LIVING WORLD

Journal of The Trinidad and Tobago Field Naturalists' Club

2015

THE TRINIDAD AND TOBAGO FIELD NATURALISTS' CLUB

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

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

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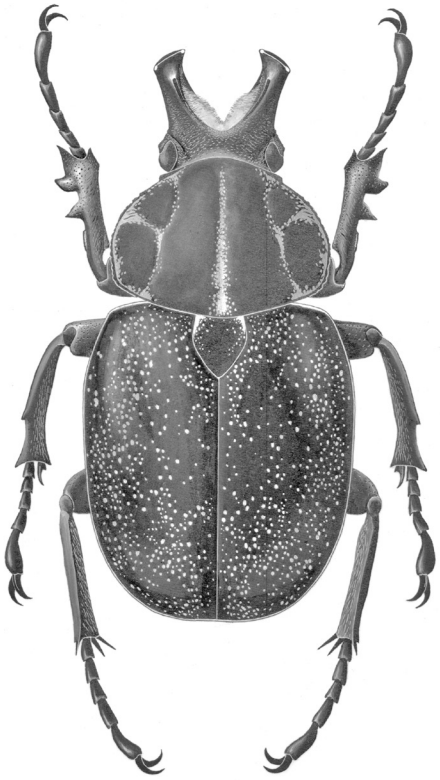

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Editorial

One of the major conservation issues in Trinidad and Tobago in 2015 was the continuation of a moratorium on hunting. In our Guest Editorial this year, our Club President, Kris Sookdeo, presents our position and makes very practical recommendations which were shared with the responsible policy makers.

On 22 December, 2014 we in the Club lost one of our most influential members, Dr. Victor Quesnel. In 1953 he returned from studies abroad and soon re-started the then Trinidad Field Naturalists' Club, which had been moribund for many years. He also re-started the Living World Journal and served on the editorial committee for many years. While we cannot fully express our gratitude to Victor in the Journal, we remember his invaluable contribution in the section Our Notable Naturalists.

In addition to the above, this 2015 Living World contains six research papers, twelve Nature Notes, one Report, and a Book Review. The research papers this year cover a wide range of taxa. Matthew Cock continues his regular installments in describing the biology of the skipper butterflies. Richard Baker and E. Hancock provide an account of some of our earlier insect collectors. The bird assemblages of the Matura Environmentally Sensitive Area are described by Graham White, Kevin Mahabir, Mike Oatham and Courtenay Rooks. Renoir Auguste, Stevland Charles and John Murphy provide an updated checklist of the Amphibians and Reptiles of the Aripo Savannas Scientific Reserve. Ryan Mohammed, Karl Phillips, Kerresha Khan and Avi Bhagan update the distribution of freshwater fish in Tobago. Finally, the mammals are represented by a review of the management of Ocelots at the Emperor Valley Zoo by Kerresha Khan and Ryan Mohammed.

The official checklist of the birds of Trinidad and Tobago was increased by an unprecedented seven species in 2014. The records are described in the report of the Bird Status and Distribution Committee by Martyn Kenefick.

Our Nature Notes section continues to record valuable observations. We start with three observations which highlight the role of the giant fishing spider, *A. bogotensis* as a generalist predator preying on a fish, a frog and a crab. The latter observation provided us with our cover. Other Nature Notes include the nesting habit of a termite on St. Eustatius, the second record of a rare wasp for Trinidad and an update on the distribution of two fish in southern Trinidad. From Tobago, one note describes a possible hybrid heron and shows the lengths that birdwatchers would go to identify a species correctly. We also have an account of the distribution of caiman in Tobago. We have two notes on butterflies, one which is a new species for Trinidad and Tobago and another which has not been recorded on mainland Trinidad since 1904. The final nature note demonstrates the recent expansion of the frog *Scarthyla vigilans* to Nariva Swamp.

We have not had book reviews in recent years. This year however we present a review on Dan Eatherley's book in which he chronicles the life of Raymond Ditmars and his hunt for the bushmaster, which brings him in contact with our Club's founders and eventually to Trinidad.

GW, July 2015

Cover Photograph

This photo of a female giant fishing spider, *Ancylometes bogotensis* feeding on the crab *Dilocarcinus dentatus* was taken at Aripo Savanna by Mike Rutherford. While *A. bogotensis* is known to feed on fish and amphibians, records of feeding on a crustacean are rare or unknown (See Nature Note on Page 65).

Guest Editorial

by Kris Sookdeo

In 2012 the Club distilled the varied positions of its membership into a very important document that reflects what we believe was, and still is, a realistic policy on hunting and wildlife management.

The guiding philosophy behind this policy states that protecting sustainable populations of all native species must be the top priority for wildlife management in Trinidad and Tobago. To this end we believe that if hunting is to continue, it must be managed based on sound empirical knowledge of the present population and population trends of each targeted species.

In the absence of such knowledge, we support the precautionary principle, which dictates that hunting should be tightly restricted until we have quantified the resource and an effective regulatory framework is formulated and enforced.

This philosophy is very important. On the heels of the two-year hunting moratorium, there has been much debate over whether or not it should be extended with ample arguments being brought forward for both positions. But there is an inherent problem in these arguments which prevents us from getting to the heart of proper wildlife management: insufficient objective data.

On one hand, you have hunters who would like to see the season reopened. The primary arguments for this include the loss of access to their chosen legitimate recreation and the proliferation of illegal activities including poaching, pipe-gun usage and marijuana cultivation due to poor or uneven enforcement of the ban. Other statements including suggestions that the temporary ban may cause certain species to multiply out of control (simultaneously implying that hunters are necessary for controlling wildlife populations) and is reminiscent of previous statements that the nation should consider culling ocelots to protect agouti stocks!

This is not to say that the anti-hunting lobby is not prone to their own embellishments, often readily depicting an alarming picture of forests devoid of game species but without the hard evidence to support it.

Persons who are against hunting should also consider that recreational hunters are often our most active honorary game wardens and some hunting groups go even further, like the South Eastern Hunters Association, in planting feed trees in the forest and hosting educational awareness sessions. Like it or not, *bona fide* hunters will remain an important part of wildlife management in Trinidad and Tobago for a long time to come. They do, after all, have a vested interest in having sufficient game mammals around.

The emotional angle that is sometimes taken is problematic as well. Depictions of innocent forest animals being shot dead by a hunter glosses over the fact that humans kill animals all the time when we believe it is acceptable. And therein lies the distinction between many of those on either side of the hunting fence – hunters see it as acceptable while those against it believe it is not. Whether you believe that killing and/or eating a wild animal is wrong or right is a matter of personal opinion. Clearly in this sort of situation, national decisions cannot rely on personal opinion or emotion.

In the absence of data driven analysis it is inevitable that a variety of views would arise. Even within our own organization (whose founding members include several passionate hunters) there exists much difference in opinion ranging from pro-hunting to anti-hunting. And that's within an organization whose members share a common appreciation of nature. Imagine the divergence of views in the wider population!

Ultimately, as indicated by the Club's policy, the national policy for wild game management has to be knowledge based, with game species treated as any other natural resource.

While it is true that the anti-hunting lobby is, for the most part, deficient on data, the belief that hunters can accurately gauge the status of our wildlife solely by their observations is likely also inaccurate. If a hunter goes into the forest with 10 dogs and catches 2 agoutis, does that say anything about the population of agouti in the area? It reveals nothing about the carrying capacity of different sections of our country (how much game there could be) or the current population (how much there is) or how sustainable the population is (is the population growing or declining?). We need information to manage our game species resource. It starts by conducting proper wildlife surveys so that we can all get a better idea of what the current status of our wildlife is. The government, via the EMA, is currently in the process of conducting wildlife surveys in conservancies throughout the country. It is hopefully just the beginning of ongoing monitoring efforts, and species specific shortcomings (viz. recording nocturnal game species) can hopefully be addressed as the survey is refined. This survey will, hopefully, form the basis of longer term monitoring.

When we have this information we will then need the appropriate laws. Last year, the Government of Trinidad and Tobago produced a very important document by way of the Draft Forestry, Protected Areas and Wildlife Conservation Bill, the product of extensive work on several policy statements (the National Wildlife Policy, the National Environment Policy, the National Wetland Policy,

the National Forest Policy and the National Protected Areas Policy).

Among the many clauses, the draft bill indicates a rise in the fine for contravening the law to TT$100,000. This is a substantial and much needed increase from the outdated fines in the existing Conservation of Wildlife Act.

Perhaps one of the more welcome changes is that protected species of fauna would be specified and ranked in terms of threat level to their populations. In the Bill, the ocelot, river otter, manatee and all monkeys are among the critically endangered mammals listed. Hopefully, this will see the end of the absurd practice of caging ocelots and monkeys by several of the entertainment-oriented 'ranches' and 'eco-parks' throughout the country. With respect to birds, the bullfinch, twa-twa, picoplat, chat and silverbeak will be listed as critically endangered so that catching and caging these species will require a permit.

Indeed, it is crucial that the Club throw its support behind this Bill and sees that it makes the transition into law.

But we do not necessarily have to wait patiently for successive surveys or new wildlife laws. If there are instances where the stakeholders, or a major subset of them, can come to agreement on what is the best management option, then it may not be necessary to wait. The management option can then be pursued immediately and has the added benefit that because there is prior agreement on the best management option by most stakeholders, there will be less of a barrier to implementation and there will be more people attempting to enforce the management option.

Even so, these moves would only alleviate concerns over legitimate recreational hunting. What then about the poachers? Subsistence hunting aside, poaching is usually conducted for economic gain. If the economic reward is removed, then poaching activity would logically decline substantially. If the poachers are indeed a big problem, then we expect that the recreational hunting lobby should readily support an outright ban on the sale of wild caught meat. Recreational hunters can then continue liming in hunting camps with an agouti or two on the fire and those opposed to hunting could rest easier knowing that hunting pressures have eased substantially.

This one wildlife management solution may very well benefit our game mammal populations more than any permanent ban or temporary hunting moratorium ever could. Imagine then what a proper data driven wildlife management policy, combined with a ban or moratorium on the sale of wild caught meat, could achieve.

So what do we as naturalists do? We can agitate for big changes, like an unconditional ban on hunting, which will probably never be approved. Or we can fight for the smaller changes which can happen and which can potentially have a huge impact, namely a complete ban on the sale of wild caught meat.

Sadly, the major recreational hunting associations have continued to defend the commercial sale of wild caught meat. Can the associations expect the country to accept that the same wildlife populations which are threatened by illegal poachers, logging, quarrying etc., are somehow able to comfortably withstand the impact of poorly regulated recreational and commercial hunting?

But many individual hunters support ending the commercial sale and this provides an important opportunity. Think about it. The TTFNC and these hunters share an interest in walking in the forest and experiencing the sights, sounds and smells of the forest. We only differ in our opinion on what to do with about ten species; we want to look at them, the hunters want to eat them. This is in contrast with other sections of the national community: developers, contractors, road builders and many agriculturalists with whom we share very little in common when it comes to natural history.

It is in our interest to work with those with whom we have something in common. Perhaps it is time that naturalists and hunters stop arguing and focus on what we all have in common – a desire to see sustainable wildlife populations throughout our country – and fight for an end to the sale of wild caught meat.

Observations on the Biology of Skipper Butterflies in Trinidad, West Indies: *Urbanus*, *Astraptes* and *Narcosius* (Hesperiidae: Eudaminae)

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ABSTRACT
Observations are provided on the food plants, leaf shelters, early stages and parasitoids of *Urbanus proteus proteus* (Linnaeus), *U. belli* (Hayward), *U. esmeraldus* (Butler), *U. dorantes dorantes* (Stoll), *U. simplicius* (Stoll), *Astraptes talus* (Cramer), *A. fulgerator fulgerator* (Walch), *A. alardus alardus* (Stoll), *A. alector hopfferi* (Plötz), *A. anaphus* (Cramer) and *Narcosius colossus* (Herrich-Schäffer) (Hesperiidae: Eudaminae) in Trinidad (Trinidad and Tobago).

Key words (not in title): egg, caterpillar, larva, pupa, leaf shelter, parasitoid.

INTRODUCTION

This paper continues from Cock (2014b) which presented partial life histories of species of several genera of Eudaminae. Here, I document partial life histories of some Trinidad species of three further genera of Eudaminae, which were either unknown, or could not be illustrated, in my earlier treatment of these genera (Cock 1986, 1988). I have avoided duplication of information available in these earlier treatments, and they should be referred to alongside this paper.

The taxonomy used follows Cock (2014a). Two major resources are reflected throughout: the Beccaloni *et al.* (2008) catalogue of food plants of Neotropical butterflies, and Janzen and Hallwachs (2014) huge online database of Lepidoptera rearing in Costa Rica. I have not attempted to critically summarise and evaluate all food plant records from these sources (Mielke 2005), but rather establish where particular food plants dominate the available records. Hence, what I present is focussed on information for Trinidad. There is relatively little here that is not available from or differs from Janzen and Hallwachs (2014), but providing corroborative information from Trinidad for many species is also useful, and indicative of the constancy (or otherwise) between the two regions.

Urbanus Hübner [1807]

This is a rather remarkable genus because of the diversity of food plants used, and in particular pairs or groups of species with very similar adults and very different food plants. Most species feed on Fabaceae, subfamily Faboideae, particularly species of vines. Some species feed on diverse families, although some of these apparent records may be based on early misidentifications. For example, *Urbanus esmeraldus* (Hübner) is reported to feed on *Urera* spp. (Urticaceae) as well as Fabaceae, but see the treatment of this species below. The possibility of cryptic diversity should not be ignored in such cases; in the author's experience such disparate food plants have several times been an indication of more than one species confused under one name, or species that should not be congeneric.

Of the other species recorded from Trinidad (Cock 1986, 2014a) but not documented here, *U. teleus* (Hübner) and *U. procne* (Plötz) feed on grasses (Poaceae), *U. pronta* Evans feeds on *Urera* spp., and the remainder feed on Fabaceae: *U. doryssus* (Swainson), *U. esma* Evans, *U. esta* Evans (particularly on *Desmodium* spp.), *U. carmelita* (Herrich-Schäffer), and *U. velinus* (Plötz), or are of unknown biology: *U. tanna* Evans (Moss 1949; Nogueira and Habib 2002; Beccaloni *et al.* 2008; Janzen and Hallwachs 2014). S. Alston-Smith (pers. comm. 1997 in Beccaloni *et al.* 2008) has reared *U. doryssus* from *Abarema jupunba* (Fabaceae) in Trinidad, but I have not found this species myself.

Urbanus proteus proteus (Linnaeus, 1758)

Figs. 1-5.

This common and widespread species (Fig. 1) has been recorded to feed on a large number of Fabaceae (Beccaloni et al. 2008), and is known as a minor pest of cultivated beans (Greene 1971; Capinera 2011).

Cock (1986) reported finding caterpillars on bodi beans (cowpea, Vigna unguiculata, Fabaceae) at Aranguez Gardens, but did not document the early stages or rear them through. Until now, the early stages have not been reported from Trinidad, although they are well known from other parts of the wide American Range of this species (e.g. Moss 1949; Minno et al. 2005; Capinera 2011; Janzen and Hallwachs 2014).

Since then, I have reared this species from caterpillars collected on *Desmodium tortuosum* (=D. *purpureum*) at St. Benedict's (96/3) and found an identical caterpillar on a small-leaved Faboideae vine at Curepe, which was parasitised (94/36).

Fig. 1. Adult male *Urbanus proteus proteus*, collected as caterpillar on *Desmodium tortuosum*, 11 July, 1996, St. Benedict's; adult 8 August; 96/3C.

Three shelters were found on *D. tortuosum* (96/3). A stage I shelter measured 7 x 3.5mm and was a triangular two-cut shelter folded upwards, with a tuck so that one end was raised above the leaf surface; it contained a medium sized caterpillar (n-2) corpse and a single exo-parasitoid larva. Greeney and Sheldon (2008) provide a more detailed account of how *U. proteus* constructs this shelter. A stage II shelter containing an n-2 caterpillar was a long two-cut flap 25 x 9mm, made by cutting a notch at each end and folding upwards. A stage III shelter containing a final instar caterpillar was formed from two partially eaten leaves, one on top of the other.

The n-2 caterpillar (Fig. 2) measured 11mm. Head rounded oval, indent at vertex; weakly rugose, except strong at apices; very short pale setae; dark brown with dull orange-brown eye-spot anterior to stemmata. T1 shiny black dorsally, dull red ventrally. Body dull green with numerous yellow speckles; darker dorsal line; yellow dorsolateral line, which is expanded and yellow-orange on A8; pale ventrolateral line. Legs T1 black, T2 dark, T3 brown; prolegs concolorous; spiracles inconspicuous.

Fig. 2. Instar n-2 caterpillar of *Urbanus proteus*, collected on *Desmodium tortuosum*, 11 July, 1996, St. Benedict's; photographed 11 July; moulted 14 July; 11mm; 96/3B.

The penultimate instar caterpillar (Fig. 3) was similar to the preceding instar, except that the head was more rugose, brown, with the eye-spots pale orange-brown.

Fig. 3. Instar n-1 caterpillar of *Urbanus proteus*, collected on Fabaceae vine, 29 September, 1994, Curepe; photographed 30 September; moulted 2 October; 13mm; 94/36A.

The final instar caterpillar (Fig. 4 below) measured 22mm eight days before it pupated. Head rounded, indent at vertex; brown, posteriorly dark, extending ventrolaterally to cover stemmata; a broad, dark oval across face, extending to top of clypeus, and ventrolaterally to mouthparts; an orange triangular eye-spot anterior to stemmata; covered with inconspicuous short pale setae. T1 shiny black dorsally, orange-red ventrally. Body dull pale green, with numerous yellow speckles; dorsal line darker, more so anteriorly; dorsolateral line yellow, or-

Fig. 4. Final instar caterpillar of *Urbanus proteus*. **Above**, collected as n-2 caterpillar on Fabaceae vine, 29 September, 1994, Curepe; moulted 2 October; photographed 4 October; parasitised; 94/36A. **Below**, collected as final instar caterpillar on *Desmodium tortuosum*, 11 July, 1996, St. Benedict's; photographed 11 July; pupated 19 July; 22mm; 96/3C.

ange from A8 around lateral margin of anal plate; dark patch below dorsolateral line on T2; white ventrolateral flange; legs black; prolegs salmon; spiracles brown. The parasitised caterpillar from Curepe (94/36) was identical, except the colouration of the head was duller (Fig. 4 above). The caterpillars of *Urbanus esta* are very similar (Janzen and Hallwachs 2014), but this species is still hardly known from Trinidad.

The pupa (Fig. 5) was formed in a shelter between a leaf and the side of the rearing container. It was fully suspended with the cremaster attached to a cross-bar of silk, and supported by a Y-shaped girdle. The pupa measured 22mm; it was brown, evenly covered with particulate white waxy powder; spiracles dark, that of T1 a large conspicuous semicircle.

Fig. 5. Pupa of *Urbanus proteus*, lateral view; collected as final instar caterpillar on *Desmodium tortuosum*, 11 July, 1996, St. Benedict's; pupated 19 July; photographed 2 August; 22mm; 96/3C.

The Hymenoptera exoparasitoid reared from the St. Benedict's collection (96/3A) was reared but has not been identified. The caterpillar from Curepe (94/36A) continued feeding and formed a pupal shelter, before larvae of an undescribed *Apanteles* sp. (*leucostigmus* species-group; Microgastrinae, Braconidae) emerged and formed cocoons, arranged irregularly in a weak matrix of silk covering the remains of the host's body. About 30 adult wasps emerged nine days later.

***Urbanus belli* (Hayward, 1935)**

Figs. 6-9.

Cock (1986) knew of no food plants, and suggested incorrectly that *U. belli* would be found to feed on legume vines. Beccaloni *et al.* (2008) include several Asteraceae food plants and one Fabaceae taken from Janzen and Hallwachs' database of Costa Rican rearings. The current version of the database (Janzen and Hallwachs (2014) includes many records of rearings of *U. belli* and similar cryptic species, all feeding on Asteraceae, so the Fabaceae record is likely to have been a corrected error. Janzen and Hallwachs (2014) show that *U. belli* itself feeds on at least 17 genera of Asteraceae, and of the 450 records, the commonest food plants are from the genera *Zexmenia* and *Melanthera*, with over 150 each, and *Calea* and *Clibadium* with over 50.

On several occasions I have found caterpillars or empty shelters of *U. belli* on *Tilesia baccata* (= *Wulffia baccata*): Palo Seco (95/40 reared), Andrew's Trace (95/24 shelters), Mt. Tabor (04/11 caterpillar, 04/21 empty shelters), Point Gourde (11/45 caterpillar). Only the first of these was reared, but the following combines information from other collections.

The early shelters are two-cut shelters (Greeney 2009), with a broad hinge, one side shorter than the other, with a tuck in the shorter side to make an elongate shelter raised well above the leaf at one end (Fig. 6). This shelter seems to be typical of *Urbanus* spp. and many other Eudaminae. I have also found a similar shelter made in the middle of a leaf lamina containing a young caterpillar (green with a dark head) on *Clibadium surinamense* (Mt. Tabor 94/39), which is likely to be *U. belli*.

Fig. 6. Leaf shelter and adjacent feeding of *Urbanus belli* on *Tilesia baccata*, Point Gourde, 16 October, 2011; not reared; 11/45.

The shelter of the penultimate and final instars is simpler. A penultimate instar caterpillar collected on Mt. Tabor (04/11, Fig. 7) made a minimal no cut shelter by pulling the edges of a leaf upwards towards each other with silk, but the top of the shelter remained open. The specimen reared (95/40) was collected as a premoult penultimate instar caterpillar in a shelter made from the distal part of a leaf; both sides of the leaf were cut to the midrib, and the distal 45mm of the leaf rolled upwards. There was some feeding distal to the shelter, and the basal half of the leaf had one half almost entirely eaten. It is not clear whether these two shelters represented stages in construction, or two different behaviours, i.e. in the former case, would the caterpillar have subsequently constructed the shelter to match the second, or was the shelter complete?

A penultimate instar caterpillar was collected on Mt. Tabor (04/11) and preserved in the final instar. No description was prepared, but photographs taken (Fig. 7) show the penultimate instar to be very similar to the final instar.

Fig. 7. Penultimate instar caterpillar of *Urbanus belli*, collected on *Tilesia baccata*, Mt. Tabor, 12 January, 2004; photographed 13 January; moulted to final instar 14 January; 22mm; 04/11B.

One day after moulting to the final instar, individual 95/40 measured 27mm long (Fig. 8) and when fully grown it measured 32mm. Head rounded, indent at vertex; rugose; dark brown; quadrate orange eye-spot anterior to stemmata; covered with scattered short recumbent setae. T1 black dorsally, red ventrally. Body matt grey-green, with yellow tint due to yellow speckles, stronger on T2-A6; narrow dark dorsal line; narrow yellow dorsolateral line, broader and orange on A8; ventrolateral flange paler; spiracles brown, inconspicuous; T1 legs red; T2-T3 legs pale red; prolegs concolorous. The instar lasted 14 days.

Fig. 8. Final instar caterpillar of *Urbanus belli*, collected as penultimate instar on *Tilesia baccata*, Palo Seco, 7 October, 1995; moulted to final instar 8 October; photographed 9 October; pupated 21 October; 27mm; 95/40.

In captivity the pupal shelter was several leaves spun together. The 22mm pupa (Fig. 9) was smoothly rounded with no projecting features; brown; covered with dense white waxy powder, more lightly on abdomen and thorax, heavier on wings, and densest on head. Spiracles T1 large, matt brown, but not projecting. The pupal stage lasted 22 days.

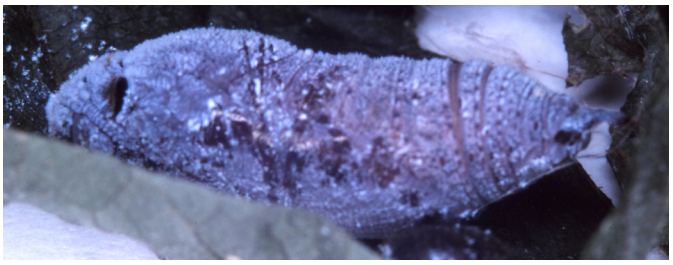

Fig. 9. Pupa of *Urbanus belli*, lateral view, collected as penultimate instar on *Tilesia baccata*, Palo Seco, 7 October, 1995; pupated 21 October; photographed 22 October; adult 11 November; 22mm; 95/40.

***Urbanus esmeraldus* (Butler, 1877)**

Figs. 10-12.

Cock (1986) was not familiar with the biology of this species. The Beccaloni *et al.* (2008) catalogue of food plants includes several records of *U. esmeraldus* from Fabaceae (*Centrosema*, *Desmodium*, *Wisteria*) and one from *Urera* sp. (Urticaceae). Janzen and Hallwachs (2014) list more than 300 rearing records in Costa Rica, nearly half from *Clitoria glaberrima*, many from *Centrosema* spp., and a few from *Desmodium* spp., *Phaseolus lunatus* and *Vigna* spp. Their photographs show that the early stages in Costa Rica are similar to that reported here from Trinidad. Kendall (1976) and Wendt and Carvalho (2001) report similar food plant species from Mexico and Rio de Janeiro, respectively.

The original record from *Urera* sp. is based on a 1992 published oviposition observation by K.S. Brown in Brazil, and there are subsequent publications by Dutra *et al.* (2006) and Moraes *et al.* (2012) of *Urbanus esmeraldus* feeding on *U. baccifera* in Brazil. The latter includes photographs of the adult and life history. Although the adult is an almost exact match to that treated as *U. esmeraldus* here (Fig. 10), the caterpillar is not, as it has a

black head with red eye-spot, and the body colouring is slightly different. They resemble the caterpillars treated as *U. pronta* by Janzen and Hallwachs (2014), which feed almost exclusively on *Urera* spp. in Costa Rica, but have a different adult. Furthermore, the shelter construction and feeding behaviour of the mature caterpillars on *Urera* spp. in Brazil are different from those observed below. It seems clear that two different species are involved: one that feeds on Fabaceae vines as observed in Costa Rica (Janzen and Hallwachs 2014), Brazil (Wendt and Carvalho 2001) and Trinidad (below), and another that feeds on *Urera* spp. as observed in Brazil (Dutra *et al.* 2006; Moraes *et al.* 2012).

Fig. 10. Adult male *Urbanus esmeraldus*, collected as final instar on *Centrosema molle*, Point Gourde, 16 May, 1999; adult 8 June; 99/5.

I have reared this species once, from a final instar caterpillar collected on *Centrosema molle* (= *C. pubescens*) (MJWC 253) at Point Gourde, 16 May, 1999 (pers. comm. in Beccaloni *et al.* 2008). The caterpillar was found in a shelter made from two leaves, one resting on top of the other. The caterpillar's colour and markings (Fig. 11) are similar to those of *U. proteus*, but even when collected it appeared different. When collected the caterpillar measured 25mm, and the body colour was dull yellow-green with yellow-orange speckles (Fig. 11 below, left), but four days later it had turned darker (Fig. 11 below, right) and the following description was prepared.

Head oval, widest at about one-third up from mouthparts; deeply indent at vertex; weak, pale, erect setae; brown, mouthparts and stemmata black; orange eye-spot anterior to stemmata; posterior margin very constricted. T1 red-brown; pronotum black. Body dark dull green, covered with tiny orange spots; dorsal line clear of spots; narrow orange slightly irregular dorsolateral line ends at anterior margin A7; orange blotch on A8, orange spot on anterior margin of A9 and orange laterally on anal plate all in line with dorsolateral line; pale ventrolateral flange; legs brown; prolegs reddish; spiracles inconspicuous.

Fig. 11. Final instar caterpillar of *Urbanus esmeraldus*, collected on *Centrosema molle*, Point Gourde, 16 May, 1999; photographed 16 May (below, left), 20 May (below, right); pupated 25 May; 25mm; 99/5.

Four days after preparing the above description, the caterpillar was preparing to pupate in a shelter formed from several leaves spun together against the side of the rearing container. Two days later it pupated, and was supported in position with the cremaster hooked on a crossbar of silk and a Y-shaped silk girdle, the remains of which are visible in Fig. 12. The pupa (Fig. 12) measured 17mm long; it was brown, paler on wings and thorax, spiracles dark; lightly covered with white waxy powder (considerably less so than that of *U. proteus* in Fig. 9). An adult male emerged after 14 days.

Fig. 12. Pupa of *Urbanus esmeraldus*, lateral view; collected as final instar on *Centrosema molle*, Point Gourde, 16 May, 1999; pupated 25 May; photographed 26 May; adult 8 June; 17mm; 99/5.

***Urbanus dorantes dorantes* (Stoll, 1790)**
Figs. 13-14.

All the records of food plants listed in Beccaloni *et al.* (2008) are Fabaceae, apart from that of Riley (1975) of *Hyptis pectinata* (Labiatae) of what Riley (1975), Smith *et al.* (1994) and some authors treat as *U. obscurus* (Hewitson), but Mielke (2004), Beccaloni *et al.* (2008) and other authors treat as *U. dorantes obscurus*; either way this record is most likely an error. Judging from more than 200 records in Janzen and Hallwachs' (2014) database of rearing in Costa Rica, *U. dorantes* is a specialist on *Desmodium* spp., with only two records from another Fabaceae. Cock (1986) describes the caterpillar and pupa found on *Desmodium incanum* in Trinidad.

In October 1993 the author observed a female ovipositing on *Desmodium tortuosum* at Point Gourde (93/36). Eggs were laid on old flowers from which the petals had dropped, and once on the hairs of the petiole of a very small leaf (Fig. 13).

Fig. 13. *Urbanus dorantes* ovipositing on *Desmodium tortuosum*, Point Gourde, 16 October, 1993, 93/36.

The egg (Fig. 14) was rounded with a flat base and the micropyle slightly indented; micropyle surrounded by eight polygons (mostly pentagons); extending from these 13 strong ribs, joined by two lateral ridges above and below the middle; the egg chorion was transparent and glossy. When newly laid, eggs are pale green and quite easy to see with the naked eye.

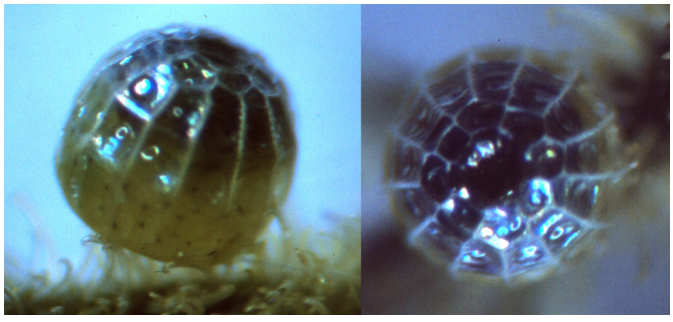

Fig. 14. Ovum of *Urbanus dorantes* laid on *Desmodium tortuosum*, Point Gourde, 16 October, 1993, 93/36; lateral view (left) and dorsal view (right).

***Urbanus simplicius* (Stoll, 1790)**
Figs. 15-17.

The food plants of this common and widespread species (Fig. 15) are Fabaceae, particularly species of *Calopogonium*, *Centrosema* and *Vigna* (Beccaloni 2008; Janzen and Hallwachs 2014).

Fig. 15. Male *Urbanus simplicius*, Rio Claro-Guayaguayare Road, 7.0-7.5km, 9 October, 2011.

Fig. 16. Penultimate instar caterpillar of *Urbanus simplicius* collected on *Vigna lasiocarpa*, Manzanilla Beach Cocal, 14 November, 1995; photographed 14 November; moulted to final instar 18 November; 18mm; 95/73.

Fig. 17. Final instar caterpillar of *Urbanus simplicius* collected on *Vigna lasiocarpa*, Manzanilla Beach Cocal, 14 November, 1995; moulted to final instar 18 November; photographed 25 November; 24mm; died; 95/73.

Cock (1986) described the biology of this species in Trinidad on kudzu, *Pueraria phaseoloides* (Fabaceae). Since then I have found a penultimate instar caterpillar (Fig. 16) on *Vigna lasiocarpa* (= *Phaseolus pilosus*; Fabaceae; MJWC 234) at Manzanilla Beach Cocal, November 1995 (95/73). Although it was not successfully reared beyond the final instar (Fig. 17), careful comparison with my earlier notes and material and with Janzen and Hallwachs (2014) convinces me it is this species.

***Astraptes* Hübner [1819]**

The early stages of the species presented here include several species with early stages similar to those of the *Urbanus* spp. presented here, i.e. with green bodies, dorsal and dorsolateral lines, a brown head and yellow, orange or red eye-spots. However, *A. talus* and *A. fulgerator* have very different caterpillars having a dark body with bright yellow bands.

All of the other species recorded from Trinidad (Cock 2014a) have been reared in Costa Rica feeding on Fabaceae: *A. apastus* (Cramer) has a red caterpillar with yellow bands, a black head with red eye-spots and feeds on *Dioclea* spp.; *A. enotrus* (Stoll) has a yellow-green caterpillar with diamond markings dorsally, a black head with red eye-spots and feeds mainly on *Lonchocarpus* spp.; and *A. janeira* (Schaus) is dull grey-green with a dorsal row of 3-4 heart shapes, a dark head with light brown eye-spots and feeds on *Lonchocarpus* and *Machaerium* spp. (Janzen and Hallwachs 2014).

***Astraptes talus* (Cramer 1777)**

Fig. 18.

Cock (1988) was not aware of the biology of this rare species in Trinidad. However, its food plants have been reported as several *Mucuna* spp. and *Canavalia ensiformis* (Fabaceae) as well as *Guarea* sp. (Meliaceae) and *Paullinia* sp. (Sapindaceae) (Beccaloni *et al.* 2008). However, Brévignon and Brévignon (2003), Resende *et al.* (2009), Turner *et al.* (2009) and Janzen and Hallwachs (2014) have only reared it from Fabaceae, notably *Mucuna* spp. and the other host plant records are considered to need confirmation (Brown and Heineman 1972). The early stages have been illustrated by Brévignon and Brévignon (2003), Resende *et al.* (2009), Turner *et al.* (2009) and Janzen and Hallwachs (2014), and on the basis of the first of these, I identified Fig. 18 as being of a young caterpillar of this species (Cock 2006).

