be the food plant of *S. esperi* (above).

In the two examples listed above, the L4 had been feeding from the apical part of the leaf which had then been folded under, one diagonally, and the other at right angles to the mid-rib. Another L4 collected off the Rio Claro - Guayaguayare Road, near the junction with Saunders Trace (11.x.1993, ref. 93/11) had eaten a large patch from the edge of the basal half of a leaf, and formed a shelter by folding over upwards the margin of the distal part of the leaf to make a shelter 2cm wide at the basal end adjacent to the feeding, and 6cm long, tapering to a point.

Plate 62. *Saliana antoninus* L5 detail of head, collected on *Costus scaber*, Point Gourde, 8.x.1995 (ref. 95/45).

The L5 grows to about 50 mm. The head is rounded triangular in shape, indent at the vertex; finely rugose; light brown, posterior margin dark brown dorsally; a short, smooth, yellow streak just below the apex of each epicranium, parallel to the epicranial suture; a smooth, yellow, roughly rectangular spot anterior to the stemmata; the area on each side between the two yellow spots is distinctly paler than the light brown ground colour; clypeal sutures brown for dorsal half. The markings of the head, especially the yellow spots are distinctive and characteristic for this species. T1 concolorous with body. Body dull, translucent dark green; dorsal line only slightly darker; gonads not obvious; spiracles pale and joined by a tracheal line; paler ventro-lateral flange; all legs concolorous with body. The wax glands develop in a single sub-ventral mass on each side of the body from the posterior margin of A7 to the anterior margin of A9. The L5 head capsule loses the yellow coloration when shed at pupation.

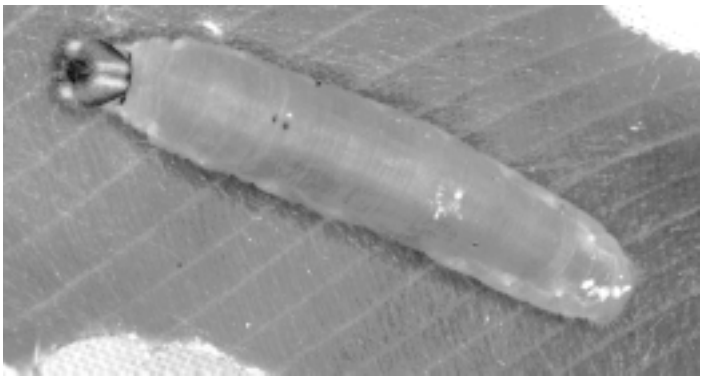

Plate 63. *Saliana antoninus* L4, 22 mm, collected on *Costus scaber*, Morne Catherine, 26.ii.1995 (ref. 94/17).

The L4 grows to about 22 mm; it is similar to the L5, except that the area on the head between the two yellow spots is not paler, leaving the yellow spots more conspicuous; T1 a short, brown, transverse dorsal plate.

Plate 64. *Saliana antoninus* pupa, 41 mm, collected as larva on *Costus scaber*, Point Gourde, 8.x.1995 (ref 95/45).

The male pupa measures 41 mm; it is elongate, cylindrical and smooth; a 2mm frontal spike, slightly upturned at apex; proboscis sheath extends 6mm beyond cremaster; colour uniform pale green, spiracles inconspicuous. Pupation took 12-19 days. The pupa cuticle after emergence of the adult is very flimsy, and easily crumpled.

The larva from the Rio Claro - Guayaguayare Road (ref. 93/11) was parasitised by a tachinid larva which emerged from the mature L5 after the formation of the wax glands, but the adult fly failed to emerge from the resultant puparium.

265. O14/15 *Saliana longirostris* Sepp 1848

This species, which occurs from Mexico to South Brazil, was described from Surinam (Evans 1955). It was first recorded from Trinidad by Kaye (1904), based on a single specimen from Tunapuna, and later (Kaye 1921) suggests this may be the commonest species of the genus. Although the Tunapuna specimen which Kaye recorded is a male *Saliana antoninus* (Trinidad, [19]02, Guppy, ex coll W.J. Kaye – labelled *antoninus longirostris* - in AME), this is a valid Trinidad species. Subsequently, Kaye (1940) incorrectly treats this as a synonym of *S. antoninus*.

Plate 65. *Saliana longirostris* (male) UNS, collected as larva on *Heliconia hirsuta*, Mt. Tamana, 13.vii.1997 (ref. 97/205). Scale in mm.

UPS brown with yellow hyaline spots; tawny setae on basal parts of wings, especially on lower half of cell F, and on termen UPF. UNF costa beige to end of cell spot, space 11 yellow-brown to same point; apical portion of wing from end of beige area on costa to vein 2, including upper part of cell distal to cell spot chestnut brown; the basal portion of spaces 4 and 5 to spot in space 4 and extending slightly further towards margin in space 5 grey-brown - this feature becoming increasingly less distinct as specimens become more worn; remainder of UNF, i.e. cell basal to cell spot, lower part of cell distal to cell, spaces 1A, 1B and 2 (apart from a marginal triangle which is chestnut brown) dark, blackish. UNH space 1A basal half yellow-brown, distal half chestnut brown; space 1B basal half clearer yellow, distal half blackish; space 1C basal half as 1A, distal half as 1B; remainder of wing divided by an arc from middle of vein 2 to just before apex; basal half light brown with a plum tint to basal part of costa and a grey-lilac tint to distal area (becoming more yellow in worn specimens); distal half dark reddish brown, with a diffuse grey-brown area in margin spaces 3-7. F (male) (reared) 23 mm, (female) 25-26 mm.

The grey-brown area in spaces 4 and 5 UNF is a distinctive character for this species - at least when specimens are fresh. Worn specimens are similar to worn *S. antoninus*, but normally the paler basal area UNH and the lighter chestnut apical area UNF in *S.*

antoninus are still apparent.

This species seems quite uncommon, but widespread in forested areas throughout Trinidad. SAS considers it commoner in the south of the island.

I have reared this species from a second instar larva found on *Heliconia hirsuta* on Mt. Tamana (13.vii.1997, ref. 97/205). Although the adults of *S. antoninus* and *S. longirostris* are confusingly similarly, the food plants and larvae are reassuringly different. Thus, whereas *S. antoninus* feeds on *Costus scaber*, *S. longirostris* feeds on *Heliconia* sp(p)., and whereas the larva of *S. antoninus* has a distinctive light brown head with yellow markings, and a dull green body, the larva of *S. longirostris* has a plain brown head and reddish green body.

Plate 66. *Saliana longirostris* L5, 35 mm, collected on *Heliconia hirsuta*, Mt. Tamana, 13.vii.1997 (ref. 97/205).

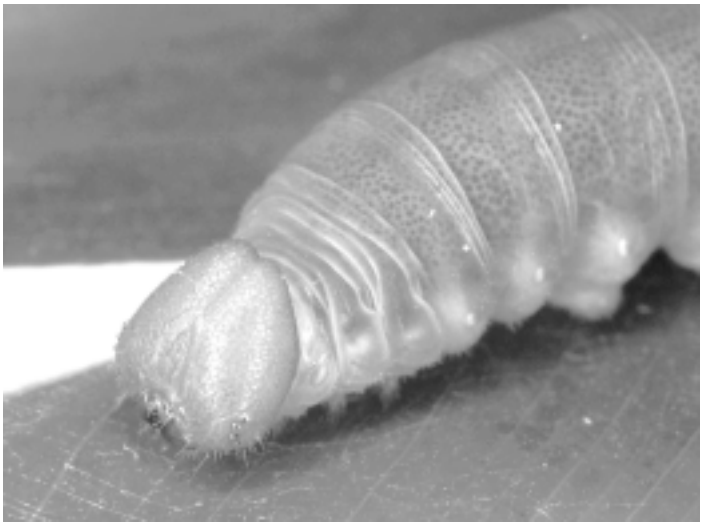

Plate 67. *Saliana longirostris* L5 detail of head, collected on *Heliconia hirsuta*, Mt. Tamana, 13.vii.1997 (ref. 97/205).

The newly moulted L5 measured 35 mm, but by the end of the instar the larva measured 54 mm. Head rounded triangular, indented at vertex; shiny rugose; uniform light brown; ocelli brown. T1 pale. Body dull translucent green with red cuticle; ventrally pale, without red colouring; yellow male gonads. All legs pale, concolorous with ventral surface. Spiracles pale. Wax glands one patch each side ventro-laterally on A7-A8.

Plate 68. *Saliana longirostris* L3, 17 mm, collected as larva on *Heliconia hirsuta*, Mt. Tamana, 13.vii.1997 (ref. 97/205).

The newly moulted L4 measures 17 mm. Similar to L5 but head only slightly rugose; uniform light reddish brown. T1 pale with brown transverse plate on posterior margin. Body reddish green, pale ventrally; yellow gonads visible. Spiracles and all legs pale; strong tracheal line. L3 similar to L4, but body colour darker and body surface shinier. L2 similar to L3; it measures 11 mm before moulting, and the gonads are not apparent. L1 not seen.

The male pupa measured 41 mm including a 2 mm frontal spike which is curled over upwards at the tip; proboscis sheath extends 6 mm beyond cremaster; smoothly elongate; light green; spiracles pale.

Moss (1949) provides an illustration of this species, but no description. The illustration shows a larva with a dark head and translucent body. A.M. Moss's material of early stages in the NHM appears to represent two different species. One head capsule appears to be of this species, while the other seems to be *S. saladin*. Similarly there is one pupa with relatively slender frontal spike which may be this species, and four with a much more robust frontal spike (although lacking the pupal markings noted below for *S. saladin*). Without associated adults this material must be interpreted with caution.

266. O14/17 *Saliana salius* Cramer 1775

This species was described from Surinam, and is found from Guatemala to Uruguay (Evans 1955). It was first recorded from Trinidad by Kaye (1914) as *Perichares salius*, when he found it to be "not rare" in St. Ann's Valley. Subsequently, Kaye (1940) inadvertently adds this species to the Trinidad list again as *Thracides salius*, noting his captures from St. Ann's Valley and adding a specimen from Manzanilla, captured by F.W. Jackson, 29.i.1922.

Plate 69. *Saliana salius* (male) UNS, collected as larva on *Costus scaber*, Rio Claro - Guayaguayare Road, milestone 7, 1.x.1994 (ref. 94/48). Scale in mm.

UPS dark brown, hyaline spots yellow; tawny setae in basal parts of both wings, especially along costa. UNF costa yellow-brown to end of cell spot; beyond this, including the upper half of cell distal to the cell spot, as far as vein 5, dark chestnut brown; space 5, 4, 3 and margin of 2 purplish brown; remainder of UNF black. UNH space 1A basal half yellow-brown, distal half dark chestnut brown, margin black; spaces 1B and 1C basal half as 1A, distal half black; remainder of UNH divided as for others of the genus, basal half pink-brown, costa sometimes more mauve, distal part may be paler, closer to lilac; distal half dark purple-brown, with marginal area in spaces 4 to 7 paler. F (male) 24 mm, (female) 24 mm. Illustration of (female) UNS in Lewis (1973, plate 86.35).

This species is close to *S. longirostris*, but has UNF spaces 3-5 purple brown to the margin, whereas in *S. longirostris* they are dark chestnut brown like the rest of the apical area, apart from the distinctive grey brown patch on spaces 4 and 5 distal to the cell.

Plate 70. *Saliana salius* adult male, collected on *Costus scaber*, Rio Claro - Guayaguayare Road, milestone 7, 1.x.1994 (ref. 94/48).

This is a fairly common and widely distributed species in forested areas of Trinidad.

There is a single emerged A.M. Moss pupa labelled in the NHM as this species; it is translucent white with no markings; smooth, elongate, with a short straight frontal spike.

I have reared this species just once, from an L4 collected 1.x.1994 in the forest near the Rio Claro - Guayaguayare Road at milestone 7. The food plant was *Costus scaber*, as for *S. antoninus*, although SAS has also reared this species from banana (Mt. Tamana, i.2000). Similarly to *S. antoninus*, the larval shelter on *C. scaber* was constructed by the larva folding over the distal part of a leaf where it had been feeding, at right angles to the mid-rib.

The 35 mm pupa is elongate, smooth; frontal spike; uniform green with no wax. Pupation took 19 days.

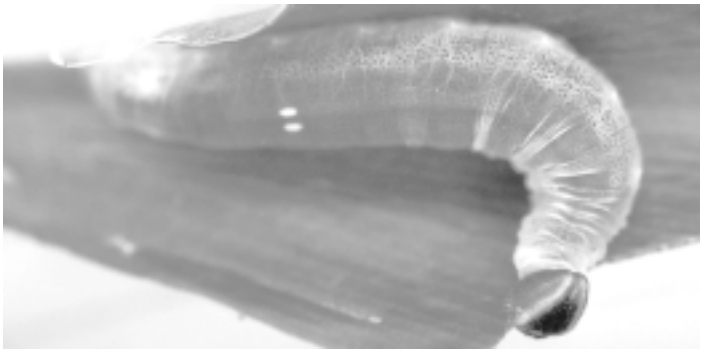

Plate 71. *Saliana salius* L5, 35 mm, collected on *Costus scaber*, Rio Claro - Guayaguayare Road, milestone 7, 1.x.1994 (ref. 94/48).

Plate 72. *Saliana salius* L5 detail of head, collected on *Costus scaber*, Rio Claro - Guayaguayare Road, milestone 7, 1.x.1994 (ref. 94/48).

The L5 measured 45 mm when mature. Head rounded triangular, indent at vertex; chestnut brown; a light brown stripe from apex down middle of epicranium to stemmata; stemmata pale; a central dark patch lies between these stripes occupying the middle half of the face. T1 concolorous with body. Body dull translucent green, paler below; a pale, diffuse, speckled fat body visible through cuticle; gonads small, yellow; spiracles pale, inconspicuous; all legs concolorous with body. The wax glands develop sub-ventrally on the posterior margin A6, A7 and the anterior margin of A8.

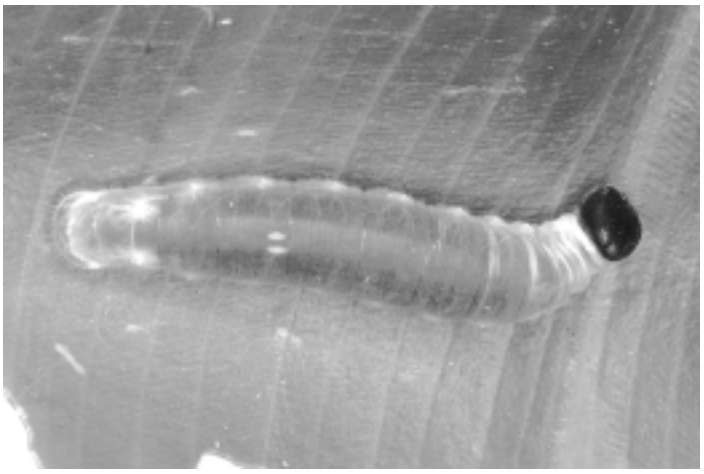

Plate 73. *Saliana salius* L4, 20 mm, collected on *Costus scaber*, Rio Claro - Guayaguayare Road, milestone 7, 1.x.1994 (ref. 94/48).

The L4 measured 20 mm. Head dark brown, slightly lighter ventrally. T1 with only a trace of colouring on the dorsal plate. Body dull translucent green, paler below; gonads visible; spiracles pale, conspicuous; legs concolorous with body.

267. O14/18 *Saliana saladin culta* Evans 1955

Three subspecies are recognised and described by Evans (1955): *saladin* Evans found from Mexico to Peru, *culta* Evans from Trinidad, the Guianas and the lower Amazon, and *catha* Evans from South Brazil. Evans' (1955) inclusion of a Trinidad specimen in the type series of *culta* is the first record from Trinidad: a male collected at Caparo by F. Birch.

Plate 74. *Saliana saladin* (male) UNS, collected as larva on *Calathea grandis*, Mt. Tamana, 12.xi.1995 (ref. 95/67A). Scale in mm.

UPS dark brown, white hyaline spots; tawny setae in basal areas of wings. UNF costa to end of cell spot yellow-brown, space 11 yellow to same point; a small area covering upper half of cell, and basal parts of spaces 8-10 dark chestnut brown; remainder of apical area to vein 2 at margin uniform dark purple-brown; rest of UNF black. UNH spaces 1A, 1B and 1C basal half yellow-brown, paler in space 1B, and distal half dark brown, shading to black in a triangle each side of vein 1B at margin; remainder of wing divided as for other members of the genus, basal half lilac, tinted brown in base of cell and space 2; distal half dark chestnut brown, with marginal area of spaces 6-7 dark lilac-purple. F (male) 25-27 mm.

The uniform dark purplish apical area UNF is a good diagnostic character for *S. saladin*. Although slightly larger than *S. salius*, worn specimens could easily be confused, but the UNF apical markings should still be distinguishable.

Plate 75. *Saliana saladin* adult male, collected as larva on *Calathea grandis*, Mt. Tamana, 12.xi.1995 (ref. 95/67A).

This species is rare in Trinidad collections, but could be confused with *S. salius*. I have a male from Parrylands (16.x.1980) which I had mistaken for *S. salius*, and one reared male from Mt. Tamana, where the larvae can be found with some searching. SAS also has a male from Parrylands (ii.1993) and has reared a female from Matura (xi.2000).

Saliana saladin is confusingly similar to *S. salius*. However, it is larger, the spots UNH are further apart, and the apical area UNF has a uniform purple flush extending from vein 3 to the apex and along the costa as far as the apical spots, whereas the flush in *S. salius* is more mauve in colour and only fills the area from vein 3 to vein 6.

The larval food plant on Mt. Tamana is *Calathea grandis*, which appears in the Flora of Trinidad and Tobago (Simmonds 1967) as *C. altissima*. Simmonds (1967) considers this an uncommon plant in Trinidad, with records from Cedros, Platanal, Oropouche Cave and Cumuto. There is also a specimen from Mt. Tamana in the National Herbarium (Y. Comeau, pers. comm). I found *C. grandis* quite common in the forested areas around the summit ridge of Mt. Tamana, in places dominating the ground cover. The specimen SAS reared from Moruga was collected off *Calathea lutea* (Marantaceae).

Plate 76. *Saliana saladin* L5 detail of head, collected on *Calathea grandis*, Mt. Tamana, 12.xi.1995 (ref. 95/54).

The larval shelter is a simple fold from the edge of the leaf. The newly moulted fifth instar larva measures 34 mm, and it grows to 48 mm, before shrinking to 43 mm as a prepupa. The head is rounded triangular in shape, 4.5 - 5.0 mm high and 4.0 - 4.5 mm wide at the level of the stemmata; slightly indent at vertex; rugose, slightly shiny; light yellow-brown, with a conspicuous dark triangular marking on the face covering the clypeus, and extending to half the width of the clypeus further onto the epicranium; the epicranial suture is yellow-brown within the dark marking. T1 concolorous with body, but with a translucent dorsal plate. Body dull translucent green; dorsal line slightly darker; spiracles white, conspicuous due to a star of surrounding trachea; tracheal line; yellow gonads on each side of the dorsal line, A6; anal plate almost round, with short setae on posterior margins. The wax glands develop ventro-laterally from the posterior margin of A6 to the anterior margin of A8.

The fourth instar larva is similar to the fifth, but the ground colour of the head is brown, and the triangular marking is diffuse. The third instar larva measures up to 18 mm; the head is uniform light brown.

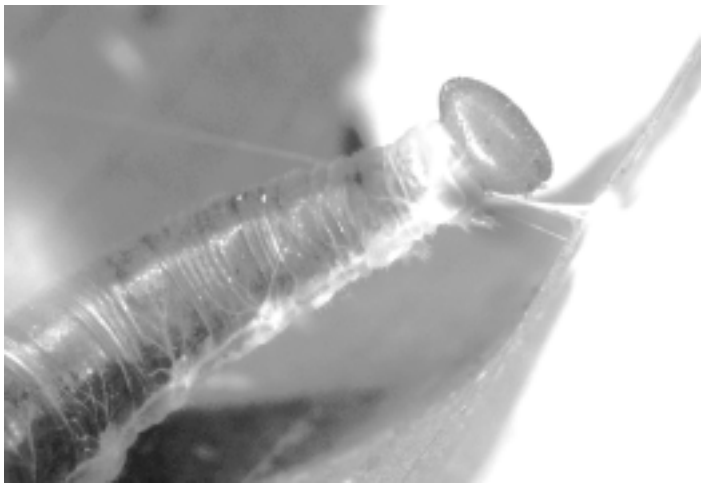

Plate 77. *Saliana saladin* L3 detail of head, collected as larva on *Calathea grandis*, Mt. Tamana, 12.xi.1995 (ref. 95/67B).

Plate 78. *Saliana saladin* pupa, 43 mm, collected as larva on *Calathea grandis*, Mt. Tamana, 12.xi.1995 (ref. 95/67B).

