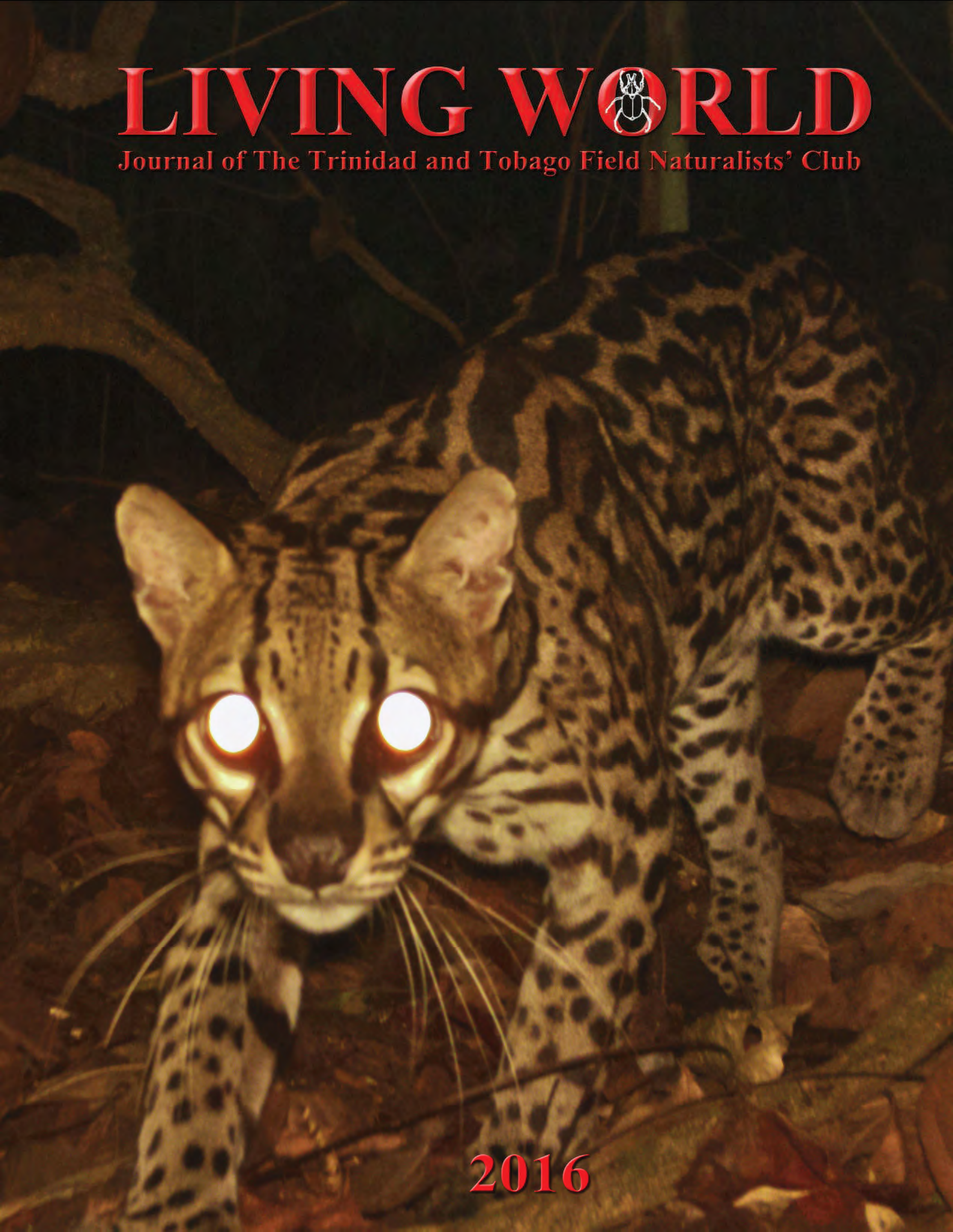
LIVING WORLD

Journal of The Trinidad and Tobago Field Naturalists' Club



2016

THE TRINIDAD AND TOBAGO FIELD NATURALISTS' CLUB

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

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

Enquiries

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

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Editorial

This year *Living World* has reached a major milestone in that we are now published online. This enables *Living World* to be more widely accessible and, even more importantly, to be searchable online through Google Scholar and similar services. Reaching the global natural history community in this manner has been one of the goals of *Living World* for several years. It has been largely through the efforts of the Club's president, Mr. Kris Sookdeo, that our goal has been achieved. *Living World* is now available in two formats—the familiar printer-friendly PDF as well as a fully searchable webpage format. Past issues are also being reformatted where possible to make them accessible online as well.