The author collected small caterpillars on *Mucuna rostrata* (MJWC 229) on Mt. Tamana in November 1995 (95/66). Within a few hours of being detached, any damage to the food plant leaves turned black and within three days the detached leaves were completely black and the caterpillars would not accept several other Fabaceae offered and could not be reared. The leaf shelters were a simple fold under from the leaf edge, basal to where the caterpillar had fed, about 20 x 8mm long x wide, so that the original lamina edge of the flap was positioned at right angles to the leaf midrib. The caterpillars are similar in all instars (Turner *et al.* 2009); the individual in Fig. 18 measured 10mm and was probably in the third instar. The head was oval, indented at the vertex; shiny; very slightly rugose; plain black; covered with short dark setae. T1 black. Body black, with double yellow lines on the posterior margin of T2-A8.

Fig. 18. Young caterpillar of *Astraptes talus*, collected on *Mucuna rostrata*, Mt. Tamana, 12 November, 1995; 10mm; 95/66A.

***Astraptes fulgerator fulgerator* (Walch 1775)**

Figs. 19-22.

This species is reported to feed on Fabaceae and a selection of other families through its wide range in Central and South America (Beccaloni *et al.* 2008). Hebert *et al.* (2004) found that in Costa Rica this name represented a complex of at least ten look-alike species with different caterpillars and food plants. Similar investigations have yet to be reported from South America. Because of this new information, the true identity of *A. fulgerator*, which was described with no type locality, becomes uncertain. Amongst its assumed synonyms is *A. fulminator* (Sepp), which was described with its early stages on a *Cassia* sp. from Surinam (Sepp 1829-1843, plate 34). These match the early stages illustrated here from *Senna bacillaris* (=

Fig. 19. Leaf shelter of premoult penultimate instar *Astraptes fulgerator fulgerator* on *Senna bacillaris*, Point Gourde, 16 October, 2011; 11/55.

Cassia fruticosa), and since many former *Cassia* spp. are now placed in *Senna*, it seems safe to anticipate that Sepp described the same morphological and biological species. The early stages of the species treated by Moss (1949) at Belem, Brazil, also seems very similar. The types of both *A. fulgerator* and *A. fulminator* are thought to be lost (Pelham 2008), but in the interests of stability, it would seem desirable to define *A. fulgerator* as this taxon and life history.

Fig. 20. Penultimate instar caterpillar of *Astraptes fulgerator fulgerator*, collected as n-3 instar on *Senna bacillaris*, Mt. Tamana, 12 November, 1995; 19mm; 95/59A.

Fig. 21. Final instar caterpillar of *Astraptes fulgerator fulgerator*, collected on *Senna bacillaris*, above St. Benedict's, 12 October, 1993; photographed 12 October; pupated 19 October; 43mm; 93/14.

Only one food plant and one form of caterpillar has been found for this species in Trinidad, so for now it is assumed to be represented by just one species here. Cock (1988) described the early stages from *Senna bacillaris* in Trinidad. Figures from more recent rearings are now provided to support this (Figs. 20-22).

Fig. 22. Pupa of *Astraptes fulgerator fulgerator*, lateral view, collected on *Senna bacillaris*, above St. Benedict's, 12 October, 1993; pupated 19 October; photographed 19 October; 27mm; 93/14.

The young caterpillars make a two-cut shelter with a tuck, similar to those of other species presented here (e.g. Fig. 6). Later they make a simple shelter by folding over part of one-half of a leaflet (Fig. 19), or between two leaflets (Curepe, 81/19A). The final instar caterpillar may not make a shelter – the only final instar that I have found in the field had not done so (above St. Benedict's, 93/14).

***Astraptes alardus alardus* (Stoll 1790)**

Figs. 23-25.

The food plant records for this species are almost entirely of *Erythrina* spp. (Beccaloni *et al.* 2008; Janzen and Hallwachs 2014). Cock (1988) describes two forms of the caterpillar found on *Erythrina poeppigiana* in Trinidad, the normal or common form, which matches the photos of this species in Janzen and Hallwachs (2014), and a variant only seen once. In the early 1980s this species seemed to be common, and I found caterpillars repeatedly; since

Fig. 23. Adult female *Astraptes alardus*, collected as final instar caterpillar on *Erythrina poeppigiana*, Mt. Tamana, 13 July, 1997; adult 9 August; 97/203.

then I have only reared it once from a caterpillar of the common form (Mt. Tamana, 97/203), which is illustrated here (Figs. 23-25).

Fig. 24. Final instar caterpillar of *Astraptes alardus*, collected on *Erythrina poeppigiana*, Mt. Tamana, 13 July, 1997; photographed 13 July; pupated 21 July; 42mm; 97/203.

Fig. 25. Pupa of *Astraptes alardus*, collected as final instar caterpillar on *Erythrina poeppigiana*, Mt. Tamana, 13 July, 1997; pupated 21 July; photographed 23 July; adult 9 August; 27mm; 97/203.

***Astraptes alector hopfferi* (Plötz 1881)**

Figs. 26-29.

The limited food plant records for this species are of *Platymiscium* spp. in Costa Rica and *Bauhinia divaricata* (both Fabaceae) in Mexico (Beccaloni *et al*. 2008). Janzen and Hallwachs (2014) reared this species nearly 400 times from *Platymiscium* spp. and only twice from *Lonchocarpus*. The biology in Trinidad had not been reported (Cock 1988), and although the food plant record below is listed as a pers. comm. in Beccaloni *et al*. (2008), the following are new observations.

Two penultimate instar caterpillars were collected on *Platymiscium trinitatis* (MJWC 258) at Inniss Field, May 1999 (99/12). One (99/12B) was newly moulted and found in a two-cut triangular flap, similar to that shown in Fig. 6. The other, which moulted to the final instar two days later, was in a simple shelter made by rolling a flap over upwards from the edge of a leaf.

Fig. 26. Adult male *Astraptes alector*, Mt. Tamana, 14 October, 1995 (resting on the handle of my butterfly net).

The larger of the two (99/12A) measured 25mm (Fig. 27). Head oval, indent at vertex; dark shiny brown, small red eye-spots anterior to the stemmata; covered with very short, pale setae. T1 red; pronotum brown. Body dull dark green, smooth and shiny; laterally a broad longitudinal stripe of irregular spots and blotches of bright yellow, from

Fig. 27. Penultimate instar caterpillar of *Astraptes alector*, collected on *Platymiscium trinitatis*, Inniss Field, 17 May, 1999; photographed 20 May; moulted 22 May; 25mm; 99/12A.

Fig. 28. Final instar caterpillar of *Astraptes alector*, collected as penultimate instar on *Platymiscium trinitatis*, Inniss Field, 17 May, 1999; moulted 22 May; photographed 24 May; pupated 4 June; 27mm; 99/12A.

an irregular yellow dorsolateral line to just above prolegs; in line with dorsolateral line and orange marking; anal plate bordered with orange, especially strong laterally; T1-T3 red ventrally, grading to green by A8; legs and prolegs red; spiracle T1 red, other spiracles yellowish. The final instar was similar (Fig. 28).

Pupation was between two leaves, and the pupa (Fig. 29) was suspended by a Y-shaped silken girdle and the cremaster attached to a cross-bar of silk.

Fig. 29. Pupa of *Astraptes alector*, collected as penultimate instar caterpillar on *Platymiscium trinitatis*, Inniss Field, 17 May, 1999; pupated 4 June; photographed 6 June; adult 22 June; 21mm; 99/12A.

***Astraptes anaphus* (Cramer 1777)**

Figs. 30-35.

Evans (1952) and Cock (1988) treated this species as occurring in two subspecies in Trinidad. *Astraptes anaphus anetta* Evans (Fig. 30) has more extensive yellow markings than *A. anaphus anoma* Evans (Fig. 31) and females have more extensive yellow than males (see Cock

Fig. 30. Adults of *Astraptes anaphus anetta*. **Top**, male collected as final instar caterpillar on *Mucuna* sp. (*pruriens* or *sloanei*), Point Gourde, 16 October, 1993; adult 26 November; 30mm; 93/30. **Bottom**, female at *Bidens* flowers, Palo Seco, 7 October, 1995.

Fig. 31. Adults of *Astraptes anaphus anoma.* Female, Point Gourde, 16 October, 2011; 11/52.

1988 for details). Cock (1988) suggested these might be better treated as forms than subspecies, and that breeding the two would clarify their status. Although this species has now been reared from Trinidad (below), more observations are needed to address this point.

The caterpillars of this species have been recorded from various Fabaceae vines including species of *Canavalia, Mucuna, Phaseolus, Pueraria, Vicia* and *Vigna* (Beccaloni *et al.* 2008), whereas *Phaseolus lunatus* and *Mucuna pruriens*, the two commonest food plants in Janzen and Hallwachs (2014), account for almost all of their rearings of ssp. *anetta*. Published records from Trinidad include *Amphicarpaea bracteata?* (S. Alston-Smith pers. comm. in Beccaloni *et al*. 2008).

Cock (1988) did not know the life history, but observed an oviposition event on *Chromolaena odorata* (Asteraceae) in Trinidad, and suggested that the female made an error for the Fabaceae vine growing intermingled with the *C. odorata.* Subsequent observations (above) indicate that such vines are the normal food plants.

Since then, I have reared a male of ssp. *anetta* once from a *Mucuna* sp. (*sloanei* or *pruriens*) at Point Gourde (93/30), and found a very similar caterpillar on *Centrosema plumieri* (MJWC 302) at Inniss Field (04/27). The shelter of the latter was made by moving the terminal leaflet diagonally over an

Fig. 32. Leaf shelter of final instar caterpillar of *Astraptes anaphus* (?) on *Centrosema plumieri*, Inniss Field, 16 January, 2004; 04/27.

adjacent one and tying it with silk threads as shown in Fig. 32.

The following is based on the first of these, except as indicated. The final instar caterpillar (Fig. 33) measured 30mm when collected, ten days before it pupated. Head rounded, indent at vertex; shiny, rugose; dark brown, yellow-orange eye-spot anterior to the stemmata; covered with short, pale, erect setae. T1 dark brown, red laterally. Body dark translucent green, covered with a network of fine yellow lines; narrow dorsal line clear, darker; narrow yellow dorsolateral line; all legs red.

Fig. 33. Final instar caterpillar of *Astraptes anaphus anetta*, collected on *Mucuna* sp. (*pruriens* or *sloanei*), Point Gourde, 16 October, 1993; photographed 16 October, pupated 26 October; 30mm; 93/30.

The caterpillar from *Centrosema plumieri* at Inniss Field (04/27) measured 31mm and differed in that T1 was black for the dorsal half and pale red for the ventral half; there was a rather conspicuous orange marking on the dorsolateral line at A8, and the spiracles were reddish (Fig. 34). This does not match any of the other recorded species of *Astraptes* from Trinidad, so it is assumed to be *A. anaphus*. However, whether the differences reflect individual variation, sexual dimorphism or a difference between the two subspecies of *A. anaphus* in Trinidad will have to be established by further rearing.

The pupa (Fig. 35) measured 24mm; reddish brown with a very light bloom of white waxy powder, speckled on abdomen; spiracle T1 black, arc-shaped and slightly prominent; black spots ventrally and ventrolaterally just in front of cremaster. The pupal period was 21 days.

Fig. 34. Final instar caterpillar of *Astraptes anaphus* (?), collected on *Centrosema plumieri*, Inniss Field, 16 January, 1993; photographed 17 January, preserved; 31mm; 04/27.

Fig. 35. Pupa of *Astraptes anaphus anoma*, collected as final instar caterpillar on *Mucuna* sp. (*pruriens* or *sloanei*), Point Gourde, 16 October, 1993; pupated 26 October; photographed 28 October; adult 16 November; 24mm; 93/30.

Narcosius Steinhauser, 1986

This small genus was separated from *Astraptes* by Steinhauser (1986), and subsequent observations of the early stages support this split. In addition to Celastraceae reported below for *N. colossus*, the food plants for *N. parisi*, another Trinidad species, are Sapindaceae, especially *Paullinia* spp. and *Serjania* spp. (Janzen and Hallwachs (2014).

***Narcosius colossus* (Herrich-Schäffer 1869)**
Figs. 36-37.

Moss (1949) thought this species fed on *Inga* (Fabaceae) or *Virola* (Myristicaceae), having found shelters on mingled foliage. In contrast, Janzen and Hallwachs (2014) reared this species from Celastraceae only: over 500 records from *Maytenus* spp. and two from *Gymnosporia haberiana*. The early stages of this species were not known to Cock (1988) and the following are new observations for Trinidad.

Two shelters with final instar caterpillars were found on *Maytenus tetragona* (MJWC 304) in Inniss Field, January 2004 (04/33); one was preserved, and the other reared through by S. Alston-Smith and the specimen is now in the author's collection. The shelters were formed by pulling two leaves together to partially overlap, and held in place by visible strands of silk (Fig. 36).

Fig. 36. Shelter containing final instar caterpillar of *Narcosius colossus* on *Maytenus tetragona*, Inniss Field, 16 January, 2004; 04/33.

The final instar caterpillar (Fig. 37) measured 28mm when collected. Head rounded, quite strongly indent at vertex; shiny, rugose; chestnut brown ground colour; a yellow line from apex laterally to just in front of stemmata; a second yellow line from apex, parallel to epicranial suture and overlapping dorsal part of frons; a third line branches from the first at about one-third of the distance from the apex, to end close to the lower end of the second line. T1 pale brown with orange tint; pronotum broad, translucent pale brown. Body yellow-khaki green; narrow almost black dorsal line; dorsolateral line comprising a short orange line on each segment, the anterior part dorsal to the posterior part of the preceding segment: T3 faint, A1-A7 strong, A8 thicker; spiracles yellow-brown; legs translucent pale brown-orange; prolegs concolorous; anal plate with a strong orange tint.

Fig. 37. Final instar caterpillar of *Narcosius colossus* collected on *Maytenus tetragona*, Inniss Field, 16 January, 2004; 28mm; 04/33.

DISCUSSION

In nearly all cases, the early stages documented here match those illustrated by Janzen and Hallwachs (2014) for the same species in Costa Rica. Since most of my information is based on a very small number of individuals, the fact that those of Janzen and Hallwachs (2014) are based on hundreds for each species, gives reason to think that the early stages are consistent both locally and between regions. The obvious exception is *Astraptes fulgerator*, which in Trinidad seems to be a single entity with one food plant, *Senna bacillaris*, whereas in Costa Rica the name is now known to be at least ten species with consistently different caterpillars and food plants (Hebert *et al.* 2004), none of which match the Trinidad population.

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CORRECTION TO THE 2014 ISSUE OF LIVING WORLD.

Article by Matthew J.W. Cock on "Observations on the biology of skipper butterflies in Trinidad, Trinidad and Tobago: *Phocides, Chioides, Typhedanus*, and *Polythrix* (Hesperiidae, Eudaminae)." Pp. 1–11.

On pp. 7 and 8, Figs. 18 and 19 of specimen 03/205 are *Polythrix roma*, and not *P. octomaculata* as stated. Accordingly, the food plant record of *Lonchocarpus benthamianus*, and the text on p. 7, column 2 should refer to *P. roma* not *P. octomaculata*. The remainder of the section on *P. octomaculata* remains valid. The minor differences between Fig. 19 and Fig. 26 reflect individual variation in the colouring of the pupa of *P. roma*.

Compiling Collectors in the Caribbean: Biographical Notes on Some Insect Collectors in Trinidad and Tobago during the British Colonial Period

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ABSTRACT

Biographical accounts are given of insect collectors, mainly from Great Britain, together with the locations of the museums where the collections are to be found. Most of the collections are held at the Natural History Museum in London. Both amateur and professional entomologists are included and some of the collectors are from Trinidad.

Key words: Trinidad, insect collectors, biography, history, museums.

INTRODUCTION

Prior to becoming a British colony at the end of the eighteenth century, Trinidad was under Spanish rule and had many French people living there. From 1899 Tobago came under Trinidad and independence for both islands was granted in 1962. It is not surprising therefore that since Trinidad was a Crown Colony, most insect material was sent to London and ended up in the British Museum. The majority of insect workers were expatriates or visitors, although a few were residents, and some were Trinidadians as the chronological listing demonstrates.

The two islands of Trinidad and Tobago lie just off the northeast edge of the South American mainland and are typical continental islands unlike the rest of the West Indies, and closely resemble nearby mainland habitats in their biotic composition and diversity (see http://ckstarr.net/cks/2009-ENCYCLOPEDIA.pdf) and have only slight endemism. The great variety of habitats include evergreen seasonal forest, swamp forest, mangrove, savanna, lower montane forest and coastal habitats with sandy beaches and coral reefs.

Trinidad and Tobago have a well-studied Neotropical insect fauna especially the Lepidoptera. It has been stated that for the size of the islands they have the richest butterfly population in the world with several hundred species. Barcant (1970) lists 617 butterfly species of which 123 occur on Tobago. Between 1843 and 1987, the Natural History Museum (NHM) in London, formerly the British Museum (Natural History), received 84 separate collections of insects, mostly Lepidoptera, from Trinidad and Tobago (pers. comm. Blanca Heurtas, 9 December, 2013), some quite small, others large and significant. There are 72 collectors' names attached. A number of them, the moth experts, are listed by Cock (2003). In some cases more than one collection has been donated with the same name but at different times, for example Henry Caracciolo (1859-1934) in 1891 and 1895 and J.H. Hart (1847-1911**)** in 1895, 1901 and after his death in 1921. The names are interesting; some are well known entomologists and collectors, others are less familiar. There were non-resident amateur collectors who visited the islands to collect insects, mainly butterflies and moths. Others were based on the islands working in their professional capacity and some were born in Trinidad. This paper is based substantially on the names of people from the NHM collections plus some other institutions.

During the period under consideration, the study of insects on the two islands was both an amateur and a professional activity and there is a clear division of interest between them. The amateurs were mainly interested in the Lepidoptera whereas the professionals worked mainly on applied aspects of entomology such as biological and chemical control, crop pests and arthropod-borne diseases. A few were active naturalists as well as being professional scientists, good examples being Martin Adamson (1901-1945) and Henry Aitken (1912-2007).

The period embraces the development of an herbarium and a museum for zoological collections, the foundation of an important field naturalists' club in 1891 and the launching of two journals, the *Journal of the Trinidad Field Naturalists' Club* and *Tropical Agriculture*. The Imperial College of Tropical Agriculture (ICTA), the Trinidad Regional Virus Laboratory (TRVL) and the Commonwealth Agricultural Bureaux (CABI) in Trinidad were established. It ends with the foundation of the University of the West Indies in Trinidad (the abbreviation UWI will be used for this in the paper).

There was a collecting frenzy during this period, within the British amateur naturalist tradition, and an obvious fascination with tropical butterflies – large and colourful insects which can be caught fairly easily with a net. This led not just to collecting in the field but to exchanges and purchases of collections. Many amateur collectors

had butterfly cabinets on display in their homes which later would be donated to museums. Although amateurs continued to play an important role in taxonomy, biodiversity and field studies, in general terms the emphasis in entomology changed somewhat during the late nineteenth and early twentieth centuries. A laboratory based approach began to develop, involving insect anatomy, histology and physiology conducted by professional scientists. In light of the discoveries made during this time, entomology became vital particularly as the role of insects as vectors of disease was elucidated.

Apart from the main collections at the Natural History Museum, London (NHM), a number of other museums in Britain contain insect material collected in Trinidad. The list below is not complete but includes museums at:

Aberdeen University
Brighton (The Booth Museum)
Cambridge (University Museum of Zoology)
Exeter (Royal Albert Memorial Museum)
Glasgow University Hunterian Zoology Museum
Leeds City Museum (Discovery Centre)
Norwich (Castle Museum)
Oxford University Museum of Natural History
University College London (Grant Museum)
Sheffield City Museums (Weston Park Museum)
Museum of the University of St. Andrews
Torquay, Devon, UK

The present paper provides biographical notes on some of these collectors, arranged chronologically, showing their interests and where a number of the collections may be found.

Lord Walsingham, Thomas de Grey, 6th Baron of Walsingham (1843-1919)

English Conservative MP, then House of Lords. President of the Royal Entomological Society on two occasions and FRS. His collection of Lepidoptera, which included other important collections he had purchased, totalled around 260,000 specimens which he donated to the NHM in 1889 with about 2,600 books. Special interest in the Microlepidoptera.

John Hinchley Hart (1847-1911)

Arrived in Trinidad in 1887 as Superintendent of the Royal Botanical Gardens and in charge of the Herbarium, to find that the previous plant collections had been badly looked after and largely destroyed by insects. British Colonial agronomist with a large publication list in applied botany including cacao (**note 1**). Collected insects and deposited them at NHM in 1895, 1901, and 1921. See Baker (1952), Baksh-Comeau (1991), Hart (1892) and Pemberton (1999).

Sir Gilbert Thomas Carter (1848-1927)

Born London; died Barbados. Educated at the Royal Naval School, Greenwich, then Royal Navy. Colonial administrator for the British Empire in Gold Coast, Gambia, Bahamas, Bermuda, Lagos, Leeward Islands and, prior to retirement, administrated Trinidad and Tobago in the absence of the Governor from 1907 to 1910. KCMG (1893, for services in Nigeria). Moth named Carters' Sphinx, *Protambulyx carteri* (Rothschild and Jordan 1903); Carter collected the type specimen in Nassau, Bahamas. Deposited Trinidad material at NHM in 1907.

Henry Caracciolo (1859-1934)

Founder and first President of the Trinidad and Tobago Field Naturalists' Club in 1891. Revived the Society in 1924 and re-elected President. Member of the Société Entomologique de France. Cocoa planter and also interested in citrus, navel orange and grapefruit. Expert on bats and interested in butterflies also. Insects deposited at NHM in 1891 and 1895. Corresponded regularly with NHM staff 1888-1895 (letters also at NHM). Published work on rearing, life histories and mimicry in butterflies, mainly in the journal of the French society and the *Journal of the Trinidad Field Naturalists' Club.* See Caracciolo (1891, 1892a, b), Lamas (2014) and Rooks (1991).

Margaret Elizabeth Fountaine (1862-1940)

Born Norwich, England; died Trinidad of a heart attack while collecting on the slopes of Mount St. Benedict. Prolific collector who travelled all over the world to collect butterflies. Also bred butterflies to study their life cycles and painted watercolours of them. Her main collection of around 22,000 butterflies is at the Castle Museum, Norwich, known as the Fountaine-Neimy collection; some material at NHM, deposited in 1937. See Fountaine (1980), Cock (2004) and Lamas (2014).

Walter Elias Broadway (1863-1935)

Born Hampshire, England; worked as a gardener both in his home county and in Devon before an appointment at Kew Gardens in 1888 where he reached the position of sub-foreman. Assistant Superintendent of the Royal Botanical Garden in Trinidad from his arrival in 1888. Founding member of the Trinidad and Tobago Field Naturalists' Club. In addition to plants, also wrote about and made collections of insects (Broadway 1892a, b). Discovered a new genus of dragonfly and a butterfly named after him (Carr 1991). Butterfly material to NHM in 1898. Several plants, a spider and an insect bear his

name. Published work on disease caused by thrips (**note 2**). See Baksh-Comeau (1991).

Sir Norman Lamont (1869-1949)

Scottish politician and agriculturalist who died in San Fernando, Trinidad. Liberal Party politician and MP. Moved to Trinidad around 1907 where family had sugar plantations but gave up unprofitable sugar and branched out into other crops. Closely involved with the development of ICTA and a Governor there from 1921 to 1945. Wide interests in agriculture, grasses, history and especially Lepidoptera of Trinidad. Prolific collector. National Museums Scotland, Edinburgh (NMS) houses Lamont's collections of butterflies (pers. comm. Graham Rotheray, email, 8 October, 2013) as does the Zoology Museum at the University of the West Indies in Trinidad; other Lepidoptera deposited at NHM in 1921. According to Cock (2003) and Tikasingh (2003), Lamont's collections are divided fairly evenly between the UWIT Zoology Museum and NMS. See Lamont (1917) regarding Tobago butterflies, and Cock (2003), Lamont (1917), Kaye and Lamont (1927) and Lamont and Callan (1950).

Frederick William Urich (1870-1937)

Born Trinidad; died Port of Spain, Trinidad. Educated in Frankfurt (Germany) and Geneva (Switzerland). Keen insect collector from youth. Later specialist in applied entomology and bats. Described by Adamson as an "excellent naturalist" (**note 3**), did not publish much on insects but a large number of animal species were named after him. Worked on froghoppers of sugar cane and thrips of cacao and corresponded with many entomologists abroad, especially in USA. "Encyclopedic knowledge of the local aspects of whatever problem or biological group" (Wolcott 1938). Entomologist for the Department of Agriculture from 1920 and on staff at the ICTA (Assistant Professor) until 1934 when he retired. Entomological material registered at NHM in 1933. See Busck (1937) and Wolcott (1938).

Sir Guy Anstruther Knox Marshall (1871-1959)

British entomologist and specialist on weevils (Curculionidae). Born India; schooled in Margate where he began collecting butterflies. Honorary doctorate Oxford and Honorary Fellow Royal Entomological Society of London. Became a scientific administrator as Scientific Secretary of the Entomological Research Committee (Tropical Africa) in 1910 which became the Imperial Bureau of Entomology, of which he was Director from 1913 to 1942. This in turn became the Commonwealth Institute of Entomology in 1947 and part of CAB. Insects donated in his name to NHM in 1917. Knighted in 1920; FRS; KCMG on his retirement in 1942. See Scrivenor (1980).

Arthur Hall (1873-1952)

Lived in Brighton. Wide interests in natural history. Collected material but the bulk of his collections were obtained by purchase and exchange; over 600 types. Described species and published over 25 papers, mainly in the 1920s and 1930s, chiefly in the *Entomologist.* Produced a large hand-written volume monograph, now in microfiche format (Hall 1983) available at Brighton. Extensive unpublished diaries, additional notes, catalogues and main collection of some 30 cabinets at the Booth Museum, Brighton (pers. comm. John Cooper, 1 September, 2014). Much of the material from Central and South America collected by him in the field. Main interests were in the Nymphalidae. Butterfly material deposited at NHM in 1933. See Hall (1905, 1929, 1933, 1983), Legg (1984). Lamas (2014) has a publication list.

William James Kaye (1875-1967)

Expert on Trinidad Lepidoptera, collecting, studying and publishing from the 1890s to 1950s, working with his brother S.J. Kaye. Large number of publications which include catalogues and lists of butterflies and some Trinidadian moths. NHM donations dated 1904 and 1906. His preliminary list of moths had 242 species which rose to 1016 by 1927. See Kaye (1904, 1914, 1921, 1940), Kaye and Lamont (1927), Cock (2003) and Lamas (2014).

Charles William Beebe (1877-1962)

Beebe was famous for a wide range of biological activities including deep sea investigations and was one of the foremost naturalists in the world for a period. He collected animals as an employee of the New York Zoological Society in India and on moving to Trinidad in 1949, purchased and renamed an old plantation house 'Simla', in the Arima Valley, after the Indian station. Director of the New York Zoological Society, Department of Tropical Research Simla Station, he donated the property to the NYZS in 1951. Although they were not a principal part of his earlier work, after settling in Trinidad, insects became a focus from 1950 and several papers were produced during this period (Welker 1975). For example, the paper on Trinidad mantids (Beebe *et al.* 1952) included the first observations from fresh specimens on the remarkable asymmetrical species *Tithrone* as described in Barabás and Hancock (2000). See Lamas (2014) for a list of some of his more general publications as well as for those on butterflies. See also, Guide to the Records of the New York Zoological Society, Department of Tropical Research Simla Station, Trinidad Expeditions, 1949-1961 (website, Collection 1005D-Department of Tropical Research). Much has been

written about the man, his life and work including Welker (1975) and Gould (2004).

Hugh Scott (1885-1960)

Born London. Started collecting butterflies around the age of seven. Cambridge University research under entomologist David Sharp; Curator of Entomology, University Museum of Zoology, Cambridge, where some of his collections are deposited. Studied the fauna of bromeliad tanks (Fig. 1). FRS. Lepidoptera at NHM in 1914 and 1922. See Scott (1912) and Thompson (1961).

Joseph Lennox Pawan (1887-1957)

Born Trinidad, educated at St. Mary's College (1900-1907), Trinidad. Scholarship to study medicine at Edinburgh University (1907-1912) then Pasteur Institute in France. Worked as a surgeon in the hospital at Port of Spain and then as District Medical Officer in Tobago. Bacteriologist for Trinidad and Tobago. First person to demonstrate that rabies could be spread by vampire bats. Isolated rabies virus from several bat species. Also studied *Aedes* and anopheline mosquitoes, their histology and role in the transmission of disease and the water supplies of Trinidad and Tobago. Insect specimens to NHM in 1921 and 1922.

Carrington Bonsor Williams (1889-1981)

Keen butterfly collector and breeder in his youth. Cambridge graduate then agricultural entomologist. Head of Entomology Department, Rothamsted Experimental Station, England 1932-1955. Early statistical ecologist. Studied thrips in Trinidad, working on insect pests of sugar cane. As a result he became interested in insect migration and biogeography, especially of butterflies (Williams 1958). Material to NHM, 1919. See also Marren (1995).

Patrick Alfred Buxton (1892-1955)

Quaker family background and interested in nature study as a boy. Cambridge and then qualified in medicine at St. George's London. RAMC. Became eminent British medical entomologist; in charge of Entomology at the London School of Hygiene and Tropical Medicine and Professor at London University from 1933. President of the Royal Entomological Society, London; FRS (1943), FLS (Linnean Medal, 1953). Special interests include lice, tse-tse flies, other insects of medical importance and insecticides. Insects to NHM in 1954. See Wigglesworth (1956).

Alistair Martin Adamson (1901-1945)

School in Ayrshire, Scotland, followed by a first class degree in Natural Science from St. Andrew's University, Scotland; assistant to Professor D'Arcy Wentworth Thompson at St. Andrew's for a short period. Following work in California and on the Pacific Entomological Survey, he was appointed Senior Lecturer and Head of the Department of Entomology at the Imperial College of Tropical Agriculture in 1933 and later Professor. PhD (1936), University of California. Correspondence at St. Andrew's with copies at the Alma Jordan Library, UWI (Trinidad). Specialities: termites (Adamson 1937, 1946), thrips and biological control (Adamson 1936). Main termite collection at the American Museum of Natural History, New York and material also at the NHM, deposited in 1936. Made wider collections in Trinidad and elsewhere for teaching purposes, including marine animals, some of which are in the Zoology Museum, UWIT. See Baker and Rutherford 2014.

Theresa Rachel Clay (1911-1995)

Educated at St. Paul's School, London and Edinburgh University. World authority on bird lice. Various posts at the NHM London, then a full time Senior and later Principal Scientific Officer there from around 1950 and Deputy Keeper of Entomology from 1970-1975. Specialised in parasitic insects, Mallophaga and Apterygota; studied lice from Trinidad. Donations to NHM in 1961. Joint author with Miriam Rothschild of *Fleas, Flukes and Cuckoos* (Rothschild and Clay 1952). See also Carriker (1962) and Marren (1995).

Thomas Henry Gardiner Aitken (1912-2007)

Born in California and died in New York, aged 94. Entomologist and naturalist. University of California, Berkeley. Doctorate on "Studies on the Anophelene Complex of Western America". Became a world expert on mosquito taxonomy, their control and on arthropod-borne viruses (arboviruses) (Aitken *et al.* 1969; Heinemann *et al.* 1980). Also worked on other flies from Trinidad (Aitken 1968). The insect material at NHM, London is dated 1955. Worked at the Trinidad Regional Virus Laboratory (TRVL), now the Caribbean Epidemiology Centre (CAREC), Port of Spain, from 1954 to 1966. According to Tikasingh (2003) it took the staff and in particular Aitken, "painstakingly to collect and identify the species of mosquitoes present in the country". Speciality - arthropods of medical importance. Nariva Swamp enthusiast who proposed the Bush Bush Forest as a nature reserve in 1960 (Aitken 1973a). Published widely on medical and entomological aspects of virology and also on the biology of animals collected in the Bush Bush Wildlife Sanctuary, including arthropods (Aitken 1973b), amphibians, reptiles and mammals. Other papers in the *Journal of The Trinidad and Tobago Field Naturalists' Club*. Collections in Trinidad are held at CAREC (Tikasingh 2003, 2007).

Edward McCallum Callan (1912-1996)

Member of staff at ICTA, Trinidad, late 1930s to 1940s. PhD, DIC. Moved to Rhodes University, South Africa as Senior Lecturer in Entomology and then Principal Research Scientist at the Australian Council for Scientific and Industrial Research (CSIRO) from 1963-1972, based at the Division of Entomology at Black Mountain, Canberra. Material deposited at NHM in 1954 and 1957. Worked with Adamson and published widely on insect pests of cash crops and termites during his time in Trinidad (Callan 1943, 1947, 1948) and the solitary wasps of Trinidad (Callan 1990).

Malcolm Barcant (1913-1986)

Born in Trinidad and died in Florida. Amateur who collected butterflies from an early age and amassed a very large collection now housed and on display at Angostura Ltd., near Port of Spain. It is regarded as one of the most important insect collections in the Caribbean. He also bred butterflies, added new records to the Trinidad list and helped to describe new species. His book on the *Butterflies of Trinidad and Tobago* (Barcant 1970) is the standard work. See Baker (2014).

Alan Brindle (1915-2001)

Born in Nelson, Lancashire; died Burnley, Lancashire. Worked in a mill for several years, later Assistant Keeper (1958-1961) then Curator of Entomology at Manchester Museum. Expert on the Dermaptera, earwigs, (see Brindle 1971) and the immature stages of Diptera. Described over 200 new species of insects; material at Manchester Museum.

Hugh Bernard Noel Hynes (1917-2009)

PhD (1941) Imperial College, London was on stoneflies (Plecoptera). Colonial Scholar 1941-1942 at the ICTA, Trinidad, studying tropical agriculture. University of Liverpool from late 1940s and then the University of Waterloo, Canada (1964-1983) to establish department, first Professor and Head of Biology. Collected and published on aquatic Heteroptera in Trinidad. See Hynes (1948) and Williams (2009).