The pupa is formed in the last larval shelter; the cremaster is attached to a stout cross bar of yellowish silk, and the pupa is held in place by a single strand of silk over the thorax; no wax in shelter or on pupa. The pupa is smooth (no setae) and elongate; quite broad; parallel sided for most of its length; a straight frontal spike of 2.5 mm; proboscis sheath extends to cremaster tip. Colour light green; darker green dorsal line on abdomen; single yellow male gonad on posterior margin of A5; black dots as follows: an equally spaced row of four on collar near anterior margin, the lateral ones just behind eyes; thorax (T2) a sub-dorsal spot, repeated in parallel row on T3, A2-7 and displaced towards dorsum on A8; dorso-lateral spot mid-segment T3; a row of dorso-lateral dots on posterior margins of A1-8, those of A1-6 slowly diverging from dorsum, those of A7-8 converging.

Two larvae died at the pre-pupal stage for no obvious reason; they may have been diseased.

268. O15/1 *Thracides cleanthes binota* Evans 1955

The range of this species extends from Colombia to Paraguay, but Evans (1955) divides it into six subspecies. Of these, *binota* Evans occurs in Colombia, Venezuela and Guyana, while *telmela* Hewitson is from French Guiana and the Amazon basin. The other subspecies, including the nominate subspecies, *cleanthes* Latreille (TL Brazil) are found further South. Subspecies *binota* is characterised by a lower spot in space 1B and a narrow constricted spot in space 2 F. The number, placing and shape of the forewing spots is variable, confusing the classification set out by Evans, since several forms can occur in each subspecies, and these forms repeat themselves in other subspecies.

Trinidad specimens are consistent in markings and sexually dimorphic. Thus, all the males I have seen have small white hyaline spots in spaces 1B and 2 F, while the females have none. Trinidad females would be considered f. *aspilota* Mabille and Boullet following Evans' treatment.

Plate 79. *Thracides cleanthes* (male), Rio Claro-Guayaguayare Road, 11.x.1993. Scale in mm.

Plate 80. *Thracides cleanthes* (female) UNS, Spanish Farm, 30.iv.1982. Scale in mm.

UPS blue with an orange patch at the tornus H, in spaces 1A and 1B; small white hyaline spots in spaces 1B and 2 in males; fringes white. UNF blue on disk, reddish brown on costa and apical area as far down as vein 2 on margin; within the reddish brown area a diffuse pale submarginal band. UNH brown; blue in spaces 1B and 1C; margin of space 1C white; margin of spaces 3-6 diffuse white; the orange spot at tornus as UPH. Body dark, except UNS head, fore femora and apex of abdomen UNS dark orange.

I have found this an uncommon species in Trinidad . There is

a female in the NHM (Siparia, x-xii.1920, A. Hall), and a specimen in the ICTA collection, labelled "Trinidad / F.W. Urich / 69-55 / coconuts", the implication probably being that it was reared from coconut. I have recorded this species four times, all from lowland forest situations: Las Lomas, Bush Bush Island, Parrylands, and off the Rio-Claro Guayaguayare Road, opposite Saunders Trace. SAS, however, considers this species not rare along tracks in southern forests and the larva fairly easy to obtain on a palm as yet unidentified.

The food plant at Belem is coconut (Moss 1949) and the larva is described as elongate and white, with a predominant subdorsal black spot on T2. The pupa is emerald green, and although the shelter is dusted with white powder, none is found on the pupa. I have found two larvae on a small plant (1 m) of the climbing palm, *Desmoncus orthacanthus*, growing in shade at Bush Bush Island (28.iii.2003, Ref. 03/235) on which the following is based.

The egg-bases associated with both larvae were strikingly large, 2 mm in diameter. A third instar larva (Plate 81) measured 17mm. Head 2.5 mm tall x 2 mm wide; rounded, wider basally, flattened dorsally and slightly indent at vertex; light brown, epicranial suture narrowly brown, a parallel stripe on epicranium which is wider ventrally; the lower part of the head covered with white waxy powder. Body dull pale green, the posterior segments and the expansion creases in front of each segment divide are dull white; body covered with white waxy powder ventrally. At 25 mm, this larva moulted to L4, but died soon afterwards. Head of L4 similar in shape to that of L3; light brown, with a broad brown stripe down each epicranium, the inner edge, sharply defined and parallel to the epicranial and clypeal sutures, the outer edge irregular and rather diffusely defined.

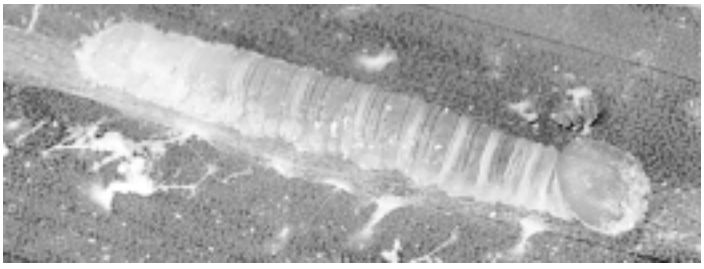

Plate 81. *Thracides cleanthes binota* third instar larva, 17 mm, collected on *Bactris* sp., Bush Bush Island, 28.iii.2003 (ref. 03/235B).

An L5 larva measured 54 mm (Plates 82, 83), and made a shelter by rolling a leaflet to make a tube, and lining the inner surface with silk and white waxy powder. Head 5mm high x 4 mm wide; covered with white waxy powder except for mouthparts; the epicranial suture appeared paler, with a dark stripe adjacent; dark spot over stemmata. Body white; dorsal line narrowly darker; distinct expansion creases anterior to each segment division; covered with white waxy powder. Anal plate rounded posteriorly, with a fringe of 1 mm setae. Note that contrary to Moss's description above, there is no subdorsal spot on T2.

Plate 82. *Thracides cleanthes binota* fifth instar larva, 54 mm, collected on *Bactris* sp., Bush Bush Island, 28.iii.2003 (ref. 03/235A).

Plate 83. *Thracides cleanthes binota* fifth instar larva, detail of head, as Plate 82.

The pupa from this L5 larva was formed on the lid of the rearing chamber, but as described by Moss (above), the surrounding area was covered with white waxy powder, while the pupa was not. Male pupa 39 mm; smooth, elongate; frontal spike 2.5 mm, parallel-sided, blunt; proboscis extends to just short of cremaster apex; colour uniform pale green, the frontal spike with a slight brown tint.

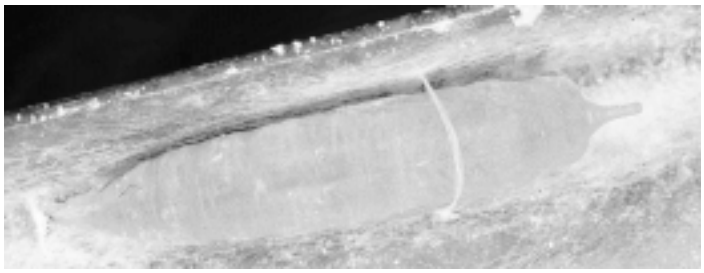

Plate 84. *Thracides cleanthes binota* pupa, 39 mm, as Plate 82.

268a. O15/5 *Thracides nanea nanea* Hewitson 1871

Evans (1955) listed specimens of the nominate subspecies from along the Amazon (TL Maranhan) and describes a further subspecies, *nida* Evans, from Colombia. A male specimen taken at Rio Claro on 15.ii.1926 by Sir N. Lamont is Kaye's basis for adding this species to the Trinidad list (Kaye 1940). In Cock (1982) I did not attribute a subspecies to this Trinidad record since I had not at that time seen Lamont's specimen. Having now examined Lamont's specimen, which is in the RSM, I can state that it belongs to the nominate subspecies.

Plate 85. *Thracides nanea nanea* (male) UNS, Rio Claro, 15.ii.1926, N. Lamont (specimen in National Museum of Scotland).

Male. UPS dark, the thorax and wing bases with a blue gloss; white hyaline spots. UPF male stigma black. UNS palpi orange-red. UNF dark brown; cell basal to cell spots iridescent blue-green. UNH plain dark reddish brown. Cilia H white from vein 1A to vein 3, otherwise cilia brown. The female has the F spots larger, the two cell spots often touching, and that in space 2 extending on its dorsal margin towards margin; UNF an extensive white area in space 1B. Illustration of UPS in Lewis (1973, plate 87.37).

Until quite recently, Lamont's specimen from Rio Claro remained the only Trinidad record of this species. SAS has caught this species several times from Guanapo Valley ((male)(male) iii.1988, xii.1998), Guayaguayare ((female) i.1983), Mt. Harris ((male) i.1989), Parrylands ((male) vii.1982, (female) x.1996).

Moss (1949) refers to this species having an elongate, white powdered larva, living in folds of *Cyclanthus bipartitus* (Cyclanthaceae), which has been collected occasionally in forests of both north and south Trinidad (Philcox 1986). Moss illustrates the fifth instar larval head, which from the front is pale, and has dark patches at the indented vertex, dorso-laterally and ventro-laterally; the clypeus is dark, and the two lateral patches project towards it. The preserved L5 skins in the NHM confirm this - the head ground colour is light brown. Emerged pupae are translucent white, hence green in life; elongate, smooth; proboscis sheath reaching cremaster tip; no markings or setae; pupal shelters with a light dusting of white wax powder, but none on the pupae; the frontal spike is slightly expanded into an irregular and variable knob at the apex. Moss's material includes cocoons of what appears to be an *Apanteles* (s.l.) sp. associated with the L5; the cocoons are attached to the shelter, scattered although usually touching other cocoons and consistently aligned with the larval body in the shelter.

SAS has reared this species twice (Mt. Harris, i.1989; Guanapo Valley, xii.1998), from *Asplundia rigida* (Cyclanthaceae). *Asplundia rigida*, known locally as mammoo, is a root-climbing liana up to 10m long, which is occasionally terrestrial; it occurs quite widely in Trinidad and Tobago in forest areas (Philcox 1986). I have seen empty hesperiid shelters on this plant on Mt. Harris (25.iii.2003), which most likely were made by *T. nanea*; the shelters were at the apex of leaves, at a height of 2-3 m; no shelters were seen on plants growing on the ground.

269. O15/7 *Thracides phidon* Cramer 1779

This species was described from Surinam and occurs from Mexico to South Brazil (Evans 1955). It was first recorded from Trinidad by Kaye (1904) without comment, although he later states that it is not rare (Kaye 1921).

Plate 86. *Thracides phidon* (female) UNS, Parrylands, pupa on *Heliconia* sp., 30.i.1980, J.O. Boos (coll. MJWC). Scale in mm.

This species, especially when fresh, is one of Trinidad's most beautiful hesperiids. Evans (1955) states that it is a very variable species, but whether this is within populations or between populations is not clear; the following is based on single male and female specimens before me. UPS dark, blackish; the base of the wings and the thorax iridescent blue; white hyaline spots. The UPF male brand is grey and inconspicuous; it is a straight line obliquely angled in three parts: a dot above and below vein 2, and a line running from the middle of space 1B to vein 1. UNF costa and space 11 white to the level of the cell spot; costa reddish brown beyond this as far as apical spots; distal to the apical spots the apex is whitish brown; space 3 distal to the hyaline spot and spaces 4 and 5 dull reddish brown; disc and termen black, except space 1B and in the female space 1A filled with a large quadrate white marking which starts below the inner margin of the cell spot and extends almost to the margin. UNH basal area white sullied with brown scales, extending along space 1B about halfway to the margin; whitish spots in spaces 3-6 with deeply excavate external margin, and a trace of a spot in space 7; basal to these white spots the discal area is reddish brown as on the UNF costa; distal to the spots, light red-brown with a white submarginal suffusion; space 1A reddish brown except base; spaces 1B and 1C dark apart from white basal area. F (male) 24 mm, (female) 26 mm. Illustrations of UPS and UNS in Lewis (1973, plates 87.38 and 87.39).

Plate 87. *Thracides phidon* (male), collected as larva on *Heliconia* sp., Chinchina, Colombia, 8.vii.1996 (ref. 96/108).

Contrary to Kaye's (1921) statement that this species is not rare, in my experience the adults are decidedly rare in Trinidad, and I have just one male taken as an adult (Parrylands, 13.ix.1980). I have also seen specimens from the "Northern Mountains" (female) xii.1938-i.1939, A. Hall, NHM, Port of Spain (female) i.1897, Dr. Rendall, NHM, St. Anns Valley ((male), NHM), Symonds Valley (female) iii.1930, A. Hall, ex coll. W.J. Kaye, AME and two males and two females with no locality details in the NHM. In contrast, the larvae are more commonly found.

Moss (1949) records the food plants as banana, *Heliconia* and similar plants. He illustrates the head, which is comparable to that described below. There is a head capsule in the NHM, but it is damaged and the markings are obscured by white waxy powder. Emerged pupae are translucent white, elongate, smooth; the proboscis sheath extending well beyond the cremaster; the frontal

spike curls over at the apex. Jansen and Hallwachs (2001) reared this species regularly from larvae on both banana and *Heliconia latispatha*.

I have reared this species from a larva which I collected on an ornamental *Heliconia* sp. at Chinchina, Caldas, Colombia, and have found, but not successfully reared, similar larvae in Trinidad, e.g. on *Heliconia* sp. (Spanish Farm, 16.i.1982, ref. 82/35B), on *H. wagneriana* (Morne Catherine, 24.iii.1982, ref. 82/57, and 26.ii.1994, ref. 94/18; Inniss Field, 1.x.1994, ref. 94/57). In addition, SAS has reared this species from banana in Trinidad.

Plate 88. *Thracides phidon* larval shelter on *Heliconia wagneriana*, Morne Catherine, 26.ii.1994.

The mature larval shelter is made from the basal part of a whole leaf, with the distal area eaten away to a lesser or greater extent. The leaf lamina is folded downwards at an angle on each side of the midrib to give a parallel sided shelter; this angle in the lamina close to the midrib is held with short silk threads attached close to the midrib and connecting to the midrib; in addition, several (e.g. seven in the example I recorded, ref. 94/18) longer threads are attached about 1.0 - 1.5 cm from the midrib, and pass directly to the opposite half of the leaf lamina. I measured shelters of 13 - 14 cm along the midrib. The larva rests upon the ventral surface of the midrib, which is covered in white waxy powder.

Plate 89. *Thracides phidon* L5, 58 mm, collected on *Heliconia wagneriana*, Morne Catherine, 26.ii.1994 (ref. 94/18).

Plate 90. *Thracides phidon* L5 detail of head, collected on *Heliconia* sp., Chinchina, Colombia, 8.vii.1996 (ref. 96/108).

The elongate fifth instar larva grows to 60 mm in length. The head is about 4mm high, 3 mm wide at the stemmata, and indented at the vertex. It is light brown in colour, with black spots at the vertex, dorso-laterally on the face, covering the stemmata and covering the clypeus; however, this is often not clear in living specimens as the head and body are covered with white waxy powder; these spots are less well defined in earlier instars. The body has a distinctive transversely grooved appearance around the intersegments, with smoother spaces in between; the anal plate is flattened posteriorly, with a rounded margin and strong backwardly directed setae. The wax glands develop laterally on A7-8.

Plate 91. *Thracides phidon* pupa, 44 mm, collected as larva on *Heliconia* sp., Chinchina, Colombia, 8.vii.1996 (ref. 96/108).

The pupa measures 35-44 mm; light green with no markings; elongate, smooth, with a 3.0 - 3.5 mm frontal spike, slightly upturned at the apex - thus differing from Moss's material in the NHM (see above). The substrate around the pupa is covered with white waxy powder, but the pupa itself is largely clear.

In Trinidad, larvae of an *Apanteles* sp. often emerge from pre-pupae. On one occasion (ref. 82/57) I found a larval shelter with the basal part blocked with tangled silken threads and small white waxy blobs (probably put in place by the larva preparing to pupate), and distal to this the host larva remains, and then a loose mass of *Apanteles* cocoons within a loose flocculence, the cocoons mostly orientated at right angles to the midrib. These cocoons had already emerged, but cocoons reared from another larva (ref. 94/18A)

yielded 26 adults, three males and 23 females, but many cocoons failed to emerge successfully.

270. O16/3 *Neoxeniades braesia braesia* Hewitson 1867

Three subspecies are recognised by Evans (1955): *aqua* Evans from Colombia and Ecuador, *braesia* from French Guiana, the Amazon Basin and Bolivia, and *andricus* Mabille described from Brazil.

I added this species to the Trinidad list (Cock 1982), based on a male which I captured within forest at Parrylands (3.iii.1980). Since SAS has captured a full series from Inniss Field (male), 3 (female) i.1983; (female) vi.1987; (male) vi.1999), Moruga East (2 (male) ii.1983), Mt. Tamana ((male), (female) ii.2001).

Plate 92. *Neoxeniades braesia* (male), Parrylands, 3.iii.1980. Scale in mm.

UPS dark brown with white hyaline spots; head and thorax with green setae. In the female the spots are larger, and the cell spots are not so deeply indented on the distal margin. UNS paler, head whitish, thorax with orange tint; white markings on costa from base to end of cell spot, space 1B below spot in space 2 (lower margin extended basally), basal third of costa UNH.

SAS notes that this species flies very quickly, and settles below leaves on forest tracks. The male he caught on Mt. Tamana was 'sunbathing' with its wings open, returning to the same spot after flights.

Although it is not included in Moss (1949), Moss did rear this species and there is preserved material in the NHM. One female specimen in the NHM is labelled "Para garden fl. *Callithea* big sp."; this is probably a reference to the use of a *Calathea* sp. (Marantaceae) as larval food plant but could refer to an adult nectar source. The single associated cast L5 skin has a white body, with setae on the anal plate; the head capsule is almost oval, wider ventrally; it is covered with white waxy powder, but appears to be light brown with an irregular dark line close to the epicranial and clypeal sutures. The pupal shelter contains white waxy powder, but this does not seem to extend to the pupa. The emerged pupa is translucent light brown, smooth, elongate, with no setae; the proboscis sheath reaches the cremaster tip; the T1 spiracle appears to be light brown; no frontal spike. There is also an associated parasitoid cocoon mass in the NHM, reminiscent of *Bracon* spp.

271. O16/6 *Neoxeniades scipio fulguratoides* Kaye 1925

There are five subspecies in Evans (1955) treatment of *N. scipio* Fabricius. Kaye (1925) described subspecies *fulguratoides* from Trinidad on the basis of specimen collected 15.iv.1922 by F.W. Jackson at St. Ann's at 1300 ft. Evans (1955) examined the type and notes that it is a female. The specimen was in Kaye's collection and is presumably now in the Allyn Museum of Entomology. Evans (1955) also lists specimens from French Guiana, and a long series from Belem.

Plate 93. *Neoxeniades scipio fulguratoides* (female) Inniss Field, iii.1983, SAS (specimen in coll. S. Alston-Smith).

Plate 94. *Neoxeniades scipio fulguratoides* (female) UNS of plate 93.

UPS dark brown; white hyaline spots; overlay of light blue setae on head and thorax, base and narrowly along termen of F and broadly on base and termen H; blue paler in female. UNS head white; UNS thorax dull green-brown; UNS abdomen light purple-brown with a pair of pale longitudinal lines. UNF with dark green along costa diffusing into purplish at apex; disc dark purple-brown, pale on termen; extensive white spot in 1B under hyaline spot in 2. UNH light purple-brown in spaces 1A-C; remainder UNH green with conspicuous white spot end cell, and traces of spots in spaces 3 and 4. Fringes, light brown, paler on UNS.

Moss (1949) not infrequently found the larvae of this subspecies on pineapple plants (*Ananas sativus*) at Belem. Jansen and Hallwachs (2001) record larvae quite commonly on two terrestrial bromeliads: *Achmaea magdalenae* and *Bromelia pinguin*. *Achmaea magdalenae* is recorded from Trinidad, but is probably not indigenous, although several other members of the genus are,

and *B. pinguin* is not a Trinidad species, although the congeneric *B. plumieri* is quite widespread (Smith and Pittendrigh 1967). SAS has reared this species from terrestrial bromeliads in Trinidad.

Apart from the type specimen, the only other Trinidad specimens have been collected or reared by SAS: Edwards Trace, Moruga ((female) iii.1983), Guayaguayare ((male) ix.1999), Inniss Field ((female) i.1983; (male), (female) ii.1983), Sangre Grande (male) i.1989). SAS has also noted larvae at North Post and Matura.

The adults are very territorial, and pick a spot along a forest track and fly up and down very quickly, returning to the same spot (S. Alston-Smith pers. comm. 2001). Such adults seem to be in poor condition due to this behaviour.

Moss (1949) illustrates the head capsule and describes the larva and its behaviour in some detail. Plants growing in shade are preferred for oviposition, and the ova are laid at the tip of a blade. The newly hatched larva feeds from the tip of the blade and pulls the edges of the blade together with silk strands below the apex to form a shelter. The mature larva measures 60mm; very dull yellow-green; irregular olive green dorsal line; spiracles ochreous; black sub-dorsal spots on each of the last two segments. Head deep ochre on face, black posteriorly; six black marks on face, narrow close to epicranial sutures, rounded above stemmata, and intermediate in between. SAS notes that the larva from Trinidad is as Moss reports but the Trinidad form has five black spots on the head capsule and not six.