Our 2015 Guest Editorial presented the Club's position on hunting in Trinidad and Tobago, stressing the need for sound management decisions based upon reliable monitoring of the species targeted. In this issue we continue to recommend such monitoring, and we build on this approach with a research paper and two nature notes that focus on the use of trail cameras ("camera trapping") as a means of monitoring the presence and activities of our mammalian fauna. The research paper, by Mike Rutherford and Kimberly Chu Foon, describes the activity patterns of the mammals of Spring Hill in the Arima Valley. Mike has also provided a nature note demonstrating the existence of a small population of Capybara in the Caroni River basin in Trinidad. Kris Sookdeo's paper describes his observations on the mammals of Cat's Hill in south-eastern Trinidad; Kris also provided us with our cover image. The results of these studies have already demonstrated that our mammalian fauna is in better shape than many had feared and that their populations can be effectively monitored. We hope that others will follow this lead and will conduct additional studies leading towards a better understanding of the impact of hunting regulations and other policies on the populations of mammals in Trinidad and Tobago.

In addition to the above, this issue of *Living World* contains six research papers, four nature notes, and one report. We cover a wide range of animal taxa including insects, arachnids, molluscs, amphibians, reptiles, birds, and mammals. Unfortunately, we received no manuscripts on plant studies for this issue. Matthew Cock's paper provides an account of the hesperid skippers of the genus *Staphylus*. We present two short studies on social insects, one on foraging by bees, by Donna-Marie Alexander and Christopher Starr, and the other, by Andrea A. Scobie and Christopher Starr, on colony founding in the social wasp *Mischocyttarus baconi*, with possible implications for the origin of sociality. We include an account of the spiders of St. Eustatius, by Joe Morpeth, Jo-Anne Nina Sewlal, and Christopher Starr; this paper is part of a series describing the spider fauna of the eastern Caribbean islands. Staying with the Arachnida, the paper by Rakesh Bhukal provides the first record of autotomy in the scorpion *Ananteris cussinii*; autotomy is the phenomenon in which an individual can cast off part of its anatomy to distract a predator and thus escape.

Ryan Mohammed and Lanya Fanovich provided a glimpse into the life of the original inhabitants of Trinidad with their account of the molluscs found during excavations at the Red House in Port of Spain. Their research suggests that the Red House was built on an Amerindian midden.

A search by Ruth Shepherd, Paul Hoskisson, and Roger Downie for chytrid fungal infections in Trinidad's frogs yielded no cases of infection. Good news, but no reason for complacency.

In their paper on Cuvier's Dwarf Caiman, Saiyaad Ali and his co-authors share their discovery of not just one individual but a population of this species in Trinidad. Their paper also provides a record and photograph of the rare Double-striped Water Snake *Thamnodynastes ramonriveroi.*

Turning to birds, we present an account by Mike Rutherford of Oilbird predation by a Common Black Hawk at Cumaca Cave. We also present the Thirteenth Report of the Trinidad and Tobago Bird Status and Distribution Committee, provided by Martyn Kenefick. The report of this committee identifies as the highlight of the birding year the discovery three Amethyst Woodstar hummingbirds in Trinidad, the first of which was in the editor's garden. This discovery increases to 481 the total number of birds recorded in Trinidad and Tobago.

Cover Photograph

The ocelot, *Leopardus pardalis*, is our only documented native species of cat. Rarely seen and typically nocturnal, its status on the island is poorly understood but it is known to exist in forested areas throughout Trinidad. This individual was photographed in Cat's Hill during a camera trapping exercise in 2013.