Douglas Keith McEwan Kevan (1920-1991)

Born Helsinki, Finland, of English parents; naturalist from an early age. Student at Edinburgh University, several prizes/medals for Zoology followed by a British Colonial Office Postgraduate Agricultural Scholarship (Entomological Special Cadet) at ICTA, Trinidad on a two-year course in tropical agriculture. Associateship ICTA (1943). Head of new Zoology section in Faculty of Agriculture, University of Nottingham (1948), Chair of Department of Entomology, McGill University (1957). Fellow of the Royal Society of Edinburgh (1958). Curator of the Lyman Entomological Museum (1971-1986). Keen collector in the field, specialist groups include Neuroptera, Orthoptera and Dermaptera, also soil zoologist. See Kevan (1951) and http://www.insects.org/ced3/dkmce_kevan.html

Other insect collectors in Trinidad, some of which fall into the timescale of the period, with the dates of their donations to the NHM, London and where possible their special interests, include F.D. Bennett (1976) Lepidoptera; E.W. Classey (1974); W.M. Crowfoot (1887) Lepidoptera but "based on collections made by another physician" (Tikasingh 2003); W. Douglas (1843) Lepidoptera, Coleoptera and Hemiptera; F.W. Jackson (1922) Lepidoptera; R. Thaxter (1917) thrips and ants (Wheeler 1916); C.L. Withycombe (1924) Lepidoptera. More recently, collections have been deposited at National Museums Scotland, Edinburgh, which now houses most of D.J. Stradling's (**note 4**) collection of butterflies and other orders of insects. At Glasgow University's Hunterian Zoology Museum are insects collected in Trinidad by E.G. Hancock (**note 5**) and other staff and students from the 1990s onwards. There are also collections in Trinidad (Tikasingh 2003) such as those of Barcant (Baker 2014) at Angostura Ltd; the Caribbean Epidemiology Centre (CAREC), CAB International Bioscience, and the Zoology Museum at UWI in Trinidad (Baker and Rutherford 2014).

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Notes

1. The cacao tree (*Theobroma cacao*) is a small, widely cultivated evergreen tree, the seed from which cocoa and chocolate are made.

2. The redbanded thrips, *Selenothrips rubrocinctus*, was first described from Guadeloupe, West Indies, and it was causing considerable damage to cacao. As a result, it was referred to as the cocoa thrips. The earliest report of damage relating to these thrips was by W.E. Broadway in 1898, when he called attention to the "blight" of cacao in the *Government Gazette for Grenada* (no.139) although he did not give the scientific name for the species at that time.

3. A.M. Adamson to D'Arcy Wentworth Thompson (ms 9289 dated 12 January, 1933).
Special Collections, University of St. Andrew's, Scotland.

4. David J. Stradling (1939-2012)
Career entomologist and ecologist at UWIT and University of Exeter. Insect collection divided between Exeter and Edinburgh. At the latter are 48 insect boxes mainly Lepidoptera but includes some Odonata, Hemiptera, Hymenoptera, Diptera and Coleoptera many from Trinidad plus two boxes of microscope slides. The rest of the collection at the Royal Memorial Museum, Exeter. Special interests were in leaf-cutting ants and hawkmoths.

5. E. Geoffrey Hancock (1948 -)
Career in museums in Liverpool, Bolton and Glasgow (Kelvingrove) moving to Glasgow University (The Hunterian) as curator of entomology in 1997. Special interest in Diptera. Collected in Trinidad on field trips with students from 1994 onwards; material mainly in the Hunterian with some at Kelvingrove.

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Fig. 1. *Dryadoblatta scotti* (Shelford 1912), bromeliad-dwelling cockroach, specimens from Morne Bleu, Trinidad, 1-15 July, 2006, Glasgow University Exploration Society. The Hunterian (Zoology Museum, Entry No. 419).

The Avifauna of the Matura Environmentally Sensitive Area, Trinidad and Tobago

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ABSTRACT

A baseline survey of the avifauna of the Matura Environmentally Sensitive Area (MESA) in Trinidad was conducted to characterise the avifauna of the site and establish the presence of species of particular conservation interest. Surveys were conducted over 22 days on nine site visits between 2008 and 2010 from 152 sector (transect) surveys, supplemented by general observation. Overall, 95 species and 1067 individuals were detected, including 89 year-round residents, three non-breeding migrants, and three species which breed locally but disperse post breeding to the mainland. This represents 59% of the species expected in the MESA. The rate of species accumulation suggests that further sampling will yield one additional species per ten sectors. The assemblages observed reflect Trinidad's proximity to South America. Both of Trinidad's endemic birds, the Trinidad Motmot, *Momotus bahamensis*, Trinidad Piping-Guan, *Pipile pipile*, and the rare Scaled Antpitta, *Grallaria guatimalensis*, were detected within the study area. High-altitude specialists observed include the Brown Violetear, *Colibri delphinae*, Speckled Tanager, *Tangara guttata*, Hepatic Tanager, *Piranga flava* and Yellow-legged Thrush, *Turdus flavipes*. The vegetation and altitude along the trail across the MESA on which the survey was conducted is described in sections. The degree of difficulty and potential camping locations of each section are also described to facilitate subsequent surveys.

Key words: Matura, ESA, avifauna, endemic, Trinidad, Trinidad Piping-Guan.

INTRODUCTION

The Matura Environmentally Sensitive Area (MESA) was created in 2004 for the protection of the area's flora and fauna (Environmental Management Authority 2004). The area is an amalgamation of three adjoining parcels, initially declared as Reserves in 1922, 1958 and 1959.

Previous ecological work in the area focussed on flora (Van den Eynden 2006), avifauna (Hayes *et al.* 1998), and use of forest resources (Van den Eynden 2006; Trewenack 2010). Van den Eynden (2006) reported that recreation, agriculture, timber extraction (in the early 1990s; now rare) and hunting (up to about 500 local hunters) were the major forest uses. In a study of forest management in northeast Trinidad, Trewenack (2010) conducted interviews with the residents and obtained similar results for resource use.

Hayes *et al.* (1998) accumulated an *ad hoc* species list of 145 birds in the northeast of Trinidad from Madamas River to Matura Bay. His fieldwork was done before the area was designated an environmentally sensitive area, and includes observations well beyond the current MESA and from habitats not represented therein. Nelson *et al.* (2007) recorded a list of birds in his study of the adjacent Madamas Watershed using fixed-radius point counts, mist netting and call playback. Sixty-one species were observed during point counts and two additional species from mist netting and general observation.

The status, distribution and abundance of the avifauna in Trinidad are well known with a long history of ornithological work (ffrench 1998), good field guides (Kenefick *et al.* 2011; ffrench 2012) and an active Bird Status and Distribution Committee (Kenefick 2014). Thus, despite the paucity of studies or observations within the MESA's boundary, a list of expected species can be prepared with some confidence. However, management of the MESA should be supported as much as is practical by actual observations within the MESA.

The primary objective of this study was to characterise the avifauna in the MESA. Specifically, the species present were documented, the characteristics of bird community structure such as species diversity were recorded, and any species which can serve as a focus for conservation efforts was identified. These should help guide the MESA's management team. A second objective was to provide training to four members of the local community to be able in the future to continue conducting such surveys or serve as guides. This activity is not reported here.

For each trip, the survey team comprised one experienced birder, two tour guides (from local community non-governmental organisations), an occasional Forestry officer, and the University of the West Indies' Project Coordinator. Field trips from the north of the MESA were led by two guides from the Grande Riviere Tour Guide Association, and trips from the south were led by two or

three guides from Nature Seekers, Matura.

STUDY AREA

The MESA is located at the northeastern tip of Trinidad (Fig. 1). It encompasses approximately 9000 ha of largely undisturbed forest in the Northern Range (CFCA 1998). Rural communities are situated on the outskirts of the perimeter. Rainfall patterns indicate that the highest annual precipitation levels in the country (3,048mm) are in the Matura/Grande Riviere area in the northeast of the range (Berridge 1981). Rainfall varies between the wet (July-December) and dry (January-June) seasons and the pattern reflects the typical moist tropical forest environment. The average annual temperature is 24°C (Kricher 1997).

At the boundaries, the landscape features slopes that reach down into the rural villages. The entire site is mountainous; ranges are a continuation of the coastal cordillera of Venezuela oriented in an east-west direction, with steep slopes which reach up to nearly 600m. Streams on the northern slopes flow into the Grande Riviere and Shark Rivers. To the south, the tributaries flow into the Salybia and Matura Rivers. Vegetation ranges from herbaceous layers up to 1 m, to large canopy species reaching 40m in height. The forest types are as described by Beard (1944), as they are in very good condition having escaped conversion to cocoa plantation due to ruggedness and isolation. The vegetation associations are Evergreen Seasonal Forest, Lower Montane and Montane Rain Forest (Beard 1944). Much of the lower southern slopes of the park are comprised of Mora forest, *Mora exselsa*, Evergreen Seasonal Forest species and some secondary forest. The dominant higher altitude species are of the Myrtaceae and Podocarpaceae families, and include the eastern-most extension of several high altitude species such as the endemics *Clusia aripoensis*, *C. tocuchensis*, *Macrolobium trinitense*, *Podocarpus trinitensis*, *Eugenia cruegeri* and *Ocotea trinidadensis* (Van den Eynden 2006). Much secondary growth exists at lower elevations on the northern side of the park where low lying areas were cleared for cocoa cultivation. The forest on the northern slopes is structurally different from the southern slopes (probably from periodic disturbance of hurricanes on the northern slopes), with significantly larger and fewer tree stems on the southern slopes. Canopy cover in the park is usually >80% and one or two sub-canopy strata are common. Gaps and clearings are few, except at ridge tops. Stream bank habitats are narrow, as the streams lie between slopes that rise quickly with steep gradients.

About 10% of the area is inhabited or farmed. Game and hunting trails can be found off the main access and survey trails, as well as scattered hunters' scaffoldings. There is evidence of old logging at the lower altitudes on both the Salybia and Grande Riviere sides of the ESA. There were no obvious signs of intensive logging, however Van den Eynden (2006) estimated that about 300 ha were disturbed at the southern (Salybia) end.

METHODS

Nine trips were made to the study site between September 2008 and August 2010. Access to the site was via Grey Trace in Salybia or Sangre Grande Trace in Grande Riviere, and each trip attempted to reach the highest point along the trail, known locally as "Mars," at an altitude of 580m. The trips were planned in pairs with one from the north and south alternating between two experienced observers and scheduled throughout the year. Some trips were postponed or shortened due to heavy rain.

Surveys using fixed-width transect sampling (Bibby *et al.* 2000) were used to record the presence and numbers of species detected visually and aurally along paths or rivers in the study area. At the beginning of a sector, we recorded data on habitat structure, visibility and dominant tree species, which could be noted while standing still. This period allowed the birds some time to adjust after initial disturbance. A Garmin 60SCx GPS unit was used to record location in UTM coordinates (Naparima BWI datum). Birds detected within 25m perpendicular to the trail were counted, whilst species detected beyond 25m were recorded as present. The GPS unit was used to adjust walking speed such that each survey unit was sampled in 15 minutes. Survey units were each a 200m long sector of the trail, and were established 200m apart to minimise the probability of counting a particular individual more than once. One hundred and fifty-two sectors were sampled in this way (Fig. 1). Any leks (closely clustered mating territories defended by male birds) observed along the trail were recorded either within the sector or with a separate GPS reading.

Sampling was conducted according to Table 1, and generally during the morning from 0600 h to 0930 h and the afternoon from 1600 h to 1730 h when the birds were most active. On overcast days this period was extended. Each survey was conducted by two persons including one experienced observer and one person taking notes.

During non-sampling periods any additional species observed, including nocturnal species heard, were recorded. On ten occasions in the late afternoon a recording alternating between the calls of the Trinidad Piping-Guan, *Pipile pipile*, and the Scaled Antpitta, *Grallaria guatimalensis*, was played for 5 minutes, followed by a listening period of three minutes.

Training was generally accomplished between sample periods and by having the trainee serve as the scribe. The training included explaining the survey methods, partici-

Table 1. Sampling logistics: Dates marked with an asteryx indicate trips where sampling was compromised because of heavy rain.

Field Trip Date	Access Point	Sectors Sampled
*22 August, 2008	Salybia	0
*17-18 September, 2008	Salybia	13
*2-4 October, 2008	Grande Riviere	12
10-13 December, 2008	Salybia	21
20-23 January, 2009	Grande Riviere	23
24-27 March, 2009	Grande Riviere	31
19-22 May, 2009	Salybia	29
*4-7 August, 2009	Grande Riviere	7
13-16 January, 2010	Grande Riviere	16

pating in the survey and learning to identify the birds either visually or by their vocalisation.

Presentation of results

Species are presented in the taxonomic order following the South American Classification Committee's (SACC) list (Remsen *et al.* 2015). For each species, the total number observed within 25m is presented as a measure of relative abundance. For species not detected within 25 m, the proportion of sectors in which it was detected is presented in brackets. For convenience, the table of relative abundance includes the status and abundance of each species in Trinidad following White *et al.* (2007).

A species-accumulation curve, alongside a plot of Simpson's (Inverse) Diversity Index (Simpson 1949), illustrate the rate of species sampling and species diversity, respectively, and serve as a baseline for subsequent investigations or comparative studies. A Cole Rarefaction curve provides a randomised recreation of the species accumulation. The determinate axis selected is the number of individuals detected. This provides a more intuitive comparison between habitats with differing visibility and may be useful in comparative studies.

The bird species assemblage is characterised by status and habitat use. The species observed during the study are compared to a hypothetical list of species which the authors expect to be present at the site. This list excludes species which, although common and widespread in Trinidad, are not generally associated with a forested habitat. It also excludes rare species unless previously recorded within the park boundary.

RESULTS AND DISCUSSION

Description of avifauna

Overall, 95 species representing 36 families were observed during this survey from 152 dedicated sector samples and incidental observations (Table 1). This list comprises 73 species detected within 25m of the sectors, an additional six species detected during sectors but beyond 25m, and an additional 16 species detected between sectors, including birds heard during the night. The species observed represent 59% of the species expected to be found in the MESA.

The abundance of each bird species detected during the survey is presented in Table 2. This reflects to some extent the relative abundance of species. However, the detectability of each species varies. Thus, very quiet and camouflaged species are under-detected, and bright noisy species are over-represented. Shy, vocal species are often detected beyond the 25m limit. The extent to which detectability varies is demonstrated by the number in brackets, which gives the number of sectors in which the species was recorded. So whilst only five Bearded Bellbirds, *Procnias averano* were detected within 25m, they were heard from 50 sectors. Four Trinidad Piping-Guans, *Pipile pipile* were detected but they were almost certainly three individuals, with one bird detected twice.

Of the 95 species observed, 89 are resident breeding species, three are non-breeding migrants and three are species which breed in Trinidad and disperse to the mainland during non-breeding periods. The 'hypothetical' list of 161observed and expected species includes 138 residents,

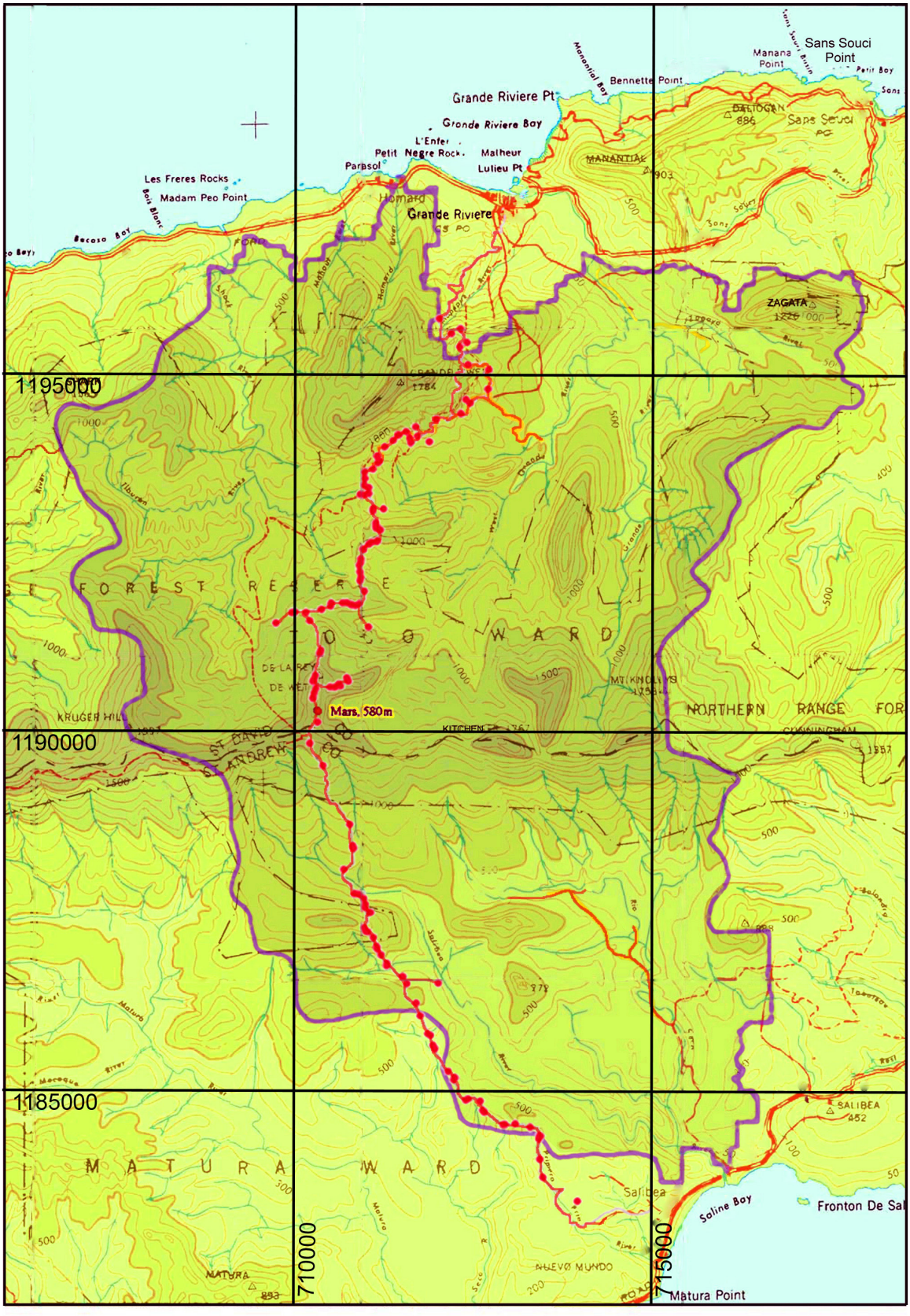

Fig. 1. Boundaries of the Matura Environmentally Sensitive Area (purple line) and the distribution of sample sectors (red dots) across the trail. (Prepared by Edward Rooks).

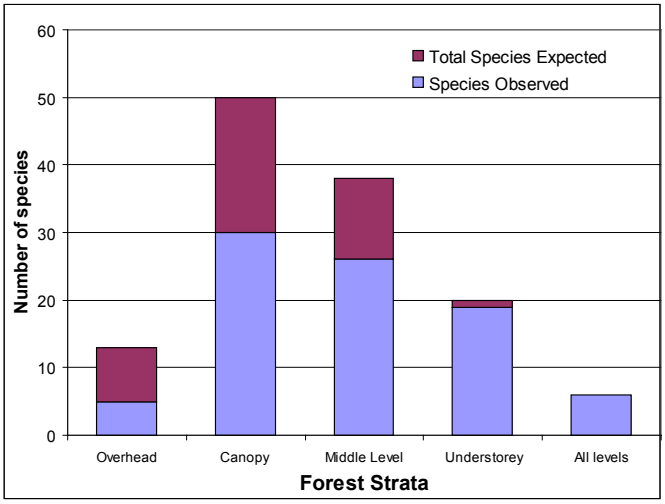

Fig. 2. Species richness observed of species favouring different forest strata, compared with a hypothetical list of species expected at the site.

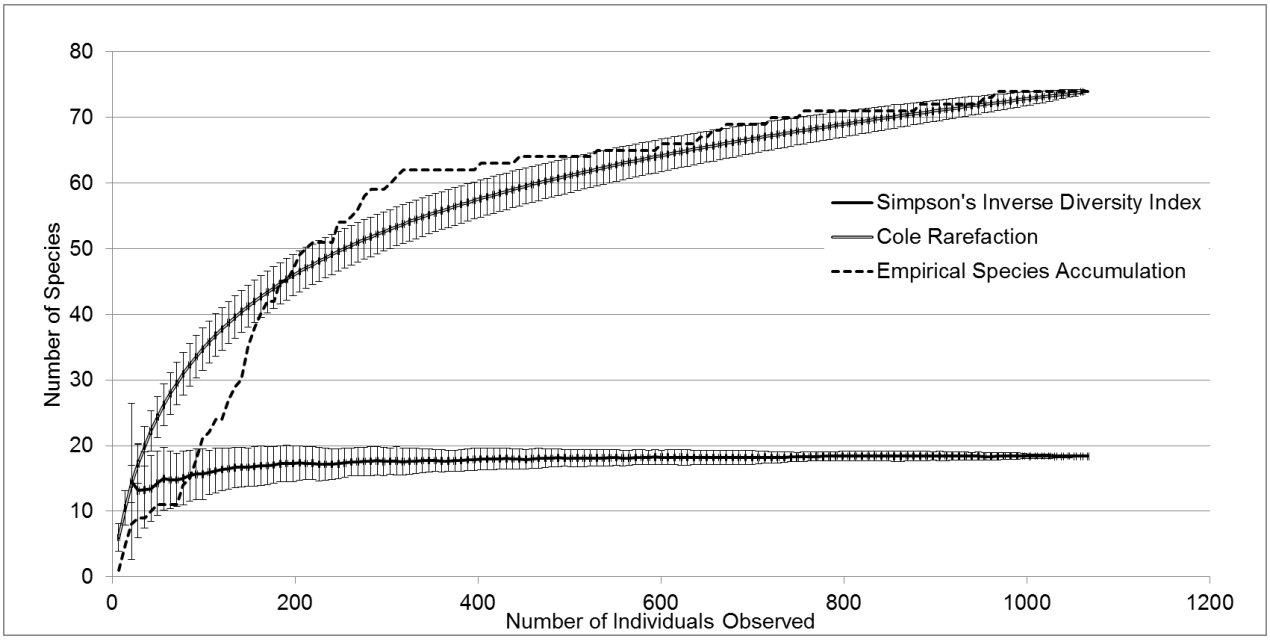

Fig. 3. Species accumulation, Cole Rarefaction curve and Simpson's (Inverse) Diversity Index for all species detected within 25m of all sectors at the Matura ESA, September 2008 -August 2010.

15 migrants (generally non-breeding) and eight species which breed locally and disperse.

With respect to habitat use, most (70) of the species observed were typical of a forest habitat. Sixteen species are found in both forest and scrub, three species are usually associated with scrub, five are aerial foragers and one can be found along rivers. Of the species usually found in forested habitats, 30 were usually associated with the canopy, 26 with the middle levels of the forest, 20 with the understorey, five above the canopy and six at all forest levels. If this distribution is compared with equivalent figures from the 'hypothetical list', it is apparent that whilst the middle and lower levels are well represented in the samples, the canopy dwelling species are under-represented (Fig. 2).

The rate of accumulation of species within 25m of the sector is illustrated by a species-accumulation curve and a supplementary plot of the species diversity (Fig. 3). This rate of species accumulation suggests that further sampling will yield one additional species per ten sectors. The cumulative plot of the Simpson's (Inverse) Diversity Index is very stable and is unlikely to change from the final value of 18.36.

Species of special interest

The assemblage reflects the avian communities of northern South America, with the tanagers (Thraupidae),

Table 2. Relative abundance (RA) of birds detected in the Matura ESA (September 2008-August 2010) and their status and abundance within Trinidad (from White *et al.* 2007).

Species	RA[a]	Status[b]	Abundance[c]
Tinamidae			
Little Tinamou, *Crypturellus soui*	1 (8)	BR	C
Cracidae			
Trinidad Piping-Guan, *Pipile pipile*	4 (2)	BR	R
Cathartidae			
Turkey Vulture, *Cathartes aura*	1 (2)	BR	A
Black Vulture, *Coragyps atratus*	2 (8)	BR	A
Accipitridae			
Swallow-tailed Kite, *Elanoides forficatus*	1 (1)	BD	U
Ornate Hawk-eagle, *Spizaetus ornatus*	(1)	BR	Sc
Plumbeous Kite, *Ictinia plumbea*	2 (3)	BD	C
Common Black-hawk, *Buteogallus anthracinus*	(2)	BR	C
Zone-tailed Hawk, *Buteo albonotatus*	(1)	BR	C
Columbidae			
Scaled Pigeon, *Patagioenas speciosa*	4 (18)	BR	C
Gray-fronted Dove, *Leptotila rufaxilla*	(3)	BR	U
Cuculidae			
Squirrel Cuckoo, *Piaya cayana*	1 (1)	BR	C
Strigidae			
Mottled Owl, *Ciccaba virgata*	N.O.	BR	R
Nyctibiidae			
Common Potoo, *Nyctibius griseus*	N.O.	BR	U
Caprimulgidae			
Short-tailed Nighthawk, *Lurocalis semitorquatus*	N.O.	BR	U
Common Pauraque, *Nyctidromus albicollis*	N.O.	BR	C
Apodidae			
White-collared Swift, *Streptoprocne zonaris*	3 (4)	MS	U
Band-rumped Swift, *Chaetura spinicaudus*	9 (2)	BR	C
Gray-rumped Swift, *Chaetura cinereiventris*	23 (5)	BR	C
Short-tailed Swift, *Chaetura brachyura*	1 (1)	BR	A
Trochilidae			
Rufous-breasted Hermit, *Glaucis hirsutus*	17 (10)	BR	C
Little Hermit, *Phaethornis longuemareus*	66 (27)	BR	C
Green Hermit, *Phaethornis guy*	65 (32)	BR	C
Brown Violetear, *Colibri delphinae*	B.S.	BR	Sc
Blue-chinned Sapphire, *Chlorestes notata*	9 (10)	BR	C
White-chested Emerald, *Amazilia brevirostris*	11 (11)	BR	C
Trogonidae			
Green-backed Trogon, *Trogon viridis*	15 (16)	BR	C
Guianan Trogon, *Trogon violaceous*	9 (20)	BR	C
Collared Trogon, *Trogon collaris*	21 (34)	BR	C

Species	RA[a]	Status[b]	Abundance[c]
Alcedinidae			
Green Kingfisher, *Chloroceryle americana*	1 (2)	BR	C
Momotidae			
Trinidad Motmot, *Momotus bahamensis*	B.S.	BR	U
Galbulidae			
Rufous-tailed Jacamar, *Galbula ruficauda*	B.S.	BR	C
Ramphastidae			
Channel-billed Toucan, *Ramphastos vitellinus*	6 (36)	BR	C
Picidae			
Golden-olive Woodpecker, *Colaptes rubiginosus*	5 (14)	BR	C
Chestnut Woodpecker, *Celeus elegans*	7 (3)	BR	U
Lineated Woodpecker, *Dryocopus lineatus*	(4)	BR	C
Psittacidae			
Lilac-tailed Parrotlet, *Touit batavicus*	2 (3)	BR	U
Blue-headed Parrot, *Pionus menstruus*	1 (5)	BR	U
Orange-winged Parrot, *Amazona amazonica*	21 (53)	BR	A
Thamnophilidae			
Great Antshrike, *Taraba major*	2 (5)	BR	C
Plain Antvireo, *Dysithamnus mentalis*	10 (19)	BR	U
White-flanked Antwren, *Myrmotherula axillaris*	21 (13)	BR	C
Silvered Antbird, *Sclateria naevia*	3 (3)	BR	U
White-bellied Antbird, *Myrmeciza longipes*	17 (52)	BR	C
Grallariidae			
Scaled Antpitta, *Grallaria guatimalensis*	B.S.	BR	R
Formicariidae			
Black-faced Antthrush, *Formicarius analis*	3 (14)	BR	U
Furnariidae			
Gray-throated Leaftosser, *Sclerurus albigularis*	5 (4)	BR	U
Plain-brown Woodcreeper, *Dendrocincla fuliginosa*	7 (5)	BR	C
Cocoa Woodcreeper, *Xiphorhynchus susurrans*	13 (49)	BR	C
Streaked Xenops, *Xenops rutilans*	1 (1)	BR	U
Stripe-breasted Spinetail, *Synallaxis cinnamomea*	3 (4)	BR	C
Tyrannidae			
Forest Elaenia, *Myiopagis gaimardii*	1 (1)	BR	C
Southern Beardless Tyrannulet, *Camptostoma obsoletum*	1 (1)	BR	C
Ochre-bellied Flycatcher, *Mionectes oleagineus*	B.S.	BR	C
Slaty-capped Flycatcher, *Leptopogon superciliaris*	2 (4)	BR	U
Yellow-breasted Flycatcher, *Tolmomyias flaviventris*	19 (26)	BR	C
White-throated Spadebill, *Platyrinchus mystaceus*	1 (1)	BR	U
Euler's Flycatcher, *Lathrotriccus euleri*	3 (7)	BR	C
Boat-billed Flycatcher, *Megarynchus pitangua*	B.S.	BR	C
Bright-rumped Attila, *Attila spadiceus*	(6)	BR	U
Cotingidae			
Bearded Bellbird, *Procnias averano*	5 (50)	BR	U

Species	RA[a]	Status[b]	Abundance[c]
Pipridae			
Golden-headed Manakin, *Pipra erythrocephala*	93 (74)	BR	C
White-bearded Manakin, *Manacus manacus*	48 (33)	BR	C
Vireonidae			
Rufous-browed Peppershrike, *Cyclarhis gujanensis*	5 (10)	BR	C
Golden-fronted Greenlet, *Hylophilus aurantiifrons*	47 (36)	BR	C
Hirundinidae			
Southern Rough-winged Swallow, *Stelgidopteryx ruficollis*	B.S.	BR	C
Troglodytidae			
House Wren, *Troglodytes aedon*	1 (1)	BR	C
Rufous-breasted Wren, *Pheugopedius rutilus*	21 (45)	BR	C
Polioptilidae			
Long-billed Gnatwren, *Ramphocaenus melanurus*	12 (17)	BR	C
Turdidae			
Yellow-legged Thrush, *Turdus flavipes*	B.S.	BR	U
Cocoa Thrush, *Turdus fumigatus*	2 (6)	BR	C
Spectacled Thrush, *Turdus nudigenis*	5 (5)	BR	C
White-necked Thrush, *Turdus albicollis*	28 (66)	BR	C
Thraupidae			
White-lined Tanager, *Tachyphonus rufus*	8 (9)	BR	C
Silver-beaked Tanager, *Ramphocelus carbo*	3 (3)	BR	C
Palm Tanager, *Thraupis palmarum*	1 (1)	BR	A
Speckled Tanager, *Tangara guttata*	B.S.	BR	L
Turquoise Tanager, *Tangara mexicana*	1 (1)	BR	C
Bay-headed Tanager, *Tangara gyrola*	15 (7)	BR	C
Blue Dacnis, *Dacnis cayana*	1 (1)	BR	C
Purple Honeycreeper, *Cyanerpes caeruleus*	38 (25)	BR	C
Red-legged Honeycreeper, *Cyanerpes cyaneus*	7 (5)	BD	C
Green Honeycreeper, *Chlorophanes spiza*	13 (13)	BR	C
Bananaquit, *Coereba flaveola*	174 (93)	BR	A
Sooty Grassquit, *Tiaris fuliginosus*	B.S.	BR	U
Cardinalidae			
Hepatic Tanager, *Piranga flava*	B.S.	BR	L
Red-crowned Ant-tanager, *Habia rubica*	25 (23)	BR	U
Parulidae			
Northern Waterthrush, *Parkesia noveboracensis*	3 (3)	MN	C
American Redstart, *Setophaga ruticilla*	1 (1)	MN	C
Tropical Parula, *Parula pitiayumi*	1 (1)	BR	C
Golden-crowned Warbler, *Basileuterus culicivorus*	5 (6)	BR	C
Icteridae			
Crested Oropendola, *Psarocolius decumanus*	1 (2)	BR	A
Yellow-rumped Cacique, *Cacicus cela*	7 (8)	BR	C
Fringillidae			
Trinidad Euphonia, *Euphonia trinitatis*	B.S.	BR	U
Violaceous Euphonia, *Euphonia violacea*	33 (29)	BR	C

Table 2 Key

[a] **Relative abundance**	Number of individuals detected within 25m (Number of sectors in which species was detected).
B.S.	Observed between sectors.
N.O.	Calls heard at night.
[b] **Status**	
BR	Resident species without significant movement out of Trinidad and Tobago. Breeding is assumed even if no nest has been documented.
BD	Species that breed locally and migrate or disperse to the mainland (sometimes only partially) during the non-breeding period.
MS	Migrants from South America. May breed occasionally.
MN	Non-breeding migrants from North America.
[c] **Abundance**	
A	Abundant; widespread.
C	Common; usually found in suitable habitat.
U	Uncommon; occasionally seen in suitable habitat.
Sc	Scarce; less than five records per year.
R	Rare; not recorded annually.
L	Locally distributed in restricted habitat.

flycatchers (Tyrannidae) and hummingbirds (Trochilidae) relatively well represented in the data. By far, the most abundant species detected was the Bananaquit, *Coereba flaveola*, followed by the Golden-headed Manakin, *Pipra erythrocephala*.

Trinidad's endemic birds, the Trinidad Motmot, *Momotus bahamensis* and the Trinidad Piping-Guan, *Pipile pipile* were detected within the study area. The former has recently been identified as a full species by the SACC following Stiles (2009). It is generally shy in Trinidad and though widespread in forested areas, it is seldom seen.

The Piping-Guan is regularly seen at the northern edge of the park where it receives some level of protection. Nesting attempts have also been observed. In this survey, three Piping-Guans were seen on the southern slopes of the study site at Grid Reference 0711215 E, 1186833 N. The species has not been observed this far south in recent years but given the appropriateness of the habitat, the bird is probably widespread in the park. The current population estimates are 70-200 individuals (Hayes *et al.* 2009a) and the species has been designated as an Environmentally Sensitive Species (Environmental Management Authority 2004). In terms of conservation, this is the most significant bird species within the MESA.