When mature, the larva cuts the silk strands, lines a hollow in the leaf with white waxy powder and pupates. The pupa has a stout frontal spike and the proboscis sheath reaches the cremaster; white waxy powder present; light creamy colour, lightly freckled with brown dots dorsally.

I have examined A.M. Moss's material in the NHM. A preserved ovum in the NHM is large, smooth and hemispherical. The head capsules of the cast L5 skins in the NHM have variable markings and waxy powder - and I believe more than one species is represented. One form matches that illustrated by Moss (1949) and Jansen and Hallwachs (2001). One of these is associated with a gregarious *Apanteles* (s.l.) sp. whose cocoons are irregularly arranged in a loose mass of flocculence. The emerged pupae in the NHM also represent more than one species, and the following is based on the form clearly associated with a pupal shelter made from a robust bromeliad leaf. The emerged pupa is opaque white with black dots covering the dorsal part of the thorax and abdomen. The light brown frontal spike is robust, straight and blunt. Moss reared a gregarious *Brachymeria* sp, in which the emerging adults each made their own exit hole in the host pupa.

The larva illustrated by Jansen and Hallwachs (2001) matches Moss's description reasonably well. It has a light brown head with a dark posterior margin, a row of three black spots down each epicranium and another over the stemmata, the clypeus black and a black inverted V above the clypeus. The body is dull, pale translucent green with a pale sub-dorsal line, broadly pale subventrally, brown spiracles and black spots on the last two segments. The pupa is white with black spots on the head and thorax.

272. O19/2 *Pyrrhopygiopsis socrates orasus* Druce 1876

Evans (1955) treats this species as three variable subspecies: *orasus* Druce is widespread in northern South America, while *crates* Mabille and Boullet is restricted to the Upper Amazons, and *socrates* Ménétriés is found from Belém south to Argentina. As is the case for *Thracides cleanthes*, there is confusing variation repeated between subspecies, and further study and rearing is needed. Typically subspecies *orasus* has a white patch at base UNH, which is absent in form *socrates*. However, all Trinidad specimens that I have seen match form *socrates* in that they have no white area at base of UNH, apart from one specimen in coll. SAS ((male) vii.1988, Inniss Field) which is f. *orasus* and has this white patch.

Plate 95. *Pyrrhopygiopsis socrates orasus* f. *socrates* (male) UNS, Parrylands, 13.ii.1980. Scale in mm.

The UPS resembles a *Pyrrhopyge* sp., being dark shiny blue, with white fringes and the head and apex of the abdomen orange. However, it is less robust than *Pyrrhopyge* spp. and the antennae are obviously clubbed before the reflexed portion whereas those of *Pyrrhopyge* spp. are reflexed before the clubbed portion (Cock 1981b). UNS head and distal half of abdomen orange. UNF dark blue in basal part of wing, olive-brown on costa and distal portion extending to below vein 2 on margin; veins dark in distal olive-brown area. UNH of f. *socrates* olive-brown with dark veins, except spaces 1A-1C dark shiny blue. Illustration of UNS f. *socrates* in Lewis (1973, plate 96.18). UNH of f. *orasus* similar to f. *socrates*, but basal area white in spaces 2, cell, 7 and costa, and basal $^1/_3$ of costa UNF also white.

Plate 96. *Pyrrhopygiopsis socrates orasus* f. *orasus* (male) UNS, Inniss Field, vii.1988, SAS (specimen in coll. S. Alston-Smith).

Sir Norman Lamont's capture of a specimen from Morne Diable (6.iv.1917) is the first record from the island (Kaye 1921); this male specimen is now in the RSM. Adults of this species are uncommon in collections, but larvae can be found on coconut, usually in forested areas. I have further records from Palmiste ((male) 5.iv.1934, N. Lamont, RSM), Parrylands, forest clearing ((male) 13.ii.1980, MJWC) and Las Lomas, Spanish Farm ((female) 30.v.1982, MJWC). SAS has records from Fondes Amandes ((male) iv.1990), Forest Reserve (male) iv.2000), Morne Catherine (male) i.1979), North Post ((male) iii.2002) and Quinam ((male) iv.1990). I have found larvae in Caura Valley, and Clive Urich reared a male from a larva on coconut at his Sans Souci Estate, Sangre Grande (v-viii.1982, MJWC).

Apart from the specimen of f. *orasus* which SAS captured at Inniss Field, he has seen one other specimen of this form at Forest Reserve (iv.2000), settling along a forest track.

Moss (1949) reared this species from larvae found on coconut palm and "assahy" palm [*Euterpe oleracea*]. In his notes, he refers to the larva as white, but his plate shows a larva with a row of three dark spots down each side of a pale head, and the body with a pale subdorsal stripe. Moss's plate matches my observations from Trinidad (below).

I have collected larvae on coconut palm near the head of Caura Valley (17.xii.1981; ref. 81/22C). In view of Moss's observations above, manac, *E. broadwayana* (Freeman and Williams 1928) may also be a food plant in Trinidad. The larval shelter was formed from the apex of a leaflet, the edges rolled upwards and held by silk, and the larva fed from the leaf lamina basal to the shelter. The final instar larva is about 40 mm long; head rounded, slightly narrower at apex and slightly indent at vertex, 4 mm diameter; pale brown, with a row of three black spots down each side of the face, the lowest of which covers the stemmata; a narrow, dark streak down the clypeus, the clypeal sutures and a dark streak on epicranium, close to and parallel to the clypeal suture; body translucent dark green, through which the trachea are evident; a broad white dorso-lateral stripe; spiracles brown with a yellow tint around them; gonads yellow. When preparing the pupal shelter, the larva develops white wax glands subventrally on segments A3-7, just behind the prolegs. The head capsules of instars 4 and 3 are similar, although the dark spots are less pronounced in the younger instars.

The pupa measures 36-38 mm; I did not record the colouring in life, but the emerged pupal case before me is light brown. The pupa is elongate and smooth, with a distinctive frontal spike shaped like a question mark or hook; the proboscis sheath extends to the base of the cremaster, which is bent under at the apex.

One pupa collected at Caura Valley (ref. 81/24C) had been parasitised by a gregarious *Brachymeria* sp., but the parasitoids failed to emerge. On a visit to Inniss Field (17.v.1999) SAS and I found two adults dead on leaves at about 1m above ground along a partially shaded forest track. They had been killed by a fungus, *Cordyceps tuberculata* (identified by Harry Evans, CABI Bioscience under reference no. I99-1170).

Plate 97. *Cordyceps tuberculata* on adult *Pyrrhopygiopsis socrates orasus*, Inniss Field, 17.v.1999.

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On the Number of Moths (Lepidoptera) that Occur in Trinidad and Tobago

Matthew J. W. Cock
CABI Bioscience Switzerland Centre, Rue des Grillons 1, CH-2800 Delémont, Switzerland
E-mail: *m.cock@cabi-bioscience.ch*

ABSTRACT

The number of species of moths known from Trinidad has increased from 242 in 1901 to 1,016 in 1927, 1,195 in 1950, and is presently around 2,275. Attempts to estimate the total number of species that occur on the island suggest a fauna of around 3,500 species. The moths of Tobago have been less well collected than those of Trinidad and currently only 259 species are known. This represents just 11% of the currently known Trinidad list, but in the best-documented moth family from Tobago (Pyralidae) this increases to 18%. If this ratio is applied to the projected Trinidad total, this would give an estimate of 640 moth species for Tobago, but even this is likely to be an underestimate.

INTRODUCTION

The insect order Lepidoptera comprises about 26 superfamilies (Heppner 1984). Two of these, Papilionoidea and Hesperioidea, are the butterflies, while the remainder are moths. Butterflies normally fly by day, and are often brightly coloured, often on both the upper surface and the under surface of the wings, whereas moths mostly fly by night, and their wing markings are largely restricted to the wing upper surface. Many Lepidoptera are effective fliers, in common with dragonflies and some groups of flies, wasps and bees, but unlike most groups of insects, which are weak fliers or flightless. Thus insect powers of dispersal vary, and the ability of Lepidoptera and other effective insect fliers to colonise new habitats or islands is likely to be qualitatively greater than for other insect groups.

While the butterflies of Trinidad are relatively well known (Barcant 1970) and have been intensively collected (Tikasingh 2003), the moths have been collected by only a handful of naturalists, and are poorly documented by comparison. However, moths are one of the richest groups of insects in Trinidad and Tobago, including many large and colourful species - and many more small and predominantly brown species (see Plates 1 and 2). They include more than 50 pest species that feed on, and can seriously damage, agricultural and forestry plants (CABI 2001), and many more that attack ornamental plants. Sphingidae, or hawk moths, include some of the largest Trinidad moths, with wing-spans of 5-18 cm. The caterpillars are correspondingly large, and always have a more or less well developed tail at the rear end of their bodies – hence their common name, hornworms. Many members of the public will have seen hornworms feeding on allamanda, cassava, frangipani, papaya, rubber, tobacco, tomato or sweet potato.

Most moths are attracted to lights at night. Light sources with a strong ultra violet component, such as those based on a mercury vapour discharge tube are especially effective. This makes moths straightforward subjects for some types of ecological research and quantitative studies. For example, Stradling, Legg and Bennett (1983) analyse light trap records of Sphingidae from more than 8 years of collecting at light traps which D.J. Stradling and F.D. Bennett ran in their St. Augustine gardens. They were able to examine relative abundance, long-term sampling trends, phenological patterns (in response to the pattern of rainfall and the lunar cycle).

William James Kaye (1875-1967) studied the butterflies and moths of Trinidad in the first half of the twentieth century, and published two lists of the moths known from Trinidad. In 1901, he published a preliminary catalogue comprising 242 species (Kaye 1901) based mostly upon his collecting and that of his brother, S. Kaye. Subsequently Sir Norman Lamont collected moths from around 1913, until his death in 1949, and was responsible for collecting many new records from the island, so that in 1927, when Kaye and he published the last catalogue of Trinidad moths, they recorded 1,016 species (Kaye and Lamont 1927). More than 40 years later, William Beebe published a list of 179 further records of moths, based on a list of 150 new records which Lamont prepared in 1941, but did not publish before his death, and records compiled by E. Mc C. Callan (Lamont and Callan 1950). The only other substantial work recording the moths of Trinidad since then has been on Ctenuchinae (Arctiidae) and Sphingidae. The Ctenuchinae are a group of small (mostly <2.5 cm wing-span) brightly coloured moths, often with transparent patches in their wings, many of which fly by day, or by both day and night. Flemming (1957, 1959) revised the Trinidad Ctenuchinae based mainly on the collecting of William Beebe and Jocelyn Crane of the New York Zoological Society at Simla. Stradling, Legg and Bennett (1983) include a full list of hawk moth species known at that time.

During my stay in Trinidad, 1978-1982, I made a collection of Lepidoptera. This was supplemented to a limited extent during nine return trips between 1988 and 1999, of which three involved significant moth collecting. Since I left Trinidad, I have worked intermittently on identifying my moth material and compiling an updated list of the Trinidad species (Annex 1). This work is far from complete, and there are many questions still to answer, but it has reached the stage where I can now start to provide realistic estimates on the numbers of species collected, even if I cannot name them all as yet. From this it is possible to make some informed extrapolations as to the total number of species which may be found to occur in the future.

Butterflies, because they are conspicuous, beautiful and fly by day have been intensively collected in Trinidad by local collectors and visitors. Hence, Barcant (1973) was able to give a comprehensive account of the superfamily Papilionoidea (all butterflies except skippers). There has been a slow but steady trickle of new species records since then, but the total probably hasn't increased by more than 10%. By comparison, the superfamily Hesperioidea (skippers) contains a large proportion of small brown species, making them less attractive to collectors, especially local

(Cont'd on P. 54)

LEGENDS TO PLATE 1

Representative moths of Trinidad. All specimens collected by M.J.W. Cock, except as stated. F refers to the forewing length measured from the base of the wing.

1. Male *Paranerita gaudialis trinitatis* Rothschild (Arctiidae, Arctiinae), Valencia Forest, MVL, 5.viii.1981; F 15 mm.
2. Male *Calonotos craneae* Flemming (Arctiidae, Ctenuchinae), Above St. Benedict's, MVL, 26.v.1981; F 20 mm.
3. Female *Dicentria nondescripta* Kaye (Notodontidae), Curepe, at light: 5.i.1980; F 23 mm.
4. Male *Josia oribia* Druce (Notodontidae, Dioptinae), Parrylands, at *Eupatorium* flowers, 7.xi.1980; F 14 mm.
5. Male *Xanthopastis timais* Cramer (Noctuidae, Hadeninae), Curepe, MVL, 26-31.xii.1980; F 20 mm.
6. Male *Heliothis subflexa* Guenée (Noctuidae, Heliothinae), Curepe, MVL, 8.xi.1978; F 14 mm.
7. Male *Antiblemma caparata* Kaye (Noctuidae, Ophiderinae), Hollis Reservoir, at light, 5.ix.1978; F 10 mm.
8. Male *Trichoplusia ni* Hübner (Noctuidae, Plusiinae), Aranguez Gardens, larva on cabbage, x.1980; F 15 mm.
9. Female *Eloria subapicalis subapicalis* Walker (Lymantriidae), Cumaca Road, 0.5 miles, MVL, 27.x.1980; F 25 mm.
10. Male *Eumorpha triangulum* Rothschild & Jordan (Sphingidae), Brigand Hill, lighthouse, MVL, 25.iii.2003 ; F 67 mm.
11. Female *Erastria decrepitaria decrepitaria* Hübner (Geometridae: Ennominae) Hollis Reservoir, at light, 2.xi.1978; F 20 mm.
12. Female *Cyllopoda jatropharia* Linnaeus (Geometridae, Sterrhinae) Maracas Valley, Ortinola Estate, 5.xii.1978; F 22 mm.
13. Male *Schidax squammaria* Hübner (Epiplemidae) Parrylands, 10.iii.1980 14 mm.
14. Female *Sematura lunus* Linnaeus (Sematuridae) Curepe, MVL, 5.x.1979; F 50 mm.
15. Female *Urania leilus* Linnaeus (Uraniidae) Maracas Valley, Ortinola Estate, 10.iii.1982; F 49 mm.
16. Male *Macrosoma conifera* Warren (Hedylidae) Morne Bleu, Textel Installation, at light, 30.i.1981; F 22 mm.
17. Male *Arsenura beebei* Flemming (Saturniidae, Arsenurinae), Arima Blanchisseuse Road, milestone 9.75, MVL, 9.xi.1978; F 70 mm.
18. Male *Ephoria marginalis* Walker (Apatelodidae), Cumaca Road, 4.6 miles, MVL, 21.x.1982; F 29 mm.
19. Male *Druentica scissa* Herrich-Schäffer (Mimallonidae), Hollis Reservoir, at light, 2.xi.1978 16 mm.
20. Male *Euglyphis olivetta* Schaus (Lasiocampidae), Hollis Reservoir, at light, 2.xi.1978; F 20 mm.
21. Male *Homoeopteryx malecena prona* Jordan (Oxytenidae), St. Benedict's, at light, 5.x.1994; F 34 mm.
22. Male *Inguromorpha polybia* Schaus (Cossidae), Brigand Hill, lighthouse, MVL, 28.iii.2003; F 12 mm.
23. Male *Acraga angulifera* Schaus (Dalceridae), Morne Bleu, Textel Installation, at light, 9.xi.1978; F 12 mm.
24. Male *Perola bistrigata* Hampson (Limacodidae), Tobago, Crown Point, at light, 15-17.v.1981; F 8 mm.
25. Female *Leucocastnia licus insularis* Houlbert (Castniidae) Lalaja South Road, milestone 1, 8.xi.1978; F 50 mm.
26. Female *Ecdytolopha aurantianum* Lima (Tortricidae) Curepe, ex cocoa pod, v.1981; F 8 mm.
27. Male *Sphenarches anisodactyla* Walker (Pterophoridae), St. Augustine, Texaco Farm, ex pupa on pigeon pea pod i.1979; F 7 mm.
28. Male *Synanthedon santanna* Kaye (Sesiidae), Arena Forest Reserve, 2.x.1982; F 7 mm.
29. *Hemerophila albertiana* Cramer (Choreutidae), Moruga East Oilfield, nr. Moruga Bouffe, 24.iii.2003 ; F 8 mm.
30. Female *Podalia farmbri* Kaye (Megalopygidae), Nariva Swamp, Manzanilla-Mayaro Road, milestone 46.5, MVL, 19.i.1988; F 22 mm.
31. Female *Draconia rusina* Druce (Thyrididae) St. Augustine, 2.ii.1982 (M. Alkins); F 26 mm.
32. Male *Diatraea saccharalis* Fabricius (Pyralidae, Crambinae) laboratory stock, ix.1981; F 12 mm.
33. Male *Macalla thyrsisalis* Walker (Pyralidae, Epipaschniinae) Arima Valley, Simla, MVL, 18.x.1982; F 14 mm.
34. Male *Mapeta xanthomelas* Walker (Pyralidae, Pyralinae) Mt. Tamana, summit ridge path, 14.x.1995; F 16 mm.
35. Female *Ategumia matutinalis* Guenée (Pyralidae, Pyraustinae) Blanchisseuse - Paria Bay Track, larva on *Clidemia hirta* 20.i.1980; F 10 mm.
36. Female *Imma cancanopis* Meyrick (Immidae) Curepe, xi.1980; F 10 mm.
37. Female *Atteva punctella* Cramer (Yponomeutidae), Morne Bleu, Textel Installation, at light, 29.iii.1979; F 10 mm.
38. Female *Alucita eudactyla* R. Felder & Rogenhofer (Alucitidae) Curepe, MVL, 7-13.xi.1980; F 8 mm.
39. Female *Cerconota anonella* Sepp (Oecophoridae, Stenomatinae) Curepe, MVL, 2.ii.1979; F 10 mm.
40. Female *Tiquadra aeneonivella* Walker (Tineidae, Tineinae) Arima Valley, Simla, MVL, 12.ii.1982; F 13 mm.
41. Male *Arrhenophanes perspicilla* Stoll (Arrhenophanidae) Curepe, Black Light Trap, 11-20.ii.1982 (F.D. Bennett); F 13 mm.
42. Male *Aepytus terea* Schaus (Hepialidae) Inniss Field, MVL, 17.v.1999 24 mm.

PLATE 1

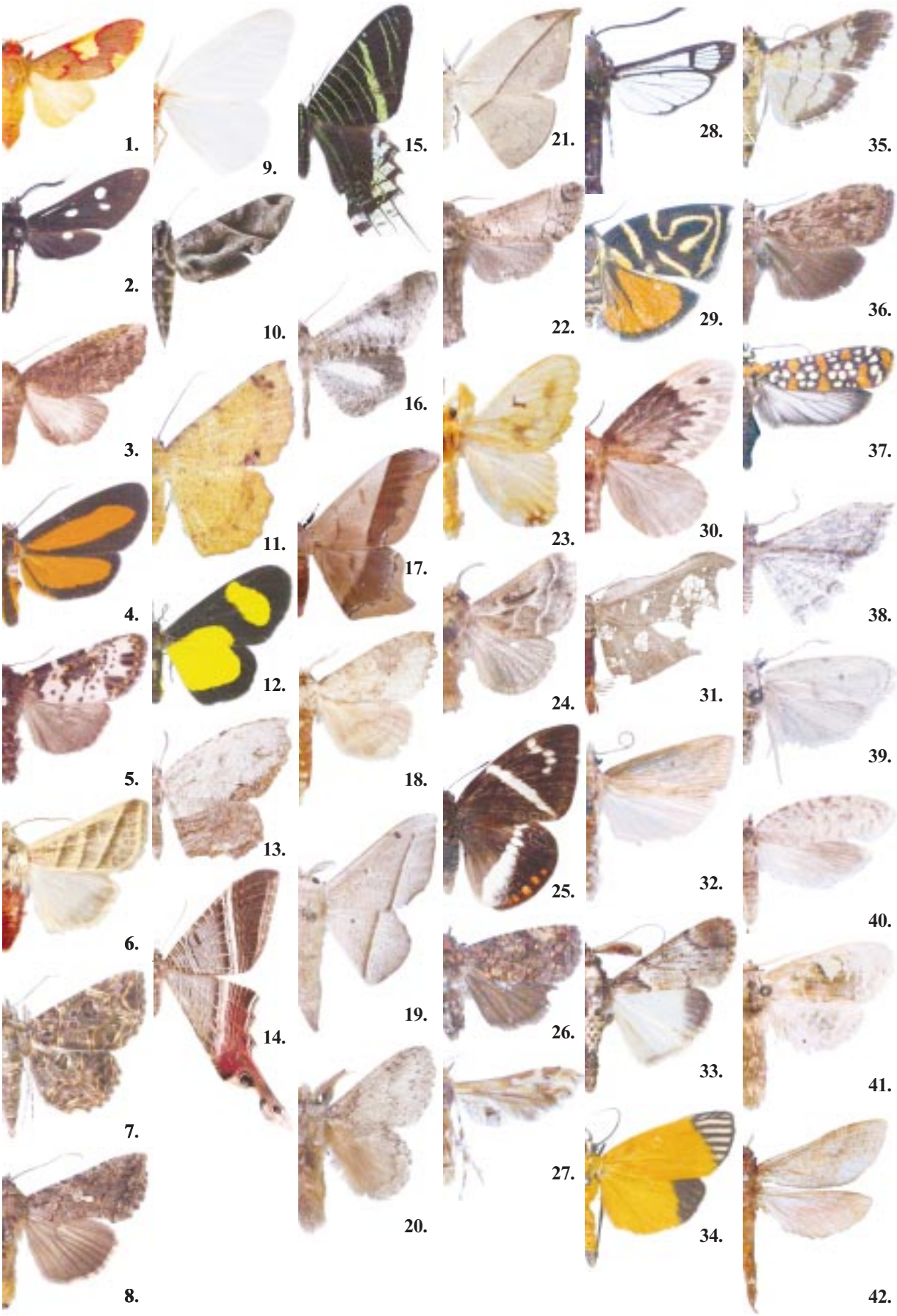
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PLATE 2

LEGENDS TO PLATE 2

Photographs of living larvae and adults of Trinidadian moths. Photographs by M.J.W. Cock where not indicated otherwise.