Staphylus spp. (Lepidoptera, Hesperiidae, Pyrginae, Carcharodini) in Trinidad, West Indies

Matthew J.W. Cock

c/o CABI, Bakeham Lane, Egham, Surrey TW20 9TY, UK.
m.cock@cabi.org / mjwcock@btinternet.com

ABSTRACT
Staphylus kayei, S. lenis and *S. tyro* are known from Trinidad; *S. tyro* is also known from Chacachacare Island, but no *Staphylus* spp. are known from Tobago. Observations are provided on the food plants, leaf shelters, early stages and parasitoids of *S. kayei* and *S. lenis*. The food plants in Trinidad are all species of Amaranthaceae, apart from one record from *Piper* sp. (Piperaceae) considered to need confirmation, and one from *Mimosa pigra* (Fabaceae) considered to be an error.

Key words (not in title): *Staphylus kayei*, *Staphylus lenis*, *Staphylus tyro*, Amaranthaceae, caterpillar, larva, pupa, leaf shelter, parasitoid.

INTRODUCTION

Staphylus is a genus of at least 50 small, brown, variably spotted Carcharodini skippers (Mielke 2004, Warren *et al.* 2016). Cock (1996) provided a detailed account of the genus in Trinidad and Tobago, based on four species: *S. kayei* Cock, *S. lenis* Steinhauser, *S. tyro* Mabille and an unidentified species known from reared females only. The recent checklist of Trinidad Hesperiidae (Cock 2014) repeated this information. No *Staphylus* spp. are known from Tobago, and since Tobago has been reasonably well collected and these butterflies fly in open disturbed spaces such as flowery roadsides, they are unlikely to have been overlooked.

The purposes of the following note is (1) to provide better illustrations of the adults, as those of Cock (1996) were of poor quality inadequate for identification, (2) document and illustrate the life history of *S. kayei*, (3) illustrate the partial life history of *S. lenis*, and (4) clarify that the unidentified species is now recognised to be *S. kayei*, which is more variable than previously recognised. Information is not repeated if given in Cock (1996), so that paper should also be consulted.

Staphylus is one of very few Hesperiidae genera that feed on Amaranthaceae. Thus far, all seven species for which food plants are known are Amaranthaceae feeders, with just a few records from other families (Beccaloni *et al.* 2008, Janzen and Hallwachs 2015), so records from other families are noteworthy and should be critically evaluated. All plants mentioned here belong to this family unless indicated otherwise. Beccaloni *et al.* (2008) list only Amaranthaceae as food plants for this genus, apart from two Trinidad records of *S. mazans*, which Cock (2014) considered misidentifications for *S. lenis*. Cock (1985) reported the work of M. Yaseen (CABI) who reared a specimen identified as *S. mazans* from *Mimosa pudica*. This single specimen is now held in the UWI Zoological Museum (M. Rutherford, pers. comm. 2015). It is a female *S. lenis*, which probably was reared as part of a general survey of insects feeding on *M. pudica* without careful observation of the biology, and is likely to represent a caterpillar wandering off its Amaranthaceae food plant to pupate on *M. pudica* or pupating in a shelter combining *M. pudica* and its normal food plant. Accordingly I discount this record. S. Alston-Smith (pers. comm. in Beccaloni *et al.* 2008) reports *Piper* sp. (Piperaceae) as a food plant of *S. mazans* (i.e. *S. lenis*). This does not seem to be the normal food plant and further observations would be desirable for confirmation.

In Trinidad, Simmonds (1964) recognised nine genera of Amaranthaceae, and notes that several species are cultivated as food (spinach) and ornamentals. I have reared *Staphylus* spp. from *Alternanthera*, *Pfaffia*, and *Cyathula* spp. and found empty leaf shelters on *Achyranthes aspera* (Figs. 1–4).

Fig. 1. Whole plant of *Achyranthes aspera* growing at the base of a concrete wall, Point Gourde, 16 October 2011; MJWC 11/63.

Fig. 2. Stage 1 shelter of a *Staphylus* sp. on *Achyranthes aspera*, Point Gourde, 16 October 2011; MJWC 11/63.

Fig. 3. Stage 1 (right) and open stage 2 shelter (left) of a *Staphylus* sp. on *Achyranthes aspera*, Point Gourde, 16 October 2011; MJWC 11/63.