One individual of the Scaled Antpitta, *Grallaria guatimalensis*, arguably Trinidad's rarest resident, was heard in the valley below the highest ridges of the study site. This is the most eastern record of this species in Trinidad with all other records in the past 50 years from the Lopinot, Arima and Marianne drainages. The observations of the Trinidad Piping-Guan (unpubl. Trinidad and Tobago Rare Birds Committee records) and the Scaled Antpitta (Kenefick 2010) have been submitted and ratified by the Trinidad and Tobago Bird Status and Distribution Committee.

Several of the species whose distribution within Trinidad is limited to comparatively high altitudes were detected. These species are mainly of Andean distribution (Snow 1985) and include the Brown Violetear, *Colibri delphinae,* Scaled Antpitta, *Grallaria guatimalensis,* Yellow-legged Thrush, *Platycichla flavipes*, Speckled Tanager, *Tangara guttata* and Hepatic Tanager, *Piranga flava.* The MESA probably represents the eastern-most edge of the range of each of these species.

Along the ridge three small clearings were observed (Fig. 4). These were described by locals as 'bird clearings'. Their suggestion was that the clearings were created and grasses and sedges (*Scleria latifolia; Bequerelia cymosa* [Van den Eynden 2006]) planted to attract the Chestnut-bellied Seed-Finch, *Oryzoborus angolensis,* which can then be trapped. The Chestnut-bellied Seed-Finch

is a popular cage-bird and locally caught individuals are much sought by cage-bird fanciers. Van den Eynden (2006) produced a map of natural resource used in and around the MESA and plotted the locations of 22 such areas, with 12 of them concentrated on the highest altitudes of the main ridge in the site. From interviews she recorded that the Chestnut-bellied Seed-Finch, *Oryzoborus angolensis*, the Lesson's Seedeater, *Sporophila bouvronides*, the Gray Seedeater, *Sporophila intermedia* and the Violaceous Euphonia, *Euphonia violacea* are popular birds to trap. No seed-finches or seedeaters were observed during the survey. However, the habitat is appropriate for the Chestnut-bellied Seed-Finch. One local resident assured us that he traps one or two individuals per year. Another local resident was seen returning to Grey Trace carrying a trap cage with a Chestnut-bellied Seed-Finch. Van den Eynden (2006) reported that, on average, 19 seed-finches are trapped per year. This species is greatly threatened in Trinidad due to bird trapping, and unless the resident population is augmented by birds immigrating from Venezuela, it is unlikely to survive in Trinidad.

Fig. 4. Small clearings across the ridgetop around a campsite at Mars. These clearings are purported to attract seedeaters.

Manakins, bellbirds and a few hummingbird species exhibit lekking behaviour. These are species in which the males are polygynous and compete with each other in closely clustered territories for the opportunity to mate with females. The females take full responsibility for nest construction and rearing of the brood. The males congregate at regular locations where they vie for the attention of females by ritualised dances and calls. The leks can last decades (Berres 2002) and, coupled with the often strikingly coloured dancing males, provide a reliable attraction to visitors along the trails. They are also attractive to students of animal behaviour, as much of the seminal work on lekking birds was done in Trinidad (see Olson and McDowell 1983; Snow and Snow 1973; Snow, B.K. 1970; Snow, D.W. 1962a, 1962b, 1968).

The distribution and abundance of leks along the main trail is illustrated in Figure 5. Leks of some species, especially Golden-headed Manakins, *Pipra erythrocephala* and Bearded Bellbirds, *Procnias averano*, may extend over an area in excess of 200m in diameter. Thus leks of the same species within 200m of each other, but recorded on different trips, may be a duplication of the same lek.

The most abundant leks were the Golden-headed Manakin, *Pipra erythrocephala* and the White-bearded Manakin, *Manacus manacus*. This is expected given the abundance of each species. The Golden-headed Manakin tends to predominate in well-forested areas. Only one Bearded Bellbird calling site was detected. According to Snow (1970), the bird selects fruits of the Lauraceae and Burseraceae families for specific nutritional value. Perhaps a scarcity of these resources contributed to a low detection of calling sites.

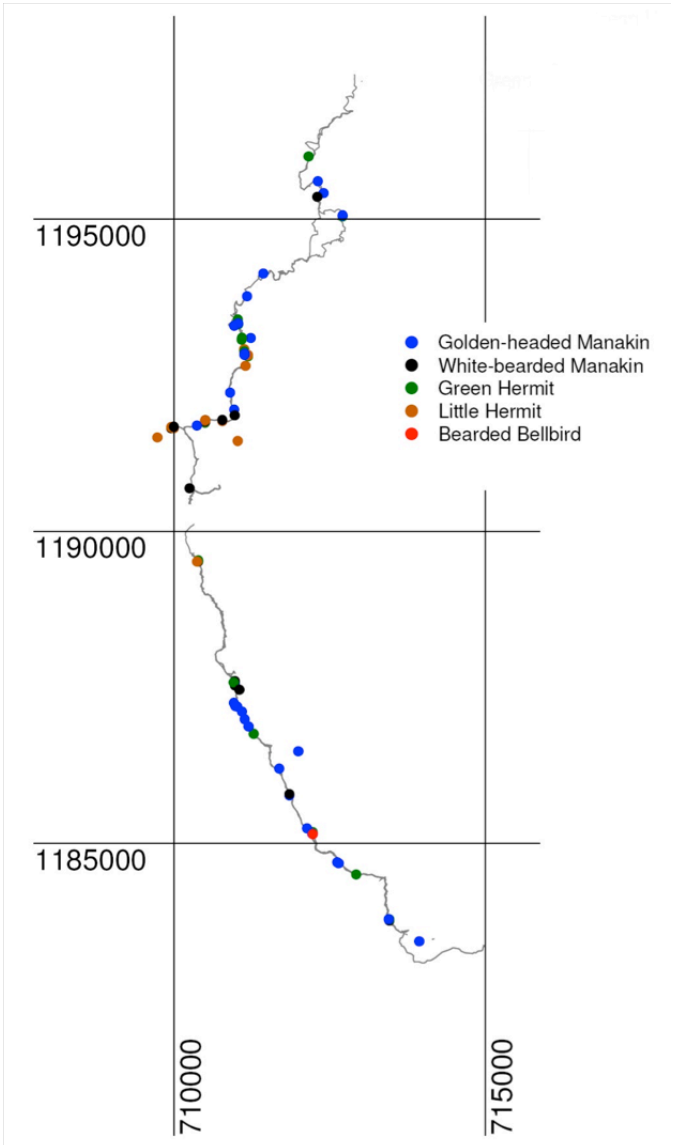

Fig. 5. Distribution of leks along the Grey Trace to Grande Riviere trail.

Of the hummingbirds, the Green Hermit, *Glaucis hirsuta* and Little Hermit, *Phaethornis longuemareus* are lekking species. Green Hermit leks tend to be quite large and noticeable. The Little Hermit is quite difficult to see when calling at leks and some effort is required. Most of the Little Hermit leks along the trail were north of the main ridge. As more trails in the park are described and mapped, more leks will be discovered. Some of these will almost certainly be closer to the access points.

Bird species richness and observation rate across the MESA

For a comparison of abundance or species richness across the MESA, the route followed was separated into the six sections based on habitat type and altitude. The topographic character of the sections is illustrated in Figure 6. Apart from the topography, sections differ in vegetation, ease of movement and survey effort. Comparisons are therefore exploratory (Table 3). The most striking observation is the lower number of species observed within the two sections above 350m altitude. This tendency was observed while conducting the surveys and may have been due to the conditions at the higher altitudes. Here the canopy was lower, visibility often poor, movement difficult and strong winds often made observation difficult. The canopy and ground vegetation along the higher ridges are illustrated in Figures 7, 8 and 9.

Section 3 comprised the Fig Walk River (Fig. 10). Here the noise of the river made detection of bird calls difficult and only the louder spected were heard.

CONCLUSIONS AND RECOMMENDATIONS

The diverse bird community of the MESA makes for a good birdwatching destination, lending to good ecotourism opportunities for the local community and its NGOs. Charismatic species observed include the Trinidad Motmot and lekking species such as the bellbird, manakins and hermits. The persistence of these leks will contribute to the attractiveness of the ESA to visitors, due to the unique lekking calls and behaviour of these species.

The most important component of the avifauna of the MESA is the population of Trinidad Piping-Guans. This species should be adopted as a flagship species for the management of the area and studies to better understand the habitat requirements of the species should be conducted or facilitated, adding to the previous studies of Alexander (2002) and Hayes *et al.* (2009b). In addition, there is no other location which supports comparable populations of the Trinidad Piping-Guan, and which have the legislative framework in place to provide for such protection. Management of the MESA for the benefit of the Trinidad Piping-Guan will benefit the entire avifaunal community, including the Scaled Antpitta.

There are no other bird species of comparative importance in the MESA. The small population of Chestnut-bellied Seed-Finches is important nationally but not from a regional perspective. The seedeaters in Trinidad are threatened by the cage-bird trade rather than habitat destruction. The Trinidad Motmot, though endemic and thus of restricted range, is still widespread in many forested parts of the country. Its endemism, however, can be highlighted to market the ecotourism potential of the MESA.

The species list recorded represents 59% of the species, exclusive of rare species, which the authors expect to observe in the MESA. Further studies will increase the species count, especially if the studies cover a wider area and target canopy species. The authors recommend that further studies specifically target the distribution and food plants of the Trinidad Piping-Guan. During such surveys, additional bird species should be recorded.

There are several species common in forested areas that were not detected in this survey. Such species will be recorded with further surveys and their absence from the current survey is probably due to chance. An exam-

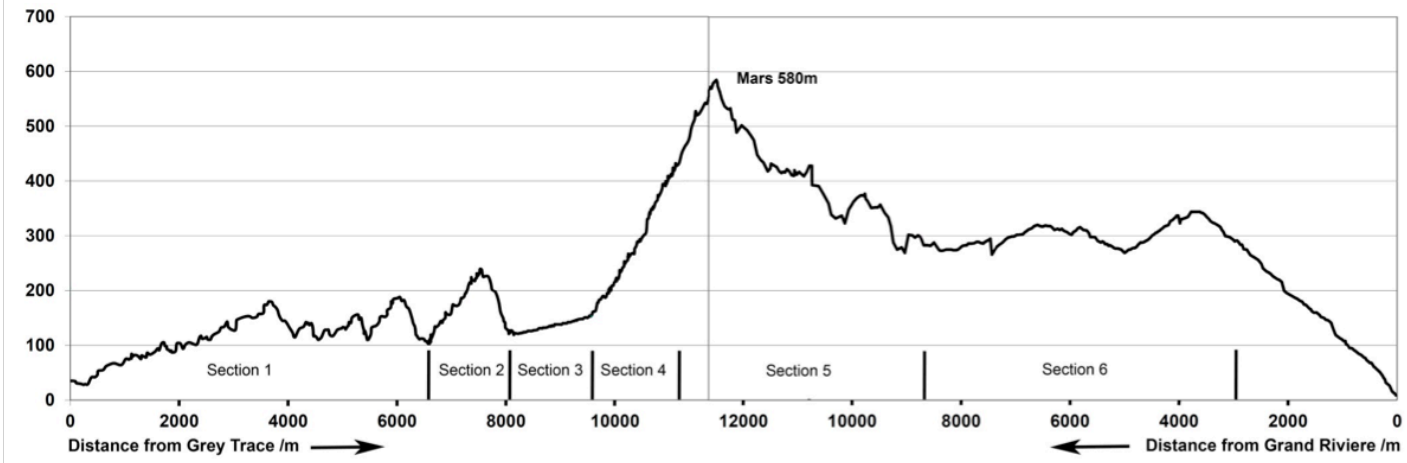

Fig. 6. Transect across ridge from Grey Trace to Grand Riviere showing sections of differing altitude.

Table 3. Summary of sample size, species richness, species diversity and observation rate per section.

Section of trail	1	2	3	4	5	4 and 5	6	ALL*
Length of section/km	6.5	1.5	1.5	2.0	4.75	6.75	5.75	22.0
Number of sectors	30	13	8	16	51	67	31	152
Number of species overall (and within sectors)	45 (39)	38 (32)	28 (19)	36 (24)	50 (41)	54 (47)	55 (46)	95 (73)
Simpson's Inverse Diversity Index	24	27	19	17	20	20	20	23
Mean number of species per sector (SE)	5.30 (0.67)	4.92 (0.96)	5.00 (0.81)	3.88 (0.41)	3.78 (0.28)	3.81 (0.23)	5.8 (0.40)	4.68 (0.21)
Mean number of individuals per sector (SE)	6.97 (0.93)	6.31 (0.79)	8.25 (1.42)	7.63 (1.30)	6.67 (0.54)	6.9 (0.51)	8.00 (0.51)	7.16 (0.32)
* Three sectors were just beyond section 6								

Fig. 7. Canopy of ridgetops.

ple of such a species is the Blue-gray Tanager, *Thraupis episcopus*. Other species, common and widespread in secondary growth in Trinidad, were not encountered or were encountered in low numbers. Their absence may be interpreted as an indicator of the quality of the habitat. Examples include the Great Kiskadee, *Pitangus sulphuratus* and Grayish Saltator, *Saltator coerulescens*.

Consequently, the species assemblage observed from these samples represented primarily an understorey community of birds of moderate to high detectability. Future surveys in the MESA, whilst targeting primarily the Trinidad Piping-Guan, should aim for better coverage by deploying additional canopy observations. Call playback at point count stations should also be used to capture the presence of focal species such as the Trinidad Piping-Guan and Scaled Antpitta. Since training assistants was a deliverable of the overall study, the "transect-walk" method was deemed appropriate for interactive survey sessions. This constrained the opportunities for survey sites and comparison with other studies. Fixed-radius point counts would provide a greater flexibility for the surveys and, as it is a more widely used method, give more opportunities to compare the data with other sites.

Fig. 8. Understorey vegetation along ridges.

Fig. 9. Bromeliads common on the ground at higher elevations.

Fig. 10. Fig Walk River.

For the current study much physical effort was needed to access sites and navigate the terrain. This resulted in a level of noise and movement which may have scared off wary species and detracted from the survey effort. Subsequent studies should budget for the use of porters to bring in equipment and supplies, thus freeing the collecting of data.

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An Updated Checklist of the Amphibians and Reptiles of the Aripo Savannas Scientific Reserve, Trinidad, West Indies

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ABSTRACT

Amphibians and reptiles are among the most threatened vertebrate taxa. Protected areas represent a conservation management tool to preserve species and the Aripo Savannas Scientific Reserve in Trinidad is one example. The aim of our study was to update the species richness of amphibians and reptiles of the Aripo Savannas Scientific Reserve. Nine amphibian species and twenty-eight reptile species have previously been reported at Aripo Savannas. Our surveys detected 19 amphibian species (10 previously unrecorded) and 40 reptile species (12 previously unrecorded) in the reserve. The amended checklist of 19 amphibians and 40 reptiles may provide opportunities for more effective conservation management measures for these species within the reserve.

Key words: Aripo Savannas, conservation, herpetofauna, Trinidad.

INTRODUCTION

Amphibians and reptiles (herpetofauna) are important components of ecosystems (Gibbons *et al*. 2000; Crump 2010). Herpetofauna play a key role in energy flow and nutrient cycling acting as herbivores, prey, and predators in ecosystems (Crump 2010). However, herpetofauna are among the most threatened vertebrate groups on Earth and especially in the Neotropics, even within protected areas (Stuart *et al*. 2004; Böhm *et al*. 2013).

Trinidad and Tobago's herpetofauna are incompletely documented (Hailey and Cazabon-Mannette 2011; Murphy and Downie 2012). Murphy (1997) listed 112 species of amphibians and reptiles for Trinidad and Tobago. This number has since risen due to scientific research including new discoveries (Murphy and Downie 2012). Trinidad and Tobago have a variety of habitats and most, if not all, are used by the herpetofauna. Some species are habitat specialists, such as *Flectonotus fitzgeraldi,* whereas others may be considered habitat generalists, for example *Rhinella marina* (Murphy 1997). One protected area which is also designated an Environmentally Sensitive Area in Trinidad is the Aripo Savannas Scientific Reserve (hereafter ASSR) (Hailey and Cazabon-Mannette 2011). Areas such as this are designed to protect all of the species found within them.

A faunal checklist compiled by Schwab (1988) for the ASSR reported nine amphibian species and 26 reptile species. Murphy (1997) noted two additional reptile species (*Gonatodes humeralis* and *Amerotyphlops* cf. *brongersmianus*) for ASSR based on museum materials. Since then, there have been no published reports on the herpetofauna within the ASSR. We provide a revised list of the known herpetofauna located within and on the border of the ASSR and briefly describe the conservation implications.

METHOD

Study Area

The ASSR comprises 1800 ha in the east-central region of the northern basin of Trinidad, just south of the Quare Valley of the Northern Range, and flanked by the Quare River in the east, and the Aripo River in the west ($10^0$35'30'' N, $61^0$12'0'' W). Mean monthly rainfall ranges from 2500mm to 2800mm and mean monthly temperature ranges from 20-32^{0}C (Richardson 1963). The topography ranges from 30 to 45m in elevation (Richardson 1963). The region is typified by sandy topsoils overlaying impervious subsoil horizons (Panton 1953) that support a patchwork of savannas, interspersed with marsh forests and palm marshes (Beard 1946). Towns bordering the ASSR include Valencia to the north, Wallerfield to the west, Cumuto to the south and Sangre Grande to the east (Figure 1).

In addition to observations within the ASSR, we included observations made along the transect referred to as the Old Train Line (a wide open grass-lined, mainly forest-flanked dirt road that forms the entire southern border of the ASSR; start point of the transect was at the Cumuto Forestry Station: $10^0$35'35'' N, $61^0$12'27'' W and the end point of the transect was 2.5km east of this), as well as at the Cumuto Forestry Station (a small field station comprised of a few buildings and open garden areas which serves as the administrative centre for the ASSR and is located at the western end of the southern border of the reserve) (Figure 1).

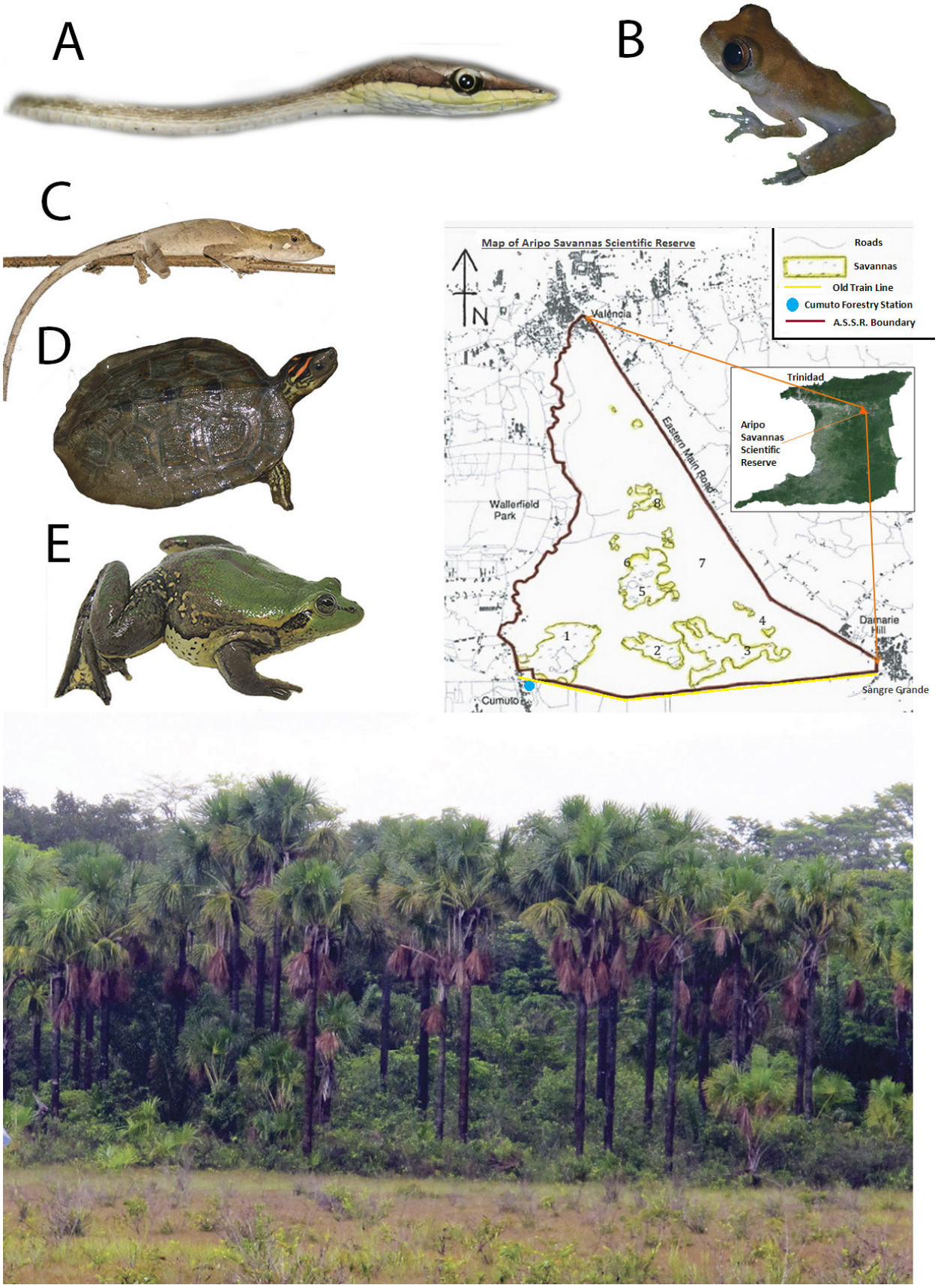

Fig. 1. ASSR map, selected herpetofauna and habitat. **A.** *Oxybelis aeneus* (Brown Vine Snake), **B.** *Dendropsophus goughi* (formerly *D. minuta*) (Minute Tree Frog), **C.** *Anolis planiceps* (Leaf Anole), **D.** *Rhinoclemmys punctularia* (Galap), **E.** *Pseudis paradoxa* (Paradoxical Frog).

Sampling Method

This study was divided into three sampling periods, one in 2011, one in 2014 and one in 2015. Data in 2011 were gathered by SPC and JCM, and data in 2014 and 2015 were gathered by RJA. The first sampling period was brief (17-19 June, 2011) but intense, and involved 1 to 2 hour searches conducted by 3 to 20 individuals at mid-morning, midday, mid-afternoon and just after night fall along trails that bisected and skirted savanna habitat (Savannas I, II and V) and that transected the intervening marsh forest habitat, as well as along the Old Train Line. In addition, chance observations were made around the buildings and garden areas at the Cumuto Forestry Station.

The second sampling period involved chance observations of amphibians and reptiles while participating in other faunal surveys taking place at daily time intervals similar to those of the 2011 sampling period. Sampling ran from April to December 2014 and was typically once per month. The third sampling period took place during the months of June and July 2015 and also involved chance observations.

For each survey period, we visually searched for herpetofauna by searching tree trunks, logs, bark, rocks, leaf litter, vegetation, and the margin of any water bodies encountered, as well as listened for frog calls. Each reptile or amphibian that was positively identified at least to genus level was recorded. Efforts were made to capture individual animals safely when species level identification at a distance was not possible. Upon confirmation of species identity, most animals were released at the site of capture. In 2011, a number of voucher specimens were taken, humanely euthanized using sodium pentobarbitone (at 60 mg/ml), fixed and stored in 70% ethanol, catalogued and lodged at the Zoology Museum of the St. Augustine Campus of the University of the West Indies. We recorded the habitat type (marsh forest, savanna, palm marsh, ecotone, trail line, forestry station) and the microhabitat of each species encountered.

RESULTS

Based on our survey within and along the border of the ASSR, we recorded 19 amphibian species in 13 genera and 7 families, and 40 reptile species including one crocodilian species, two freshwater turtle species from two families, 14 saurians in 13 genera and 10 families, and 11 serpents in 11 genera and 4 families for the ASSR which represents approximately 42% of the herpetofauna for Trinidad and Tobago as listed by Murphy (1997) (see Table).

DISCUSSION

Species records

The results of our surveys were largely unsurprising given that most of the species that we recorded have been cited as occurring in locales proximate to the ASSR (Murphy 1997). One species, *Hydrops triangularis,* had not been previously recorded in proximity to the ASSR. The distributions of most snakes are poorly assessed both globally (IUCN 2014) and in Trinidad. This record may thus be considered as likely to have been expected, considering that the specimen was observed in habitat and microhabitat that is generally typical for the species (Murphy 1997).

Eleven reptiles reported by Schwab (1988) and one by Murphy (1997) were not observed during our surveys. These included ten snakes (*Amerotyphlops* cf. *brongersmianus, Boa constrictor, Corallus ruschenbergerii, Eunectes murinus, Leptophis coeruleodorsus, Mastigodryas boddaerti, Phrynonax poecilonotus, Cleia cleia, Pseudoboa neuwiedii* and *Lachesis muta*), one freshwater turtle (*Mesoclemmys gibba*) and one tortoise (*Chelonoidis denticulata*). Given the relatively brief nature of our surveys, we can make no conclusions regarding the current status of these species in the ASSR. Many reptiles, in particular some turtles and many snakes, as a consequence of their specific microhabitat use and cryptic behaviour are fairly difficult to survey (Gibbons *et al*. 2000; Böhm *et al*. 2011). As such, it is possible that these undetected species are still present in the ASSR and that they, and others not recorded in this study or previously in the literature, are likely to be observed in future surveys.

Habitat variation among species

Approximately forty-three percent of herpetofauna observed during our study were recorded solely within the marsh forests of the reserve. No species were recorded solely in the savannas. Generally, the diversity of herpetofauna in savannas is low compared to tropical forests (Stuart *et al*. 2004; Böhm *et al*. 2013). The remaining 57% of herpetofauna were observed in ecotone areas as well as on the border of the reserve, along the train line and the Forestry Station. Thus, it should be expected that more than half of our new records for the reserve (approximately 55%) comprise these species which may be considered habitat generalists.

Conservation implications

Two frogs recorded in our study, *Pristimantis urichi* and *Flectonotus fitzgeraldi,* are currently considered endangered by the IUCN Red List (IUCN 2014). Their detection in the ASSR increases our knowledge of their distribution and further validates the conservation value of the reserve. The green iguana (*Iguana iguana*), matte (*Tupinambis teguixin*), and caiman (*Caiman crocodilus*) are reptiles that have been historically hunted for food in Trinidad (Hailey and Cazabon-Mannette 2011) whereas

Table. Herpetofauna recorded for the Aripo Savannas Scientific Reserve in this study and in the literature. * New Record; Habitat: S – Savanna, MF – Marsh Forest, E – Ecotone, ASB – Aripo Savanna Border, TL – Train Line, FS – Forestry Station; Survey: D – Diurnal, N – Nocturnal.

TAXA/SPECIES NAME	COMMON NAME	HABITAT	MICROHABITAT	SURVEY
AMPHIBIANS				
Family Bufonidae				
Rhinella beebei	Beebe's toad	MF, S, (TL)	Grass, Muddy track	D and N
Rhinella marina	Crapaud	MF, (TL)	Muddy track	D and N
Family Hemiphractidae				
Flectonotus fitzgeraldi	Trinidad and Tobago marsupial frog	MF	Tree branch	D and N
Family Hylidae				
Dendropsophus microcephalus	Small-headed tree frog	MF, E, (TL)	Vegetation above pool of water	N
*Dendropsophus goughi (*formerly *D. minuta)*	Minute tree frog	MF, ASB	Vegetation near ditch	N
Hypsiboas geographicus *	Map tree frog	MF	Tree branch	N
Hypsiboas punctatus *	Lesser green tree frog	MF, (TL)	Vegetation on ground	N
Phyllomedusa trinitatis *	Trinidad leaf frog	MF, ASB	Vegetation above pool of water	N
Pseudis paradoxa *	Paradoxical frog	E, (MF/S), (TL)	Flooded ditch	N
Scinax ruber	Lesser brown tree frog	E, (MF/S), (TL)	Vegetation near ponds and ditches	N
Sphaenorhynchus lacteus *	Lime tree frog	MF	Vegetation near pool of water	N
Trachycephalus typhonius *	Warty tree frog	MF	Tree branch	D and N
Family Leiuperidae				
Engystomops pustulosus *	Tungara frog	E, (MF/S), (TL)	Muddy track	N
Family Leptodactylidae				
Leptodactylus fuscus *	Whistling frog	MF, S, (TL)	Forest floor, muddy track, ditch	D and N
Leptodactylus cf. *hylaedactylus* *	Lesser dark-spotted thin-toed frog	MF	Leaf litter on forest floor	N
Leptodactylus validus	Garmin's thin-toed frog	MF	Forest floor and ditch	D and N
Family Microhylidae				
Elachistocleis ovalis	Common narrow-mouthed frog	MF	Pool edge, forest floor	D and N
Elachistocleis surinamensis	Flashy narrow-mouth frog	MF, S, (TL)	Muddy track	N
Family Craugastoridae				
Pristimantis urichi *	Urich's litter frog	MF	Forest floor	N
REPTILES				
TURTLES				
Family Chelidae				
Mesoclemmys gibba	Gibba turtle	Recorded in Schwab 1988		
Family Geomydidae				
Rhinoclemmys punctularia	Galap	MF, S	Muddy track, forest floor	D and N
Family Kinosternidae				

TAXA/SPECIES NAME	COMMON NAME	HABITAT	MICROHABITAT	SURVEY
Kinosternon scorpioides	Scorpion mud turtle	MF	Forest floor	D
Family Testudinidae				
Chelonoidis denticulata	Yellow-footed morocoy	Recorded in Schwab (1988)		
CROCODILIAN				
Family Alligatoridae				
Caiman crocodilus	Spectacled caiman	MF, S	Pool of water, stream	D and N
LIZARDS				
Family Amphisbaenidae				
Amphisbaena fuliginosa *	Black and white worm lizard	ASB (FS)	Driveway	D
Family Dactyloidae				
Anolis planiceps	Jungle anole	MF	Vegetation	D and N
Family Gekkonidae				
Hemidactylus mabouia *	Wood slave	ASB (FS)	Wall of field station building	D
Family Phyllodactylidae				
Thecadactylus rapicauda *	Chec-a-chec	MF	Tree branch, bunker wall	D
Family Sphaerodactylidae				
Gonatodes humeralis	Spot-nosed gecko	MF	Tree bark	D
Gonatodes vittatus *	Streaked lizard	E, (MF/S), (FS)	Walls of buildings	D
Sphaerodactylus molei *	Mole's day gecko	ASB (FS)	Wall of building	D
Family Iguanidae				
Iguana iguana	Green iguana	MF, ASB	Forest floor, tree branch	D and N
Family Hoplocercidae				
Polychrus marmoratus	Multi-coloured tree lizard	MF	Tree branch	D
Family Scincidae				
Copeoglossum aurae	Greater Windward skink	MF	Tree branch	D
Family Teiidae				
Ameiva atrigularis	Zandolie	MF, E (MF/S), (FS)	Forest floor, open trail, lawn	D
Cnemidophorus lemniscatus	Striped runner	ASB (FS)	Lawn	D
Tupinambis teguixin	Matte	MF, E, (MF/S)	Grassy trail	D
Family Tropiduridae				
Plica caribeana *	Caribbean treerunner	MF	Tree trunk	D
SNAKES				
Family Typhlopidae				
Amerotyphlops cf. *brongersmianus*	Trinidad blind snake	Recorded in Murphy 1997		
Family Boidae				
Boa constrictor	Macajuel	Recorded in Schwab 1988		
Corallus ruschenbergerii	Cascabel dormillon	Recorded in Schwab 1988		
Eunectes murinus	Anaconda	Recorded in Schwab 1988		
Family Colubridae				

TAXA/SPECIES NAME	COMMON NAME	HABITAT	MICROHABITAT	SURVEY
Chironius sp.	Machete savane	MF	Forest floor	D
Leptophis coeruleodorsus	Green lora	Recorded in Schwab 1988		
Mastigodryas boddaerti	Machete couresse	Recorded in Schwab 1988		
Oxybelis aeneus	Horse whip	E, (MF/S), (FS)	Tree branch, garden fence	D
Phrynonax poecilonotus	Dos cocorite	Recorded in Schwab 1988		
Spilotes pullatus	Tigre	MF	Forest floor, flooded ditch	D
Family Dipsadidae				
Cleia cleia	Black cribo	Recorded in Schwab 1988		
Erythrolamprus melanotus nesos *	Beh-belle chemin	MF	Tree branch	D
Helicops angulatus	Water mapepire	MF, S	Pool of water, flooded trail	N
Hydrops triangularis *	Water coral	E, (MF/S)	In pool of water	N
Imantodes cenchoa *	Blunt-headed snake	MF	Fallen tree log at forest edge	N
Leptodeira annulata *	Cat-eyed snake	E, (MF/S), (TL)	Muddy track	N
Pseudoboa neuwiedii	Ratonel	Recorded in Schwab 1988		
Siphlophis compressus *	False coral snake	E, (MF/S)	Small tree	N
Family Elapidae				
Micrurus lemniscatus diutius *	Large coral snake	MF	Forest floor	N
Family Viperidae				
Bothrops sp.	Mapepire balsain	MF, S	Forest floor, savanna floor	D and N
Lachesis muta	Mapepire zanana	Recorded in Schwab 1988		

turtles like the Galap (*Rhinoclemmys punctularia*) and Scorpion mud turtle (*Kinosternon scorpioides*) have been utilized in the pet trade both globally (Ceballos and Fitzgerald 2004) and locally (SPC pers. obs.; Stephen Smith pers. comm.). The ASSR may represent an area where populations of these species may experience reduced levels of human exploitation because of its protected status and may provide us with useful baseline data for measuring the impact of human exploitation in unprotected areas. Our study addressed mainly species richness, which represents only one component of the biodiversity and the wider general ecology of the reserve. We highly recommend that species abundance and composition studies are undertaken within the reserve and compared to similar studies from other areas in order to more vigorously assess the reserve's conservation standing.