1. Male *Ceroctena amynta* Cramer, Maracas Valley (J.S. Kenny); F 19 mm. A distinctive member of the subfamily Ophiderinae (Noctuidae); green markings are unusual in this family.

2. Male *Dinia eagrus* Cramer, Rio Claro - Guayaguayare Road, 11.x.1993; F 16 mm. This ctenuchine (Arctiidae) flies by day, when it comes to flowers and *Heliotropium* bait, and by night, when it comes to light. It can be recognised by the red margins to the abdomen.

3. *Pseudsphex kenedyae* Flemming (Arctiidae, Ctenuchinae) at *Heliotropium* bait, Lalaja Ridge, 6.v.1995; F 11 mm. This species was described from Simla, Arima Valley, and named after Ms. Rosemary Kennedy, who was a Research Assistant at Simla. It is one of three ctenuchines that are consummate mimics of *Polistes* wasps in Trinidad.

4. The distinctive and unusual larva of *Phobetron hipparchia hipparchia* Cramer (Limacodidae) (K.G. Preston-Mafham/ Premaphotos); c. 15 mm. Larvae of this species feed on various plants including cocoa and citrus.

5. The striking larvae of *Crinodes striolata* Schaus f. *insularis* Rothschild (Notodontidae), Maracas Valley, 25.vi.1978, on an unidentified vine; c. 70 mm..

6. Adult male *Crinodes striolata* f. *insularis* reared from the larva illustrated; F 37 mm. These moths are occasionally common at light in the forests of the Northern Range.

7. Full grown larva of *Pseudosphinx tetrio* Linnaeus; c. 120 mm. Larvae feed on frangipani and sometimes allamanda.

8. Female of *Pseudosphinx tetrio*, attracted to light at St. Benedicts, 12.x.1993; F 70 mm.

9. Adult *Trygodes musivaria* Herrich-Schäffer (Geometridae, Sterrhinae) (K.G. Preston-Mafham/Premaphotos); F 17 mm.

10. Male *Apicia cayennaria* Guenée (Geometridae, Ennominae) (K.G. Preston-Mafham/Premaphotos); F 14 mm. This species is sexually dimorphic, and both sexes were described as new species; hence this species appears in Kaye & Lamont (1927) under two names (*A. alteraria* Guenée and *A. distycharia* Guenée, both synonyms of A. cayennaria).

11. Adult *Paloda acutangulata* Herrich-Schäffer (Epiplemidae) (K.G. Preston-Mafham/Premaphotos); F 14 mm. Like several other members of this family, this moth holds its wings in a very distinctive way.

12. Unidentified larva of an *Automeris* sp. (Saturniidae) on a species of Convolvulaceae, Morne Bleu, 16.i.1985, c. 60 mm.

13. Newly emerged E *Cerodirphia speciosa* Cramer (Saturniidae) uncharacteristically at rest on a tree trunk (K.G. Preston-Mafham/Premaphotos); F 44 mm.

14. Male *Phiditia cuprea* Kaye (Apatelodidae) (K.G. Preston-Mafham/Premaphotos); F 22 mm. This species was described from Trinidad; note the characteristically bent abdomen at rest.

collectors, and Barcant (1973) provides only a list based on earlier publications (Cock 1982). Since 1973, my studies (Cock 2003 and earlier papers) have added more than 10% to the known number of species. As I complete my review of the Trinidad Hesperiidae, the number of new species recorded is likely to slow, and we can be fairly sure by then that the total number of butterfly species known will be close to the true total. In contrast, moths in Trinidad and both butterflies and moths in Tobago have not been as comprehensively collected, and so it is necessary to estimate the number of species involved from available information. Extrapolation from the best-collected groups to the less well-collected groups is the first approach used here.

The theory of island biogeography (McArthur and Wilson 1967) predicts that the number of species on an island will increase with the size of the island (less frequent local extinction, more niches), and decrease with the distance from a rich source of colonising species (fewer colonisation events). On both counts, Tobago can be expected to have an impoverished fauna compared to Trinidad. With the exception of social wasps, most groups that have been well-collected on both islands have between twice and five times as many species in Trinidad as in Tobago (C.K. Starr, unpublished) – or conversely, the number of Tobago species in a group represents between 20% and 50% of the number of Trinidad species. The number of species of moths estimated for Tobago is interpreted in light of C.K. Starr's finding.

MATERIALS AND METHODS

In Table 1, the numbers of species of moths are presented by families, based on the published lists (Kaye 1901, Kaye and Lamont 1927) and my unpublished lists for Trinidad and Tobago (Annex 1). The classification used here is that of Heppner (1984, 1995, 1996). I am aware that this classification appears to need modification (see e.g. Epstein 1996), but for the purposes of this analysis, this is not critical.

I have interpreted the lists of Kaye (1901) and Kaye and Lamont (1927) in light of the classification used here, so that in the presentation of numbers by families, there are small differences between Kaye's allocations and mine, but the totals are correct. My own studies have shown that several times Kaye referred to one species by two or more different names in his lists, and equally,

Table 1. Historical overview by families of the known species of Trinidad and Tobago moths.

Superfamily	Family	Kaye (1901)	Kaye and Lamont (1927)	Cock Trinidad unpublished (2003)	Cock Tobago unpublished (2003)
Noctuoidea	Arctiidae	43	137	244	18
	Notodontidae[1]	8	69	149	7
	Noctuidae	71	364	745	81
	Lymantriidae		2	3	1
Sphingoidea	Sphingidae	15	54	91	12
Geometroidea	Geometridae	35	135	286	31
	Epiplemidae	2	7	16	
	Sematuridae	2	2	2	
	Uraniidae		1	1	1
	Hedyliidae	1	1	2	
Bombycoidea	Saturniidae	13	23	44	1
	Apatelodidae	2	4	9	
	Mimallonidae	1	2	11	1
	Lasiocampidae		6	18	1
	Oxytenidae		2	3	
Cossoidea	Cossidae		3	12	1
	Dalceridae		2	5	
	Limacodidae		14	36	3
Castnioidea	Castniidae	1	6	9	1
Tortricoidea	Tortricidae		1	15	1
Pterophoroidea	Pterophoridae			1	
Sesioidea	Sesiidae	1	3	9	
	Choreutidae		1	6	
Zygaenoidea	Zygaenidae		1	1	
	Megalopygidae	1	8	22	4
Pyraloidea	Thyrididae		2	8	
	Pyralidae	46	151	443	80
Immoidea	Immidae		1	4	
Yponomeutoidea	Plutellidae			1	1
	Yponomeutidae		2	1	1
	Heliodinidae			3	
Copromorphoidea	Alucitidae			1	
	Carposinidae			1	1
Gelechioidea	Oecophoridae		7	43	5
	Momphidae			1	1
	Gelechiidae		1	6	1
Tineoidea	Tineidae		4	13	2
	Psychidae			6	1
	Arrhenophanidae			1	
	Lyonetiidae			1	1
	Gracillariidae			5	
Hepialoidea	Hepialidae			2	1
Total		242	1016	2275	259

[1] Including Dioptinae, i.e. Dioptidae of Kaye & Lamont (1927)

sometimes what he referred to as one species represents two or more species. I have ignored this in my analysis, on the basis that the number of species involved is not large and these factors at least partially cancel each other out.

In Table 2, I show how the number of species known from Trinidad has increased since 1927, by calculating the percentage increase in numbers for each of the larger groups compared to Kaye and Lamont's (1927) list. I also calculate the Tobago representation as a percentage of the Trinidad 2003 list. Because many of the families known from Trinidad are represented by small numbers of species, I have selectively pooled these to present a clearer picture of the patterns. Partly, I have used the traditional (but taxonomically invalid) groupings Macrolepidoptera (or larger moths, including Zygaenoidea, Cossoidea, Castnioidea, Uranioidea, Geometroidea, Bombycoidea, Sphingoidea, and Noctuoidea) and Microlepidoptera (all other superfamilies). The rationale for this is that the Macrolepidoptera are relatively well collected in Trinidad, whereas the Microlepidoptera have been more or less ignored (apart from the Pyraloidea) because of their small size, and difficulty to prepare and identify.

Table 2. Increases in the number of known Trinidad moths, by family groups, 1927 to 2003, and the currently known Tobago moth fauna as a proportion of the known Trinidad fauna.

Family Group	Kaye & Lamont (1927)	Cock Trinidad unpublished 2003	% increase from 1927 to 2003	Cock Tobago unpublished 2003	Tobago / Trinidad (%)
Arctiidae	137	244	78	18	7
Notodontidae	69	149	116	7	5
Noctuidae	364	745	105	81	11
Sphingidae	54	91	69	12	13
Geometridae	135	286	112	31	11
Saturniidae	23	44	91	1	2
Pyralidae	151	443	193	80	18
Limacodidae	14	36	157	3	8
Other Macrolepidoptera	49	122	149	10	8
Microlepidoptera	20	120	500	16	13
Total / average	1016	2275	124	259	11

In Table 3, I show two attempts to estimate the total number of species of moths that occur in Trinidad, one partially objective, the other largely subjective. The former approach is based on the fact that numbers are available for the known neotropical fauna for all Lepidoptera families. If one assumes that the Trinidad fauna for each family comprises a fairly constant proportion of the total neotropical fauna, then one can calculate this proportion for the well known families and use it to predict the Trinidad fauna for the less well known families as the same proportion of the neotropical fauna.

The numbers of species in the neotropical fauna by families were abstracted from the neotropical checklist (Heppner 1984, 1995, 1996) – those for Uranioidea, Geometroidea and Noctuioidea being estimates in Heppner (1984), the others based on the actual checklist numbers.

The second approach is subjective, and basically represents my best guess. This is loosely based on (1) I have seen but ignored many, diverse, very small moths that came to light when I collected, (2) the rate at which I continue to find new island records when collecting at any but the most well collected sites, and (3) surveys of plants in Trinidad for potential biological control agents turn up species of Microlepidoptera not present in general collections, and often impossible to identify because they have not yet been described.

Table 3. The known total neotropical fauna for the moth families, compared to the known Trinidad totals, and extrapolations as to the possible total number of moths for Trinidad.

Superfamily or Family	Known neotropical Fauna	Trinidad fauna (Cock, unpublished 2003)	Trinidadian fauna as %age of neotropical fauna	Trinidad fauna: Estimate (1)	Trinidad fauna: Estimate (2)
Micropterigoidea	2	0		0	0
Heterobathmoidea	2	0		0	0
Neopseustoidea	4	0		0	0
Hepialoidea	133	2	1.5	9	4
Neptiuloidea	29	0		2	0
Tischeroidea	8	0		1	0
Palaephatoidea	28	0		2	0
Incurvarioidea	46	0		3	0
Tineoidea	691	26	3.8	44	250
Gelechioidea					
Oecophoridae	1733	43	2.5	111	100
Other Gelechioidea	1187	7	0.6	76	150
Copromorphoidea	46	2	4.3	3	10
Yponomeutoidea	208	5	2.4	13	30
Immoidea	36	4	11.1	4	8
Pyraloidea					
Other Pyraloidea[a]	190	8	4.2	8	15
Pyralidae[a]	4562	443	9.7	443	600
Pterophoroidea	208	1	0.5	13	10
Sesioidea	433	15	3.5	28	50
Zygaenoidea[a]	411	23	5.6	23	30
Cossoidea[a]	671	53	7.9	53	70
Castnioidea[a]	134	9	6.7	15	10
Tortricoidea	1454	15	1.0	93	200
Uranioidea[a]	271	19	7.0	19	25
Geometroidea	7804	288	3.7	288	350
Bombycoidea					
Other Bombycoidea	1147	41	3.6	41	60
Saturniidae[a]	926	44	4.8	44	55
Sphingoidea[a]	406	91	22.4	91	100
Noctuoidea[a]					
Other Noctuoidea[a]	180	5	2.8	5	10
Notodontidae[a]	2150	147	6.8	147	200
Arctiidae[a]	6300	244	3.2	244	300
Noctuidae[a]	8516	745	8.7	745	900
Total / average	39916	2280	5.7	2562	3537

[a] – these families are relatively well-collected in Trinidad, and for estimate (1) were used to predict the numbers in other families less well-collected (i.e. the sum of the totals for each well-known Trinidad family divided by the sum of the totals for the same neotropical families, i.e. 6.4%, was multiplied by the current neotropical total for each less well-known family).

RESULTS AND DISCUSSION

Table 1 shows how our knowledge of the moths of Trinidad has increased substantially over the last century. The number of species of moths known has increased from 242 in 1901 to 2,275. The five largest families account for nearly 90% of this total.

Table 2 shows the relative increase in our knowledge from 1927 until now. Overall, the 1927 total has been increased by 124%. Within individual families, the increase is variable, with Sphingidae (69%), Arctiidae (78%) and Saturniidae (91%) showing the smallest increases. This is most probably explained by the relative efforts of the early collectors who would have concentrated on these families with large and colourful species first. These are also the species noted by naturalists and the public and brought to collectors' notice. Although comprising smaller species, Arctiidae are often brightly coloured, and include the Pericopinae which are mainly day-flying and hence more frequently caught by butterfly collectors, Arctiinae which includes many colourful species, and Ctenuchinae, which, as noted above, includes many colourful and distinctive species, including a proportion of day-flying species, and furthermore was a particular interest of W.J. Kaye.

Conversely, Table 2 shows that the largest increases are in the Microlepidoptera (500%) and Pyralidae (193%). The Microlepidoptera, except for a few larger species, were mostly ignored by early collectors. Apart from the Oecophoridae, I too have largely neglected these small moths, and many of the new records represent economic records (pests or herbivores found during surveys for weed biological control agents). So, although there has been a large proportional increase in the number of species, the current total surely represents only a small proportion of those that may be found in the future.

The two attempts to estimate the number of Trinidad moths (Table 3) produce figures of 2,562 extrapolating from the known neotropical fauna and 3,537 based on the author's informed guesses. The obvious flaws with the first approach are (1) it would be naïve to think that even the best known families are comprehensively known in Trinidad, and (2) the less well-known families in Trinidad are probably equally poorly known in the rest of the neotropical region. The second explanation would lead to a predicted fauna not so different to that currently known – as is the case here. I attempt to take these flaws into consideration in my subjective estimate (Table 3). As the study of Trinidad moths continues, and particularly if attention is paid to the Microlepidoptera, I believe the likely total would be of the order of 3,500.

It is also worth noting from Table 3, that Trinidad records of the well-collected family Sphingidae (hawk moths) represent 22.4% of the total known for the neotropical region, whereas the next best represented families are only around 10% of the neotropical fauna. While, without doubt the efforts of F.D. Bennett and D.J. Stradling (Stradling, Bennett and Legg 1983) mean that this family has been far more comprehensively sampled than any other in Trinidad, this high percentage may be a reflection of the known dispersive powers and vagile habits of these large powerful fliers. Comparing the Tobago numbers with the Trinidad numbers (Table 1) shows some interesting differences. Most strikingly, the number of Pyralidae at 80 is relatively high, and only just less than the number of Noctuidae. This reflects the results of the collecting in Tobago by D. Hardy and W. Rowe. Their material is in the USNM, and has been curated for Pyralidae but not for the other common families of moths, such as Noctuidae.

On average, the Tobago fauna is equivalent to 11% of the Trinidad fauna (Table 2), but Saturniidae at 2% and Pyralidae at 18% represent the extremes. Only one saturniid is recorded from Tobago, compared to 44 from Trinidad. I cannot explain this, but one contributing factor may be the lack of collecting in forested parts of Tobago, since I have noted that there is a greater diversity of Saturniidae in forested areas of Trinidad.

Given that Pyralidae is the best documented family for Tobago, one might take 18% as the most realistic estimate of the percentage that the Tobago fauna comprises of the Trinidad fauna. Extrapolating from the subjective Trinidad total suggested above (3,537 species), the Tobago fauna might be expected to be of the order of 640 species. The known Tobago butterflies comprise 20 – 21% of the known Trinidad butterfly fauna (M.J.W. Cock, unpublished), but as noted above the Tobago butterflies are far less well collected than those of Trinidad. Extrapolating 21% of the Trinidad estimated moth fauna gives a prediction of 742 moths for Tobago. However, taking into consideration C.K. Starr's unpublished observation that this proportion is between 20% and 50% for other groups of animals and plants, even 21% is likely to be on the low side. Thus, the true total for Tobago is likely to be higher than 742, although I think it is unlikely to be as high as 50% of the Trinidad fauna.

Seventy-five years ago, Kaye and Lamont (1927) commented on the likely number of species of moths to be found in Trinidad. "It is impossible to forecast what the fauna will be when fully explored, but it can be safely assumed that we do not know half the smaller species of the Pyralidae, Geometridae or Noctuidae. In the Sphingidae the total of 54 species is already large and additions are not likely to be numerous, …. The Castniidae with 6 species, the Syntomidae [Ctenuchinae] with 83 species, … are … very well represented, and … are not likely to give many more." It is still very difficult to hazard a justifiable guess of the total, but not only has the total number of species been more than doubled, but even the numbers for the well-known groups highlighted by Kaye and Lamont have increased by more than 50%: to 91, 9 and 133 respectively. It would be rash to suggest that further additions will not be made in these or other groups, but for Sphingidae and Castniidae at least, I think there will be rather few additions now (Table 3).

In 1941, Sir Norman Lamont wrote in the introduction of his list of additions published posthumously as Lamont and Callan (1950): "The combined total of 1166 species can, however, bear little relation to the total number inhabiting Trinidad. …. Several of the more interesting captures now recorded came from the Arima Valley and I think that there is little doubt that, if lights were systematically worked in the valleys of the northern range, an immense number of interesting captures would be made, of insects new to this imperfect list …". Many of the new records in my list were obtained by doing exactly what Lamont suggested. The Arima Valley at least is now relatively well collected – for the future I suggest the lowland forest areas of southern Trinidad, the drier North-West peninsula and other habitats such as savannahs and swamps will yield many more new records. However, as indicated above, the greatest increases are likely to be made amongst the Microlepidoptera, perhaps best collected by rearing from leaf mines, stems, buds, inflorescence, fruits and seeds etc. of known host plants. For now, I hope my predecessors would be satisfied

with the progress made.

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Annex 1.

The basis of my unpublished lists of moths of Trinidad and Tobago

My list of Trinidad moths (referred to here as Cock Trinidad unpublished 2003) is based largely upon my own collecting. This material is currently divided between my personal collection, the collection of CABI Bioscience in Curepe, and the Natural History Museum, London. The great majority of my collection was made by collecting at light, particularly mercury vapour light. Day-flying moths were collected using a net. Many Ctenuchinae, some Pericopinae and some Arctiinae were collected using dried *Heliotropium* (Boraginaeae) as an attractant (Beebe 1955), mainly by day, but also by night. The following were the principal venues for collecting by light:

1. Curepe. I ran a mercury vapour light trap in my garden more or less continuously when I was present between 1978 and 1982. F.D. Bennett also ran a light trap at his house on Santa Margarita Road, and provided many specimens.
2. Morne Bleu. More than 20 visits were made to collect at the lights of the Textel Morne Bleu Installation, mostly 1978-1979.
3. Simla, Arima Valley. Thanks to the hospitality of Jack Price, a mercury vapour light trap was run overnight on more than 20 occasions during 1981-1982.
4. Collections at mercury vapour light during the early night using a portable generator at Arima-Blanchisseuse Road, milestone 10.5 (6.ix.1982), and milestone 9.75 (21.ix.1982), Caura Valley (24.ix.1978), bottom of Cumaca Road (27.x.1980), Cumaca Road Quarry (18.vii.1981, 21.x.1982), Inniss Field (17.v.1999), Lalaja Ridge (3.ix.1982), Nariva Swamp (19.i.1988), North Coast Road, Carisal Trace (5.iv.1979), Rio Claro – Guayaguayare Road (30.ix.1978), Parrylands Oilfield (13.xi.1980, 25.vii.1981), Point Gourde (16.v.1999), Sangre Grande (6.viii.1982), St. Benedicts (26.v.1981), and Valencia Forest (iv.1980, 31.vii.1980, 5.viii.1981).