Fig. 4. Stage 3 shelter of a *Staphylus* sp. on *Achyranthes aspera*, Point Gourde, 16 October 2011; MJWC 11/63.

***Staphylus kayei* Cock**

In Trinidad, this is a common species in disturbed areas of low vegetation including roadsides and neglected gardens. Pinned and living specimen are shown as Figs. 5–9. Cock (1996, 2014) included an unidentified *Staphylus* sp., based on a short series of female specimens reared from the south of Trinidad on *Cyathula achyranthoides*, an introduced African species. Selected specimens were barcoded in association with Professor N.V. Grishin, University of Texas, using methods similar to those described by Cong and Grishin (2014) and Shiraiwa *et al.* (2014). Initial results showed that one of these specimens has almost the same barcode as that obtained from one of the male paratypes of *S. kayei*, and should very likely be considered conspecific. Re-examination of preserved material led to the conclusion that they are all one species, sharing features of the UNS, particularly the pale shading at the tornus, but being more variable in the UPS than previously realised. Thus, Cock (1996, 2014) treated specimens of *S. kayei* with subapical spots but no discal spots (Fig. 6) as *S. kayei*, and those with discal spots in spaces 1A, 1B and 2 (Figs. 7 and 9) as *Staphylus* sp.

I reared this species from *Pfaffia iresinoides* at Mt. St. Benedict's 15 July 1996 (96/10) and several times from *Cyathula achyranthoides* at Inniss Field, north-east of Moruga (2 October 1994 94/53, 17 May 1999 99/11, 16 January 2004 04/30). A further collection on C. *achyranthoides* near Moruga Bouffe (24 March 2003, 03/222) was not reared through. Leaf shelters photographed on *Achyranthes aspersa* (Point Gourde, 16 October 2011, 11/63, Figs. 2-4) and on *P. iresinoides* (Mt. St. Benedict's, 9 October 2011, 11/10, Fig. 11) are most likely this species too. Collection 94/53 was described in Cock (1996) as *Staphylus* sp., but the following is based primarily on collection 96/10.

Leaf shelter 1 is an oval two-cut shelter, about 4 x 3mm cut from the edge of the leaf lamina (Fig. 2) or from the edge of a hole in the leaf lamina (Fig. 3) and folded upwards. Leaf shelter 2 is often made on the same leaf (Fig. 3) and is an irregular flap about 12 x 7 mm cut from the leaf edge and folded upwards along a main vein. The stage 3 shelter may be similar to the stage 2 shelter but larger, and the fold may be along the midrib (Figs. 4, 11), with or without making a cut depending on the leaf size. In captivity, one caterpillar constructed the pupal shelter from a whole leaf rolled upwards. The cremaster hooked into a cross bar of silk at one end and there was no evidence of a Y-shaped silk girdle to support the pupa.

The final instar (Figs. 12–13) is up to 18mm long. Head 2.1 x 2.3 mm wide x high; chordate, broadly indent at vertex; matt black or very dark brown; rugose, shiny; a group of seven small concolorous domes adjacent to each other

Fig. 5. Paratype male *Staphylus kayei*, Spanish Farm, near las Lomas.17 December 1980 (Cock 1996, Plate 3).

Fig. 6. Paratype female *Staphylus kayei*, Curepe, March 1980 (Cock 1996, Plate 4).

Fig. 7. Female *Staphylus kayei*, reared from caterpillar collected on *Cyathula achyranthoides*, Inniss Field, north-east of Moruga, 2 October1994; 94/53.

Fig. 8. Male *Staphylus kayei*, Rio Claro–Guayaguayare Road, 9 October 2011. The forewing costal fold indicates that it is a male, the yellow-orange dorsal head and lack of white spots are diagnostic for male *S. kayei* in Trinidad.

Fig. 9. Female *Staphylus kayei*, reared from caterpillar collected on *Cyathula achyranthoides*, Inniss Field, 2 October 1994; photographed 31 October; MJWC 94/53. (See also Fig. 7; DNA MJWC 2015-060). The absence of a costal fold indicates this is a female; the white spots are similar to those of *S. lenis* (Fig. 21); in Trinidad female *S. kayei* can be distinguished by the relatively even speckling of the wings, but more reliably by the pale area at the tornus UNH (Figs. 6-7).