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NATURE NOTE

Range Expansion of *Scarthyla vigilans* (Anura: Hylidae) in Trinidad, West Indies

Scarthyla vigilans is a small frog in the family Hylidae (Solano 1971). It inhabits marshy areas as well as channels and ditches (Barrio-Amorós *et al.* 2006). Males have been known to call from relatively high perches on grasses or from on floating vegetation such as water hyacinths, whereas females typically perch on the lower parts of plants (Barrio-Amorós *et al.* 2006).

This species was previously only known from mainland South America and only relatively recently for the first time recorded in the southwestern peninsula of Trinidad (Smith *et al.* 2011). Based on our subsequent observations, we herein report a range expansion for the species on Trinidad.

Scarthyla vigilans were observed in Tucker Valley, Chaguaramas, in the northwest of Trinidad on 17 November, 2012 during the Tucker Valley Bioblitz 2012 event. R.A. and other members of the herpetology group saw and heard several specimens calling from grasses adjacent to streams in Tucker Valley between 1800 and 2100 h.

Scarthyla vigilans were also observed in Nariva Swamp in the east of Trinidad on 18 October, 2014 during the Nariva Swamp Bioblitz 2014 event. R.A. saw and heard several frogs calling from grasses on the side of a road in proximity to a water filled ditch in Kernaham between 1800 and 2100 h. *Scarthyla vigilans* were also observed in the Aripo Livestock Station (ALS), Wallerfield, in the northeast of Trinidad on 23 November, 2015. R.A. saw and heard several individuals calling from grasses next to water filed ditch at ALS between the hours of 0900 and 100h. It is possible, given the numbers seen, that the species has been present at these locales without prior detection for some time and it appears that populations are more widespread across Trinidad than originally thought.

Fig. 1. *Scarthyla vigilans.* Photo: J. Murphy.

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A Survey of Freshwater Fish Distribution in Tobago, West Indies

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ABSTRACT

The freshwater fish of Tobago were reported by a number of researchers between 1910 and 1998, with differing species richness and diversity being listed by each. Results of the recent survey reported here serve to update this baseline. Surveys were conducted at 81 sites in Tobago over the time period 2004-2015, with observations being conducted both nocturnally and diurnally. The most widespread species was *Sicydium punctatum* (Gobiidae). The species with the highest abundance was *Poecilia reticulata* (Poeciliidae), and the rarest species was *Gobiesox nudus* (Gobiesocidae). *Micropoecilia picta* (Poeciliidae), *Ctenogobius boleosoma* (Gobiidae), and *Synbranchus marmoratus* (Synbranchidae) were documented for the first time for Tobago. The ichthyofaunal richness for this survey now stands at 13 species. The drainage with the greatest species richness was Roxborough River, with nine species noted.

Key words: Tobago, fish, freshwater, distribution, survey, Trinidad and Tobago.

INTRODUCTION

The freshwater fish assemblages of Trinidad and Tobago have been described previously by several authors including Kenny (1995), Phillip (1998), Phillip and Ramnarine (2001), Mohammed *et al.* (2010), and most recently by Phillip *et al.* (2013). Guppy (1910) listed only two species from Tobago, whilst Phillip (1998) listed 10 species. Most authors have focussed their attention on Trinidad; here we focus on Tobago's freshwater ichthyofaunal distribution.

Tobago can be considered as the last outpost of the Andean chain, at the edge of the South American continental shelf and separated from the Lesser Antilles by many kilometres of deep waters (Hardy 1982). As a result, the flora and fauna of Tobago is typical of continental South America, yet it differs from that of Trinidad in being rather depauperate, as is typical of small islands, with a distinct West Indian influence. Trinidad has a colonising zone with a South American influence (Kenny 1995) as a result of low salinities in the Columbus Channel, coastal near shores of the Atlantic and heavy Orinoco River discharge. Tobago, however, does not seem to possess such a region. Kenny (Ibid.) noted that the major oceanic currents near Tobago are influenced by the Orinoco River and the Atlantic Ocean and come from a southeastern direction, flowing in a northwest direction. Coupled with a steep coastal topography, colonisation of Tobago's estuaries and watercourses by South American or Trinidadian freshwater fish would seem very unlikely. However, brackish estuarine regions are ideal habitats for migratory species of fish, and such habitats should be investigated and their ichthyofauna documented in dedicated surveys.

The nature of freshwater fish sampling means that there can be considerable heterogeneity over space and time and imperfect sampling, especially for rare species. New species may be added to the list by means of increased sampling effort and increased number of sites sampled. Previous datasets of fish distribution on Tobago are dated, with Phillip (1998) being the most recent study. The purpose of our account is to provide an updated baseline distribution for future studies rather than a definitive account of which species are present on Tobago.

METHODOLOGY

Between 2004 and 2015, several freshwater sites in Tobago were visited by parties that varied from 1 to 4 persons including R.S. Mohammed and K. Phillips. These were done repeatedly for scientific observations or ecological evaluations. These sites included rivers, artificial water channels, and ponds. Surveys were conducted both nocturnally and diurnally. A total of 81 sites were visited, at least annually. Confirmed detection of fish species is reported here per site (Fig. 1). Identifications were confirmed by use of taxonomic keys in Phillip *et al.* (2013) where necessary.

We restrict our review herein to true freshwater species (outlined by Phillip *et al.* 2013) and intentionally omit estuarine species. Our account is also void of distributions

on Little Tobago and all other islands near Tobago, since these do not have permanent water channels.

Seining was done by use of two-person seines (1.0m and 5.0m) of mesh size 0.5cm and additionally by use of a single-person seine (1.0m) with a mesh size of <0.1cm. Cast netting with a 2.0m diameter (1.0cm mesh) was conducted. Fish pots (30.0 x 30.0 x 60.0cm, with a mesh size of 0.5cm) were used for overnight trapping at some sites where vegetation and water depth allowed. These methods were not standardised for all sites visited but were adjusted to suit each particular site, depending upon variability of substrate, riparian vegetation, and elevation. In addition, accessibility to sites was considered when transporting and deploying sampling gear. All specimens from sampling efforts were released immediately after identification at the site where collected.

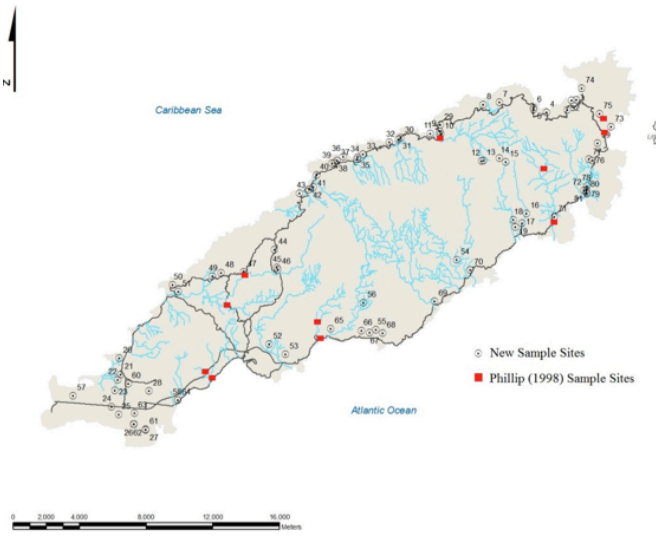

Fig. 1. New and previous (Phillip 1998) sample sites.

RESULTS

Our survey yielded nine families and 13 species of freshwater fish: two members of the Poeciliidae - *Poecilia reticulata* and *Micropoecilia picta*; one member of the Rivulidae - *Anablepsoides hartii* (formerly *Rivulus hartii*); three members of the Gobiidae - *Awaous banana*, *Ctenogobius boleosoma* and *Sicydium punctatum*; two members of the Eleotridae - *Eleotris pisonis* and *Gobiomorus dormitor*; one member of the Gobiesocidae - *Gobiesox nudus*; one member of the Synbranchidae - *Synbranchus marmoratus*; one member of the Mugilidae - *Agonostomus monticola*; one member of the Anguillidae - *Anguilla rostrata*; and one member of the Cichlidae - *Oreochromis mossambicus*.

Sicydium punctatum was the most widespread species. It had the most even distribution across the island, being found at 34 of 81 sites, followed closely by *Agonostomus monticola* (30 of 81 sites). However, the guppy, *Poecilia reticulata*, had the highest densities and abundances (pers. obs.). The Roxborough River supported nine of the 12 species reported and had the highest ichthyofaunal species richness.

The following maps (Figs. 2-13) show species distributions as well as comparisons to data from Phillip (1998). Table 1 provides GPS coordinates (UTM 20P) for all sites sampled. Most sightings of *Agonostomus monticola* were made on the periphery of the island along the southeastern, northeastern, and northwestern coasts, similar to the distributions noted by Phillip (1998) (Fig. 2). *Anablepsoides hartii* had sparse distributions across the island but was the only species that ventured across the Main Ridge and breached elevation barriers at several short waterfalls (Fig. 3). *Awaous banana* was detected on both the north and south coasts; previously, Phillip (1998) had noted its distribution only on the south coast (Fig. 4). The *Ctenogobius boleosoma* sightings represent the first report of this species for Tobago. The species is localised along east and northeast coast regions (Fig. 5). *Sicydium punctatum* was found at 34 of the 81 sites, giving it the widest distribution on the island; as did *Anablepsoides hartii*, it has also conquered elevation barriers of the Main Ridge (Fig. 6). *Gobiesox nudus* is the rarest species on the island, only found in the northern drainages. Previously, Phillip (1998) had noted it at multiple sites in the northeast; however, our data expand its distribution to additional drainages, mostly along the northern coast (Fig. 7). *Gobiomorus dormitor* has a wide distribution and has ventured into the interior of the island, conquering some of the elevation barriers (Fig. 8). *Eleotris pisonis* is the second rarest species on the island. It can be found in all coastal rivers but has a sparse distribution. Phillip (1998) found it on both north and south coastlines; our data expanded its distribution to additional sites on drainages of the flat water stretches below the last riffle towards the coastline (Fig. 9). *Synbranchus marmoratus* was found only in the central eastern drainages; our detection constitutes the first official confirmation of the species in Tobago (Fig. 10). *Poecilia reticulata* has a predominantly southeast to northeast distribution and is the most abundant freshwater fish species in Tobago (Fig. 11). *Micropoecilia picta* has a distribution similar to that of *P. reticulata*. *Micropoecilia picta* had sparse localised detections in the southern and northeastern regions; although regarded as a freshwater species, it has a wide tolerance for brackish systems. Mixed shoals of *P. reticulata* and *M. picta* were seen at Site 22 and on the Richmond, Lois D'or, Roxborough, Argyle, Goldborough, and Delaford Rivers (Fig. 12). However, the rare red male morph was noted at King's Bay, Bon Accord, Buccoo and Richmond. This morph has only been documented in males on the South American mainland (Lindholm *et al*. 2015). *Oreochromis mossambicus* is localised to southern Tobago and has an isolated population at the Hillsborough Dam (Site 56) (G. White pers. comm.) (Fig. 13).

Table 1. Family, species and sites list for Tobago. 0 indicates non-detection; 1 indicates presence. Ichthyofaunal species richness is also given per site.

		Anguillidae	Cichlidae	Eleotridae		Gobiesocidae	Gobiidae			Mugilidae	Poeciliidae		Rivulidae	Synbranchidae	
SITE #	GPS Co-ordinates 20P (UTM)	*Anguilla rostrata*	*Oreochromis mossambicus*	*Eleotris pisonis*	*Gobiomorus dormitor*	*Gobiesox nudus*	*Awaous banana*	*Ctenogobius boleosoma*	*Sicydium punctatum*	*Agonostomus monticola*	*Poecilia reticulata*	*Micorpoecilia picta*	*Anablepsoides hartii*	*Synbranchus marmoratus*	Site Species Richness
1	E 0767261, N 1252301	0	0	0	0	0	0	0	1	1	0	0	0	0	2
2	E 0766970, N 1252259	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	E 0766697, N 1251691	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	E 0765476, N 1251528	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	E 0764683, N 1251722	1	0	1	0	0	0	0	1	1	0	0	0	0	4
6	E 0764692, N 1251817	0	0	1	1	0	1	0	1	1	0	0	0	0	5
7	E 0762641, N 1252142	0	0	0	0	0	0	0	0	0	0	0	1	0	1
8	E 0761661, N 1252005	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	E 0759072, N 1250390	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	E 0759117, N 1250229	0	0	1	1	1	1	0	1	1	0	0	1	0	7
11	E 0758476, N 1250260	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	E 0761567, N 1248633	0	0	0	0	0	0	0	0	0	0	0	1	0	1
13	E 0761692, N 1248663	0	0	0	0	0	0	0	0	0	0	0	1	0	1
14	E 0762631, N 1248804	0	0	0	0	0	0	0	1	0	0	0	1	0	2
15	E 0763010, N 1248559	0	0	0	0	0	0	0	0	0	0	0	1	0	1
16	E 0764265, N 1245467	0	0	0	1	0	1	1	1	1	1	0	1	1	8
17	E 0764007, N 1244901	0	0	0	1	0	1	1	1	1	1	1	1	1	9
18	E 0763475, N 1245093	0	0	0	1	0	1	1	1	1	1	0	1	1	8
19	E 0763579, N 1244659	0	0	0	1	0	1	1	1	1	1	1	1	0	8
20	E 0739810, N 1236828	0	1	1	0	0	0	0	0	0	1	1	1	0	5
21	E 0739894, N 1235823	0	0	0	0	0	0	0	0	0	1	0	1	0	2
22	E 0739710, N 1235517	0	1	0	0	0	0	0	0	0	1	1	1	0	4
23	E 0739551, N 1234884	0	0	0	0	0	0	0	0	0	1	0	1	0	2
24	E 0739337, N 1233903	0	0	0	0	0	0	0	0	0	1	0	0	0	1
25	E 0739780, N 1233428	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	E 0740682, N 1232858	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	E 0741387, N 1232513	0	1	0	0	0	0	0	0	0	0	0	0	0	1
28	E 0741596, N 1234864	0	0	0	0	0	0	0	0	0	1	0	0	0	1
29	E 0759090, N 1250795	0	0	0	1	0	0	0	0	1	0	0	0	0	2
30	E 0756722, N 1250015	0	0	0	1	1	1	0	1	1	0	0	0	0	5
31	E 0756581, N 1249923	0	0	0	1	1	1	0	1	1	0	0	0	0	5
32	E 0756035, N 1249761	0	0	0	1	0	1	0	1	1	0	0	0	0	4
33	E 0754451, N 1249015	0	0	0	1	0	1	0	1	1	0	0	0	0	4
34	E 0754133, N 1248845	0	0	0	0	0	0	0	1	1	0	0	0	0	2
35	E 0754092, N 1248742	0	0	0	0	0	0	0	1	1	0	0	0	0	2
36	E 0753243, N 1248885	0	0	0	1	0	1	0	1	1	0	0	0	0	4
37	E 0752876, N 1248649	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	E 0752754, N 1248500	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	E 0752591, N 1248477	0	0	0	1	0	1	0	1	1	0	0	0	0	4
40	E 0751669, N 1247798	0	0	0	1	0	1	0	1	1	0	0	0	0	4

41	E 0751478, N 1247077	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	E 0751206, N 1246909	0	0	0	0	0	1	0	0	0	0	0	0	0	1
43	E 0750643, N 1246681	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	E 0749128, N 1243306	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	E 0749275, N 1242236	0	0	0	0	0	0	0	1	0	0	0	1	0	2
46	E 0749325, N 1242124	0	0	0	0	0	0	0	1	0	0	0	1	0	2
47	E 0747280, N 1241992	0	0	0	0	0	0	0	1	0	0	0	1	0	2
48	E 0745921, N 1241927	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	E 0745400, N 1241715	0	0	0	0	0	0	0	0	0	1	0	0	0	1
50	E 0742994, N 1241216	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	E 0743362, N 1240788	0	0	0	1	0	0	0	0	0	0	1	0	0	2
52	E 0748812, N 1237643	0	1	0	1	0	1	0	1	1	1	0	1	1	8
53	E 0749805, N 1237050	0	0	0	0	0	0	0	0	0	1	0	1	1	3
54	E 0760065, N 1242718	0	0	0	1	0	1	0	1	0	1	0	1	1	6
55	E 0755217, N 1238527	0	0	0	0	0	1	1	1	1	0	0	0	1	5
56	E 0754465, N 1240124	0	1	0	0	0	0	0	0	1	0	0	0	0	2
57	E 0737044, N 1234576	0	1	0	0	0	0	0	0	0	1	0	0	0	2
58	E 0743325, N 1234317	0	0	0	0	0	0	0	0	0	0	1	0	0	1
59	E 0768524, N 1249681	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60	E 0740337, N 1235276	0	1	0	0	0	0	0	0	1	1	0	0	0	3
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62	E 0740685, N 1232857	0	0	0	0	0	0	0	0	0	0	0	0	0	0
63	E 0740714, N 1233536	0	0	0	0	0	0	0	0	0	0	0	0	0	0
64	E 0743328, N 1234318	0	0	0	0	0	0	0	0	0	0	1	0	0	1
65	E 0752513, N 1238563	0	0	0	1	0	1	1	1	1	1	0	0	0	6
66	E 0754356, N 1238472	0	0	0	0	0	0	0	0	0	0	0	0	0	0
67	E 0754841, N 1238352	0	0	0	0	0	0	0	0	0	1	0	0	0	1
68	E 0755626, N 1238313	0	0	0	0	0	0	0	0	0	0	0	0	0	0
69	E 0758751, N 1240233	0	0	0	0	0	0	0	0	1	1	0	0	0	2
70	E 0760892, N 1242105	0	0	0	1	0	0	0	0	0	1	1	1	1	5
71	E 0765925, N 1245273	0	0	0	1	0	1	1	1	1	1	1	1	0	8
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74	E 0767585, N 1252971	0	0	0	0	0	0	0	1	1	0	0	0	0	2
75	E 0768653, N 1251453	0	0	0	0	0	1	1	1	0	1	0	1	0	5
76	E 0768201, N 1248640	0	0	0	0	0	0	1	1	0	0	0	0	0	2
77	E 0768023, N 1248741	0	0	0	0	0	0	1	1	0	0	0	0	0	2
78	E 0767893, N 1247128	0	0	0	1	0	0	1	1	1	0	0	0	0	4
79	E 0767887, N 1246659	0	0	0	0	0	0	0	0	0	0	1	0	0	1
80	E 0767873, N 1246748	0	0	0	0	0	0	0	0	0	0	0	0	0	0
81	E 0767852, N 1246851	0	0	0	1	0	0	1	1	1	0	0	0	0	4
Number of sites detected (N=81)		1	8	5	24	3	22	12	34	30	22	11	24	8	

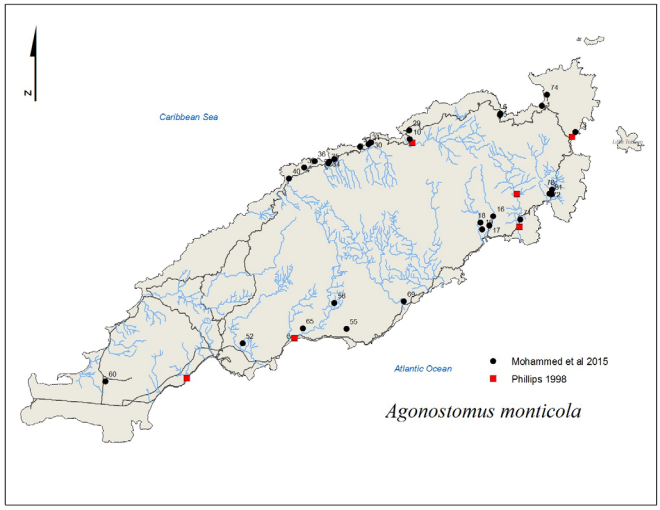

Fig. 2. *Agonostomus monticola* (Mugilidae) distributions. Common name: Mountain mullet.

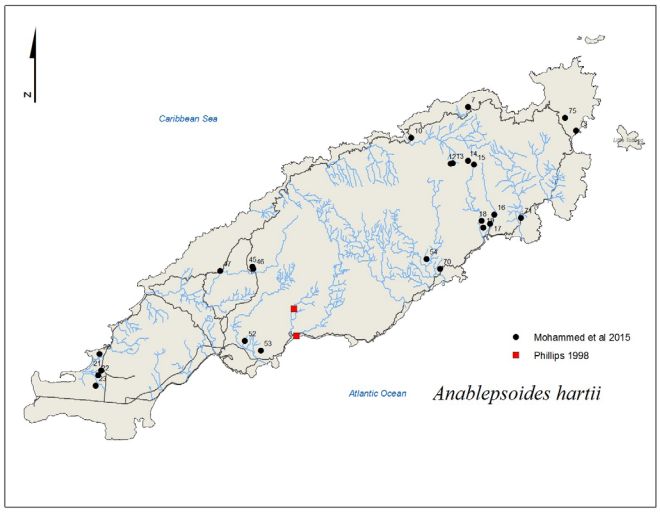

Fig. 3. *Anablepsoides hartii* (formerly *Rivulus hartii*) (Rivulidae) distributions. Common name: Jumping guabine.

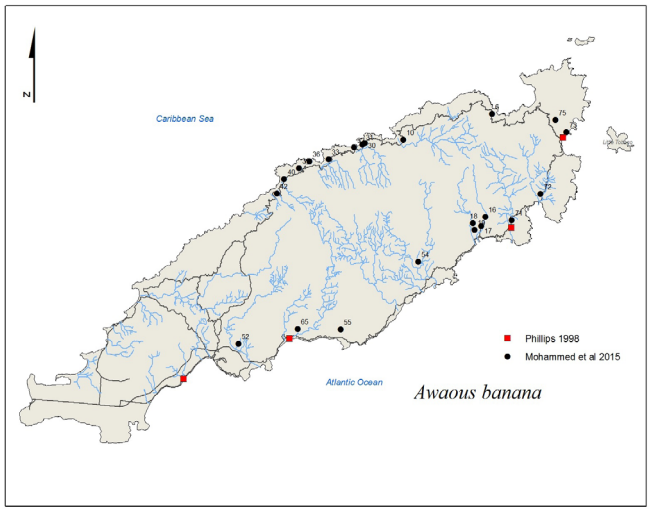

Fig. 4. *Awaous banana* (Gobiidae) distributions.

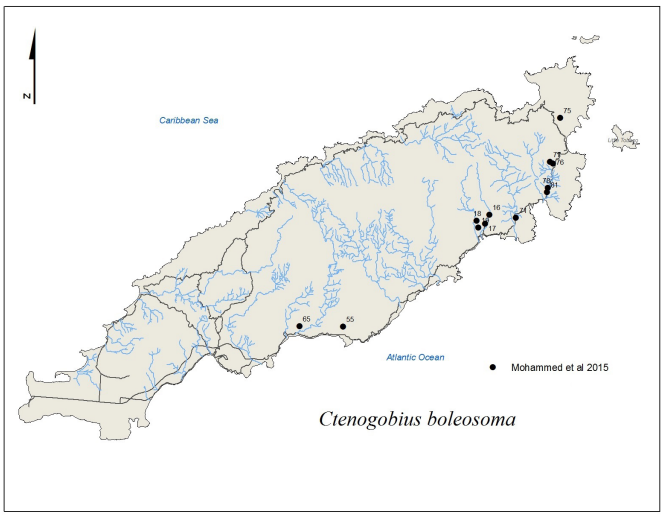

Fig. 5. *Ctenogobius boleosoma* (Gobiidae) distributions.

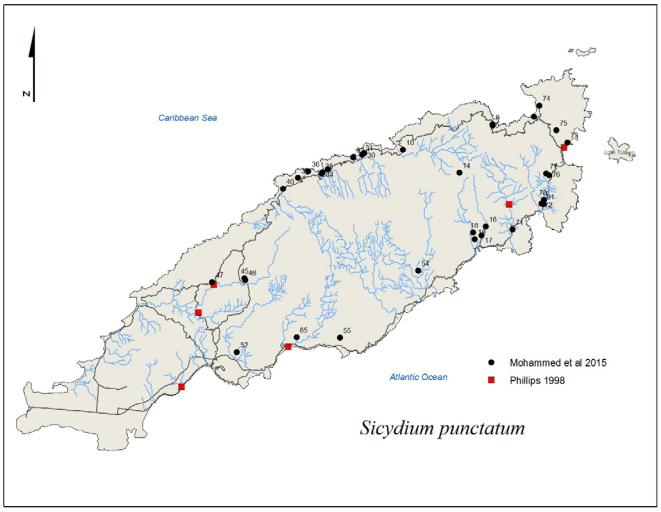

Fig. 6. *Sicydium punctatum* (Gobiidae) distributions.

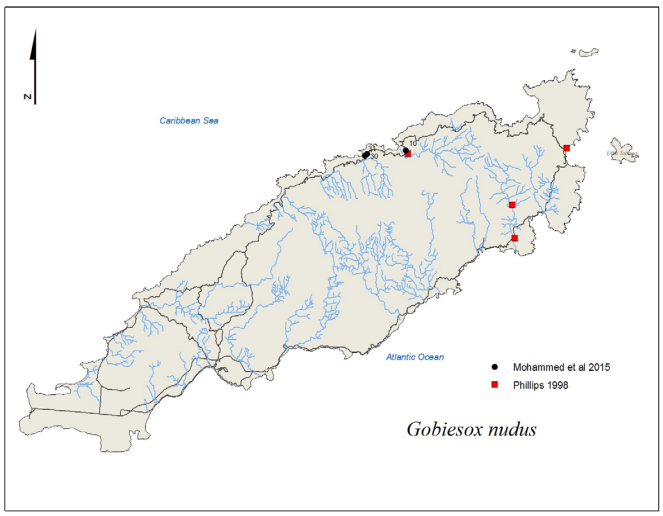

Fig. 7. *Gobiesox nudus* (Gobiesocidae) distributions. Common name: Cling fish.

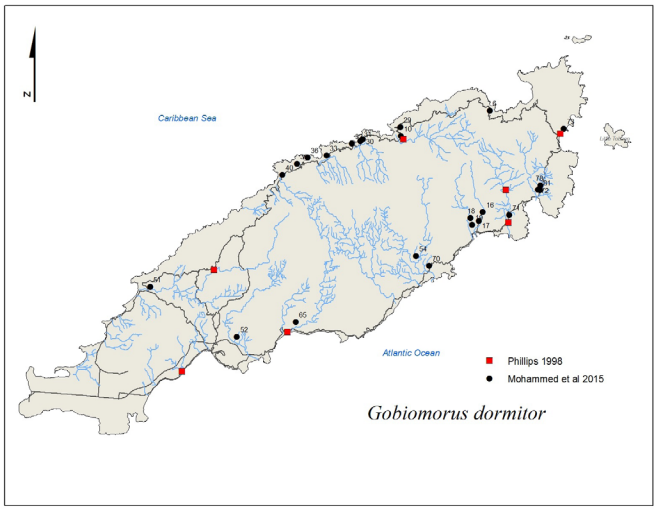

Fig. 8. *Gobiomorus dormitor* (Eleotridae) distributions. Common name: Sand guabine.

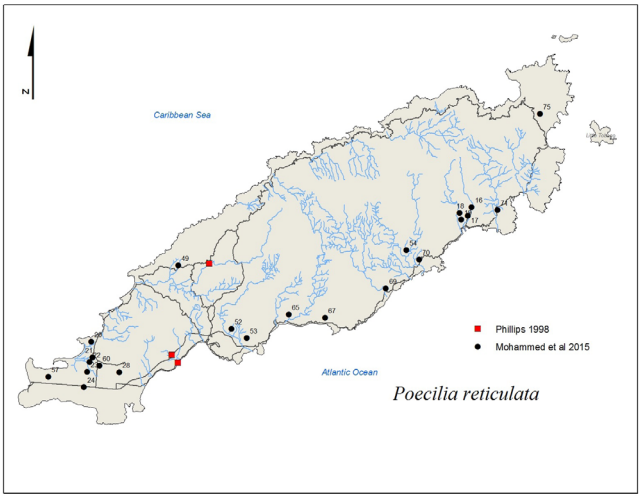

Fig. 11. *Poecilia reticulata* (Poecilidae) distributions. Common name: Guppy, Millions fish, Seven colours.

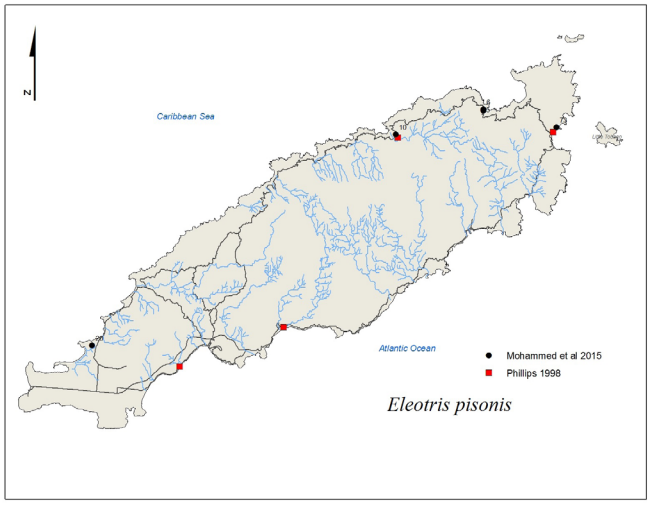

Fig. 9. *Eleotris pisonis* (Eleotridae) distributions. Common name: Sleeper goby.

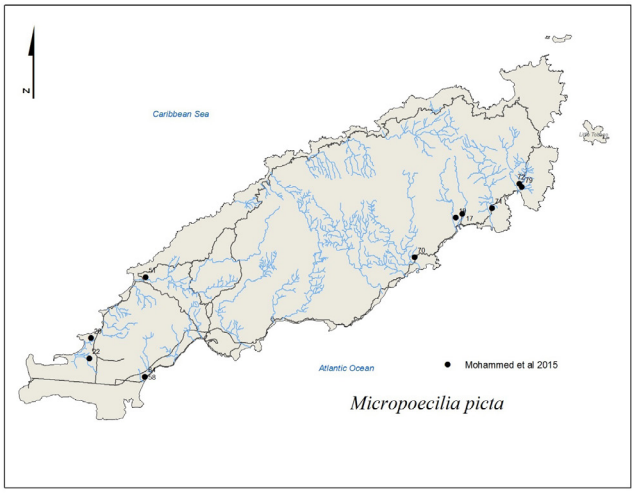

Fig. 12. *Micropoecilia picta* (Poecilidae) distributions. Common name: Swamp guppy.

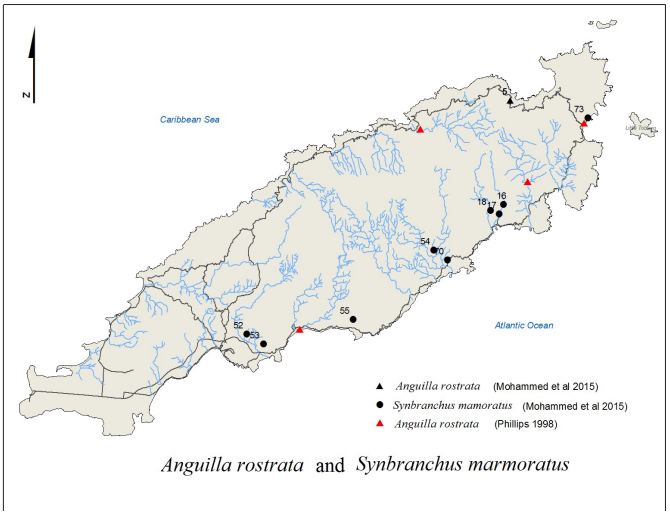

Fig. 10. *Synbranchus marmoratus* (Gobiesocidae) distribution. Common name: Zangee, Congo/Conga eel; and *Anguilla rostrata* (Anguillidae) distributions. Common name: American eel.

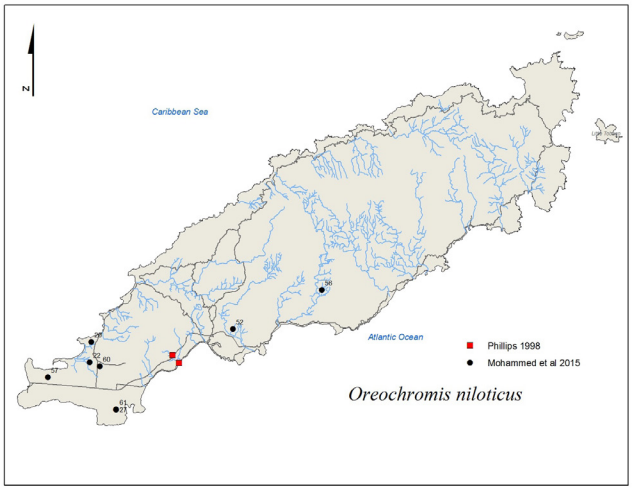

Fig. 13. *Oreochromis mossambicus* (Cichlidae) distributions. Common name: Mozambique tilapia, Black tilapia.

DISCUSSION

This paper provides comprehensive freshwater fish distribution data for Tobago because of number of sites and number of return visits. There were a number of limitations to our survey, including a lack of electrofishing as a method of sampling; however, our survey was more robust than any survey conducted previously, being spatially and temporally wide and including 81 sites visited over a span of ten years. Such prolonged, intensive sampling had not been conducted previously in Tobago.

We detected and have mapped the distribution in Tobago of 13 fish species, including three species new for Tobago: *M. picta* (Fig. 14), *C. boleosoma*, and *S. marmoratus* (Fig. 15). A narrower distribution of *Anguilla* during our survey likely resulted from lack of electrofishing and also because it is a rare species that may be missed during sampling efforts that are not extensive.