I have reviewed much of the taxonomic and economic entomology literature, and although this process is not yet complete, the number of new records found in this way is small, and mostly relate to species of the so-called Microlepidoptera. More importantly, I have reviewed the main collections containing Trinidad moths, and extracted data, as follows:

1. The collection of the Natural History Museum, London, which contains historical material collected by J.H. Hart, H. Caracciolo, Dr. Rendall, and S. Kaye in the 19th century and extensive material collected by W.J. Kaye, W.E. Broadway, F. Birch, S.M. Klages, F.W. Jackson, F.W. Urich, Sir N. Lamont, C.L. Withycombe, F.D. Bennett, R.E. Cruttwell, myself and others in the 20th Century;
2. Sir Norman Lamont's collection divided between the National Museums of Scotland and the University of the West Indies (St. Augustine);
3. The collection of the Oxford University Museum, containing material collected by F.W. Jackson, R.M. Farmborough, A. Lickfold, Mrs. H. Turner and others;
4. The CABI Bioscience collection in Curepe containing material collected by F.J. Simmonds, F.D. Bennett, M. Yaseen, R.E. Cruttwell, myself and others;
5. The collection of the United States National Museum (Smithsonian Institution) which contains limited Trinidad material collected by A. Busck, F.W. Urich, etc. and a collection of Pyralidae and Oecophoridae made by D. and S. Duckworth at Simla in 1966.
6. The collection of the University of the West Indies (St Augustine), incorporating the collection of the Imperial College of Tropical Agriculture and part of Sir Norman Lamont's collection (referred to above); and
7. The Allyn Museum of Entomology, Sarasota, Florida which contains W.J. Kaye's collection of Ctenuchinae.

There is relatively little information available on the moths of Tobago. This is based on much more limited collecting than is the case for Trinidad, and nothing has as yet been published on the moths of Tobago. Nevertheless, I have been able to compile a list

of Tobago Lepidoptera including moths (referred to here as Cock Tobago unpublished 2003). This includes my own collecting, mainly around Crown Point (at house lights), Scarborough (one light trap night in January 1982 at Marden House with a UWI field course) and Speyside (four light trap nights, May 1982). I have also incorporated a list of Sphingidae caught by light trap one night at Arnos Vale by D.J. Stradling (pers. comm.), and collections made at house lights in Charlotteville by R.A. Hammond and P. Meynell in June 1998 and by R.A. Hammond in June 1999. I have also searched for Tobago specimens in museum collections while reviewing the Trinidad fauna. There is quite extensive material in the USNM collected at light by D. Hardy and W. Lowe at several localities in March 1966, 1979 and 1999 (only Pyralidae and Oecophoridae are incorporated into the collection – possibly other families are awaiting curation). Otherwise, I have found only a handful of specimens in other museum collections, e.g. a small collection made in 1914 by W.E. Broadway now in the NHM. There is still much work to be done on the Tobago moth fauna.

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NATURE NOTE

The Moruga Silk Cotton Tree: Grandest of them All

Ceiba pentandra (silk cotton or kapok, family Bombacaceae), reaches a height of 60 m and is the tallest tree in Trinidad and Tobago (Quesnel and Farrell 2000). It is the tallest tree in the Amazon rain forest (www.tropilab.com) and tropical Africa (Watson and Dallwitz 1992). The silk cotton with its massive, wide spreading, plank-like buttresses inspires awe in some and fear in others. Legends abound about this tree which is reputed in local folklore to be a haven for jumbies and frequented by practitioners of spiritism. The ancient Mayas considered the tree to be sacred and today the Maroons and Amerindians share that tradition (www.tropilab.com). *Ceiba pentandra,* though scattered throughout the forests of Trinidad and Tobago, does not occur in pure stands (Beard 1946). In 1983, during a field trip of the Trinidad and Tobago Field Naturalists' Club to Moruga Bouffe, David Rooks, an ornithologist and a past president of the Club, mentioned that the largest tree he had seen was a silk cotton in a section of the nearby mora (*Mora excelsa*) forest. They did not see the tree at that time.

Glenn Wilkes, returned on 22 January, 1984, and made an attempt, using triangulation, to estimate the height of the Moruga silk cotton. He failed because he could not see the topmost branch.

A second attempt was made on 14 May 1984, when Glenn Wilkes returned on foot with Victor Quesnel and Frankie Farrell in a helicopter above. A rope was lowered from the hovering helicopter, and when it touched the ground, the rope was cut at the level of the top of the tree. This gave a height of 56 m. Mora trees attain a height of of 45 m and it was assumed that this mora canopy was 45 m. Therefore, the silk cotton was 11 m above the canopy.

On 21 July, 2002, the authors set off to measure the girth of the Moruga silk cotton. The tree has nine massive buttresses to support its giant trunk. The tallest one is 13 m high. The plan was to cut two long poles, secure a tape measure firmly to one pole and loosely to the other, which would then be carried around the tree. This took three hours as the tree is closely surrounded by thick forest and it was necessary to prevent the tape from getting entangled among hanging lianas, epiphytes and the branches of under-storey trees. The circumference measured 10.3 m just above the buttresses. We also measured a hexagonal perimeter at 1.7 m above the ground on the six most prominent buttresses. This perimeter was 27.2 m.

This silk cotton thrives in a well-watered area with a thick mat of decaying vegetation. It appears to be in excellent shape, with no healed over scars and no indications that it has started rotting from within (21 July, 2002). The tree is probably no more than 200 years old.

We hope this report will encourage others to record the girth and height of giant silk cottons and any uncommonly large trees.

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John Lum Young, Paul Comeau, Dan Jaggernauth, Fulton Wilson

E-mail:jlumyoung@trinidadexpress.com

Abundance and Activity Patterns in the Butterfly Genera *Caligo* and *Eryphanis*

Victor C. Quesnel
P.0. Box 47, Port of Spain, Trinidad and Tobago

ABSTRACT

During a study of the function of the eye-spots on the wings of the local species of *Caligo* and *Eryphanis*, records were kept of the dates and times of observations. These are brought together here to show the annual trend in abundance and the preferred times of activity. Abundance is at a maximum during the months October to January with a minimum in June. The major peak of daytime activity , 33 % of the observations, occurred in the period 1700-1800, the hour that included the mean time of sunset. A minor peak, 18 % of the observations, occurred from 0800 to 0900, approximately two hours after the mean time of sunrise.

INTRODUCTION

Butterfly taxonomy seems to be in a period of transition. The genera *Caligo* and *Eryphanis* are assigned to the subfamily Brassolinae of the family Nymphalidae by Kirkpatrick (1957) and Scobie (1995) and D'Abrera (1987). I choose to follow the latter rather than the former and call our three species of *Caligo* and one of *Eryphanis* brassolids rather than brassolines.

In our three species of *Caligo*, *C. eurilochus*, *C. illioneus* and *C. teuer*, a large eye-spot is situated on the under surface of the hind wing within a darkened area which has been likened to the head of a frog (Stradling 1976). *Eryphanis polyxena* (Barcant 1970) now called *E. autmedon* (D'Abrera 1987), has two smaller but still prominent eye-spots within a darkened area that has been likened to the head of a lizard (Stradling 1976). While engaged in a study of how the eye-spots might function to enhance survival of these species I made many incidental observations. They are gathered together and presented here to show the abundance and activity patterns of these butterflies.

OBSERVATIONS AND CONCLUSIONS

For the study of abundance the only observations used were those that recorded butterflies flying into my home near Talparo in central Trinidad. They seemed to be attracted by the lights within. Two lights remained on at all times. The pattern of use of the other lights was fairly constant from day to day so that the building could be thought of as a light trap of fairly constant attractiveness that sampled the population from day to day. However, at all times there were dark areas as well as well-lit ones.

Over the period 1995-2002 there were 108 records (Table 1).

There are two striking features of these data. First, the small numbers in the period 1995-1997 contrast with the much larger numbers later on. Second, there is a notable annual cycle of abundance with a maximum in October and a minimum in June.

The small numbers for the years 1995-1997 are easily explained. Two *Averrhoa carambola* trees and one custard apple (*Rollinia mucos*a) near the house had not yet reached maturity at that time. Diseased, damaged and over-ripe fruit of these two species are very attractive to *Caligo* and *Eryphanis* and it is very likely that the increase in the numbers of these butterflies coincided with the coming into bearing of the trees. On the other hand, the two observations in June over a eight-year period indicates recurring small populations in that month which are almost certainly due to the preceding dry season of January-May.

This is not the pattern of abundance of many other butterflies. Butterfly collectors in Trinidad have noted that there is a tremendous increase in butterfly populations in June, soon after the rainy season begins, with populations declining thereafter to a minimum in May (Barcant 1970, Charles de Gannes personal communication).

The relatively low numbers of 2000 compared with 1998, 1999 and 2001 have no obvious explanation, but they could be due to unfavourable conditions for breeding during that year. When they become available from the Central Statistical Office, rainfall records may provide an answer.

As noted above, I first regarded the house as a light trap. However, I have never seen within it any of the common sun-loving butterflies such as *Agraulis vanillae, Heliconius aliphera* or *Amartia amathea.* Nor have I seen indoors the fast-flying, sun-loving *Morpho peleides* which, like (*Caligo*) feeds on rotting fruit, and is common in the area. On the other hand, other Brassolines (or Brassolids) have been recorded indoors, and a few of the shade-loving *Euptyghia* species have also visited the house. Thus, it is possible to think of the house as a "shade trap" rather than a light trap, effectively competing with the nearby secondary forest as an attractant for the shade lovers, but not effectively competing with sunlight as an attractant for the sun lovers.

For the study of the daily cycle of activity the acceptable observations were those that referred to butterflies actually in flight that was obviously not triggered by the observer. Observations of butterflies feeding at sap or fruit, or drinking at puddles, were excluded even though the butterflies were obviously active. Furthermore, the time of observation had to be reasonably precise. Sixteen of the 76 records had been rounded off to the hour, such as "about 0900 h." Eight are accurate to the minute, such as "1402 h" and the remainder fell between these two extremes, rounded off

Table 1. Numbers of Brassolid butterflies of the genera *Caligo* and *Eryphanis* entering the study area in Trinidad, West Indies.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1995				1						1			2
1996								1					1
1997											1		1
1998		2	2						4	10	1	1	20
1999	7	3		2				1	1	2	2	2	20
2000	2					1	3		1	1			8
2001			2	1	2		2	3		2	5	6	23
2002	5	3	2	2	1	1	2	1	2	1	4	9	33
Total	14	8	6	6	3	2	7	6	8	17	13	18	108

to 10 or 15 minutes, such as "1820 h" or "1915 h." The study site was not restricted to the house, and only 29 of the 76 observations are common to both studies, the other 47 observations having been made in a variety of other locations.

For analysis, the observations that had been rounded off to the hour (eg 0900 h) presented the problem of deciding whether it was better to count these in the hour preceding the recorded time (eg. 0801-0900 h) or in the succeeding hour (eg. 0900-0959 h). To find the solution, two frequency distributions were prepared, one with all such figures in the hour preceding the recorded time, and the other with all 16 figures in the hour succeeding the recorded time. The main features of the two histograms were identical - a bimodal distribution with a minor peak at 0800-0900 h and a major peak at 1700-1800 h. The true situation is likely to be something between the two extremes, but both histograms give an adequate picture of the situation. Because the histogram given by the first procedure gave a more symmetrical major peak it is reproduced here as Fig. 1.

Because these butterflies are thought to "fly at dusk or in deep forest shade" (Scoble 1995) it was of interest to know how the peaks were related to sunrise and sunset. The time of sunrise on the dates of all seven flights occurring at the minor peak in the morning was determined from weather reports in the Trinidad Guardian, and the mean time was calculated. It was 0607 h. A similar procedure for the 25 flights at the major peak gave a mean time for sunset as 1757 h. It is clear that the time of maximum activity in the morning is more than two hours after sunrise, whereas the time of maximum activity in the evening is in the hour that includes sunset, with most flights occurring before sunset.

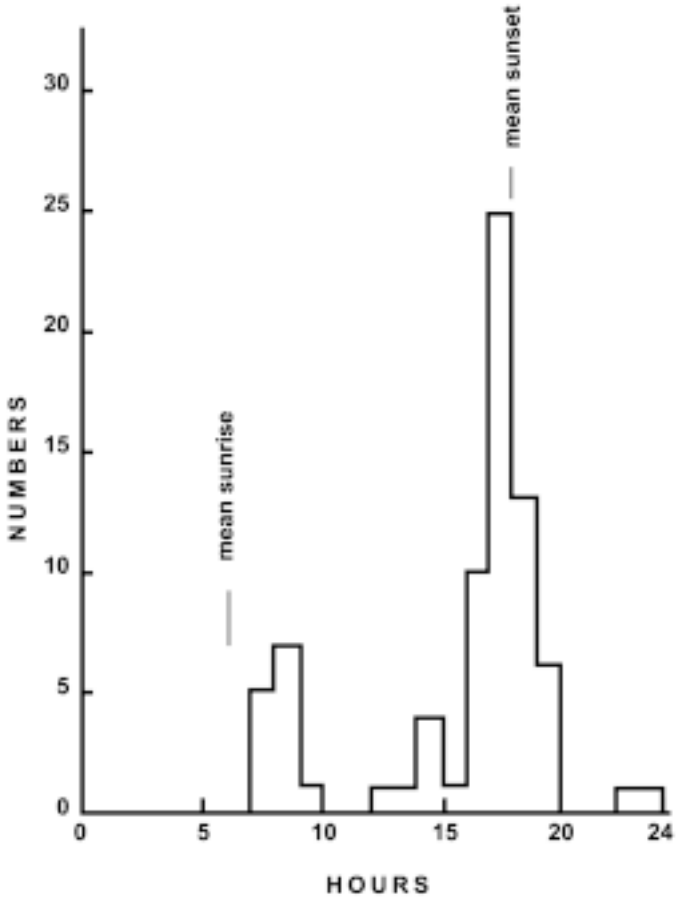

Fig. 1. Numbers of individuals of *Caligo* and *Eryphanis* species observed in flight at different hours of the day. Observations on the hour are treated as belonging to the preceding hour.

Why is the minor peak of activity so much farther from sunrise than the major peak is from sunset? Since ambient temperatures at sunrise can easily be 5° C lower than those at sunset, I postulate that the butterflies require an hour or more to warm up before they begin to fly. By that time (on fair days) the sunlight has strenghtened and the temperature rapidly becomes higher than the temperature preferred by the butterflies. Hence, the peak is later than expected if its timing were determined by light intensity alone, but also smaller than the peak at sunset.

Only about 28% of all flights occurred after sunset. Why then are *Caligo* and *Eryphanis* described as crepuscular? Different answers are possible: 1. The perception is based on casual observation and is inaccurate. 2. Because the areas that these butterflies frequent are forested, crepuscular conditions obtain long before sunset and long after sunrise. 3. Weather conditions could influence light intensity for long periods and make suitable some periods that would not normally be suitable for activity. Perhaps all these answers have some truth in them. Activity is not restricted to dim light. I have seen *Caligo* feeding on the sap of a fallen fig tree in noonday sunlight, but how common is this?

Other questions arise. How much light does a *Caligo* need before it will fly? Will it fly by starlight alone? Of two flights contributing to Fig. I in the period 2200-2400 h, one, one day before last quarter, would have benefitted from some moonlight, but the other, two days before new moon, would have been made in starlight alone.

All these questions suggest that another study is needed, one in which both light intensity and air temperature are measured.

I thank Gail Abdulla for two records of flying *Caligo* butterflies, and Chris Starr and Charles de Gannes for their comments on earlier versions of this paper.

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Breeding of the Tropical Screech Owl, *Otus choliba* in Talparo, Trinidad and Tobago

Victor C. Quesnel
P.O. Box 47, Port of Spain, Trinidad and Tobago.

ABSTRACT

Between 1988 and 1995, a pair of *Otus choliba* attempted to breed beneath the eaves of my home near Talparo, Trinidad. Eggs were laid and incubated, but only in 1995 was incubation successful when two chicks hatched after an incubation period of 26 days. The chicks flew at about 30 days old. Observations were made on the frequency of visits by the male to the incubating female, the times when the female vacated the nest and the progress of the chicks as they grew. In all aspects studied here *Otus choliba* conforms neatly with its congeners in North America.

INTRODUCTION

Compared with what is known about breeding in North American species of *Otus* (Gehlbach 1995; McCallum 1994; Terres 1982) the information available about breeding in *Otus choliba* in Trinidad (ffrench 1991) is minuscule. ffrench (1991) states merely that the breeding season is February-May, the nest is usually a hole in a tree, and clutch size is 1-3 white eggs that average 33.8 x 29.1 mm. The following observations add to this short list.

STUDY SITE

My home off Leotaud Trace, Talparo, Trinidad is a prefabricated house of greenheart timber. There is no continuous ceiling under the eaves, but at each corner a partial ceiling serves as a base for a security light. Thus, at each corner there is a shallow, rectangular cavity about 85x60x15 cm with a gently sloping floor and one side open towards the central ridge of the roof. Two of these, at the SE and SW corners attracted the attention of a pair of *Otus choliba* during the dry season in 1988 and subsequent years.

The cavities are slightly over three metres above ground level, but by standing on the nearby windowsill, I could easily see inside the cavities. The room at the SW corner of the house is my study where I spend most of my time and sitting at my desk at night I could easily hear in the stillness of night-time in the countryside footsteps of the owls as they came and went, the rolling of the eggs as the female moved them, the soft calls of the owls to one another and the sounds made by the chicks when they eventually hatched.

OBSERVATIONS

1988

The owls first appeared at the beginning of February, 1988 and by 30 April settled on the SW cavity as their nesting site. In the morning of 1 May an owl, which I identified as a female (Perrins and Middleton 1985), was sitting there and in the evening was seen there three more times. At 1831 hours on 2 May there was one egg in the nest, and between 1835 on 3 May and 2400 on 6 May a second egg was laid. The eggs were incubated until 31 May, but failed to hatch. During this period I watched the pair as often as possible and recorded what I saw of their behaviour.

In the evenings, the male would arrive, perch in a nearby tree and call. Usually the female would fly from the nest at his call, spend some minutes with him and then return to the nest. Both outside and within the nest cavity the birds called to each other with a quick series of hoots, about 2-10 in number, each series lasting 0.5-1.0 seconds in a softer and lower version of the usual call without the terminal accented hoot. Less often, soon after the male called he would join the female in the cavity. After a few seconds, he would fly out again with the female following him. I have only one record of the time spent together off the nest for the year 1988 – 9 minutes. For 1989 I have three: 13, 12 and 5 minutes. The mean for all four is 9.75 minutes. The female left the nest later in the night too. I have six such records, one for the period 2000-2100 , two for 2200-23:00 and three for 0000-0100.

Table 1 gives times for the evening vacation of the nest in relation to sunset for the period of incubation. As the sunset got later, so did the time of departure. (Table 1). The correlation coefficient is r=0.95. (P=0.001 by Student's t test). The duration of the waiting period, i.e. the time between sunset and the departure from the nest (column 4, Table 1) is highly correlated with the duration of incubation (column 1, Table 1), r =0.86, p = 0.2, by Student's t test.

Table 1. Female's vacation of the nest in relation to time of sunset in May, 1988.

Date	Time of departure	Time of sunset	Diff. minutes col. 2 – col. 3
2.5.88	1831	1817	14
3.5.88	1836	1817	19
8.5.88	1844	1818	26
10.5.88	1837	1818	19
11.5.88	1838	1818	20
15.5.88	1846	1819	27
31.5.88	1915	1824	51

1989

A pair of owls appeared again in 1989 on 13 March and by the morning of 15 March the female was in the nest cavity seemingly incubating the eggs from the previous year (???). Incubation came to an end on 4 April after 32 days. Table 2 gives a record of visits by the male to the nest on the eight days when observations were made. The period of observation was 2000-2300, except for 3 April when observation ceased at 2200, and twice (9 and 14 April) when the period was 0000-0100. The mean time between visits was 32.9 minutes. Ten visits (43 %) occurred in the period 2000-2100, more than any other one hour period before midnight, but in terms of visits per hour of observation, more occurred in the hour after midnight than any other hour.

Table 2. Visits by the male *O. choliba* to the female in the nest in 1989.

Date	Time of visit	Interval between visits (minutes)
21.3.89	2055	
	2106	11
	2148	42
	2208	20
23.3.89	2010	
	2035	25
	2100	25
	2250	110
30.3.89	2024	
	2055	31
2.4.89	2024	
	2043	19
	2051	8
3.4.89	2100	
	2131	31
9.4.89	0005	(3 visits in 23 minutes)
	0028	
10.4.89	2020	
	2025	5
	2130	65
14.4.89	0020	
	0030	10

1993

In 1993 one egg was laid and abandoned after a few days. As the site could have been too draughty and prevented the eggs reaching the right temperature for incubation, I insulated it with paper and Styrofoam, and reduced the size of the cavity about half.

1994

When the owls came back on 5 March 1994, I tore up a brown paper bag into small pieces about 15 x 10 cm and pushed them into the lower end of the cavity. The owls did not remove them. Two eggs were laid between the 20 April and 25 April (while I was absent). They were incubated until 24 May and then abandoned.

1995

The owls came back in 1995 and I made another attempt to provide better insulation. I also made sure that there were no old eggs in the nesting cavity. In the morning of 13 March the female was back in the cavity, and was there that night and the next day. There was no egg at 1840 on 16 March, but about 2330 on 18 March I heard sounds as though an egg was being moved. At 1830 on 19 March there was still only one egg in the cavity, but two eggs were there at 2000 on 20 March. No more eggs were laid and the owls were continually in attendance at the site thereafter.

Two eggs were still present in the cavity at 1830 on 12 April. No check could be made on 13 April, but on 14 April at 0815 light "squeaky-chirpy" sounds were coming from the cavity. A check at 0915 h revealed the female and some broken egg shell. At 1000 the next day a large piece of eggshell (more than half) was evident, and at 2320 there were two large pieces of eggshell.

During the next four weeks there was always a period of some minutes between 1830 and 1930 when both birds were away from the cavity, and I examined the site nearly every day at that time to note the progress of the chicks. I saw both chicks for the first time on 17 April. They were a little smaller than the chicks of a domestic fowl, one slightly larger than the other, and both covered in white down. Their eyes were closed and they made the "squeaky-chirpy" sounds I had heard earlier. Their eyes did not seem to be both directed forward as in adult owls, but on each side of the head as in chicks of the domestic fowl. For this reason they did not look like owls.

By 26 April, 17 days after the hatching of the first chick, they were looking much more like owls, with the eyes directed forwards but still closed. On 27 April the larger chick seemed to have its eyes open, but covered by a nictitating membrane. On 30 April the eyes of both chicks were wide open. On 2 May the larger chick was a very pale grey and finely barred with darker grey. The illustration of immature *Otus asio* in Terres (1982) gives a good idea of their appearance at this stage. On 4 May I noticed that the irises were yellow. On 7 May there was still no hint of brown, but by 12 May the plumage was distinctly brownish, and the wing feathers were well grown and patterned in brown and tan. This was well seen when the older chick spread its wings, lowered its head swayed from side to side and repeatedly made loud snapping sounds with its bill in a typical threat display. On 6 May the adult female had made a similar display when I looked into the cavity. On 14 May at 0800 both chicks were present, but by 2330 one had flown and the other was standing at the edge of the cavity seemingly ready to fly too. By 0800 on 15 May the second chick had flown.

In subsequent years the site deteriorated and the owls did not come back after 1995.

DISCUSSION

My notes for the first four years are not complete enough to fix the number of days that the female occupied the nest before laying the first egg. The period may have been as short as 24 hours. In 1995, however, she occupied the nest for five days before laying the first egg. This preliminary occupancy seems to be typical of owls in the family Strigidae (Perrins and Middleton 1985) and *Otus asio* is known to occupy the nest for six days prior to laying (Gehlbach 1995). During this period and during the succeeding period of incubation the male feeds the female. This is true of *Otus choliba* as well.

My observations were not frequent enough to fix the exact time the eggs were laid. This makes calculating the duration of incubation difficult. Most diurnal birds lay near sunrise at the start of their period of activity (Welty 1975; Terres 1982), but much less is known about nocturnal birds. The pauraque *Nyctidromus albicollis* lays near sunset at the start of its period of activity (Terres 1982; pers. obs.), and I shall assume that owls do too.

In 1995 the first egg was laid between 1840 on 16 March and 2330 on 18 March. I feel confident that if the first egg had been laid in the evening of either 16 or 17 March I should have heard it being moved much earlier than 2330 on the 18 March. Therefore, I place the laying of the first egg in the evening (about 1800) of 18 March. Owls are known to lay the second egg 38-48 h after the first (Welty 1975), though some lay on successive days as does *O. asio* (Gehlbach 1995). Therefore, I place the laying of the second egg in the evening of 20 March (before 2000) and not on 19 March

after 1830. *O. asio* lays its first 2-3 eggs on successive days (Gehlbach 1995); *O. flammeolus* lays three eggs, the first two on successive days and the third after two more days. If my argument is accepted, *O. choliba* lays the second egg two days after the first. The observations of 1988 also indicate a gap of two days between the two eggs. I assume that incubation began after the laying of the first egg because of the difference in size between the two chicks and the difference in hatching dates. In *O. asio* 63% of females incubated immediately and 25% began with the laying of the second egg (Gehlbach 1995). In *O. flammeolus* incubation begins one night before the third egg is laid (McCallum 1994). The first chick hatched between 1830 on 12 April and 0815 on 14 April. I could find no information at all about the time of hatching of nocturnal birds, but the pauraque hatches in the evening (pers. obs.), so I shall assume that owls do too. Therefore, the choice lies between the evening of 12 April (after 1830) or the evening of 13 April. I feel confident that I would have heard "squeaky chirpy" sounds long before 0815 on 14 April if hatching had occurred on 12 April, so I assign the hatching of the first chick to 13 April, 26 days from 18 March. The second chick hatched between 1000 and 2330 on 15 April, most probably in the evening, 26 days from 20 March. If my assumptions are wrong, incubation can be given no more accurately than 25-29 days for both chicks. In *O.asio hasbrouckii* the maximum period of incubation for the first egg is 34 days; the minimum for the others is 27 days, the actual value depending on environmental conditions (Gehlbach 1995). In *O. asio asio* incubation "is often given as 26 days …apparently following Sherman (1911)," (Gehlbach 1995). In *O. flammeolus* eggs require 22 to 24 days incubation depending on locality (McCallum 1994).

The first chick to hatch flew in the evening of 14 May, and the second by early the following morning. Thus, the first chick flew after 31 days and the second at 29-30 days. The plumage passed from white down to the finely barred appearance of the adult in about 19 days, and brown appeared in the generally grey colour at 26-27 days from hatching. The movement of the eyes from a lateral to a more forwardly directed position came after about 13 days. I have found no mention of this in the literature.

The two outstanding stage-markers in the continuous process of development of young birds are the opening of the eyes and the eruption of the vanes from the quills of the primary feathers. Table 3 compares my observations on *O. choliba* with others on some of its congeners. From the scanty data, it seems that *O. choliba* is slower in development than the other species and closest to *O. flammeus.* It is noteworthy that of the three other species, this last has the widest distribution and "lives on every continent except Australia" (Terres 1982), including South America.

I paid little attention to the behaviour of the parents after the chicks hatched but my impression was that the female spent most of her time in the cavity where she was fed by the male. On 10 May, 27 days after the first chick hatched, she was not in the cavity at 0730, and might have spent the rest of the daylight hours away from the chicks. She was present at 0830 on 11 May, and absent again at 0830 on 13 and 14 May, so nearing full fledging the female may leave the chicks unattended during the daytime.

The observations of 1988 (Table 1) showed that the female became more and more reluctant to leave the nest as hatching approached. This seems to be true for all species (Terres 1982) and may be a behavioural adaption to increase the chance of a favourable outcome to incubation. "Recess time decreases as incubation progresses" in *O. asio* (Gehlbach 1995), and this may be true of *O. choliba* as well.

O. choliba has the smallest clutch size of the *Otus* species considered here (Table 3). This is consistent with the "egg rule" that tropical birds have smaller clutches than similar birds in temperate countries (Terres 1982).

Table 3. A comparison of *O. choliba* with some congeners.

Feature	*O. choliba*	*O.asio* [a]	*O. flammeolus* [b]	*O. flammeus* [c]
Eyes open*	16-17 (1)+ 14-15 (2)++	7-9		8-12
Primaries erupt*	26	13-15		
Fledging*	31 (1) 29-30 (2)	28	25	31-36
Clutch size	1-2	2-8	2-4	4-14

* Days from hatching: +(1) = chick 1; ++(2) = chick 2.
a. Gehlbach 1995; b. McCallum 1994; c. Terres 1982.

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A Survey of Freshwater Macroinvertebrates in Tobago

David Bass
Biology Department, University of Central Oklahoma, Edmond, Oklahoma, USA 73034
E-mail: Dbass@ucok.edu

ABSTRACT

A survey of macroinvertebrates inhabiting the freshwater environments of Tobago was made during April, May, and June of 1996. This collection yielded 61 species, bringing the total number of freshwater macroinvertebrate taxa known from Tobago to 112. Dominant taxa included a few species of gastropods, decapod crustaceans, ephemeropterans, odonates, hemipterans, and coleopterans. Species richness was usually greatest in streams having cobble substrates and flowing through undisturbed forested land. Generally this macroinvertebrate fauna is sparse when compared to that of continents, most likely due to the relatively small size of Tobago and to a much lesser extent, human disturbance of freshwater environments in some areas of the island. Further studies are likely to find additional species that were previously unknown to occur on Tobago, some of which may be endemic to the island.

INTRODUCTION

Tobago is a small island lying on the northeastern edge of the South American continental shelf in the southeastern Caribbean basin. This oval-shaped island is approximately 43 km long and 14 km wide. It has a central spine of mountains rising 567 m above sea level and comprises approximately 302 km^2. Tobago is separated by about 33 kilometers of sea from its sister island of Trinidad. Although rocks present on Tobago are assumed to be of Cretaceous age (Maxwell 1948) and Comeau (1991) speculates Tobago was continuous with Trinidad as recently as 14,000 y.b.p., it is unknown exactly when Tobago separated from Trinidad or the South American continent (Hardy 1975). The central mountain range shows no signs of having ever been submerged (Flint 1996).

Several types of aquatic environments are present in Tobago. Steeply flowing streams and rivers drain toward the southeast or northwest from the central mountainous spine. Many of the smaller streams exhibit periods of intermittent flow. Near the coast, some rivers flow slowly across a narrow lowland, forming a marsh prior to entering the sea. Two larger marshes are present on the low, flat southwestern portion of Tobago.

Very little is known about the freshwater invertebrates of the Lesser Antilles and other nearby small islands. Some investigations were made on nearby islands including Trinidad (Hynes 1971; Alkins *et al*. 1981; Alkins-Koo 1990) and St. Vincent (Harrison and Rankin 1975, 1976a, 1976b; McKillop and Harrison 1980), but similar published efforts are generally lacking for Tobago. While some invertebrate groups have been studied, such as decapod crustaceans (Chace and Hobbs 1969; Hart 1980), odonates (Donnelly 1970), and trichopterans (Flint 1968, 1996), many others have yet to be surveyed. In cases where previous investigations exist, they are often limited in scope to a few sites or taxa (Hynes 1948; Hinton 1971; Nieser and Alkins-Koo 1991; Botosaneanu and Alkins-Koo 1993; Stark 1994). Furthermore, additional collections can yield previously unknown populations or species (Flint 1996; Bass and Volkmer-Ribeiro 1998).

The objectives of this investigation include: 1) determine the species of aquatic macroinvertebrates inhabiting freshwaters of Tobago; 2) note microhabitat preferences of each species; 3) determine the relative abundance of each species; and 4) compare the Tobago macroinvertebrate fauna to that on other small Caribbean Islands.

METHODS

Seventeen sampling sites were established in various freshwater habitats across Tobago (Fig.1). Macroinvertebrate collections were made during April, May, and June 1996. Water temperature was also recorded from each site at the time of collection.

Several methods of collecting were used to ensure as many species as possible were captured. Submerged debris, such as stones, leaves, and wood, were carefully examined by eye 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 of each specimen was noted. A drift net was used at two sites to collect additional samples during the night. Specimens were preserved in 70% ethanol and returned to the laboratory for further identification. The list of taxa known from Tobago was compared to those of other small Caribbean Islands by applying Sorenson's index of similarity (1948).

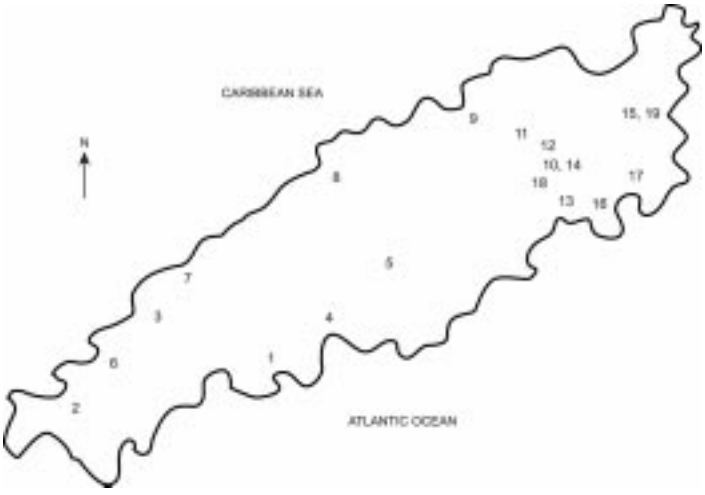

Fig. 1. Map indicating location of collecting sites in Tobago. Specific locations and dates of collections are listed below Table 1.

RESULTS & DISCUSSION

Water temperatures, measured during the collection period, ranged from 23°C in tributaries of the Argyle and Bloody Bay Rivers to 32°C in Courland and Bloody Bay Rivers. Generally cooler temperatures were measured in small streams at higher elevations of the mountain forests while warmer temperatures occurred in

lowland rivers. This 9°C difference in temperature was much greater than the 2.2°C reported in the Arima River system in Trinidad through a similar elevation gradient (Hynes 1971).

Prior to this collection, 71 species of freshwater macroinvertebrates had been reported from Tobago, and most of these were caddisflies (Botosaneanu and Alkins-Koo 1993; Flint 1996) and shrimps (Hart 1980). Sixty-one taxa were collected during this study. Of these, only 20 had been previously reported, bringing the total number of freshwater macroinvertebrates known from Tobago to 112 taxa (Table 1). The major findings are summarized below.

Gastropoda

Ten species of aquatic snails were collected on Tobago. The introduced *Melanoides tuberculata* was abundant in several habitats across the island. Three species of nerites were present, grazing on algae growing on submerged rocks. The left-handed pond snail, *Physella*, was uncommon on Tobago, but is usually abundant on other nearby islands of the Lesser Antilles.

Table 1. List of freshwater macroinvertebrates, including collecting sites, life cycle stages present, relative occurrance, microhabitats, and proposed trophic relationships in Tobago during April, 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*
Gastropoda					
Hebetancylus excentricus	4	A	+	Detritus	Algivore
Marisa cornuarietis	5, 6, 7	A	+	Detritus	
Melanoides tuberculata	4 - 9, 12, 15, 16, 18	A	+++	Detritus	
Neritina clenchi	1, 3, 9, 13, 15, 17	A	++	Rock	Algivore
Neritina virginea	9	A	+	Rock	Algivore
Neritina usnea	9, 17	A	+	Rock	Algivore
Physella cubensis cubensis	6	A	+	Detritus	Detritivore
Pomacea sp.**	**	A	+		
Pyrgophorus parvulus	4 - 6, 13, 15	A	++	Detritus	
Tropicorbis pallidus	13	A	+	Detritus	
Bivalvia					
Eupera cubensis	6	A	+	Sediment	Bacterial feeder
Amphipoda					
Grandidierella sp.	1	A	+	Detritus	Detritivore
Decapoda					
Atya innocous	8, 14, 15, 20	J, A	+	Detritus	Omnivore, Collector
Atya scabra	20				Omnivore, Collector
Atya sp.	2, 8 - 11, 14, 16, 18	J, A	++	Detritus	Omnivore, Collector
*Eudaniela garmani****	11, 18	J, A	+	Stream bottom	
Jonga serrei	13, 15, 17, 20	J, A			
Macrobrachium acanthurus	13, 20	J, A	+	Detritus	Omnivore, Predator
Macrobrachium carcinus	20				Omnivore, Predator
Macrobrachium crenulatum	7, 20	J	+	Detritus	Omnivore, Predator
Macrobrachium faustinum	2, 4, 5, 7 - 10, 12, 14 - 16, 18, 20	J, A	+++	Detritus	Omnivore, Predator
Macrobrachium sp.	1, 3	J	+	Detritus	
Palaemon pandaliformis	20				
Potimirim sp.	2, 4, 8 - 12, 14, 16, 18	J, A	+++	Detritus	
Sesarma rectum	20				
Xiphocaris elongata	15, 20	A	+	Detritus	
Ephemeroptera					
Americabaetis sp.	12, 14 - 16, 18	N	++	Detritus	Collector
Baetodes sp.	18	N	+	Detritus	Collector
Caenis sp.	14	N	+	Detritus	Collector
Farrodes sp. 1	7 - 10, 14 - 16, 18	N	++	Detritus	
Leptohyphes zalope	14	N	+	Detritus	
Leptohyphes sp. 1	9, 16, 18	N	+	Detritus	
Tricorythodes sp.	9	N	+	Detritus	Collector
Odonata					
Argia sp.	2, 8, 9, 11, 12, 14 - 16, 18	N	++	Detritus	Predator
Dythemis sp.	7	N	+	Detritus	Predator
Erythemis vesicula?	1, 13	N	+	Detritus	Predator
Ischnura ramburii	1, 3 - 6, 13	N	++	Detritus	Predator
Micrathyria sp.	13	N	+	Detritus	Predator
Plecoptera					
Anacroneuri isleta	20	A			
Hemiptera					
Belostoma subspinosum	6	A	+	Detritus	Predator
Brachymetra albinervis	2 - 4, 7, 8, 10 - 12, 15, 18, 20	N, A	+++	Neuston	Predator
Brachymetra unca	10, 20	A	+	Neuston	Predator
Buenoa antigone	4, 20	A	+	Detritus	Predator
Gelastocoris flavus	20	A			Predator
Limnogonus franciscanus	2, 4, 20	N, A	+	Neuston	Predator
Mesovelia amoena	20	A			Predator
Mesovelia mulsanti	1, 2, 4, 6, 20	A	++	Neuston	Predator
Microvelia hinei	20	A			Predator

Taxa	Collections	Life Cycle	Occurrence	Microhabitat	Trophic Relationship*
Microvelia longipes	20	A			Predator
Microvelia mimula	20	A			Predator
Microvelia pseudomarginata	20	A			Predator
Microvelia pulchella	20	A			Predator
Microvelia sp. near tumida	20	A			Predator
Microvelia sp.	2, 9	A	+	Neuston	Predator
Ochterus perbosci	20	A			Predator
Paravelia brachialis	20	A			Predator
Rhagovelia insularis	10 - 12, 14, 15, 16, 18, 20	N, A	+++	Neuston	Predator
Rhagovelia tenuipes	20	A			Predator
Trepobates taylori	20	A			Predator
Trochopus plumbea	20	A			Predator
Trichoptera					
Amphoropsyche sp.	20	A			
Austrotinodes adamsae	20	A			
Cerasmatrichia argylensis	20	A			
Cernotina hastilis	20	A			
Cernotina mandeba	20	A			
Chimarra bidens	20	A			
Chimarra caribea tobaga	20	A			
Chimarra flinti	20	A			
Chimarra sp.	15, 16, 18, 19	L	+	Detritus	Collector
Chimarrhodella tobagoensis	20	A			
Helicopsyche margaritensis	9, 15, 20	L, A	+	Rock	Scraper
Hydroptila grenadensis	20	A			
Hydroptila tobaga	20	A			
Leptonema albovirens	14 - 17, 20	L, A	++	Detritus	Collector
Leucotrichia botosaneanui	20	A			
Leucotrichia tritoven	20	A			
Neotrichia armata	20	A			
Neotrichia tauricornis	20	A			
Neotrichia unamas	20	A			
Ochrotrichia geminata	20	A			
Ochrotrichia oblonaata	20	A			
Ochrotrichia platygona	20	A			
Oxyethira azteca	20	A			
Polycentropus altmani	20	A			
Polyplectropus pugiunculatus	11, 20	L, A	+	Detritus	
Protoptila ignera	20	A			
Rhyacopsyche duplicispina	20	A			
Smicridea anomala	20	A			
Smicridea bivittata	20	A			
Smicridea tobada	20	A			
Wormaldia plana	20	A			
Xiphocentridae sp.	20	A			
Xiphocentron piscicaudum	20	A			
Xiphocentron stenotum	20	A			
Zumatrichia anomaloptera	20	L, A			
Lepidoptera					
Petrophila sp.	9	L	+	Rock	Scraper
Coleoptera					
Cyphon sp.	15		+	Detritus	
Elsianus clypeatus	20				
Enochrus psuedochraceus	6	A	+	Detritus	Predator, Herbivore
Heterelmis simplex codrus	20				
Hexacylloepus smithi	20				
Hydrocanthus sp.	6		+	Hydrophyte	Predator
Limnichorus moratus	16	A	+	Detritus	
Microcylloepus carinatus	20				
Neoelmis pusio	20				
Notionotus rosalesi	14	A	+	Drift	
Phanocerus congener	20				
Psephenops smithi	16, 18	A	+	Rock	Scraper
Tropisternus setiger	5, 6	A	+	Detritus	Collector
Diptera					
Ablabesmyia sp.	13	L	+	Sediment	Predator
Anopheles sp.	3, 4	L	+	Detritus	Collector
Chironomidae sp.	13	L	+	Sediment	Collector
Chironomus sp.	4, 6, 13	L	+	Sediment	Collector
Euparyphus sp.	15	L	+	Detritus	Collector
Fittkauimyia sp.	5	L	+	Sediment	
Pseudochironomus sp.	9	L	+	Sediment	Collector

Collections:

1. *Bacolet River, Bacolet, Tobago, 24 April 1996*
2. *Bon Accord Spring, Bon Accord Tobago, 26 April 1996*
3. *Courland River, Courland, Tobago, 26 April 96*
4. *Hillsborough West River, Mesopotamia, Tobago, 26 April 1996*
5. *Hillsborough East River, Hillsborough, Tobago, 26 April 1996*
6. *Buccoo Marsh, Buccoo, Tobago, 27 April 1996*
7. *Arnos Vale Creek, Arnos Vale, Tobago, 27 April 1996*
8. *Little Englishmen's Bay Creek, East of Castara, Tobago, 27 April 1996*
9. *Bloody Bay River, Bloody Bay, Tobago, 27 April 1996*
10. *Argyle River Tributary, 4 1/4 mile marker, Main Ridge Forest Reserve, Tobago, 28 April 1996*
11. *Bloody Bay River Tributary, Gilpin Trace, Main Ridge Forest Reserve, Tobago, 28 April 1996*
12. *Argyle River Tributary, Bridge 1961, Main Ridge Forest Reserve, Tobago, 28 April 1996*
13. *Roxborough River, Roxborough, Tobago, 29 April 1996*
14. *Drift Sample-Argyle River Tributary, 4 1/4 mile marker, Main Ridge Forest Reserve, Tobago, 28 April 1996*
15. *Tyrrel's Bay Creek, Speyside, Tobago, 31 May 1996*
16. *Delaford Creek, Louis d'Or Nurseries, Delaford, Tobago, 31 May 1996*
17. *King's Bay River, King's Bay, Tobago, 31 May 1996*
18. *Argyle River, Argyle Falls, Tobago, 1 June 1996*
19. *Drift Sample-Tyrrel's Bay Creek, Speyside, Tobago, 1-2 June 1996*
20. *Reported by other researchers.*

* Determined for non-insects from Thorp & Covich (2001) and for insects from Merritt & Cummins (1996).