Only one introduced species, *Oreochromis mossambicus*, is known for Tobago. This species was first documented in Scarborough (Phillip 1998). It has inhabited the fresh and estuarine waters of south Tobago for the last 20 years (anecdotal account). G. White (pers. comm. 2012) noted *O. mossambicus* at Hillsborough Dam in the 1980s; high densities also were observed at a spring site in southwest Tobago (Mohammed 2014). It is unknown whether this species should be deemed an alien invasive species or simply an established exotic, as it also is not known whether it has negatively impacted other species of fish in the localised system or whether it has spread since it was first documented. This situation highlights the importance of conducting more detailed and focussed studies of the spread of alien invasive species in Trinidad and Tobago. Site 52 of this study was sampled by Phillip (1998); *O. mossambicus* was not detected at that time but was found during this study. This is another example of why it is crucial to conduct studies of species distributions and to provide extensive baseline data to enable understanding of potential relations between anthropogenic disturbances and the presence of invasive species. The mapping of the distribution of this species on Tobago would itself provide sufficient justification for publication of this paper, since baseline data for this species was lacking until these data were obtained.

Kenny (1995) described the ichthyofaunal assemblages of the north coast of Trinidad as Antillean; that region shares substantial aquatic fauna with Tobago, with some exceptions; no native species of Cichlidae were documented during our survey, nor had any been documented historically for Tobago, yet one cichlid species, *Cichlasoma taenia*, is present on the north coast of Trinidad in at least two regions. Similarly, one characin, *Astyanax bimaculatus*, can be found at northeast Trinidad, but no characins have been detected in Tobago. Hardy (1982) noted the catfish *Hypostomus robinii* in Tobago and went as far to allude to it being different in several morphological characteristics (without a description) from the Trinidad specimens and suspected it as being introduced. No freshwater catfish, native or introduced, have since been observed or documented for Tobago. Hardy (Ibid.) also mentioned a swamp eel being present but provided no description or distribution pattern. Communications with D. Hardy indicated he was referring to *Synbranchus marmoratus*. Apart from Trinidad, Tobago shares similar ichthyofaunal diversity with Barbados, having four species of freshwater fish in common, including *Awaous banana* (Gobiidae), *Agonostomus monticola* (Mugilidae), *Poecilia reticulata* (Poeciliidae), and an introduced exotic, *Oreochomis* sp. Such sharing of species gives support to Kenny's (1995) designation of Antillean similarities for Tobago.

The relatively high number of our detections and distribution expansions, compared to those from previous studies of freshwater fish in Tobago, are most likely an artefact of our longer periods of sampling, both diurnally and nocturnally, alongside a greatly increased number of sample sites. We do not provide evidence for any temporal changes to distribution patterns since previous surveys. It should be noted that our sampling yielded similar patterns to those recorded by Phillip (1998). Together, these studies confirm that very few fish species have traversed and surmounted the gentle elevations of the east coast and that even fewer species have moved inland from the west coast, which has an even steeper topography (Hardy 1982). Nonetheless, *Agonostomus monticola*, *Anablepsoides hartii*, and *Sicydium punctatum* managed to conquer some of these elevation barriers of the Main Ridge, which stretches along the diagonal axis of the island, influencing drainage patterns and producing a hybridised dendritic and radial system. *Ctenogobius boleosoma* and *S. marmoratus* have also shared similar south-to-northeastern distributions that are directly influenced by northwest-flowing oceanic currents from South America. It can be speculated these might have been the most recently colonised species; however, in the absence of genetic testing, we are unable to confirm their origins.

The eel-like freshwater fish *Synbranchus marmoratus* was seen in shallow, isolated pools among submerged riparian vegetation, feeding both diurnally and nocturnally. It is not surprising that the distribution of *S. marmoratus* closely resembles that of the poeciliids, as these were observed being preyed upon, particularly nocturnally. *Synbranchus marmoratus* and *Gobiomorus dormitor* can be regarded as the major freshwater piscivorous fish species for Tobago, although both will forage for carrion as opportunistic carnivores.

On the basis of the distributions reported by Phillip (1998) and the current data, *Gobiesox nudus* can be regard-

ed as the rarest freshwater fish in Tobago. This tiny cling fish (<15.0cm total length) is highly adapted to a benthic lifestyle in high velocity waters and is extremely cryptic. Efficient documentation and collection of this species usually requires electrofishing, which was not conducted in this survey but which was conducted by Phillip for her 1998 dissertation, which possibly explains why she found the species at more sites than we did. Nonetheless, even then it was documented at only four sites.

Some recommendations for further work include extensive quantitative sampling using multiple methods and taking into consideration abiotic, biotic, and anthropogenic factors that may contribute to variations in Tobago's fish assemblages. An area of concern is commercial gravel stripping from riverbeds, particularly in northwestern Tobago, where some of the rarer species are found, such as *Gobiesox nudus*, which is a benthic species. Coastal near-shore developers should also consider the impact of construction on estuarine species, catadromic species (such as *Anguilla rostrata* and *Agonostomus monticola*) (Harrison 1995), and anadromic species whose life cycle might be negatively affected by near-shore development.

Fig. 14. *Micropoecilia picta* (male) found in proximity to some coastal sites. (Approximately 2.0cm total length). Rare red male morph below.

Fig. 15. *Synbranchus marmoratus* found at several inland sites. (Approximately 1.0m total length).

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We would like to thank the Tobago House of Assembly for granting us permission to collect several years' worth of field data in riverine habitats. Several research institutes, including the University of the West Indies, Adam Mickiewicz University, and Cardiff University contributed resources towards producing this manuscript; for that, we are grateful.

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Captive Ocelots at Trinidad's Emperor Valley Zoo: Retrospective and Suggested Management

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ABSTRACT

To facilitate research and conservation of ocelots (Leopardus pardalis) in Trinidad, data was compiled in January 2014 and April 2015 on previous and current individuals housed at the Emperor Valley Zoo in Port of Spain as well as on maintenance and housing conditions. Historical records (genetic, spatial and temporal) had been destroyed by water, but interviews with zoo managers and employees produced considerable data. Ocelot breeding at the zoo is currently unmanaged because of a lack of staff. The genetics and geographic origin of the current housed ocelots is unknown. It is suggested that a structured breeding programme would maximise the breeding success of the current population at the zoo. This way the viability of the captive ocelots would be enhanced by increased genetic diversity obtained through additions of confiscated or accidentally trapped ocelots. Several captive breeding strategies are suggested to increase the success of ocelot breeding and survival of kittens either for release into the wild or for display animals in the zoo.

Key words: Captive breeding, conservation.

INTRODUCTION

The ocelot (*Leopardus pardalis)* is a medium-sized felid (7.0-15.8kg) that ranges from the southern United States (Arizona, New Mexico and Texas) throughout Central and South America, excluding coastal areas. They also range along the Pacific Coast south of Ecuador and all of South America (Murray and Gardner 1997; González *et al*. 2003). Ocelots inhabit a variety of habitats, from moist tropical forests to drier scrublands (Navarro 1993; Eizirik *et al.* 1998; Ahumada-Carrillo *et al.* 2013). Ocelots are solitary and require vast expanses of habitat and home ranges for feeding as well as defendable territory for breeding. Average home ranges are approximately 26.09±7.33 km^2, with the home ranges being slightly larger for males than females (Dillon and Kelly 2008). They are nocturnal, resorting to concealment in trees or dense bush in the daytime (Nowell and Jackson 1996). Mothers provide continual care for their offspring for three months, after which the family leaves the den so the young can learn hunting skills (Zerinskas and Pollio 2013).

Populations of large felids such as jaguars, lions and leopards have been severely reduced by humans throughout the ranges of the species (Inskip and Zimmermann 2009; Khan 2008); however, populations of smaller species of felids such as the ocelot are also at risk because the pelts and fur are highly prized (Khan 2008). Among the spotted cats, from the early 1960s to mid-1970s the ocelot was most heavily exploited internationally for its pelts (Nowell and Jackson 1996).

Ocelots formerly ranged throughout Trinidad and Tobago (Nelson 2004). They were extirpated from Tobago at around the eighteenth century (Rooks 2014). They still range throughout Trinidad (Nelson 2004) but are considered rare and threatened, and their populations are decreasing (EMA 2004) because of habitat loss and fragmentation and by hunting and trapping for the pet trade (Rooks 2014).

Except for Nelson (2004), little is known about current natural breeding populations of ocelots in Trinidad. This lack of information raises conservation concerns. Zoos traditionally are used as *ex situ* stores of genetic information, serving to maintain breeding populations or simply to preserve species whose existence is threatened (Swanson *et al*. 2003). In Trinidad, the Emperor Valley Zoo (EVZ) in Port of Spain serves those functions, hosting a population of ocelots that possibly originated in Trinidad. The EVZ, founded in 1947, contains exhibits that spread over 7.2 acres (ZSTT Inc. 2009) and includes several ocelot displays. To facilitate research on ocelots in Trinidad, especially in regard to maintenance of genetic diversity, we assayed the current status of the population of captive ocelots at the EVZ.

METHODOLOGY

Information about the status of ocelots at the EVZ was obtained by interviewing senior zoo managers and staff and by reviewing the limited data available about previous and

current ocelots at the EVZ. Data sought for each animal (whether caught in the wild, confiscated or captive-born) included gender and origin, length of time of each individual in captivity (births and deaths) as well as historical captive breeding successes. Characteristics of each of the ocelot exhibits (four exhibits - display and two housing enclosures - concrete) were noted, along with presence/number of cage mates (or ocelots only) in each enclosure.

RESULTS

Currently there are no physical data records (soft or hard copies) regarding ocelots at the EVZ because in the 1990s water destroyed the historical records of ocelots and other animals housed there. Ocelots have been housed at the EVZ for more than 25 years, with some individuals having survived 15 years in captivity (R. Wallace [EVZ Assistant Curator] and N. Biptah [Curator] pers. comm.). Information obtained from staff at the EVZ indicates that the maximum number of ocelots housed at the EVZ at any time was 10. However, staff considers the EVZ to have the capacity to house as many as 16 ocelots, depending upon their interactions with each other (inclusive of the Brigand Hill Animal Rehabilitation Keep) (BH ARK) - a sister facility to the EVZ (established late 2009).

As of January 2014, the EVZ hosts nine ocelots (four males and five females) (Table 1) housed in six enclosures (four display enclosures all fenced with habitat enrichment using vegetation, as well as two concrete enclosures). In April 2015, changes were noted as indicated in Table 1.

Up until January 2014, nine ocelots were housed at the EVZ for 4-15 years, (three males and six females) with all six females having been housed the longest. The two females housed together were confiscated from Maraval, and are thought to be sisters although no genetic tests have been conducted to confirm their relationship, and their place of origin is unknown (suspected from Venezuela

Table 1. Ocelot housing and historical data.

Enclosure	No. of Ocelots	Sex	Enclosure Type	Source	Housed	Comments	Data Collection Date
1	1	♂	concrete	confiscated	EVZ	Chaguanas	Jan. 2014
2	1	♀	concrete	trapped	EVZ	Bobtail	Jan. 2014
3	2	1♂, 1♀	display	trapped	EVZ	Reproductive	Jan. 2014
4	2	1♂, 1♀	display	trapped	EVZ	Non-reproductive	Jan. 2014
5	2	♀	display	confiscated	EVZ	Maraval[1]	Jan. 2014
6	1	♀	display	born at zoo	EVZ	Patches	Jan. 2014
1	1	♀	concrete	confiscated	EVZ	Temporarily housed for observation	Apr. 2015
2	1	♀	concrete	trapped	EVZ	Bobtail	Apr. 2015
3	1	♂	display	confiscated	EVZ	Chaguanas	Apr. 2015
4	1	♂	display	trapped	EVZ	Change in reproductive status[2]	Apr. 2015
5	2	♀	display	confiscated	EVZ	Maraval[1]	Apr. 2015
6	1	♀	display	born at zoo	EVZ	Patches	Apr. 2015
7	2	1♂, 1♀	caged	trapped	BH ARK	Replacement[3]	Apr. 2015

EVZ = Emperor Valley Zoo
BH ARK = Brigand Hill Animal Rehabilitation Keep
display = fenced display with vegetated habitat enrichment
caged = caged with vegetated enrichment
1. Confiscated from Maraval but possibly not from Trinidad
2. Male and female previously non-reproductive, separated because of suspected pregnancy, female moved to enclosure 1 for observation
3. The male (trapped) that was previously reproductive, female died, replacement female

based on size and colouration, which are larger and spotted differently - pers. comm. N. Biptah, Curator EVZ).

The reproductive pair housed together in the display enclosure reproduced regularly (approximately every two to three years).

Survival of kittens has been low (deaths within a few weeks of birth), however there have been at least three surviving cubs born at EVZ. These include twin births within the last decade. One female (Patches) born at EVZ was the last survivor of this reproductive pair (approximately seven years old) and she is housed alone (Table 1).

One of the two males housed in the concrete enclosure was confiscated from a private owner in Chaguanas; its origin is also unknown. The trapped female housed in a concrete enclosure (Bobtail) has been alone for quite some time since she does not interact well with other ocelots.

In April 2015, the number of ocelots housed at EVZ was seven (two males and five females) and two housed at BH ARK (one male and one female). The male from the reproductive pair (previously housed together for 15 years) was moved from EVZ to BH ARK since the female passed away within the last year due to old age (pers. comm. B. Ragubir-Waldropt and D. Charleaux, Zookeeper 3). The current female housed with this male was recently trapped by a hunter from Central Trinidad in agricultural lands in Freeport. However, the previously non-reproductive pair reported in January 2014 (housed together for the last decade) recently mated and the female has since been isolated for observation for pregnancy status in a separate concrete enclosure.

Ocelots not housed at the EVZ or BH ARK are released into the wild. At least three releases into the Arima Valley have been conducted within the last decade (pers. comm. N. Biptah, Curator).

These releases have been rehabilitated, captured ocelots. However, these wild releases were not at the capture sites.

DISCUSSION

Globally, the biology and status of many species of wild felids are mostly unknown, especially regarding smaller felids such as the ocelot (Morais *et al.* 2002). Ocelot conservation and recovery plans are important for the continued survival of the species. One of the most effective recovery scenarios for wild ocelots is protection and restoration of their habitat (Haines *et al.* 2006). Additional strategies, such as propagation of captives, also are highly recommended for conservation of rare and endangered species such as the ocelot (Wielebnowski 1998). Management practices for captive ocelots should include considerations for territorial requirements, intraspecific interactions, reproductive behaviour, and parental care (Wielebnowski 1998).

The presence of breeding pairs (within the last decade and current) is an indication of the potential for establishing a successful ocelot breeding programme. At this time, a lack of human resources at the EVZ precludes management of captive breeding of ocelots; only maintenance of individuals is performed. Although the breeding pairs produce offspring, a structured breeding programme cannot be initiated with them because of lack of information about their genetic diversity and pedigree. Within the last year (2014-2015), only one female has been added to the EVZ collection.

The EVZ is not alone in being challenged in these areas. A basic requirement for establishing a successful captive breeding programme is knowing the biology and reproductive traits of the species (Swanson *et al.* 2003). *In situ* ocelot management is difficult because the species is extremely elusive and thus difficult to study; hence the lack of adequate distribution and population data for Trinidad. In the USA and South America, captive breeding of ocelots is hindered by diminished genetic variation, lack of basic biological data on reproduction and behaviour, and improper husbandry conditions (Morais *et al.* 2002). In South American zoos, success rates of captive breeding programmes of felid species are notoriously low. In studies done by Swanson *et al.* 2003, it was found that most felids (>95%) in the surveys conducted were of wild-born origin, and <20% of these had subsequently produced offspring in captivity as a result of low birth numbers (usually only 1-2 kittens per litter) as well as low sperm counts and presence of abnormal sperm in males (Morais *et al.* 2002; Swanson *et al.* 2003).

Inbreeding depressions such as physiological deformities and expression of deleterious genes are always possible in captive populations; however, with the addition of confiscated and wild ocelots to those already at the EVZ, increases in overall genetic variation might produce increases in the number of viable offspring annually.

Although ocelots are considered to be among the smaller felids, compared to their larger relatives such as jaguars and leopards, they nevertheless require large territories. Lacking the proper mental and ecological stimulation, many captive, wild-caught felids express signs of cage stereotypy such as pacing, which is a sign of ill mental health and which can lead to a decrease in biological and reproductive health (Mason 2006). This behaviour was not observed in any of the ocelots at the EVZ; however, pacing was displayed by a jaguarundi (*Herpailurus yagouaroundi*), another species of small felid, in an enclosure at the EVZ, suggesting that the potential exists for cage stereotypy to occur in ocelots housed in similar enclosures.

Captive breeding of ocelots at the EVZ to maintain a

population should be continued so there would be no need to extract individuals from the wild for display. In addition, a structured captive breeding programme geared towards periodic releases of ocelot offspring into the wild in Trinidad would be a worthwhile conservation goal, providing pedigree and opportunistic additional stock was available (such as confiscated individuals).

To achieve this, the EVZ would need to train staff in proper handling techniques for ocelots targeted for release into the wild. A collaborative effort would be needed among the EVZ, biologists, NGOs, local citizens, and hunters. Moreover, breeding of ocelots intended for reintroduction into the wild should be considered only after baseline surveys of ocelot populations have been conducted to determine which regions of Trinidad could support additions to the existing populations of this apex predator. Management prior to breeding must include determination of the genetic pedigree of each ocelot to avoid potential inbreeding depression.

Confiscated ocelots whose areas of origin in Trinidad are known should be rehabilitated and released into their area of origin as soon as possible. Conflicts may arise if these areas are heavily hunted or impacted by agriculture. This supports the need for genetic mapping of populations within Trinidad to determine suitable release areas where genetic integrity can be maintained without human-wildlife conflicts.

Conservation efforts should be geared towards basic and applied studies of ocelot reproduction at the EVZ, with adequate records being kept of numbers and histories of resident ocelots. A systematic inventory programme should be initiated at the EVZ, compiling information on captive populations and relaying that information to other facilities housing similar animals. In this manner, through research on their captive ocelots, the EVZ could contribute significantly to ocelot conservation globally while amassing baseline data on the genetics and biology of ocelots in Trinidad. By doing so, the EVZ would also serve as an "ark" for ocelot survival, providing an opportunity for establishing self-sustaining captive populations to be used for reintroduction into the wild in the future (Wielebnowski 1998), if the genetic pedigree is deemed suitable.

Regarding physical management of ocelots at the EVZ, a number of different approaches could be considered. Ocelots currently are maintained for display and interactive purposes. We suggest managing housing for a variety of purposes: display, interaction, public display (breeding pairs), not for public display (breeding pairs), and eventually captive-bred offspring for release into the wild. Breeding pairs whose offspring are targeted for release into the wild should be housed in separate enclosures, and human contact with them should be kept to a minimum. The offspring should be able to hunt on their own and develop an appropriate fear of humans to reduce the risk of future undesirable human-wildlife conflicts (Zerinskas and Pollio 2013). To prevent improper filial and sexual imprinting, by the age of three months ocelot kittens should begin learning to hunt, with the goal of future release into the wild. This strategy has been successful with other felid species such as tigers and cheetahs (Wielebnowski 1998). Unless these 'educating for release' strategies are to be employed, breeding of ocelots for release into the wild should not be considered at the EVZ.

The EVZ should also maintain records of tag and DNA data for all captive and released ocelots for monitoring, evaluation of success, and managing pedigree. This strategy should be extended to ocelots in other private collections in Trinidad as well as to ocelots trapped in the wild to provide data on the genetic history of ocelots in Trinidad. Several breeding strategies are useful in minimising the occurrence of inbreeding depression. Van Oosterhout *et al.* (2007) suggested that reduced levels of immunogenetic variation caused by inbreeding and lack of exposure to natural parasites may increase susceptibility of captive-bred individuals to infectious diseases. The threat of disease outbreak is particularly high when naive captive-bred hosts are released into wild populations (Van Oosterhout *et al*. 2007). Susceptible captive-bred ocelots could facilitate transmission of parasites throughout a wild population, initiating an epidemic of a pathogen such as the fungus *Aspergillus fumigatus*, which was diagnosed to be infecting an ocelot with chronic rhinitis at the EVZ (De Gannes *et al.* 2013). A risk such as this could potentially be reduced by exposure of captive ocelots to wild environments before their release to allow them to develop antibodies.

In conclusion, the EVZ should establish a breeding programme for ocelots as outlined above, in a structured manner, with detailed recording of pedigree and spatial distribution of ocelots in Trinidad.

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NATURE NOTES

Observation of a Semi-Aquatic Spider Attack: An Overlooked Fish Predator in a Well-Studied Ecosystem?

We describe here a noteworthy spider encounter that took place on the bank of the Ramdeen Stream in Trinidad's Arima Valley (10º41'32"N; 61º17'36"W) on 23 August, 2014. This stream forms part of one of the most intensively-studied freshwater ecosystems in the tropics; for more than four decades international researchers have been visiting this valley to discover more about the ecology and evolution of the fishes that it supports – primarily the Trinidadian guppy *Poecilia reticulata* and the killifish *Rivulus hartii* (recently revised as *Anablepsoides hartii*). This unrivalled body of research has greatly expanded our understanding of natural selection, evolution and community ecology (Magurran 2005).

A series of semi-naturalistic pools have been constructed on the bank of this second-order stream to study interactions between guppies and rivulus as part of another study. While conducting a fish census of one of these pools in the mid-afternoon (around 1430 h), a large male rivulus (~80 mm) jumped out of the pool and onto the surrounding leaf litter, attempting to evade the dip net with its characteristic tail-flip. Within seconds, before it was possible to capture the fish, a large spider had leapt onto it grasping it firmly.

After a few minutes, possibly disturbed by the presence of the observers, the spider moved a few centimetres towards the pool and rested on the water (Fig. 1). It then reclimbed the bank and remained there, completely still, with the motionless fish still in its grasp for some time (Fig. 2).

The authors are very familiar with *R. hartii* and have a good intuition for estimating lengths of this species visually. Therefore, the estimated length of the fish (80mm) was used to calculate the size of the spider using the software package ImageJ (Rasband 1997-2014). Using this method, the cephalophorax (combined abdomen and thorax) of the spider measured about 35mm x 15mm, with a ~120mm legspan.

From our photographs and description, Dr Hubert Höfer of the State Museum of Natural History Karlsruhe (SMNK) in Germany identified the spider as being from the family Ctenidae (tropical wolf spiders) of the genus *Ancylometes* (giant fishing spiders) and of the species *Ancylometes bogotensis* (Keyserling 1877). The individual here is a female; the male of this species has white stripes on his abdomen. A body length of 35mm is typical for an adult female *A. bogotensis* (Brzostowicz and Greven 2007). It is found from Bolivia to Nicaragua, and is the only species of this genus to be found in Trinidad (Höfer and Brescovit 2000).

Nyffeler and Pusey (2014) reviewed accounts of spider predation on fish worldwide by collating 80 published and anecdotal reports. According to this paper, the sighting described here is the first recorded incidence of fish predation by a spider in Trinidad. This is most likely because few people have witnessed the event, and/or that previous descriptions have remained unpublished rather than reflecting the actual rarity of fish predation by spiders.

The pools in this case are manmade, but mimic pools that are often found in such habitats and are naturally colonised by rivulus. Over the course of 84 pool visits by the authors over two years, fishing spiders were observed in 10% of cases; anecdotal evidence suggests this frequency is typical of the stream over the past two decades (unpublished data). One of the authors (DFF), who has worked in this habitat for over two decades, has seen a spider with *rivulus* in its grasp before (unpublished observation) but never witnessed the attack itself.

According to Nyffeler and Pusey's review, 10% of reports of fish predation by spiders can be attributed to the family Ctenidae. The vast majority (80%) are associated with *Dolomedes* sp. of the family Pisauridae; this family is also present in Trinidad (Sewlal and Cutler 2003).

A. bogotensis is typically found on banks or on aquatic vegetation, ready to attack when the surface of the water is disturbed (Brzostowicz and Greven 2007). In a separate encounter, at the same pool around one year earlier, two of the authors witnessed a similar spider, poised, abdomen out of the water with its thorax submerged vertically; on being disturbed, the spider swam *underwater* across the pool and emerged on the other side. Indeed, *A. bogotensis* often uses diving to avoid predators as well as for temperature regulation (Brzostowicz *et al.* 2007) and has been observed to stay underwater for considerable periods (Höfer and Brescovit 2000; Brzostowicz and Greven 2007). The ability to move on the water surface and to remain submerged for extended periods seems to be aided by a coating of fine hairs that trap air bubbles around its body. These hairs are also used to detect disturbances in the water and alert the spider to the presence of prey (Brzostowicz and Greven 2007).

The prey in this case, *R. hartii,* and the other dominant species in the habitat, *P. reticulata*, both belong to the Cypridontiformes, which account for 28% of all identifiable fish species in spider predation reports worldwide (Nyffeler and Pusey 2014). *A. bogotensis* appears to be a generalist feeder. As well as fish, it is also known to feed

Fig. 1. *A. bogotensis* resting on the water with a freshly caught killifish, *R. hartii*.

Fig. 2. *A. bogotensis* grasping its prey.

on frogs and insects on the water surface (Brzostowicz and Greven 2007; White *et al*. 2015) and, as described for the first time in this issue, crustaceans (Bhukal *et al.* 2015).

In general, fish predation by spiders tends to be more common in the tropics. On average, prey species tend to be 2.2 times longer than the spider predator. Our fish was ≈ 2.3 times larger than our spider, which is well within the range of previous observations (Nyffeler and Pusey 2014).

The streams and pools of the Arima Valley are extremely well studied in terms of fish, and predation is often a focus of these evolutionary ecology studies (e.g. Croft *et al.* 2006; Dugatkin and Godin 1992; Fraser and Lamphere 2013). This encounter, coupled with the frequency at which similar spiders are seen poised by our pools, suggests that the role of arachnid predators may be underplayed in the literature thus far, and may be an important source of mortality and selection in these populations, especially in pools and streams where the main fish predators such as the pike cichlid *Crenicichla frenata* and the wolf-fish *Hoplias malabaricus* are absent. Owing to its ability to breathe cutaneously, *R. hartii* can evade immediate aquatic predators by flipping out to riparian habitats (Gibb *et al.* 2011). This behaviour, however, may make them susceptible to predation from semi-aquatic, edge-dwelling spiders.

It would be of great interest to find out more about the distribution and abundance of *A. bogotensis*, and other fish-eating spiders, in Trinidad and to better understand the role they play as predators in aquatic habitats. It would be especially pertinent to address these questions within the Northern Range freshwater ecosystem, given the considerable existing knowledge on other taxa and habitat characteristics in this location.

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Predation on a Freshwater Crab, *Dilocarcinus dentatus* (Tricodactylidae), by Several Tropical Wolf Spiders, *Ancylometes bogotensis* (Ctenidae), in Trinidad, W.I.

On 4 September, 2014, during a nocturnal field trip to the Aripo Savannas, Trinidad, (WGS 84 UTM 0697545 1176021), an unusual observation was made. Three adult spiders were observed feeding on an adult freshwater crab. The spiders were on vegetation above a flooded trail and there were many crabs in the water below. The crab was initially held by a female spider; two males were then seen to approach and also feed on the crab (Fig. 1 and Cover Photo).

The spider was identified from photographs as *Ancylometes bogotensis* (Keyserling 1877) of the family Ctenidae (pers. comm. H. Höfer) and the crab identified as *Dilocarcinus dentatus* (Pretzmann 1968). No other species within the genus is known to inhabit Trinidad. *Ancylometes* spp. have a mainly South American distribution and are more commonly called 'giant fishing spiders', to prevent confusion with the smaller 'fishing spiders' (*Dolomedes* sp.). They inhabit moist Neotropical forests where they hunt at night at the edge of water bodies (Höfer and Brescovit 2000). *Ancylometes* spp. are documented as having a diet consisting of anything from insects to small vertebrates such as fishes, tadpoles, frogs, toads and lizards (Menin *et al.* 2005). Deacon *et al.* 2015 and White *et al.* 2015 document instances of *A. bogotensis* feeding on a fish and a frog respectively, in Trinidad.

Although the capture of the crab was not observed (carapace length ≈4.0cm), it is likely that it was caught live by the female spider and taken into the surrounding vegetation to be fed upon, as *Ancylometes* sp. are only known to feed on prey they have caught themselves (pers. comm. H. Höfer). While fish and amphibian predation by spiders has been widely reported (see Platnick 2013; Nyffeler and Pusey (2014); Menin *et al.* 2005), to our knowledge, there have not been any recorded observations of spiders of this family feeding on crustaceans. While these spiders are known to be ambush predators, where they lay in wait for prey that passes within striking distance, they also actively dive, such is the case when they hunt for fish. Indeed, prey of the size and morphology of a freshwater crab present an additional challenge to a spider predator, as do the crab's formidable pincers which can be used as a defensive tool.

Social groups can form when individuals aggregate because of inherent advantages of group living according to Alexander (1974). These benefits are usually associated with defence against predators or detection and harvest of food resources. As it pertains to social behaviour in spiders, it is uncommon, with only around 60 out of the more than 40,000 species having been documented exhibiting such behaviour (Lubin 2010). Of these, almost all are records from web-building species, therefore seeing ground-hunting spiders feeding peaceably together is a rare occurrence. In all of the social species, several spiders attack large prey jointly and feed together on it because by hunting in a group, spiders can capture larger prey and save on per capita costs of silk production (reviewed in Avilés 1997). In addition to this, they may also benefit from sharing digestive enzymes. However, as the capture of the crab was not witnessed, it is not possible to say if the spiders were actively foraging together or just brought together independently by the presence of potential prey. It must be noted however, that despite being in proximity to each other, aggressive behaviour amongst the three spiders was not observed.

This is, therefore, the first account of a member of the

family Ctenidae feeding on a crustacean and exhibiting social behaviour out of the courtship period. It would be of great interest to establish definitively that *Ancylometes bogotensis* captures live crabs, and whether individuals hunt together or happen to aggregate near to prey-rich habitats.

We would like to thank Dr Hubert Höfer of the State Museum of Natural History Karlsruhe, Germany for confirming the identification of the spider and providing further information.

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Fig. 1. Female *Ancylometes bogotensis* (top) feeding on female *Dilocarcinus dentatus* with male spider attempting to feed as well.

Observation of a Spider, *Ancylometes bogotensis* (Ctenidae), Preying on the Frog *Rhinella beebei* (Bufonidae) in Trinidad

In 2005, Alex De Verteuil, Reginald Potter, Stephen Broadbridge and myself were filming frogs along the Exchange Road between Waterloo and Couva (grid ref: 667800E- 1158300N) when we observed a frog, *Rhinella beebei*, Beebe's toad, being preyed upon by a spider. Heavy rainfall earlier in the day had provoked choruses of frogs including *R. beebei* alongside *Dendropsophus microcephalus misera, Rhinella marina* and *Scinax ruber* in this location. The habitat was the edge of a grassy ditch, bordering a narrow road surrounded by abandoned sugar cane fields. The ditch was choked with grasses and held standing water. At the time, we believed the spider to be a wolf spider but were unable to confirm the identification.

In this volume of Living World, two Nature Notes were submitted which describe predation by the giant fishing spider *Ancylometes bogotensis* (Keyserling 1877) of the family Ctenidae (tropical wolf spiders). Deacon *et al*. (2015) observed this spider preying on a killifish *Anablepsoides hartii* (= *Rivulus hartii*) when it jumped out of the water to escape pursuit by the observer. Subsequently, at the Aripo Savannas, Bhukal *et al*. (2015) observed several individuals of this same species feeding on the freshwater crab *Dilocarcinus dentatus*. In both of these cases the spider was identified from the photographs by Dr Hubert Höfer of the State Museum of Natural History Karlsruhe in Germany.

Reading these observations prompted me to send photos from my own 2005 observation to Dr Höfer, who subsequently confirmed that the spider that I witnessed preying on the frog was most probably the same species as that observed predating on the killifish and the crab. Therefore, it seemed pertinent to include this third observation alongside the others.

Spiders of the genus *Ancylometes* are known to feed on frogs, among other prey. For example, Moura and Azevedo (2011) noted an instance of *A. rufus* preying on the tree frog *Dendropsophus melanargyreus* in Amazonia. Indeed Toledo (2005), in a review of the subject, describes invertebrate predation on post-metamorphic amphibians as quite common and lists 31 published accounts of a spider preying upon an anuran; there are also several You-Tube videos of anurans being preyed upon by fishing spiders. Toledo (2005) highlighted the value of reporting such predation events especially where the behaviour of the predator, prey interaction and the nature of the immediate surrounding habitat is described. In this case the prey was already captured when we noticed it and it is likely that our presence altered the behaviour we observed. At the time, the frog appeared to be still breathing though otherwise motionless. The spider's fangs were moving slightly as it probed the frog and we assumed that the spider was waiting for the enzyme action to kick in. We did not observe the eventual outcome.

The photographs show, however, that despite the frog being larger than its predator (Fig. 2), the spider was able to move it effectively. Toledo *et al*. (2007) attempted to seek relationships between invertebrate predator and anuran prey size. In this case neither the spider nor the frog were measured *in situ*, however Figure 2 allows us to calculate that the frog (snout-vent length) is 1.39 times larger than the spider (total length). In addition, we expect an adult *R. beebei* to be 51-61mm in length (Murphy 1997). This places it within expectations for the prey of a venomous

Figs. 1 and 2. Giant fishing spider *Ancylometes bogotensis* feeding on *Rhinella beebei* , screen-shots from the documentary Wild T&T directed by Alex De Verteuil and produced by Pearl and Dean Caribbean Limited in association with Caribbean Discovery Tours in 2005. This shot was filmed by Reginald Potter. Figure 1 (above) shows the spider holding onto its prey, and Figure 2 (below) shows the spider capably transporting the frog despite its large size relative to the spider.

invertebrate anuran predator (Toledo *et al*. 2007).

Prior to these reports, two genera of the family Ctenidae have been recorded in Trinidad (Sewlal 2013), including *Ctenus trinidadensis* and *Ancylometes* sp. In a review of the genus *Ancylometes,* Höfer and Brescovit (2000) list just the one species, *A. bogotensis,* as occurring in Trinidad.

The three recent observations of *A. bogotensis* preying on a fish, a crab and a frog, highlight the important role that this spider may play as a generalist predator. Until detailed studies of the natural history of this species are conducted, such observations help to piece this picture together.