** A single dead specimen (shell) was found in Kilgwyn Marsh on 27 April, 1997.

*** Several individuals were observed but not collected.

Bivalvia

Only a single species of freshwater clam was collected. The fingernail clam, *Eupera cubensis*, was found in the sediments of Buccoo Marsh where it filters and feeds on bacteria suspended in the water. This clam has a widespread distribution throughout the Holarctic, including islands of the Lesser Antilles, such as Nevis (Bass 2000).

Amphipoda

Grandidierella was collected from submerged detritus along the edge of the Bacolet River. Amphipods are usually detritivores and scavengers.

Decapoda

Decapods are one of the best known groups of freshwater invertebrates in Tobago (Chace and Hobbs 1969; Hart 1980). A total of 11 freshwater decapods have been reported from the island. These include 10 species of shrimp and one species of crab. Here, the shrimp, *Potimirim,* is reported for the first time from Tobago. The *Atya* sp. and *Macrobrachium* sp. listed in Table 1 probably belong to species that were previously reported. Whereas both *Atya* and *Macrobrachium* are omnivorous as juveniles, *Atya* develops into a collector and *Macrobrachium* becomes more predacious as it matures (A. Covich, pers. com.). All shrimps were usually found in streams among submerged detritus and plant roots.

Ephemeroptera

At least seven species of mayflies are known from Tobago. This number may be higher since some genera listed may contain more than one species. Accurate species determinations of mayflies often require the adult stage and the collections contained only the aquatic nymphs. *Farrodes grenadensis* was previously reported from nearby Grenada by Edmunds *et al*. (1976). However, based on differences in color and maculation of the abdomen, another species, *Farrodes* sp. 1, was determined to be present in this collection (M. Pescador, pers. com.). *Leptohyphes zapode* was recently found in Tobago (Baumgardner, D.E., Burian, S.K. and Bass, D., unpublished observations). It is possible some of the specimen designated *Leptohyphes* sp. 1 collected in this investigation may actually be *Leptohyphes zapode*, but the definitive characteristics had not yet developed in the specimen.

Odonata

Five species of odonates have been collected in Tobago. Of these, three are dragonflies and two are damselflies. The most common taxa observed include *Argia* sp. and *Ischnura ramburii*. All are predators and nymphs live among submerged leaf debris. Since the adults are strong fliers, odonates have a fairly widespread distribution in the West Indies, with only a few species being endemic to a single island (Flint 1978). No endemic species of this group are known to exist on Tobago.

Plecoptera

Stark (1994) described a new species of stonefly, *Anacroneuria isleta*, from forested areas of eastern Tobago. This is the only known species of stonefly on the island and it appears to be endemic to Tobago. The immature stage, presumably aquatic, is unknown and I did not encounter this species in my collections.

Hemiptera

Hemipterans were a common group encountered during this investigation, being collected from most sites. Of the 20 species listed in Table 1, 19 were already known to occur on Tobago (Nieser and Alkins-Koo 1991). Most water bugs collected in the present study were various species of water striders, with *Brachymetra albinervis*, *Mesovelia mulsanti*, and *Rhagovelia isularis* being the most common taxa found. All are predators of smaller insects. The phenomena of wing polymorphism and flightlessness were observed in several populations. The loss of wings is a widespread phenomenon that has been well documented in water striders (Schuh and Shlater 1995; Thorp and Covich 2001) and among island populations (Darwin 1859). This loss of wings is beneficial since the energy cost to maintain them may be high (Roff 1986) and they may be of little value on a small island (Darwin 1859), especially if the aquatic habitats are persistent so flight is not necessary (Roff 1990). Although wings may be a useful mechanism as a means for dispersal, they may also be considered deleterious if an insect flies away from an island because its chance for survival is greatly reduced once it journeys over the sea (Darwin 1859). However, it is unlikely flying insects would leave an island in large numbers (Roff 1990).

Trichoptera

Four species of immature trichopterans were collected from freshwater environments in Tobago during this study. However, only one of these, *Leptonema albovirens*, was common. Most caddisfly larvae were found among submerged leaf debris and rocks. In previous studies, Botosaneanu and Alkins-Koo (1993) reported at least 19 species of caddisflies were collected from six sites in Tobago. Flint (1996) listed 33 species of caddisflies from Tobago, of which seven are endemic to Tobago while another six are limited to only Tobago and Trinidad. As additional collections are made on nearby islands and the South American mainland, it is suspected some of the species currently thought to be endemic may be discovered to have greater ranges than are currently known.

Lepidoptera

Petrophila was the only aquatic lepidopteran found on Tobago. Larvae were collected from their small, self-spun silken retreats covering the 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.

Coleoptera

Hinton (1971) reported six species of elmids (riffle beetles) existing in Tobago. Although 13 species of freshwater beetles are known from Tobago today, none appear to be common or occur in large numbers. It is interesting to note that no more than one species was collected from any site.

Diptera

Seven species of dipteran larvae were encountered during this investigation, including five midges. Because midge larvae are often very small and primarily inhabit the sediments, a more extensive sampling effort of the sediments would probably yield additional species.

Species richness varied between the sites sampled. Sites having greatest diversities generally were those of streams having cobble substrates and flowing through forested land where human impact appeared minimal. Species richness was greatest at a site in the Argyle River near Argyle Falls and lowest in an isolated pool of a non-flowing section of King's Bay River.

Hynes (1971) concluded the zonation of stream macroinvertebrates in the Arima River system of Trinidad was based largely on elevational differences. For this study of Tobago macroinvertebrates, 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. Most species of molluscs, odonates, coleopterans, and dipterans seemed restricted to lower elevations. Only the crab, *Eudaniela garmani*, and the trichopteran, *Polyplectropus pugiunculatus*, were found exclusively at higher elevations. Many taxa, including shrimps, ephemeropterans, hemipterans, and trichopterans were collected at several elevations.

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

Island	Distance (km)	Similarity Value
Grenada	125	0.22
Barbados	215	0.12
St. Lucia	260	0.17
Dominica	450	0.13
Montserrat	620	0.08
Antigua	645	0.08
Nevis	685	0.10
St. Kitts	700	0.12
Saba	760	0.02
Cayman Brac	2240	0.00
Little Cayman	2280	0.03
Grand Cayman	2360	0.00
Guanaja	2775	0.05

Of the 13 islands listed in Table 2 for which similar collections were made by the author, Tobago shares the greatest faunal similarity with Grenada. This is a reasonable result as Grenada is near Tobago and possesses a similar terrain. Tobago showed no species in common with Cayman Brac and Grand Cayman. Both of these are small, low-lying distant islands that possessed 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 island area, island elevation, and habitat similarity should also be considered.

The macroinvertebrates inhabiting freshwater environments of Tobago today may have been present before Tobago became separated from the mainland or colonized the island after it drifted away from the continent. 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 also be tolerant of seawater during the period of dispersal. Due to its close proximity to South America and its recent connection to that continent, it seems likely that much of the fauna of Tobago would be dominated by species tracing their ancestral populations to the freshwaters on the South American mainland as suggested by the distributions of shrimps (Hart 1980) and trichopterans (Flint 1996). Further studies of macroinvertebrates in freshwaters of Tobago are likely to find additional species that were previously unknown to occur here, some of which may be endemic.

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

NATURE NOTE

Do Male Cowbirds Scout for Appropriate Hosts' Nests?

In this article I report on observations of ambiguous behaviour of a male Giant Cowbird *Scaphidura oryzivora* and a male Shiny Cowbird *Molothrus bonariensis* on Trinidad, seen in the course of a bird-watching tour for Cheesemans' Ecology Safaris.

On 27 January 1998 an adult male Giant Cowbird was observed at the junction of the Guacharo and Chaconia Trails at the Asa Wright Nature Centre in the Arima valley. It flew into a flowering Mountain Immortelle tree *Erythrina micropteryx*, which was festooned with about 24 nests of the Crested Oropendola *Psarocolius decumanus*. The cowbird was immediately engaged in a physical struggle with a male oropendola. As they grappled and pecked each other, almost falling from the perch, female oropendolas watched from a distance. The cowbird was undeterred by two very aggressive attacks made by the male oropendola, which then gave up the struggle and flew to an outer branch of the tree. He paid no more attention to the Giant Cowbird, which proceeded to take its time examining the interior of four oropendola nests in the colony. The cowbird was seen to fly to a nest, stand erect at the opening for a few seconds, with its iridescent ruff blowing in the breeze, enter the nest and descend immediately to the bottom of the long sock-like structure. The nest bulged and moved actively while the cowbird was in it; then the cowbird emerged, checked his surroundings and flew to another nest. Each examination of a nest lasted no longer than 30 seconds, and nothing was seen to be removed from the nests. There was no evidence that the cowbird consumed oropendola chicks or eggs, but we wondered whether a male cowbird may play a part in choosing suitable host nest sites for its females.

On the following day our group was on the Arima-Blanchisseuse Road about two miles south of the village of Morne La Croix. A pair of Blue Dacnis, *Dacnis cayana* was observed moving about together in a tree overhead. They were followed everywhere they went by an adult male Shiny Cowbird, which was not begging for food but silently following the tanagers. As with the Giant Cowbird, we wondered if the male cowbird may have been scouting for appropriate host nest sites.

A comment on the above article by Tim Manolis

Actually, searching behaviour by male Shiny Cowbirds that has been construed as searching for hosts' nests has been previously observed by me and others. The relevant passage from my thesis (1982, p.104) is as follows: "Pairs of cowbirds were frequently observed in House Wren territories … Both male and female cowbirds were often observed walking and peering about under the eaves of houses, sheds, pens, etc. at all rural sites. At Terry Hill on Tobago cowbirds were frequently seen probing with their beaks at the bases of epiphytes on large samaan and other trees (52% of 25 observations of apparent foraging activity). As House Wrens and occasionally other birds construct nests in such sites, this searching behaviour could serve to find both food and host nests. Female cowbirds might accept mate-guarding by males if males helped find nests or flushed out nesting birds while foraging. Such behaviour could account for Young's statement (1929, p. 256) that "the male does most of the work of prospecting for nests, and I have often watched them examining wrens' nests in houses".

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Edward Rooks
Brewster Ave,
San Jose, CA 95124-5448, U. S. A.

Ruddy Turnstones at Home in Tobago

Richard ffrench
Toftingal, Laurieston Road, Gatehouse of Fleet, Scotland DG7 2BE.
E-mail: *Richardffrench@aol.com*

ABSTRACT

The Ruddy Turnstone is a regular non-breeding visitor to Trinidad and Tobago. Groups of up to 20 birds have been studied on the beach at Speyside, Tobago over several years. During 2001 – 2002 some individuals were seen to be marked with coloured leg-bands. From these it was found that the birds had come from the coast of New Jersey, U.S.A., where a major study of the species is being carried out. The Tobago birds were seen feeding on their usual diet of invertebrates, crabs etc, but also on readily available fallen fruits of Sea Grape, an unusual food item for a sandpiper.

The Ruddy Turnstone *Arenaria interpres* is a member of the family Scolopacidae, generally known as Sandpipers, of which some 30 species are known to visit or breed in Trinidad and/or Tobago either regularly or merely from time to time.This bird can easily be distinguished from the other shorebirds by its rather squat appearance, rather short, bright orange legs, and contrasting black and white upperparts mingled with varying amounts of chestnut and brown. The species is known on both sides of the Atlantic; the subspecies *morinella* occurs on the American side. It can be classed as a fairly common visitor or non-breeding resident, having been recorded in every month, although it is rather uncommon during the months of April through June. During the period 1960 – 1962, when my wife and I trapped and banded many species of shorebirds, mainly at Pointe-a-Pierre, but also on the east coast of Trinidad near Manzanilla, we banded seven individuals of this species, but those individuals were not recorded again.

During the period 1994 – 2002 I made regular visits to Tobago, and frequently stayed at or visited Blue Waters Inn at Speyside, usually in September, but also in March, April , May and December. I often encountered small flocks of up to 20 Turnstones feeding on the sandy beach beside the hotel, and was often struck by the propensity of these individuals to become remarkably tame, on occasions coming to within a metre or two from humans, and even venturing up the steps to the bar area of the hotel. No doubt they are attracted by the possibility of tit-bits, though this is not a usual habit of this species.

In September 2001 while watching these Turnstones from close quarters, I discovered that two of the birds were carrying on their legs bands of varying colours, which with binoculars from close range could be fairly easily discerned. Because one of the bands consisted of a rather larger coloured marker, sometimes known as a "flag" the bands were clearly designed to catch the attention of observers. Thus, one bird had on its left leg a green flag above the leg joint, and below the joint a white-over-red band. On its right leg it had a metal band above the joint, and a green band below the joint. The second bird had on its left leg a green flag above the joint, and a blue band below; and on its right leg it had a metal band above the joint and below it had a green-over-red band. Although it was impossible to see the details imprinted on the metal bands without handling the birds, I knew that these bands were issued by the U. S. Fish & Wildlife Service, and contained a specific number and address in the U.S.A. to which such details could be reported.

When I reported these findings, I was informed that the first bird had been banded on the coast of Delaware Bay in New Jersey in May 2000, while the second bird had been banded at the same location about one year later in May 2001. These birds were banded as part of a study to determine migration routes and body condition of shorebirds stopping over in Delaware Bay, and were included amongst some 25,000 shorebirds banded there since 1997, mainly of four species including Ruddy Turnstones, stopping in the Bay on their northbound migration to Arctic nesting areas.

It was particularly interesting to note that our second bird had been banded at Delaware Bay in May 2001, but by early September in the same year was already in Tobago. Could it have been able to breed in the Arctic during those four months ? As a further development, I was at Blue Waters Inn on Tobago in September 2002, and these two birds were again present, along with two more with a different series of colour-coded bands. All of these have been reported to the U. S. authorities, and details are awaited. If, as I suspect, all these Turnstones leave Tobago for the north in April or May, then we would have evidence that some individual shorebirds return to precise wintering grounds in subsequent years. The use of such colour-coding is particularly helpful, since it enables individual identification to be made without recourse to trapping and handling the birds, which is not always practicable or desirable.

It seems likely that at least some, if not all, of the members of the flock I saw at Blue Waters Inn spend most of the off-season there, so what advantages do they find at that site? It may well be that the peaceful nature of the beach, which lacks the bustle and crowds of beaches like Maracas or Manzanilla on Trinidad, provides a safe haven. There are few predators, though very occasionally a dog may appear. The people who frequent the beach are mostly content to relax or sit quietly reading or sun-bathing. There is not much there to scare off the birds, and certainly all the encounters they had with humans whilst I was present led me to believe that the birds might quickly become accustomed to people, so in time would tolerate quite a close approach.

In addition, the Blue Waters Inn beach provided a constant food supply. Generally Turnstones live on invertebrates and small creatures that live amongst the rocky shores and sand beside the sea. Many times I have watched them busily rooting about in the sand, digging vigorously and frequently finding tiny organisms and occasionally small crabs or sand-hoppers. The bird's name indicates that it is adept at using its short and slightly upturned bill to flip over pebbles, leaves and other objects on the beach which might be hiding a tasty morsel. But closer scrutiny revealed that the birds were also finding sustenance in a more unusual source. The beach is lined on the landward side by a row of mature trees of

the Sea Grape *Coccoloba uvifera***.** During August and September, and possibly in other months, many berries are produced, which hang in bunches from the tree. When ripe, they are purple in colour and about the size of marbles. The Turnstones were often seen pecking at these berries, when they had fallen on to the sand, and were so partial to the fruit that if a berry rolled down the sand towards the sea, the feeding bird would follow it down for several metres in order to continue feeding at it. Attempts were made to ascertain whether the birds might be trying to extract seeds from the berries or even possibly invertebrates that were infesting the fruit, but this could not be demonstrated. Indeed the seed of the Sea Grape is comparatively large and unlikely to be nutritious for Turnstones, especially if swallowed whole. Certainly the impression was that the birds were actually pecking at the flesh of the fruit, sometimes after discarding the outer skin. This interest in feeding on Sea Grape appeared to be shared by all in the group of 15 birds under observation, but without recourse to recognisable markings or bands, one cannot be certain that every individual fed on the fruit. It has been shown (Cramp and Simmons 1983) that the species is an opportunist, resorting to berries of the Crowberry (*Empetrum)* and certain sedges on its breeding grounds, possibly when other food was in short supply. But there seem to be few known examples of the species feeding extensively on fruit, which was certainly the impression given on Tobago in September, when other food was certainly available.

ACKNOWLEDGEMENTS

My thanks are due to Kathy Clark of the New Jersey Division of Fish & Wildlife for information on the trapping and banding programme in the U.S.A., also to Daniel England for assistance with observations and fruitful discussion on the Tobago birds' feeding methods.

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Ornithology in Trinidad During the Late 19th Century - A Retrospective View

Richard ffrench

Toftingal, Laurieston Road, Gatehouse of Fleet, Castle Douglas, Scotland DG7 2BE

E-mail: *Richardffrench@aol.com*

ABSTRACT

A review of the evidence in the earliest Journals published by the Trinidad Field Naturalists' Club reveals the paucity of serious ornithological endeavour amongst the members of the Club at that time. Some interest was shown in a measure to protect local birds from the plume trade and at Club meetings specimens of spectacular birds were occasionally displayed. Oilbirds elicited some interest, but members seemed equally ready to eat them. Naturalists also enjoyed hunting expeditions, but with no ornithological purpose. Most of the early serious collecting was done by visiting scientists.

The interests and practice of the early members of the Trinidad Field Naturalists' Club are intriguingly revealed in the articles published in the Club's Journal during the period 1892 – 1896. My copy of those publications (very shabby and much damaged by termites) unfortunately lacks the first six issues, but the next eighteen, covering the period from 1893 onwards, contains no less than 490 pages and makes very interesting reading. Evidently the Club got off to a flying start from its inauguration in 1891, but it is clear that within only a few years things were already beginning to wind down, partly owing to the death of some key members and the departure from Trinidad of others. Membership remained fairly stable in numbers, however, and the meetings were regularly attended and fully documented in print every other month.

As an ornithologist, I am struck by the lack of a scientific approach towards the subject shown in most of the references to birds, starkly contrasted by the careful and well documented work produced by those writing about entomology, herpetology and botany. In fact, during this period there are very few signs of any serious study of local bird-life, other than copies of papers produced by the American collectors Brewster and Chapman (1895) who worked in various parts of the island during this period. Of course, the publication of Leotaud's fine work (1866) meant that there was at hand a reference work, which might be used as a basis for any future work on the local birds. But nothing more appeared apart from isolated scraps of information.

This is not to say that birds were not appreciated by those early members. S. Devenish had presented a short Report for the Ordinance for Protection of Trinidad's wild birds in 1875, and this was reprinted in the Club's Journal for 1894. The principal subject of concern was the killing of birds "of rich plumage", whose skins and feathers were used for decoration, mainly of women's hats and clothing in other parts of the world. It was claimed that many thousands of these specimens were exported every year. Devenish also lamented the increase in harmful insect life resulting from the disappearance of their bird predators, but of course there was no scientific research to back up this claim. Apart from these colourful birds, Devenish mentions "table birds", i.e. edible species, such as pigeons of several species, and any kind of water bird. He evidently thought it was all right to hunt these species.

Ornithology at that time was of course heavily oriented towards collecting, and very little else seemed to interest those early members. Several times stuffed specimens were exhibited at Club meetings, but they were almost always the more spectacular species, such as owls, the potoo, motmot, etc. Two exceptions to this were an observation of a Great Kiskadee *Pitangus* swooping on a beetle, and the description of an unusual nest (probably of a Slaty-capped Flycatcher *Leptopogon*). Two species that did catch the imagination of those pioneers were the Potoo *Nyctibius* and the Oilbird *Steatornis*. The potoo was first identified as the creature uttering its especially unusual song by A. B. Carr, who lived near Caparo, and seems to have been the foremost member of the Club in his knowledge of birds. Carr proved that the call of the "Poor-me-one" came from this bird and not from the Pygmy Anteater as was believed by most country folk at that time. But of course Carr went on to shoot the bird, as was the custom then.

The Oilbird and its unusual life style and habits seemed to have intrigued people in the 19th century as much as in the 21st. Expeditions were made, usually to the Oropouche caves, but also to others in Trinidad, which in those days involved several days trekking from Port of Spain, with a retinue of servants to carry

equipment! But in spite of the fascination people felt for this bird, it was not enough to prevent them from hunting it. F. W. Urich tells of how one of his men obtained two young birds from a nest with a long pole, but sadly they were "too young for the table". In his Report, Devenish even reveals that he had himself with his own hands taken 175 young Oilbirds from the caves, but claims that "had I not done so, they would in all probability have been taken next day by a party of greedy Spaniards", whom he had met at the foot of the mountains! Clearly, even by those charged with legislative input, Oilbirds were considered to be not much different from chickens when it came to food.

Whenever naturalists of that time, such as Carr, Devenish and Mole, went out into the bush, they expected to take with them their guns. Constant reference is made in their accounts to the danger of snakes, but it seems that the main reason for the guns was that they expected and hoped for some sport. The descriptions of the expeditions include many references to the beauty of the forests and the exhilaration of the chase. If they came across any likely bird quarries, the gunners were not slow to react, and the maxim seems to have been "Shoot first and identify later". In fact, one could say that for many early naturalists the "bird in the hand" rather than "in the bush" was truly the rule. Ornithology would have to develop for another fifty years or more before anyone thought seriously about how birds lived.

The collections made by Leotaud and Chapman were the cornerstone of early ornithology in Trinidad, and these were followed very soon by Andre and others in the first years of the 20th century (ffrench 1991). There were further collections right up to the early 1950s, ending with those by Mees (1958), with very few attempts at work on the ecology, behaviour or nesting of birds, other than those of Williams (1922) and Belcher & Smooker (1934 – 1937), which dealt with nesting, but were concerned principally with making further collections of material. Ironically, such collections are supposed to produce tangible proof of biological facts, but, as I hope to show in a future publication, even such tangible proof can sometimes turn out to be faulty.

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NATURE NOTE

Temporary Beaching of a Pilot Whale *Globicephala macrorhynchus,* at Waterloo, Trinidad and Tobago.

A pilot whale, *Globicephala macrorhynchus,* was observed at Waterloo on the western coast of Trinidad on 20 January 2003. The shoreline at Waterloo is characterized by shallow water and coastal mudflats. The whale was first sighted at 1330 hours and was watched by several observers. By 1630 the whale was approximately 200 m from shore and four persons waded out to assist it into deeper water. They managed to shift the whale to face out to sea and encouraged it to slowly swim off, however it swam in an arc and headed back to shore, eventually coming within 50 m of the shoreline. Several further attempts were made to encourage the whale to leave but with the same effect. The tide was rising and eventually the whale reached 2 m from the shoreline. Several villagers then walked up to touch and even climb on the whale.

At about 1745 the spout of a second whale was observed about 200 m out to sea. Very shortly afterwards the beached whale became animated and launched out to sea, splattering mud several meters into the air, as it swam in the shallow, muddy water. The shoreline at Waterloo has extensive mudflats.

The following morning, GW scanned the coastline from Barracones Bay to Orange Valley, but there was no sign of the whale. In addition, there was no indication in the media of any whales stranded on subsequent days and we assumed that the whale survived.

The whale was about 7 m (tip to tail), and the dorsal fin was comparatively short (about 30 cm). The tail flukes were estimated to be six times the height of the dorsal fin. The head was blunt, and square with the mouth ventral in position. These observations fit the description of a short-finned pilot whale, albeit a large one (Eisenberg 1989). The dorsal fin was too short and the wrong shape for a pygmy sperm whale and the body was too large for a Risso's dolphin.

Whale sightings are rare around Trinidad and beachings should be recorded. What makes this observation different is the sudden change in the disposition of the whale and the ease with which it returned of its own volition to the sea.

Previously on 14-15 April, 1999 two whales were sighted close to the shore, one at Orange Valley and the other at Brickfield. The one at Orange Valley was slaughtered but efforts were made to save the one at Brickfield (Trinidad Express Newspaper April 28, 1999).

Other recent whale beachings in Trinidad include three separate incidents in the Galeota area, during the second half of April 1999 (Trinidad Express Newspaper April 28, 1999), and one incident on Manzanilla beach on 13 October, 1999 when 25 pilot whales were stranded. Of these 14 were saved (Trinidad Express Newspaper 15 October, 1999).

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G.L. White and **R. Gosine**
16 Waterloo Estate, Carapichaima.
E-mail:g-white@tstt.net.tt

BOOK REVIEWS

Studies in Trinidad and Tobago Ornithology
Honouring Richard ffrench.
Edited by Floyd E. Hayes and Stanley A. Temple.
Occasional Paper No. 11, Department of Life Sciences,
U. W. I., St. Augustine, Trinidad and Tobago. 2002. 209 p.
US$ 28.00

Studies in Trinidad and Tobago Ornithology (known affectionately amongst the birding fraternity in Trinidad and Tobago as "the ffrench Monograph"). It is not a "coffee table book", nor was it ever intended to be. It does, however, merit prominent display on our bookshelves. This is a major addition to our knowledge of the avifauna of the twin island republic and outlines some real threats to its survival. After a short biography of Richard, the book contains a total of 18 papers, some anecdotal, some technical, together with six shorter works. The variety appeals to both layman and scientist alike and contains a wealth of previously un-published information.

The first eight pages of Section One are about Richard. Most who are familiar with his name and reputation will know of his 27 years at Pointe-a-Pierre. Some will know that he was awarded not only the Chaconia Medal, but also the Order of Member of the British Empire (MBE) for his services to both education in Trinidad and his work in Life Sciences. However, few will have appreciated the extent of his written contribution to the Ornithology of Trinidad and Tobago.

The next article (and perhaps the most enjoyable "read") is an extract from C. Brooke Worth's "A Naturalist in Trinidad". Here Brooke relates tales of various expeditions to Soldado Rock with Richard and Staff of the Trinidad Regional Virus Laboratory banding terns and analysing the parasitic ticks that infest them. They noted that "each young Sooty Tern dropped almost 1000 (ticks) during the next five days". The hardships they endured were obviously tempered by night-time liquid imbibing - "once again, I failed to pull my weight, except that I passed the rum bottle", yet the data gleaned adds to our knowledge both of the breeding ecology of Sooty Terns and Brown Noddies, and to the virus borne by the ticks.

Section Two contains three papers concerning various aspects of taxonomy. Firstly, a short yet highly technical paper by Charles T. Collins and Tamara Araya examines a selection of natal downs of Gray-throated Leaftosser and Yellow-chinned Spinetail and assesses the distribution of such down, in comparison with other members of the ovenbird family.

There follows a study by Floyd Hayes of one of our most endangered species, the White-tailed Sabrewing. This globally threatened hummingbird occurs in just three populations: two in Venezuela and the third in Tobago. The paper assesses population trends in Tobago, and puts forward theories as to the value and purpose of the "sabre" or bent outermost primary feather in adult males.

No less than a generation ago, the Picoplat and its presumed variant subspecies the Ringneck, were common birds of our lowlands. Now, due in no small part to the cage bird trade, they are (almost) certainly locally extirpated. Thankfully, both still occur widely in Venezuela and Colombia. In the final paper of this segment, Robin Restall looks at the taxonomy of the two forms; considers consistent plumage and bill colour differences, and suggests that they are two separate species. This paper provides the beautiful illustration for the book's front cover.

Section Three deals with species distribution not only in Trinidad and Tobago but in the surrounding seas and nearby islands. The first paper, by Gail Cuffy documents the changes in one of our best known birdwatching areas - the Caroni Swamp. Gail highlights the adverse effect on species density brought about by the ingress of salt water into former freshwater marshes and tabulates species sightings both "before and after". Looking at the species list found no more than thirty years ago, and realising what has been lost, is a real clarion call for the implementation of the much talked about joint restoration project.

"Avifauna of Laventille Marsh" by Michael Gochfeld is a poignant reminder of "what used to be" and clearly illustrates the fragility of the remaining freshwater marshland of Trinidad and Tobago. Michael provides quantifiable data for 125 species from studies during the period 1959-1967. (The importance of this data is not lost on today's birdwatcher - no less than five of the species recorded during the studies have not been documented in Trinidad or Tobago since at least 1995). This marsh is no more: bowing to reclamation for industrial and residential development, and the need for agricultural land. Indeed, the social problems affecting access to neighbouring wetlands bordering Port of Spain currently prevents any feasible study of what marshland is left in this portion of Trinidad, and what it may/may not contain

By contrast, the Bocas Is. have remained relatively undisturbed in recent years. The next paper, by Floyd Hayes and Ishmael Samad summarises both historical knowledge and recent survey work, tabulating the 135 species of birds seen on the major islands. *Ad hoc* census work is still undertaken (primarily on Chacachacare). Hopefully this paper will be the catalyst for further published works in an effort to protect from development these unspoilt areas of littoral and deciduous seasonal forest.

"Ground based Nearctic-Neotropic landbird migration during autumn in the Eastern Caribbean" is an extensive study by Douglas McNair *et al.* based at two mist netting sites on Barbados and Guana Is., BVI. Using both sight and mist netting data, the paper tabulates the occurrence of 36 migrant species, all of which breed in eastern North America. It further considers which of the two traditionally accepted migratory routes used to reach South American wintering grounds ("island hopping" from the tip of Florida vs over oceanic flight direct from north eastern USA), is used by which species. Undoubtedly, many of these migrants pass through our forests - however, relatively few are ever seen. Far be it from me to suggest that we have too much forest !

" The status of pelagic seabirds wintering in the south eastern Caribbean is poorly known..." is the first line of a paper by Bill

Murphy. Indeed, in Trinidad and Tobago to date, very little systematic "seawatching" has been done either from our headlands or on our coastal waters. This study documents the avifauna seen "from ship"during three cruises between Curacao and the Orinoco River. Each cruise sailed through our territorial waters. Of the species tallied, Cory's Shearwater and Wilson's Petrel are currently considered extremely rare in T&T waters and Long tailed Jaegar is yet to be recorded. The continual threat, by human activities, to seabird nesting colonies in the region amplifies the need for further quantitative studies of both wintering and migrant species.

Like our coastal waters, there is currently little ornithological study undertaken in "south Trinidad" This makes "A mist netting study in Guayaguayare and the Victoria Mayaro Forest Reserve" by Stewart White all the more important. Four different forest types were studied during summer 1999: pristine virgin forest, a mixed area of virgin and disturbed secondary forest and two sites where different logging methods had been used. The paper compares bird density in these different sites.

Section Four comprises 8 papers studying bird behaviour. Despite it being our only endemic species, little is known about the ecology of the Trinidad Piping-guan. Gavin Alexander's paper describes daily behaviour of "Pawi" at the well-known study site at Montevideo in both 1989 and 1991. Both vocalisations and feeding habits are described as is the attitude to the birds displayed by residents in the area.

A bird behavioural pattern known to many is the "lekking" of manakins. Mark Berres' paper "Long term persistence of White-bearded manakin leks in the Arima Valley" documents his search for leks first described in 1962, some of which were still active some 38 yrs later. It further details the make up of a male manakin's "court" and describes a manakin's behaviour when an existing lek becomes dissolved and the resultant effect on local manakin populations.

"Notes on the Biology of Band rumped Swifts" by Charles T Collins summarises the paucity of existing knowledge about the geographical distribution and possible breeding ecology of the species. It then suggests distinction from other *Chaetura* swifts in feeding pattern, documents a different moult timetable and fields the possibility of this species having a biannual breeding cycle (previously unknown in Neotropical swifts).

We all marvel at the structure of "cornbird" nests. "Weaving techniques in Yellow Oriole and Crested Oropendola" by Mykela Heath and Mike Hansell illustrates the construction strategy employed and the complexity and variety of "stitches" used by both species, drawing comparison with the weaverbird family of Africa and Asia.

It is said that what a bird loses in physical appearance is more than compensated for by its intriguing behaviour. Such is the case with the Shiny Cowbird, a host parasite. With good cause it is known locally as "Lazy Bird". The next paper by Tim Manolis and Alexander Cruz illustrates the differing strategies used by Cowbirds in selecting host species and suggests that the degree (or lack thereof) of their sexual fidelity is directly related to the identity of the foster species.

Few in T&T can emulate the attention to detail that is Victor Quesnel at work. His topic, and the next paper in the Section, the breeding biology of the Black-throated Mango. It is rather a common hummingbird, yet little had been historically published. No less than 30 Black-throated Mango nests, constructed within the greenhouses at his home, were studied over a nine-year period. In this work, Victor considers the reasons for nest site selection and provides the first lengthy analysis of their breeding timetable.

The penultimate paper is Stan Temple's early warning call "Extinct prone birds of Trinidad and Tobago". Whilst I do not pretend to understand the complex mathematics used in determining the results, his down-to-earth approach in describing "threat factors" make this an essential read for all who enjoy watching birds. Separate tables are considered for each of the twin islands. A total of 272 species of landbirds were analysed; results from the criteria employed suggest that there are 63 threatened species in Trinidad and 23 in Tobago.

The subject of the final "behavioural" paper, by Graham White and Stan Temple, considers one of Richard's own "study subjects" - the Dickcissel, and its impact on rice production. The damage done to growing rice by overwintering swarms of Dickcissels in Venezuela is well documented. Trinidad is at the edge of the species winter range, however we witness huge flocks (in one instance considered to be in excess of 100,000 birds), spending the latter part of their winter in Trinidad before embarking on northward migration. The analysis measures the estimated rice content consumed per bird per day, against both flock population and, more importantly, duration of stay.

Section Five is devoted to six short communications. The first documents unusual behaviour displayed by a Common Black-hawk. Next we learn of the first occurrence in our islands of Franklin's Gull, Wood Sandpiper, White eyed Vireo and Slaty Elaenia - truly rare sightings; only Franklin's Gull has been seen subsequently.

Finally, there is a short article by Graham White highlighting the danger of birds becoming trapped in grass panicles and cites examples of both Bananaquit and Green Hermit suffering this hazard. Perhaps this is my only criticism of the book - I am in no way being critical of the article itself, it poses valid concerns - just its placement within the context of the book. I just feel that to end this monograph on a "downbeat" is itself an anti-climax. Nevertheless, the criticism is minor in the overall context of a book which I wholeheartedly recommend .

Perhaps the greatest pleasure I personally obtained from the book was the knowledge that Richard was totally unaware of its preparation, and that the postal delivery to his home in Scotland came as a complete surprise. The two editors should be roundly applauded for putting together a wealth of invaluable studies under one umbrella and the authors can be rightly proud of their contributions. Richard, I know, is honoured to have such a work linked to his name.

Martyn Kenefick
E-mail: martynkenefick@hotmail.com

The Palm Book of Trinidad and Tobago, Including the Lesser Antilles

By Paul Comeau, Yasmin Comeau, Winston Johnson
Trinidad and Tobago: the International Palm Society.
108 p.

Twice in his short forward John Dransfield of the Royal Botanic

Gardens Kew calls this publication a "beautiful" book – and that is true; it is beautiful. One might call it stunningly beautiful because of the high quality printing, layout and binding, the attractive subject matter, the large number of excellent colour photographs and faithfulness with which the pictures convey not only the shapes and colours of the living palms, but also the mood of the localities in which they grow, e g. the quiet intimacy of rain forest or the hint of menace of the windswept south coast of Trinidad. However, it is also a scientific book and a thorough book. First, it is scientific. The 22 native palms and two introduced ones are described in detail with coloured pictures to complement the descriptions and illustrate, for most of them, not only the whole plant but also the inflorescence, fruit and spines, if any. The names are the ones in current use, each with the author of the names well as the Latin binomial. A table on page four gives the classification of the palms and a map gives the distribution of each species. Four pages of references identify the sources of information. Herein lay two surprises. More than half of the references are concerned with dispersers, the animals that eat palm fruit, and the first surprise was the variety of the animals involved. One might expect to find, as I did, oilbirds, monkeys, rodents, toucans, parrots and the like among these, but fish, iguanas and tortoises were entirely unexpected. The second surprise was sheer determination with which the authors pursued the information they wanted. A reference in Portuguese to an unpublished thesis in the Universidade de Brasilia is a measure of this. Less is known of the pollinators, a circumstance that should stimulate local naturalists to fill the gaps in our knowledge of this aspect of palm ecology.

The five species that occur in the Lesser Antilles, but not in either Trinidad or Tobago, receive less lavish treatment, but each is illustrated, four of them with more than one picture. Two tables give details of distribution and botanical features.

Lastly, the book is thorough. This is evident in many features: a key to the identification of the native palms; two sections on the meaning and origin of both the botanical and common names; a list with the location and date of every photograph; a topographic map giving the location of every place name mentioned in the text; a list of all the introduced palms giving their botanical names, common names and country of origin, grouped according to botanical features; a very comprehensive index which runs to nine pages. Nothing seems to have escaped the authors' attention.

This book will immediately become the most comprehensive and authoritative guide to the palms of Trinidad, Tobago and the Lesser Antilles. I foresee that it will be consulted, read, treasured for many years to come.

Victor Quesnel

Reviewers for Living World

The Editor thanks the following individuals for the time and effort they took to review articles for Living World between 1999 and 2003 (In alphabetical order):

Carral Alexander
Mary Alkins-Koo
Matthew Cock
Paul Comeau
Paula Cushing
Charles Dondale
Richard ffrench
Floyd Hayes
Julian Kenny
Victor Quesnel
Christopher Starr
Graham White
Dudley Williams

CORRECTIONS TO THE 2002 ISSUE OF LIVING WORLD

Unfortunately, two errors appeared in the 2002 issue of Living World. Here are the corrections.

1. Article by M.J.W. Cock on *"Proteides mercurius grenadensis* Pinchon & Enrico (Hesperiidae) and other Lepidoptera observed, October 1995". P 45.

Fig. 2 was reproduced twice and Fig. 1 was omitted. Here are the correct photos.

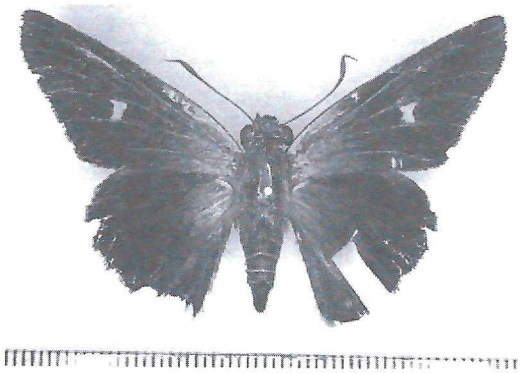

Fig. 1. Female UPS *Proteides mercurius grenadensis* Pinchon & Enrico, Grenada, Grand Anse 5.x.1995 (MJW Cock). Scale bar in mm.

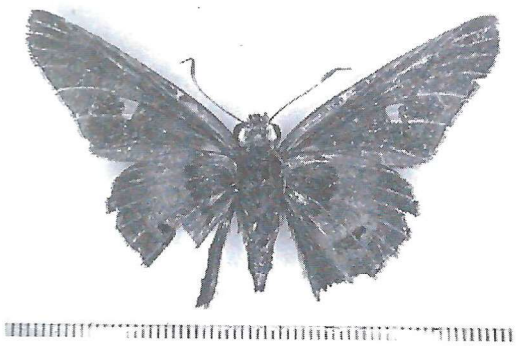

Fig. 2. UNS as for Fig. 1.

2. Identifications to photos on Back Cover (see p. 66)
   Chira sp. was omitted and *Chinoscopus maculipes* was listed as No. 3 instead of No. 4.

   Here are the correct identifications:
   1. *Eustiromastix* sp., female
   2. *Freya* group
   3. *Chira* sp.
   4. *Chinoscopus maculipes*, female
   5. *Amycus* group
   6. *Lyssomanes* sp., male
   7. *Freya* group, male
   8. *Thiodina* sp., feeding on an orthopteran insect
   9. *Synesmosyna ankeli*, male
   10. *Corythalia* sp., feeding on a bachac (leaf-cutter ant)

The Editor apologises to the Authors and its readers for these lapses.

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