ACKNOWLEDGEMENTS

I would like to thank Dr Hubert Höfer for identifying the spider and Alex De Verteuil, Reginald Potter and Stephen Broadbridge for permitting me to use the screenshot from Wild T&T. I would also like to thank Amy Deacon for her very helpful comments on the manuscript.

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Nesting Habit of the Termite *Nasutitermes corniger* (Isoptera: Termitidae) on St. Eustatius, a Very Small Oceanic Island

Nasutitermes corniger (Motschulsky) is very widespread in the Neotropics, including the West Indies (Constantino 2009; Scheffrahn *et al.* 1994), where its distinctive brown, dimpled nests are a conspicuous landscape feature. Its covered galleries, 8-10mm wide, are readily seen running up tree trunks and along major branches. On the continent and continental islands, the nests are usually above ground on trees, whilst in the Lesser Antilles they are usually at the bases of trees (C.K. Starr and I. Karsái unpubl.). Where colony foundation has been studied, colonies are characteristically initiated at ground level and may later move to a higher level (T. Hartke pers. comm.).

St. Eustatius is a small (21 km^2) volcanic island in the northern Lesser Antilles (17°30'N). The Quill (alt. 600 m) is a dormant volcano towards the southeastern end of the island, its slopes mostly covered with closed-canopy secondary forest. *Bursera simaruba* is among the common trees. *Nasutitermes corniger* is very abundant throughout most of the lower- and mid-level forest.

Preliminary observations suggested that a) unlike elsewhere in the Lesser Antilles, a significant fraction of nests was not attached to a tree base, and b) nests were never associated with *B. simaruba*.

On a walk through mid-level forest, I recorded the positions of 50 *N. corniger* nests. None was above ground level, nor was any at or close to the base of any *B. simaruba*. I noted no galleries on *B. simaruba* trunks. Thirty of the 50 nests were directly attached to tree bases, whilst the other 20 were not (Fig. 1).

The distribution of nest sites is more continuous than the 30:20 dichotomy suggests. Some of the 30 attached nests were less tightly bound to the tree base than is usual in this species - a few were attached not to the trunk but to a large superficial root - while most of the 20 unattached

nests were close enough to particular trees to be considered associated.

The substantial minority of nests without direct attachment to a tree is unusual for this species. My working hypothesis is that colonies are typically founded at or in tree bases, as usual, and that some later move away from the tree. The relative advantages of nesting arboreally or at ground level remain unknown.

Avoidance of *B. simaruba* presumably has to do with its flaking bark. Galleries on trunks of this tree - which I have seen, but very seldom - are expected to be unstable.

These observations were made on a field trip organised by JoAnne N. Sewlal, who also helped with the figure. Our hosts on St. Eustatius were the St. Eustatius National Parks (STENAPA) and Caribbean Netherlands Science Institute (CNSI).

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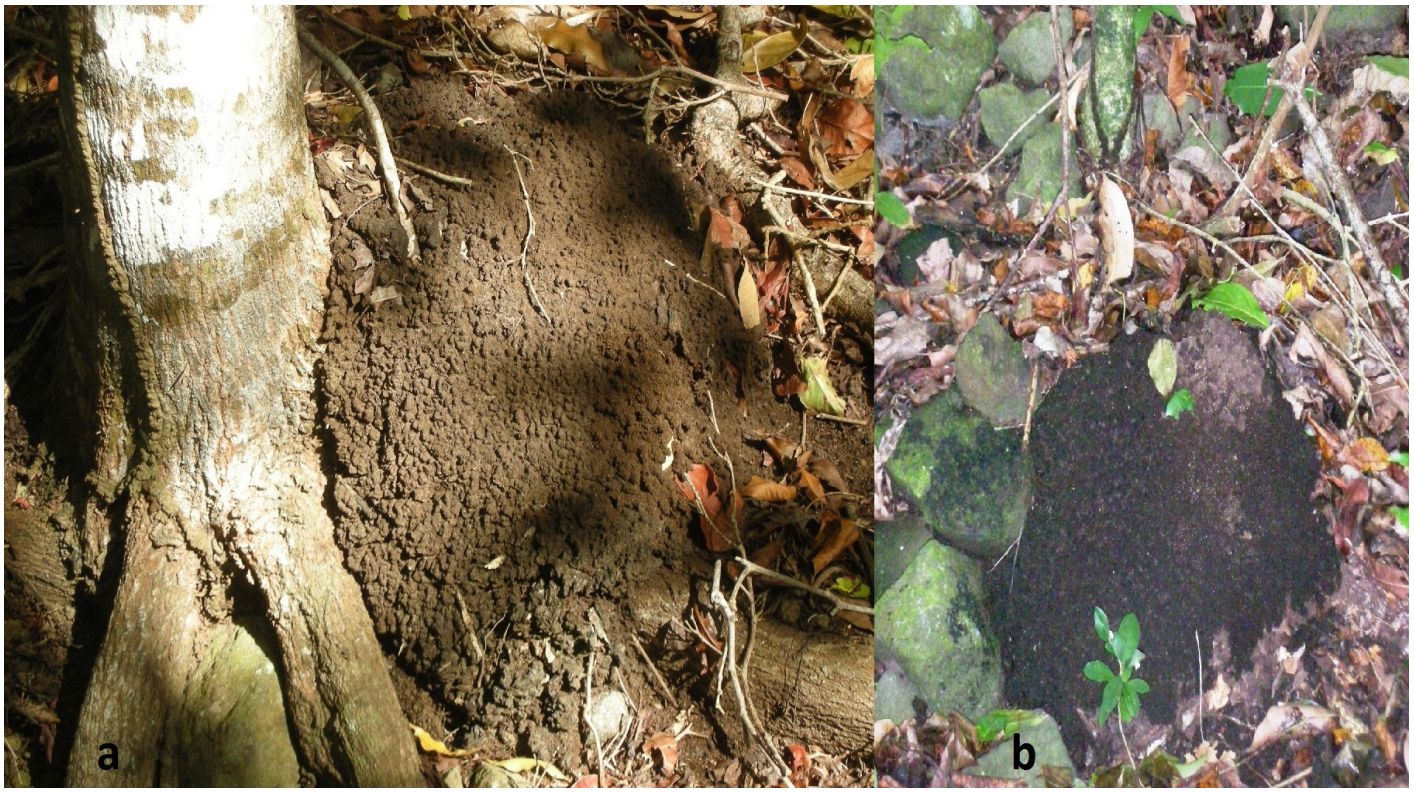

Fig. 1. Active *Nasutitermes corniger* nests with associated trees. **a)** Directly attached at a tree base. **b)** Not attached but with major galleries running up the trunk of the nearby small tree behind it.

Distributions of a Natural Coloniser and an Established Exotic Fish Species: *Gephyrocharax valencia* (Characiformes: Characidae) and *Trichogaster trichopterus* (Perciformes: Osphronemidae) in Trinidad

The freshwater ichthyofaunal assemblage of Trinidad is dynamic, and our understanding of it is affected by changes in taxonomy and new findings. Phillip and Ramnarine (2001) listed 41 species of freshwater fish within Trinidad and Tobago, with no species unique to Tobago. Since then there have been three additions to the freshwater fish checklist, bringing the species richness up to 44. These three additions were the Three spot gourami, *Trichogaster trichopterus,* at one site in the Oropouche Drainage (Mohammed *et al.* 2010), the Driftwood catfish, *Trachelyopterus galeatus,* in the Caroni and Guayamare Rivers (Mohammed and Lalla 2013), and the characin, *Gephyrocharax valencia*, localised in the Moriquite and Moruga Rivers (Vanegas and Phillip 2013). The three species we examined here were chosen because they are the most recent additions to the fish assemblage and because they are important as a result of their potential ecological impacts.

Kenny (1995) suggested that there were five zones within Trinidad, each with a characteristic freshwater ichthyofaunal assemblage. These included Antillean Zone (north coast), Unstable Relic Zone (southern slope of Northern Range), Stable Relic Zone (majority of which are in the central region), Eastern Colonising or Relic Zone (east coast including Nariva and Ortoire, overlapping into the Stable Relic region of Valencia), and lastly the Colonising Zone (south coast). Vanegas and Phillip (2013) supported Kenny's (1995) claims that the southern regions of Trinidad are "colonising zones" for fish, particularly during periods of heavy discharges of the Orinoco River into the Columbus Channel. Evidence for this included the fact that *G. valencia* was restricted to the freshwater reaches of the Moriquite and Moruga Rivers, which are both located in the south of the country, as well as being found throughout the northern coastal regions of Venezuela.

Repeated sampling by use of river seines and cast netting at more than 100 sites in southern Trinidad over the last five years has allowed us to learn more about these three additions to the checklist. Identifications were confirmed by use of taxonomic keys from Phillip *et al.* (2013).

These identifications have allowed for an increase in the knowledge of distributions of *G. valencia* and *T. trichopterus*. No changes were observed in the distribution of *T. galeatus.* This does not necessarily mean that the ranges of the former two species are expanding, as these new regions of occurrence could potentially be due to lack of monitoring in the past. Figure 1 illustrates the current and previous regions within which *T. trichopterus* and *G. valencia* have been detected, accompanied by Table 1, which gives the GPS coordinates (20P, UTM).

Ornamental strains of *T. trichopterus* that differ from the original wild strains were introduced to the Oropouche Drainage, and this exotic species has since established there. The individuals now being caught closely resemble the wild strain found in the Cambodian Mekong where they originated (Mohammed *et al*. 2010), which indicates that the strain has reverted to the wild type.

Shoals of *G. valencia* usually were found together with other characin species such as *Corynopoma riisei* and *Astyanax bimaculatus.* The general regions in which these were found were mostly within ephemeral drainages along the Penal Rock Road (eastern end) as well as at the original sites of the first records by Vanegas and Phillip (2013). The shoals were found clustered in pools along the rivers during the late rainy season (November 2014). Formation of such mixed shoals would increase survival of all species from piscivorous predators (Ward *et al.* 2002).

In contrast, *T. trichopterus* has established mono-species populations among the shallow lagoons near Ramsingh Trace west of Rochard Road as well as near to Nagesar Trace south of the Penal Rock Road (western end). Being an anabantid species, it is well adapted to low dissolved oxygen concentrations and has the potential of establishing itself rapidly in stagnant waters (Knight 2010; Mohammed *et al.* 2010). Capitalising on this, *T. trichopterus* has displaced several native characins from the lagoons (anecdotal evidence and pers. comm. with several subsistence fish collectors). It is safe to say that this exotic fish has established breeding populations within the Oropouche Basin.

Internationally, *T. trichopterus* also has established populations in parts of India such as Chennai (Daniels and Rajagopal 2004; Daniels 2006) and Vembanad Lake in Kerala (Krishnakumar *et al.* 2009). There is a dearth of information on its ecological impacts in these regions of introduction. However, *T. trichopterus* is considered a territorial and aggressive opportunistic carnivore. In Taiwan it is suspected to be a resource competitor with the endangered Chinese Barb (*Puntius semifasciolata*), causing a decline in populations of that species (Liao and Liu 1989).

Kenny (1995) suggested that the drainage systems of south Trinidad may be a colonising zone for new species of fish from the South American mainland. Our findings support this theory, particularly the presence of *G. valencia*. Whilst *T. trichopterus* and *T. galeatus* are introduced

Table 1. Historical and current distribution of *Trichogaster trichopterus* and *Gephyrocharax valencia.*

Species	Year	Eastings	Northings
Trichogaster trichopterus	2010	667160	1127058
	2012	678626	1128880
	2014	671819	1120567
		673037	1121860
		672763	1121881
		673315	1122197
		673473	1121879
Gephyrocharax valencia	2012	690946	1120488
		686888	1118540
	2014	687659	1127013
		685925	1127135
		685503	1122249
		691065	1120680
		685306	1115005
		685432	1120061
		684705	1120096
		681226	1121503
		679898	1121754

species from Asia and South America, respectively, this new information will contribute towards increased knowledge of freshwater fish distributions within Trinidad.

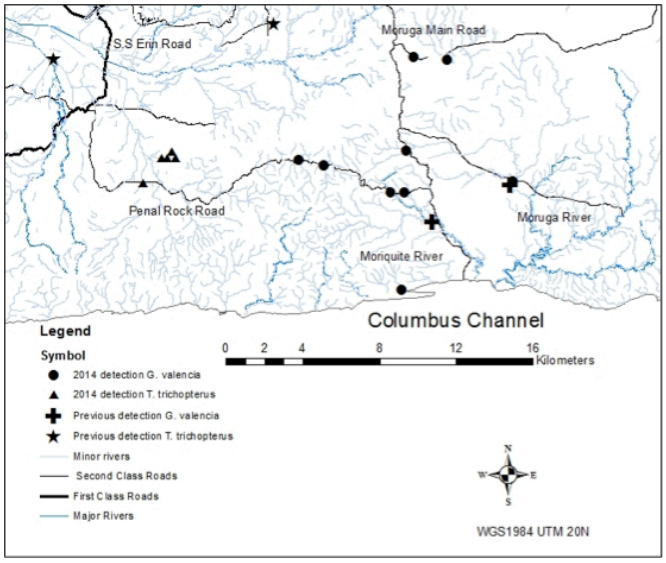

Fig. 1. Distribution of *Trichogaster trichopterus* and *Gephyrocharax valencia.*

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Distribution of the Caiman, *Caiman crocodilus* on Tobago

The Spectacled or White Caiman, *Caiman crocodilus* ranges throughout much of Central and South America, from southern Mexico to Ecuador, eastern Peru, the northern tip of Bolivia and the northern half of Brazil. In various parts of Latin America it is also locally known as Baba, Babiche, Babilla, Cachirré, Caiman Blanco, Caiman de Brasil, Caiman Llanero, Cascarudo, Common Caiman, Jacaretinga, Lagarto, Lagarto Blanco, Spectacled Caiman, Tinga and Yacaré Blanco. Caiman populations have been documented in Trinidad and Tobago (on both islands) and on the small islands north of the Venezuelan coast (IUCN 1996) such as Los Testigos Islands, Porlamar, Isla de Coche, Isla de Cubagua, Isla La Tortuga, Isla La Orchila, Aruba, Curacao and Bonaire. In Trinidad its population was well documented by Murphy (1997). However, its distribution on Tobago has not been fully documented. Hardy (1982) stated that the caiman once occurred in most rivers and marshes on Tobago but that by the 1980s they had become limited to a few rivers in southern Tobago. He documented two historical occurrences, both of which were by potentially crocodilian drifters from South America: 1) In August 1979, Captain Isaac Augustine killed a large caiman swimming approximately 5.0km off northeastern Tobago, and 2) Woodcock (1867, p. 192) reported a 5.0-m-long individual from the Hope River, possibly the Orinoco crocodile, *Crocodylus intermedius*. Woodcock (*Ibid.*) wrote,

> "In the rivers in the windward part of the island the alligator is often seen; one has been taken 17 feet [5.18 m] long; it was killed in the Betsey's Hope River, where it had attacked a man who was crossing the stream, but who fortunately escaped the monster. It has always been considered that this animal was a stranger, brought by the current from one of the continental rivers; the native alligators do not measure much over six feet [1.83 m], and I have not heard of any injury done by them to man."

Spectacled Caiman were first recorded on Tobago by Woodcock (*Ibid.*), but the species was not listed officially for Tobago until more than 100 years later (Mertens 1969). Boos (2007), via personal communications 1982-1983 with F.M. Madem (Roberto Franco Tropical Biological Station, Villavicencio, Colombia), suggested that Tobago's caiman (to which Boos referred as *C. crocodilurus*) may be a distinct subspecies, on the basis of the smaller size of adults observed on Tobago in relation to their length. To date, this has not been verified, either genetically or morphologically, thus, the native crocodilian on Tobago is still regarded as the generic *Caiman crocodilus*.

From 2007 to 2015, I searched for caiman on Tobago both at night (using eye spotting with flashlights) and during daylight. Figure 1 illustrates the current distribution of the caiman on Tobago, according to my findings.

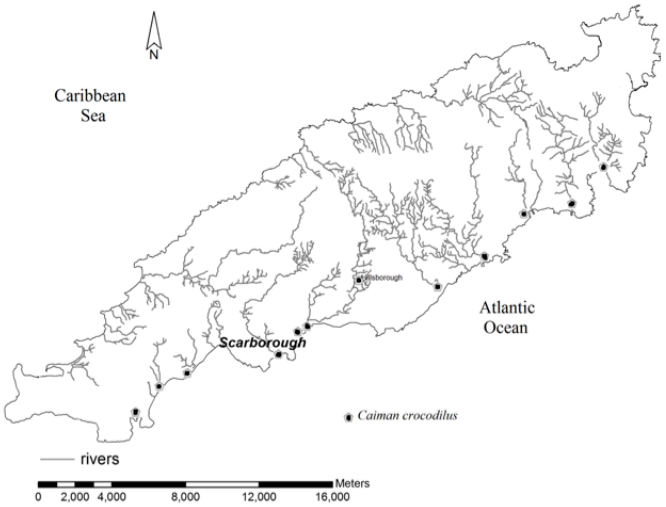

Fig. 1. Current distribution of *Caiman crocodilus* on Tobago.

During these investigations, *Caiman crocodilus* was noted mainly along Tobago's Atlantic Coast. From this distribution one could hypothesise, as did Woodcock (1867), that the Atlantic Ocean and the outflow of the Orinoco River have had the greatest impact on colonisation and/or re-colonisation by this species. Most sites at which *C. crocodilus* was found were near the coast (less than 1.0 km distant), but water depth seemed to be the common factor among all sites where the species was found. From north to south, sightings were at the lagoon at the mouth of Kings Bay River, Louis D'or River, Argyle River, Richmond (Dog) River, Goldsborough River, Hillsborough Dam, Hope River, Blenhem River, swamps along Milford Road, and the ponds around the Magdalena Grand Beach and Golf Hotel. Individuals were only observed in the deep water regions. Many rivers on Tobago flow into the Atlantic Ocean, but caiman were noted on the Atlantic Coast only in rivers deeper than 2.0m. Hillsborough Dam supports the population at the highest elevation (approximately 300m). The major obstacle to movement of caiman from the Atlantic to the Caribbean side of Tobago seems to be the high elevation of the Main Ridge. For example, one might expect them to occur at the Courland River on the Caribbean coastline. The Courland River has several reaches with deep water and similar riparian vegetation to all other localities where the species was observed. Swimming around the island to colonise would seem a bit challenging as they would be moving against the ocean and Orinoco currents.

These results show the distribution of *C. crocodilus* to be not only localised to the south as previously described by Hardy (1982), but that it has an Atlantic coastal distribution potentially influenced by topography, elevation, water depth and proximity to the coast.

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Potential New Establishment of an Exotic Snail, *Pomacea canaliculata* (Lamarck 1819) (Gastropoda: Ampullariidae) in Trinidad

The aquatic freshwater gastropods are represented by eight families in Trinidad: Ampullariidae, Hydrobiidae, Lymnaeidae, Neritidae, Physidae, Planorbidae, Pleuroceridae and Thiaridae. Within these families, three established exotics can be deemed invasive aquatic species (IAS): *Melanoides tuberculata* or the "Red rimmed melania" and *Tarebia granifera* or the "Quilted melania," both belonging to the family Thiaridae. The third IAS is *Pomacea diffusa* or the "Spike-topped apple snail," which belongs to the family Ampullariidae, of which there are three other native species (Mohammed and Rutherford 2012). This note brings to light the occurrence of a potential fifth member of the Ampullariidae family to be documented in natural drainages of Trinidad, *Pomacea canaliculata* or the "Channelled apple snail."

During January 2014, while walking southward in the Guanapo River, from the bridge along the Churchill-Roosevelt Highway, three snail egg cases were found at the following coordinates (20P UTM): Site 1 (691249 E, 1174326 N), Site 2 (691223 E, 1174250 N) and Site 3 (691169 E, 1174216 N). At Site 1, the egg case was seen attached to rock, whereas at Sites 2 and 3 they were attached to concrete debris. All egg cases were bright pink to red (Fig. 1A), very different from the aquamarine-coloured egg case typical of the native *Pomacea glauca* as well as from the bright peach- or orange-coloured egg cases typical for the invasive *P. diffusa*. All three egg cases were collected. One was immediately stored in 70% alcohol, whilst the other two were secured in tissue paper then placed in a sample jar and taken back to the Department of Life Sciences (DLS) at The University of the West Indies (UWI) for further study. A search of the Guanapo River for novel-looking *Pomacea* like snails was launched, but no individuals were found.

At the DLS, all egg cases were measured and found to be the following lengths; 4.5cm, 5.2cm and 4.8cm. They were all of similar height (approx. 1.5cm) and width (approx. 2.1cm). Individual eggs ranged between 1.0mm to 2.0mm in diameter. The two egg cases that had not been preserved in alcohol were then mounted with Blu Tack (Bostik, France) to the side of a glass aquarium 5.0cm above 10.0cm deep water with mild aeration in an attempt to hatch the eggs. After nine days, juvenile snails emerged from one of the egg cases; however, after 20 days the second egg case disintegrated into the water. The juveniles have since been housed at the DLS in a glass aquarium and the sub-adults photographed to confirm identification.

Preliminary findings indicate that these snails are possibly *Pomacea canaliculata* on the basis of the egg case and the morphology of the snail shell, which have a deep, characteristic channel within the shell (Fasulo 2004) that gives the species its common name (Fig. 1B). Similarly Hayes *et al.* (2012) also support this. K.A. Hayes (Department of Biology, Howard University, Washington, DC, USA) indicated that the snails are definitely of the *P. canaliculata* group, of which several species are native to the Orinoco Basin (pers. comm.). Juveniles of the other local species, *P. glauca* and *P. diffusa,* lack a deep bore within the shell and can thus be differentiated from *P. canaliculata*. Generally the live specimen has a superficial resemblance to *P. glauca*.

In September 2014, adult *Pomacea* were noted at an

outdoor enclosure at a fish import facility at Mausica, Trinidad, and pink egg cases were noted on the inner sides of the large plastic tank. The outflow from the facility enters the Mausica River, which is downstream from the Guanapo River along the main Caroni River system. Investigations at the Guanapo, Mausica, Caroni and Arima Rivers, which are located between the Guanapo and Mausica Rivers, have not yielded any additional egg cases or suspicious adult snails. Nonetheless, I suspect that a breeding population of *P. canaliculata* has become established within the general Mausica and Guanapo region and can seed establishment of the species in Trinidad. *Pomacea diffusa* became established in Trinidad almost a decade before first being recorded officially (Mohammed and Rutherford 2012). Therefore, no records of the early distribution and spread of *P. diffusa* were noted. It is premature to deem juvenile *P. canaliculata* an established species, but monitoring of this species should be continued within the general area. The juveniles were retained for genetic comparative investigations.

Specimens of the juvenile snails hatching from the egg mass are now lodged at the Zoological Museum, DLS, UWI, and also have been sent to the Department of Biology, Howard University, for morphological and genetic identification.

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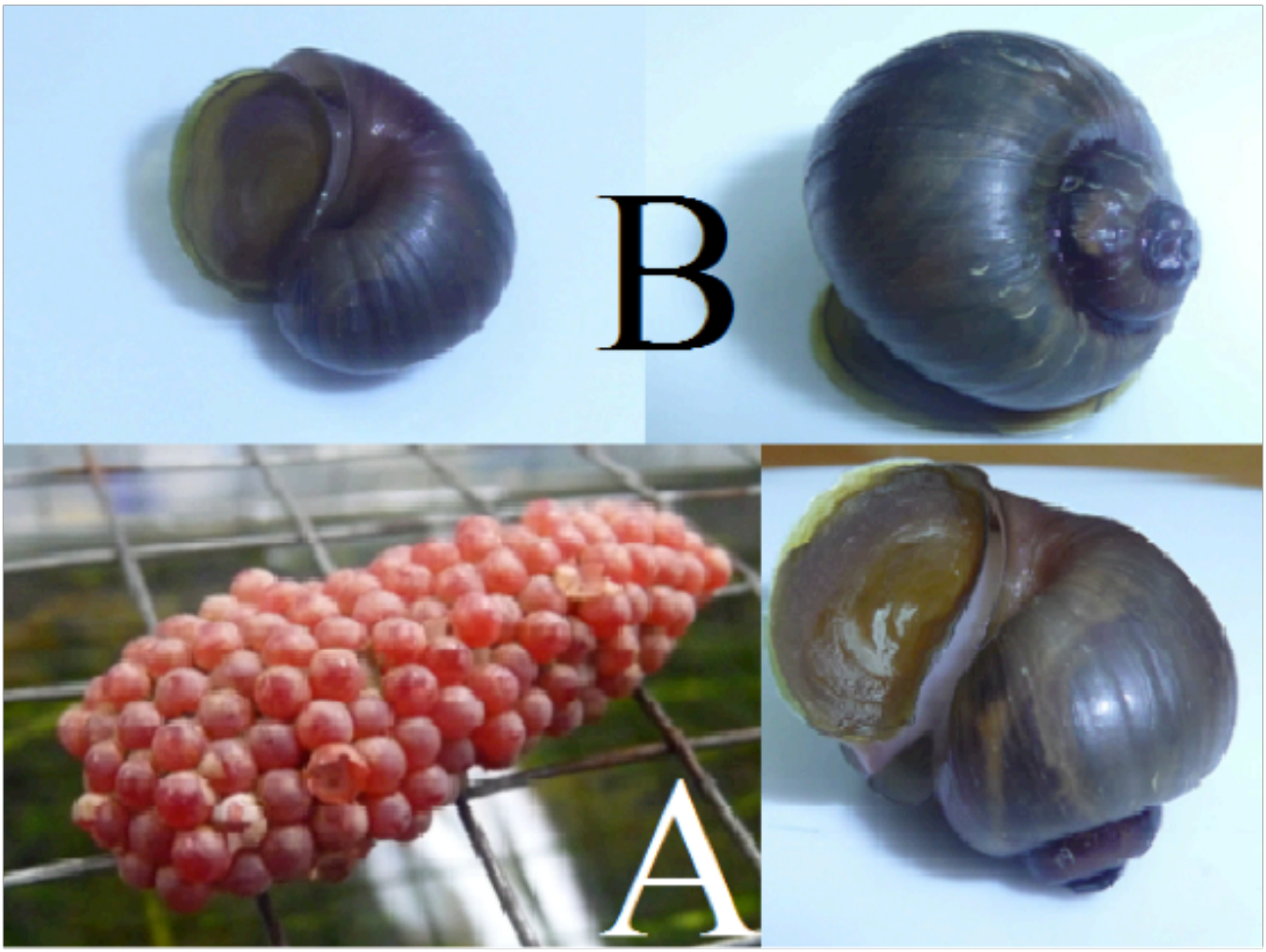

Fig. 1. (A) Pink egg case found at the Guanapo River; **(B)** 1-year-old juvenile *Pomacea canaliculata* (1.5cm shell diameter).

Second Record of *Polistes goeldii* (Hymenoptera: Vespidae) Wasps on Trinidad

On 15 March, 2014, Selwyn Gomes, Kamal Mahabir and I were watching birds at the far end of Lalaja Road. Lalaha Road is accessed via the Arima Valley but ends in the Guanapo Valley. While scanning the branches of a small tree, I saw a small wasp nest which was different from any that I had seen previously. The nest was hanging from a small branch, open to the weather. There were at least 12 cells on a long spindly open-hanging comb, with no nest covering. The nest was attended by two adults. Their predominant colour was a brilliant metallic dark blue. I took some pictures (Fig. 1) and later emailed them to Christopher Starr. He identified the wasp as *Polistes goeldii*, and noted that this was only the second record for Trinidad for this species.

Starr and Hook (2006) reported their find in similar terms: "In September 2004 we found an active colony of this…species at Caura Village, Trinidad…hanging from a highly eccentric petiole, attached to a fence wire…a little over one meter from the ground." Starr's paper showed only 19 other known sites of these wasps in all of Central and South America, from Nicaragua to Peru and Brazil. Starr's nest had 22 cells, also with two wasps in attendance.

About a week later, Chris Starr and Rakesh Bhukal were able to relocate the nest. Starr noted that the nest was about eight meters from the ground, in contrast to the other, which was only about one meter up. They were both out in the open, with no covering above them. Due to the shape of the nest, only a small surface was exposed to rain from above and run-off will be rapid.

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Fig. 1. *Polistes goeldii* nest, Lalaja Road, March 2014.

A Pairing Between a Green Heron (*Butorides virescens*) and a Presumed Green x Striated Heron (*Butorides virescens* x *striata*) in Tobago

Two species of *Butorides* herons are currently recognized: (1) the rufous-necked Green Heron (*B. virescens*) of North America, Central America and the West Indies; and (2) the gray-necked Striated Heron (*B. striata*) of South America (including dark *B. s. sundevalli* of the Galápagos Islands), Eurasia, Africa and Australia (American Ornithologists' Union 1998; Banks *et al.* 2003). Based on an increase in the variability and intermediacy of neck colour in the contact zone between the two species in central Panama and Tobago, the two species are thought to hybridise (Payne 1974; Hayes 2002, 2006; Hayes *et al.* 2013). Because random mating tends to reduce variability around an intermediate phenotype (observable expression of heritable traits), the full range of phenotypes among herons within the two contact zones suggests a tendency towards assortative mating (preferring to mate with one's phenotype) despite occasional hybridisation, supporting their recognition as distinct species (Hayes 2006; Hayes *et al.* 2013). However, there are no published observations of a mixed pair breeding. In this note we provide such evidence for a possible pairing between a hybrid *B. virescens* x *striata* and a *B. virescens* in Tobago.

At 0739 h on 27 March, 2012, we found an adult *Butorides* heron with a tan-coloured neck seemingly intermediate between the gray of *B. striata* and rufous of *B. virescens*, on a nest approximately 5m above the ground at Lowlands, Tobago (Fig. 1). Using a colour photograph of Payne's (1974) hybrid index specimens (Fig. 2), which ranked neck colour of the two species on a scale of 1-9, we scored its neck colour, based on our photos of the upper portion of the neck, as 5, which is intermediate between the normal range of variation within *B. striata* (1-4) and the normal range of variation within *B. virescens* (6-9), suggesting that it was probably a hybrid *B. virescens* x *striata*. Earlier studies suggest that the accuracy of scoring neck colouration is ±1 score (Hayes 2006; Hayes *et al.* 2013).

Another adult *Butorides* heron was perched just 3m away from the nest, flew about 25m away, and returned within a few minutes with a twig, but then got into a fight with two other *Butorides* herons that arrived almost simultaneously in the tree about 4m from the nest. The second adult *Butorides* had a darker rufous neck, indicating it was a *B. virescens*, but we were unable to score its neck colour because it flew off before we obtained a photograph. The other two *Butorides* herons also appeared to be *B. virescens*, including one well photographed with a neck colour score of 8. We suspect that the mate of the nesting heron was the individual that returned to the nest with a twig.

After observing and photographing the herons for about 5 mins, we departed and then returned about 15 mins. later, at 0759, when we observed a darker rufous-necked adult with a neck colour score of 7 on the nest (Fig. 1). Unfortunately, a cloud was passing over at the time so the lighting was not as good, but the neck of the heron was definitely deeper rufous than that of its mate. Scrutiny of our photos revealed a few other characters distinguishing it from the adult first observed on the nest (e.g., more yellow on bill, more sharply defined yellow loral streak, thinner white and thicker black malar streaks). We returned later in the day, at 1745h, and again observed the darker rufous-necked adult on the nest. After taking additional photographs, Hayes climbed the tree and observed at least two bluish eggs in the nest (there may have been more).

Based on a previous study of neck colour variation

Fig. 1. A relatively brown-necked (score of 5) presumed *B. virescens* x *striata* incubating eggs in a nest (left photo) and its more rufous-necked (score of 7) mate, a *B. virescens* (right photo), at Lowlands, Tobago on 27 March, 2012. Photos by Floyd E. Hayes.

Fig. 2. Voucher specimens from the National Museum of Natural History used by Payne (1974) to score neck coloration of *Butorides* for a hybrid index scale. Photo originally published in Hayes (2002).

among 50 individuals of *Butorides* in Tobago, the population is dominated by rufous-necked *B. virescens* with neck colour scores of 7-8 (50%), with a smaller proportion of intermediate individuals with neck colour scores of 4-6 (34%), and a few gray-necked *B. striata* with neck color scores of 1-3 (16%; Hayes 2006). There has been an apparent historical decline in the proportion of intermediate phenotypes in Tobago, which accounted for 72% of 18 specimens collected from 1892-1913 but only 34% of 50 live individuals during 2000-2002, suggesting a recent increase in assortative mating despite occasional hybridisation, and the rapid evolution of reproductive isolation (Hayes 2006). The only previously published data on breeding in Tobago is a simple statement that nesting by *B. virescens* had been "recorded in March" (ffrench 1991:59, 2012:71). Our observations reveal that a presumed hybrid *B. striata* x *virescens* with a neck color score of 5 was mated with a presumably pure *B. virescens* with a neck color score of 7, confirming that mating and successful egg laying occurs between relatively intermediate and relatively pure phenotypes. Further observations of mate choice among *Butorides* herons in Tobago and central Panama may provide further insights on the taxonomic status of the two species.

ACKNOWLEDGEMENTS

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Megeuptychia antonoe (Cramer) (Nymphalidae: Satyrinae: Satyrini), a New Butterfly for Trinidad, West Indies

On 4 January, 2015, Charles De Gannes and I were recording butterflies in the Cats Hill / Inniss Field area in south Trinidad. The weather was generally good and the rain held off. I netted a fairly large, dark Satyrini butterfly, flying at about shoulder height amongst some bushes. I did not recognise the butterfly, and kept it for later identification.

When I looked through the Satyridae section in Bernard D'Abrera's *Neotropical Butterflies Volume V*, my specimen appeared to be *Megeuptychia antonoe* (Cramer). I sent images of my specimen to Matthew Cock, (CABI UK) who confirmed both the identification and that this was a new species record for Trinidad (Barcant 1970; Cock 2014). *Megeuptychia antonoe* has underside spotting similar to that of some other Trinidad Euptuchiini but is considerably larger than any other Trinidad species of this group (Fig. 1). The Warren *et al.* (2015) *Butterflies of America* website gives the range of this species as "Southern Mexico to Bolivia." Below are images of the specimen from Cats Hill.

I assume that this is an overlooked species rather than a vagrant or a recent arrival. Given that most of the Satyrini found in Trinidad are reasonably common and easily collected, at first it would seem strange that a species of this subfamily could have been overlooked for so long, especially as the Cats Hill area has been well studied by many entomologists, and members of the tribe normally frequent low scrub, rarely visiting flowers but readily coming to rotting fruit. However, according to DeVries (1987), in Costa Rica *M. antonoe* is a canopy flier, rarely seen at ground level and not coming to rotting fruit at ground level. This perhaps explains why it has avoided discovery in Trinidad until now.

DeVries (1987) stated that the larvae of *M. antonoe* feed gregariously on *Calathea lutea* (Marantaceae). Working in western Costa Rica, Janzen and Hallwachs (2015) recorded it commonly from *C. lutea* and occasionally from *Pleiostachya pruinosa* (Marantaceae) and illustrate groups of the white caterpillars blending with the food plant leaf undersurface. *Calathea lutea* is common in lowland swampy areas of Trinidad (Meyer 1967) and frequently is seen along oilfield roads in swampy parts of Trinidad. It may be easier to locate the early stages than adults of this interesting addition to the entomofauna of Trinidad.

ACKNOWLEDGEMENTS

Thanks to Matthew Cock for confirming my identification and for assistance with the literature.

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Fig. 1. *Megeuptychia antonoe* upperside.

Fig. 2. *Megeuptychia antonoe* underside.

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Ganyra josephina janeta (Dixey) (Lepidoptera: Pieridae), a Butterfly Recorded on the Mainland of Trinidad for the First Time in Over 100 Years

Ganyra josephina janeta (Dixey) is a white butterfly of the Pieridae family, with subspecies *janeta* being known only from Venezuela and some of Venezuela's offshore islands. It has been referred to as *Pieris sevanta janeta* and *Ascia menciae janeta* in the Trinidad literature (Cock 2014).

In his book *The Butterflies of Trinidad and Tobago*, Malcolm Barcant (1970) did not accept it as a valid species for Trinidad and Tobago, although he noted that a single specimen had been recorded from Teteron Bay (on the Chaguaramas Peninsula) in 1904. There were no further records until Urich (1978) discovered it on Gasparee Island, also on the Chaguaramas Peninsula, so it was finally confirmed as occurring on Trinidad and Tobago. Then in January 1980, on a trip to Chacachacare Island, Matthew Cock and Julius Boos found it to be the commonest butterfly they encountered (Cock 1981).

On 15 October, 2014, I saw several white butterflies that looked a little different than the normal species on Point Gourde, and I captured one. It proved to be a male *G. josephina janeta*. These were very fresh individuals, so I assume they are breeding there. The specimen was positively identified by Matthew Cock.

As far as I am aware, this is the first record of the species from mainland Trinidad since the 1904 specimen was collected. Having said that, *G. josephina janeta* is plain white with only a narrow black tip to its forewings and an indistinct hindwing spot, so it is possible that it

Fig. 1. *Ganyra josephina janeta* upperside.

Fig. 2. *Ganyra josephina janeta* underside.

could have been overlooked or confused on the wing with other white butterflies found in Trinidad, such as males of *Glutophrissa drusilla* (Cramer) or even the common cabbage white, *Ascia monuste* (L.). The specimen from Point Gourde is shown in Fig. 1 (upperside) and Fig. 2 (underside). The distinctive white scaling along the veins is particularly clear in the left half of the upperside figure.

On a subsequent trip to Chacachacare, Cock (1984) witnessed *G. josephina janeta* ovipositing on *Quadrella odoratissima* (then known as *Capparis odoratissima*; Capparaceae). The recorded food plants of the genus are other species of *Quadrella* along with *Capparis* and *Forchhammeria* (Capparaceae) (Beccaloni *et al.* 2008). In *The Flora of Trinidad and Tobago*, Williams (1929) recorded eight species of *Capparis*, which are now included among the genera *Capparis*, *Quadrella* and *Cynophalla*; several of these are found on northwest peninsular Trinidad, although *Q. odoratissima* has been recorded only from Chacachacare. One or more of these is likely to be a suitable food plant for the butterfly on the main island of Trinidad.

ACKNOWLEDGEMENTS

Many thanks to Matthew Cock for his assistance in identification and for supplying background information on this species.

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Twelfth Report of the Trinidad and Tobago Birds Status and Distribution Committee: Records Submitted in 2014

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The abundance and status of most of our bird species, especially the common ones, are reasonably well known and described in the available field guides (ffrench 2012; Kenefick *et al.* 2012). Our knowledge of the rarer species is less complete. Rare species comprise 44% of our bird species richness, and since these species are rare, years of accumulated records are needed to assess status or changes in abundance. Without formal review and archiving, records would be haphazard and confidence low, making trends difficult to detect or interpret. The Trinidad and Tobago Rare Birds Committee was established in 1995 to assess, document, and archive the occurrence of rare or unusual birds in Trinidad and Tobago and thus provide reliable long-term monitoring of rarer species. Now renamed the Trinidad and Tobago Birds Status and Distribution Committee (TTBSDC), we have assessed all records submitted during 2014. In all, 85 records were adjudged, representing 49 different species. Of the submissions assessed, in only six cases did the TTBSDC find the identification inconclusive (see Inconclusive Records, below). In several instances, documented sightings were submitted as photographic evidence alone which can be difficult to assess with no supplementary written account. An excellent example of this is shown in Plate 1(a). This bird is clearly a medium sized, unfamiliar shorebird, yet expert opinion differs as to its identity. The Committee would welcome further comment. The records presented herein follow the taxonomic order and nomenclature of the American Ornithologists' Union's South American Classification Committee (http://www.museum.lsu.edu/~Remsen/SACCBaseline.htm), version of 18 February, 2015. All sightings were made in 2014 unless otherwise stated.

In terms of excitement and extreme rarity, 2014 will be remembered not only for the unprecedented number and variety of New World warbler sightings, but also for the addition of Fasciated Tiger-Heron, Black Kite, Red-tailed Hawk, White-eyed Parakeet, Eastern Kingbird, and Tennessee and Kentucky Warblers as new species to the Official List of the Birds of Trinidad and Tobago, bringing the running total to 480 species.

As of 31 December, 2014, the TTBSDC comprised the following members: Martyn Kenefick (Secretary), Geoffrey Gomes, Floyd Hayes, Bill Murphy, Kris Sookdeo and Graham White. Some instances require us to consult international experts to assist with difficult identification issues. In that regard we wish to acknowledge the valuable assistance provided in 2014 by William C. Clark, Dave Cooper, Dick Forsman, John Marchant, Richard Porter and David Rosair.

Archived records, including photographic submissions, numbered 1,112 at the end of 2014. TTBSDC records are held at 36 Newalloville Avenue, San Juan, Trinidad. Previous reports of this committee were prepared by Hayes and White (2000), White and Hayes (2002) and Kenefick (2005, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014).

The list of species considered by the TTBSDC, together with the Official List of the Birds of Trinidad and Tobago and details of all TTBSDC-accepted records, can be accessed at our new website at http://rbc.ttfnc.org. We urge finders of rare or unusual birds to document and report their sightings to the TTBSDC.

RECORDS ACCEPTED

Two adult **Jabirus (*Jabiru mycteria*)** were photographed as they fed in a shallow lagoon at Fullerton Swamp on 4 June, 2014 (CK); they remained until at least 8 June. An adult found on 5 August, 2014 (DR) in the freshwater marsh east of the Bush Bush Reserve in Nariva Swamp was joined by a second, slightly younger bird on 20 August (LE). The adult remained in the general area and was seen intermittently at Kernaham through at least 19 October, 2014 (FO). In 2013, two birds were seen regularly in the same area from June through November (see Kenefick 2014). Nariva Swamp is a huge area in which even a species as large as a Jabiru could hide, so it is conceivable that these birds were present all along.

A group of six **White-faced Whistling-Ducks (*Dendrocygna viduata*)** were found at the Caroni Rice Project on 9 August, 2014 (NL), two of which remained until at least 16 August. A flock of 26 were found at the same site on 8 October, 2014 (MK). Whilst seen annually at this site, the species has been documented elsewhere in Trinidad only twice in the last 19 years. All sightings have been between late May and early October.

A male **Muscovy Duck (*Cairina moschata*)** was photographed at Fullerton Swamp on 14 June, 2014 (KM). Of the ten documented sightings since 1995, seven have been from the tip of the southwestern peninsula.

An adult **White-tailed Tropicbird (*Phaethon lepturus*)** was found amongst the numerous Red-billed

Tropicbirds (*P. aethereus*) on Little Tobago Island, Tobago, on 14 January, 2014 (DL). Several other undocumented reports were received during the year, as in prior years; breeding was suspected but unproven.

Belated but still exciting, the TTBSDC received a photographically documented report of an adult **Fasciated Tiger-Heron (*Tigrisoma fasciatum*)** taken beside the Shark River, Matelot on 26 April, 2005 (HB, RK, ER, DS) (Plate 1e.). This is the first definitive record of the species for Trinidad and Tobago. Unlike the similar Rufescent Tiger-Heron (*T. lineatum*) which inhabits lowland swamp forest and freshwater marsh in Trinidad, Fasciated Tiger-Heron prefers running water in dense forests. The true identity of several undocumented reports involving immature Tiger-Herons beside streams in the Arima Valley over the years is likely to be this species.

A sub-adult **Grey Heron (*Ardea cinerea*)** was photographed at the Caroni Rice Project on 27 December, 2014 (MK, LJ). Once considered extremely rare in Trinidad and Tobago, 14 sightings of the species have been documented in as many years.

An adult **Cocoi Heron (*Ardea cocoi*)** was photographed along the Richmond River, Tobago on 11 February, 2014 (MKe). Only seven sightings in Tobago have been documented during the last 20 years. This sighting may pertain to the individual found at the same locality the previous year (March 2013) (see Kenefick 2014).

A sub-adult **Western Reef-Heron (*Egretta gularis*)** was photographed in the marshy fields adjacent to the Bon Accord sewage lagoons, Tobago; the bird was present at least 19-28 December, 2014 (SL). This sighting constitutes the second record for Tobago and only the third record for Trinidad and Tobago. Previous sightings were in January 1986 and December 2000. All three individuals have been of the dark colour morph, which is much more prevalent in West Africa than is the white colour morph. Elsewhere in South America, vagrants have also been found in Brazil and Ecuador.

An adult **Little Egret (*Egretta garzetta*)** was photographed at Bon Accord, Tobago on 18 January, 2014 (QQ). Once a traditional site for this species, this was the first Little Egret documented from Tobago for 14 years.

An adult **Scarlet Ibis (*Eudocimus ruber*)** was photographed in the mangroves alongside Bon Accord Lagoon, Tobago on 24 January, 2014 (MKe). This is only the second documented sighting for Tobago in the last 20 years.

Two **Glossy Ibises (*Plegadis falcinellus*)** were photographed at Kernaham on 11 January, 2014 (KM), and two were well observed at Bon Accord, Tobago on 20 January, 2014 (DK, MKe). Neither of the Tobago birds resembled the individual photographed at this latter site in November 2013 (see Kenefick 2014). Finally, a group of three were photographed feeding at the Caroni Rice Project on 9 August (NL), with one remaining in the area until at least 14 October, 2014 (MK).

An adult male **Green-winged Teal (*Anas crecca*)** was photographed flying over the sewage ponds at Lowlands, Tobago on 16 February, 2014 (FM). Two birds in non-breeding plumage present at this site in November 2013 (see Kenefick 2014) were not seen subsequently. This is a well watched site, so it is highly likely that this was a different individual.

A **Black Kite (*Milvus migrans*)** was photographed at the Petrotrin Pointe-à-Pierre dam on 26 November, 2014 (NHa, JM)(Plate 1f.). It was seen on two further occasions through 3 December, 2014. This is the first documented record of Black Kite for Trinidad and Tobago and indeed for South America. Whilst this species usually is found in Europe, Africa and Asia, this individual was of the highly migratory race *M. m. migrans*, which has been found as far afield as Iceland. Of interest, a Black Kite was reported (unconfirmed) in Barbados on 4 February, 2015.

Single **Crane Hawks (*Geranospiza caerulescens*)** were photographed at Sangre Chiquito on 21 February, 2014 (KM), North Manzanilla on 30 May, 2014 (KM) and Guapo, Point Fortin on 17 June, 2014 (DH). Documented in every year bar one since first being discovered in 2000, almost all sightings continue to come from either eastern or southwestern Trinidad.

A sub-adult **Red-tailed Hawk (*Buteo jamaicensis*)** was photographed from the roadside in the Main Ridge Forest Reserve, Tobago on 24 February, 2014 (NG, TT) (Plate 1b.). This is the first documented record of Red-tailed Hawk for Trinidad and Tobago. The Nearctic distribution of this species is unclear. The normal wintering grounds for boreal migrants extend south along the Central American land bridge to Panama, with single sight records from Colombia and Venezuela. Some authorities consider Red-tailed Hawk part of a superspecies that includes the sister taxa Rufous-tailed Hawk (*B. ventralis*), native to Argentina and Chile.

A basic-plumaged male **Ruff (*Philomachus pugnax*)** was found on the beach at Charlotteville, Tobago on 9 September, 2014 (NH). Whilst there were a flurry of sightings between 2000 and 2003, this was the first documented report of this Eurasian shorebird in nine years.

A **Pomarine Jaeger (*Stercorarius pomarinus*)** was photographed feeding at the mouth of the Caroni River on 24 January, 2014 (HD). Whilst this species is regularly found wintering in the waters of the Lesser Antilles to our north, this is only the fourth documented sighting in the last 20 years.

An alternate-plumaged **Black-headed Gull (*Chroicocephalus ridibundus*)** was found amongst numerous

Laughing Gulls (*Leucophaeus atricilla*) at Orange Valley on 13 May, 2014 (NL). This species has now been seen in eight of the last 14 years. All sightings have been from either the west coast of Trinidad or southwestern Tobago.

A first-winter **Franklin's Gull (*Leucophaeus pipixcan*)** was photographed at Orange Valley on 14 January, 2014 (NL). It was widely reported until 4 February. At the same site, a basic-plumaged adult was found on 18 January, 2014 (MK). At nearby Brickfields, another first-winter individual was found on 9 November, 2014 (NL). The increase in documented reports in recent years reflects enhanced observer awareness of identification criteria.

A **Lesser Black-backed Gull (*Larus fuscus graellsii*)** in first-winter plumage was photographed off Store Bay, Tobago on 24 January, 2014 (MKe). By coincidence, a similarly aged bird was found at the same locality in February, 2013 (see Kenefick 2014). Prior to that, the species had not been reported from Tobago for 10 years.

An adult **Caspian Tern (*Hydroprogne caspia*)** was found amongst the high tide roost at Brickfields on 22 October, 2014 and remained until 9 November, 2014 (NL). This was only the third record of the species in 19 years; all sightings have been 22 October - 24 November.

At least two **Scaled Doves (*Columbina squammata*)** were documented feeding in a garden on Gasparee Island on 16 March, 2014; and had been seen regularly before and continued to be seen after this date (EA, MF, MK). Elsewhere, four individuals were photographed in Tucker Valley, Chaguaramas on 15 September, 2014 (IK, FO), and another four at the Pitch Lake on 26 November, 2014 (DH). These sightings are further indications of a significant change in the status and distribution of this species. None were documented during the 70 years from 1926 (when first discovered in Trinidad) to 1996 (when one was documented from Nariva Swamp). A further 15 years passed before birds were found on Monos Island (2011). They have been found at La Brea annually since 2011 (see Kenefick 2012, 2013). Scaled Dove has a highly distinctive vocalisation, so it is unlikely that the species could have remained undetected if present during the intervening years.

A Short-eared Owl (*Asio flammeus*) favoured three overgrown fields at the Caroni Rice Project 10-23 August, 2014 (MK, GW). All four documented sightings from Trinidad and Tobago, involving five birds, have been at this site.

An adult **Aplomado Falcon (*Falco femoralis*)** was found in the fields to the north of Kernaham Village on 14 January, 2014 (DL). This possibly was the same individual documented during November 2013 (see Kenefick 2014). Elsewhere, three immature Aplomado Falcons were found hunting over Fullerton Swamp on 8 June, 2014 (KS).

A flock of at least 12 **White-eyed Parakeets (*Psittacara leucophthalmus*)** were seen close to the Arena Dam on 25 February, 2014 feeding on a flowering immortelle tree (FO) (Plate 1c.). A flock of six were photographed at Granville, Cedros on 27 June, 2014 (SP). Whilst we are aware of a small feral population that escaped from captivity a number of years ago in north Port of Spain, there is every reason to believe that the reports in 2014 are of wandering wild birds from the South American mainland. This species is common in Guyana, Venezuela and Colombia.

A pair of **Brown-throated Parakeets (*Eupsittula pertinax*)** was found at the entrance to the Aripo Agriculture Station avidly exploring a hole in the side of a termites' nest on 4 March, 2014 (KC, MR); they continued to be seen regularly throughout the month. Whilst unproven, breeding is suspected.

A **Variegated Flycatcher (*Empidonomus varius*)** was photographed at Fishing Pond on 1 March, 2014 (KM). Long considered a scarce austral migrant, this species has now been documented in Trinidad in all months except April and September. It is hoped that breeding may be proven in the near future.

The TTBSDC received documentation in 2014 of an immature **Eastern Kingbird (*Tyrannus tyrannus*)** photographed inside the Aripo Agriculture Station on 6 October, 1984 (CT *et al.*). This record constitutes the first record for Trinidad and Tobago of this migrant from North America. However, its similarity to an immature Fork-tailed Flycatcher (*T. savana*) may have hindered other potential submissions.

For the past five years there has been evidence of suspected breeding of **Lesson's Seedeaters (*Sporophila bouvronides*)** in a south Trinidad forest during June 2014 (KS). In view of the susceptibility of this species to bird catchers, no further details are being published at this time.

An adult male **Chestnut-bellied Seed-Finch (*Sporophila angolensis*)** was photographed at Carli Bay on 8 December, 2014 (NL). Whilst the identification is proven, wild provenance, especially in an area known for cage-bird activity, is doubtful.

A (presumed) pair of **Hepatic Tanagers (*Piranga flava*)** was photographed at Gran Couva on 15 December, 2014 (NL). Regularly seen at much higher elevations on the upper Blanchisseuse Road, this is the first documented record elsewhere in Trinidad.

It is now recognised that **Summer Tanager (*Piranga rubra*)** is one of the more regular wintering migrants in Trinidad, yet it is still decidedly rare in Tobago. During the last 20 years, the species has been documented at least 23 times. In 2014, sightings were as follow: 9 January, an adult male at Gran Couva (NL); 15 January, an immature

male at Carli Bay (NL, FM); 29 January, an immature male at Las Lapas Trace (MK); and 4 March, what might have been the same male but now in full adult plumage (MK, GW).

Single **Black-and-White Warblers (*Mniotilta varia*)** were found at Las Lapas Trace on 29 January, 2014 (MK) and at Carli Bay on 24 December, 2014 (NL). Of the 12 documented sightings in the last 20 years, six have been from Las Lapas Trace.

A basic-plumaged **Tennessee Warbler (*Leiothlypis peregrina*)** was found actively feeding in flowering trees in the park at Carli Bay on 4 January, 2014 (NL), joined on 1 February, 2014 by a second bird, partly moulted into alternate plumage (MK, NL). One bird remained until at least 17 February. This constitutes the first documented sighting of the species for Trinidad and Tobago. On 25 February, 2014 two alternate-plumaged birds were found in trees bordering a cocoa plantation at Gran Couva (MK) (Plate 1d.).

A female **Kentucky Warbler (*Geothlypis formosa*)** was mist-netted in the Aripo Savanna on 12 October, 2014 (RA,CF, DN) (Plate 1g.). This is the first record for Trinidad and Tobago of a species whose migration path and wintering grounds are, for the most part, through the Central American land bridge.

An adult male **Hooded Warbler (*Setophaga citrina*)** was found along the Blanchisseuse Road on 13 February, 2014 (CR, TT). This is only the third sighting for Trinidad and Tobago of this normally secretive North American migrant, the others being in December 1978 and January 2006.

An adult male **Northern Parula (*Setophaga americana*)** was photographed adjacent to a cocoa plantation at Gran Couva on 20 February, 2014 (NL, FO). This is the seventh documented record of this North American migrant for Trinidad and Tobago and the first record in Trinidad since 1998.

Continuing the increasing trend in **Bay-breasted Warbler (*Setophaga castanea*)** occurrences, no fewer than six birds were photographed in 2014 as follows: one at Morne Catherine, Chaguaramas on 4 February (RN), two at Gran Couva on 17 February (NL), two at Erin Savanna on 30 March (NL), and one again at Gran Couva on 9 December (MK, NL). Previously there were only 11 documented records for Trinidad and Tobago (of which four were in 2013 - see Kenefick 2014). It is unclear whether this cluster of sightings represents a true widening of the migration route of this species or if their similarity to Blackpoll Warbler (*S. striata*) has historically obscured their true status in Trinidad and Tobago.

A **Yellow Warbler (*Setophaga petechia*)** of the rufous-capped form, known colloquially as Golden Warbler, was found close to the Diego Martin River on 29 April, 2014 (FO). Whilst its subspecific identification is impossible to determine from the photographic evidence provided, it was likely either *S. p. petechia*, resident in Barbados, or *S. p. alsiosa*, found on Carriacou and The Grenadines; both subspecies look extremely similar to each other.

A breeding-plumaged **Chestnut-sided Warbler (*Setophaga pensylvanica*)** was photographed along the upper Blanchisseuse Road on 4 March, 2014 (DR, RS). This is the sixth documented sighting of this North American migrant in the last 20 years. All sightings have been in the Northern Range.

A flock of 25 **Bobolinks (*Dolichonyx oryzivorus*)** was found at the Caroni Rice Project on 8 October, 2014 (MK). Of the 17 documented sightings of this species since 2000, all but two have been from October through December.

ESCAPED CAGE AND AVIARY SPECIES

A feral flock of as many as nine **Village Weavers (*Ploceus cucullatus*)** were reported regularly from the Caroni Rice Project during 2014. A **Java Sparrow (*Lonchura oryzivora*)** was photographed at Carli Bay in November 2014. Additionally, there will always be the thorny question of provenance when it comes to many seedeater and seed-finch sightings; therefore, the TTBSDC has decided to restrict assessment to identification only.

ADDITIONAL RECORDS

Acceptable records also were received for 18 sightings of the following species whose status already has been established: **Rufescent Tiger-Heron (*Tigrisoma lineatum*)**; **Hook-billed Kite (*Chondrohierax uncinatus*)**; **Rufous Crab Hawk (*Buteogallus aequinoctialis*)**; **Black Hawk-Eagle (*Spizaetus tyrannus*)**; **Crested Caracara (*Caracara cheriway*)**; and **Black-whiskered Vireo (*Vireo altiloquus*)**.

INCONCLUSIVE RECORDS

Documentation of sightings of the following species were deemed inconclusive: **Glossy Ibis (*Plegadis falcinellus*)**; **Aplomado Falcon *(Falco femoralis)***; **Curlew Sandpiper (*Calidris ferruginea*)**; **Venezuelan Flycatcher (*Myiarchus venezuelensis*)**; **Chestnut-bellied Seed-Finch (*Sporophila angolensis*)**; and **Black-and-White Warbler (*Mniotilta varia*)**.

NOMENCLATURE CHANGES

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

As a result, the following nomenclature changes were made in 2014 that affect the Official List of the Birds of Trinidad and Tobago: Mangrove Rail (*Rallus longirostris*), formerly Clapper Rail; Red-breasted Meadowlark (*Sturnella militaris*), formerly Red-breasted Blackbird.

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Legend to plate

a. Mystery Sandpiper, Brickfield, December 2014. Photo: Nigel Lallsingh
b. Red-tailed Hawk, Main Ridge Forest Reserve, Tobago, February 2014. Photo: Tat Taylor
c. White-eyed Parakeet, Arena Forest, February 2014. Photo: Feroze Omardeen
d. Tennessee Warbler, Gran Couva, February 2014. Photo: Cyril Coomansingh
e. Fasciated Tiger-Heron, Shark River, April 2005. Photo: Dean Schuler
f. Black Kite, Gasparillo, December 2014. Photo: Jameel Mohammed
g. Kentucky Warbler, Aripo Savanna, October 2014. Photo: Darshan Narang


a.
b.
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Victor C. Quesnel (1925-2014)

Compiled by Kris Sookdeo from Input by Yasmin S. Baksh-Comeau, Adrian Hailey, Elisha Tikasingh, Christopher Starr and Other Members

How does one summarize the work of such an accomplished naturalist as Dr. Victor Clement Quesnel? While it would be perfectly acceptable to speak solely of his personal life, given the choice, Victor would probably most like to be remembered by his academic and Club life.

His second eulogy (for such was the magnitude of Victor's life that two eulogies were read at his funeral) is reprinted in the first quarterly bulletin of 2015 and a much earlier dedication to Victor appeared in the Special Centenary Issue of the Living World in 1991. The account that follows was compiled from both documents, as well as from written accounts by Victor himself and comments from Club members.

Victor Quesnel was born in Port of Spain on 23 November, 1925. He was privately tutored from 1930 to 1934 and attended St. Mary's College from 1934 to 1944. He placed first in the Higher School Certificate Examination in 1944 and was not only awarded the Jerningham Gold Medal, but also won the science scholarship of that year.

He left Trinidad in 1944 to attend the University of Toronto where he obtained his B.A. in Physiology and Biochemistry in 1949. That summer he returned to Trinidad and met Ludolf Wehekind, the then President of the Trinidad Field Naturalists' Club, who informed Victor of the Club's grave need for a secretary (and without which the Club had not been able to meet). Victor indicated his willingness to accept the post after he had completed his studies and returned to the University of Toronto where he completed his M.A. in Plant Physiology in 1950. Postgraduate studies on the dependence of protein synthesis on RNA synthesis, continued at the University of Cambridge where he was awarded his doctorate in 1955.

By this time Victor had already returned to Trinidad "for good", in July 1953, and began his working career at the Colonial Microbiological Research Institute (CMRI) at Federation Park. He made good on his promise to the Club and on 28 January, 1954 at St. Mary's College, Victor became the Club's Honorary Secretary. He would hold that post for six years until he relinquished it on 11 February, 1960. During this time, he was behind the move to resuscitate the Journal of the Trinidad Field Naturalists' Club, production of which restarted in 1956. Following his stint at the CMRI, he began working at the Cocoa Research Unit at the University of the West Indies (UWI) in 1961, focusing on how the fermentation process affected the flavor of cocoa. He would eventually quit UWI in 1961 to dedicate his time to his hydroponic farm at Talparo.

Between 1975 and 1977, Victor served as Vice President of the Club and again as Honorary Secretary in 1980 and 1981. In 1984 and 1985 he returned as Vice President and then finally, between 1986 and 1988, he served as President.

Having revived the Club's journal in 1956, Victor served periodically on the editorial committee for a period of over 24 years. The Living World journal is one of the signature publications of the Club, where Victor's legacy is branded *ad infinitum* with the insect on our logo which is the Inca beetle, *Inca clathrata*. The subspecies found in Trinidad is *Inca clathrata quesneli*.

Within his field of work, he published twelve papers relating to the physiology and biochemistry of fermentation in cocoa beans. But it is perhaps his research outside of his profession for which he is most admired. Victor wrote at least one article in every issue of the journal from 1956 to 2008. He was happy doing original research in topics far from and has authored over 25 original research papers and co-written at least 11 papers with other researchers (See Appendix II), co-written three books on the natural history of Trinidad and Tobago (See Appendix III).

As noted by Adrian Hailey, Victor has consistently published over a sustained period of 55 years, in an extremely broad range of topics.

Dr. Quesnel was the first in the world to recognise the phenomenon of cyclorotating eyes in tadpoles, based on observations of a local tree frog. This is one example of an internationally influential paper published in 1956 on tadpole eye movement (that should have your eyes rotating).

Similarly, his joint paper in 2009 on *Anolis* lizards entitled, "The persistence of *Anolis trinitatis* as a naturalized lizard in Trinidad against hybridization pressure with *Anolis aeneus*", is an astonishing example of continuity in research efforts, as it refers back to the 1959 paper on two sibling species of anoles in Trinidad. Dr. Quesnel must be one of very few researchers to have published on the same topic 50 years apart - an example of a rare continuity of research effort. Victor's publications are well-cited by the international research community and will continue to be so for posterity.

It is not surprising that in order to be such a prolific writer Victor kept detailed field notes. These notes are compiled into 42 volumes of notebooks which in themselves are a valuable resource. These notebooks were handed

over by Victor to Yasmin S. Baksh-Comeau and Adrian Hailey, in the Department of Life Sciences at UWI, with the understanding that they will be published in the near future.

His fascination with the natural world manifested itself in other ways as well. He mapped cave systems, collected specimens for international museums and readily used his own body to satisfy various questions related to human health, including the effects of consuming charcoal and the toxicity of manchineel and mora.

Victor's health began to decline after a relatively minor surgical procedure and eventually it became difficult for him to attend meetings and other activities of the Club. On 22 December, 2014, he passed away in the company of his cargiver. His funerary mass at the St. Anthony's R.C. Church in Petit Valley was well attended and his body was cremated at the St. James Crematorium.

The list that follows is a compilation of the work of Victor Quesnel. It stands as testimony to the life of one of our country's greatest naturalists.

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BOOK REVIEW

Bushmaster: Raymond Ditmars and the Hunt for the World's Largest Viper. Dan Eatherley. Arcade Publishing, New York. xivv, 303 pp.

The 1935 book, *Snake-Hunters Holiday* is a combination travelogue, adventure and scientific quest, co-authored by Raymond Ditmars, a New York Zoological Society reptile curator and William Bridges, a reporter for the *New York Sun*. It tells the story of a working summer vacation to Trinidad to collect reptiles in the summer of 1934. While Ditmars is listed as the senior author, he had little to do with the actual text written by Bridges; but, the book was commissioned by Ditmars. The major focus of the trip, capturing the giant pit viper, *Lachesis muta* - also known as the bushmaster or on Trinidad as mapepire z'annana. *Snake-Hunter's Holiday* is also significant because of its recognition of the TTFNC, which is still thriving more than 80 years later. Now, Dan Eatherley has written a biographical volume on Raymond Ditmars and his obsession with finding a bushmaster in the wild.

Eatherley's *Bushmaster: Raymond Ditmars and the Hunt for the World's Largest Viper* will be an interesting and rewarding book for anyone familiar with Ditmars, interested in Trinidad's natural history, or passionate about snakes. And, for those who are not, it will open a window to early 20th century herpetology and the exploration of the natural world. Eatherley follows Ditmars' career, visiting locations where Ditmars lived, worked, and collected snakes. Ditmars sphere of influence extended well beyond herpetology into public education and conservation. He had the attention of President Theodore Roosevelt and undoubtedly contributed to Roosevelt's enthusiasm for all of nature. Ditmars' books lead the way forward for reptile conservation as he investigated the decline in snake dens, learned to maintain reptiles in captivity and generate widespread interest in a group of animals badly in need of a publicist.

Eatherley's blending of humour, memoir and natural history stimulates our appreciation for Ditmars quest by illustrating his ingenuity in making his way through life and his unwaivering determination to study snakes. The anecdotal stories of Ditmars amassing a snake collection as a teenager reveal his lifelong fascination with snakes, which launched a zoo career, academic research, and a public education campaign that added herpetology to the average American's vocabulary.

Readers with a phobia of snakes may cringe at the story of Ditmars' extensive snake collection housed in his parents' home, and how he once manoeuvred a bushmaster, loose in the room into a cage. True, natural history adventure stories like this one may be just what is needed to expand interest in younger generations often consumed by technology and oblivious to the natural world.

Throughout the book are many side trips in topics, time and geography: the founding of the New York Zoological Society and the National Parks in the USA, Ditmars' time as a newspaper reporter, and his transition to Curator of Reptiles at the New York Zoological Society (AKA the Bronx Zoo); the problems associated with the CroFab antivenom; and discussions of vampire bats and rabies.

Ditmars, Trinidad and the bushmaster all came together because of Richard R. Mole, a Trinidad newspaper editor and snake enthusiast. In his teenage years Ditmars corresponded with people from all over the planet. Mole sent 19-year-old Ditmars an eight foot bushmaster as part of a trade for some North American snakes. This is the story that initiates Eatherley's book. The bushmaster captured Ditmars' attention and increased his fervour to find one in nature. But, the sight of a bushmaster in the wild eluded Ditmars. Trips to Central America and the 1934 trip to Trinidad that resulted in *Snake-Hunter's Holiday* did not satisfy Ditmars' quest. I will leave the results of Eatherley's parallel quest to discover a bushmaster in the field to the reader.

Bushmasters are an iconic reminder that nature is both dangerous and our life support system. Much remains to be learned about bushmasters, their relationships with the large rodent, *Cuniculus paca* and the bizarre and ancient pentastomid parasites than infect their respiratory system. Pentastomids are thought to be most closely related to barnacles. Because bushmasters are the only Neotropical pit vipers documented to lay eggs, they may also provide some interesting clues to the evolution of reproductive modes in snakes. Bushmaster… is a good introduction to the snake and herpetological history and will hopefully stimulate some readers to become more interested in both.

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Notes to Contributors

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

Articles submitted for publication are sent to two referees for review.

Articles are accepted on the condition that they are submitted only to *Living World*. Regarding a co-authored article, the senior author must affirm that all authors have been offered an opportunity to peruse the submitted version and have approved of its publication.

Articles may be emailed to: **g.whitett@gmail.com** or **ysbaksh.comeau@gmail.com**

In general, we follow the Council of Science Editors Style Manual (https://writing.wisc.edu/Handbook/DocCSE.html).

All articles, except for Nature Notes, should be accompanied by an abstract and a list of key words.

Nature Notes is a section allowing contributors to describe unusual observations on our flora and fauna. The title of each Nature Note should include key words and the note should not exceed three journal pages in length, including tables and photographs. Only a few key references should be included.

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

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

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

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

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

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