Fig. 10. *Pfafffia iresinoides*, a food plant of *Staphylus kayei*, Mt St Benedict's, 9 October 2011; MJWC 11/10.

dorsolaterally on the face; head covered with short, pale, erect setae, those on face shorter and divided near apex, those laterally and dorsally longer with multiple branches; posterior margin a very narrow, long 'neck'. Pronotum transparent, shiny, concolorous with body. Body smooth dull translucent green with underlying pale fat bodies and scattered small dull yellow speckles, except on dorsal line which therefore seems darker; pale tracheal line; male gonads conspicuous dull yellow; scattered short, pale, erect setae, which are branched distally; all legs concolorous; spiracles pale, inconspicuous.

Fig. 11. Two stage 2 shelters of *Staphylus ?kayei* on *Pfafffia iresinoides*, Mt St Benedict's, 9 October 2011; MJWC 11/10

Fig. 12. Final instar caterpillar of *Staphylus kayei*, collected on *Cyathula achyranthoides*, Inniss Field, north-east of Moruga, 17 May 1999; photographed 20 May; pupated 25 May; 18mm; MJWC 99/11A.

The penultimate instar (Fig. 14) is similar to the final instar, 13mm long; head 1.5 x 1.6mm wide x high; as final instar, but no domes dorsolaterally on face. T1 pronotum is slightly dark on the posterior margin. Body dull translucent green; dorsal line darker due to absence of underlying fat bodies; gonads pale, diffuse; pale tracheal line; ventrolaterally and ventrally pale; all legs concolorous. The earlier instar caterpillars are dull green; T1 pale; head black, chordate; Ln-2 1.0 x 1.0 mm, Ln-3 0.7 x 0.7 mm wide x high.

The pupa (Fig. 15) measures 10–12 mm long; elongate, fairly smooth, with bulbous eyes; brown;

Fig. 13. Detail of head of final instar caterpillar of *Staphylus kayei*, collected as penultimate instar on *Cyathula achyranthoides*, Inniss Field, 16 January 2004; moult to final instar not recorded; photographed 29 January 2004; pupated 15 February; MJWC 04/30B.

Fig. 14. Penultimate instar caterpillar of *Staphylus kayei*, collected on *Cyathula achyranthoides*, Inniss Field, north-east of Moruga, 17 May 1999; photographed 20 May; moulted to final instar 1 June; 11mm; MJWC 99/11B.

short pale, erect setae; covered with white waxy protrusions except for a stripe down the centre of the eye, and spiracle T1 which is large, brown and slightly protuberant; other spiracles inconspicuous.

An *Apanteles* sp. (Braconidae, Microgasterinae) was reared from one of two caterpillars collected on *Cyathula achyranthoides* at Inniss Field, north-east of Moruga, 16 January 2004 (04/30). Three parasitoid larvae emerged from the mature caterpillar and span cocoons in the leaf shelter on 2 February; on 14 February two adult parasitoids emerged. J.L. Fernández-Triana (pers. comm. 2014) advises that they represent an undescribed species of *Apanteles*, closely related to *A. ruthfrancoae* Fernández-Triana.

Fig. 15. Pupa of *Staphylus kayei*, collected as caterpillar on *Pfaffia iresinoides*, Mt. St. Benedict's, 15 July 1996; pupated 7 September; photographed 8 September; adult 22 Sep; 10mm; MJWC 96/10.

Another collection made on *Pfaffia iresinoides* at Mt. St. Benedict's 15 July 1996 included final instar host remains in a leaf shelter with emerged Microgasterinae cocoons (96/10E), which could have been the same species. Approximately 20 white cocoons were arranged in an irregular group held together with silk.

One pupa reared from a caterpillar collected on *C. achyranthoides* at Inniss Field, north-east of Moruga, 17 May 1999 (99/11A) was parasitised by a larval-pupal tachinid parasitoid. Five days after the pupa was formed, the parasitoid puparium was formed within the host pupa and the head of the pupa broke off as the fly emerged. The tachinid has not been identified.

Staphylus lenis Steinhauser

This is a fairly common species in Trinidad, found in similar habitats to *S. kayei* (e.g. Figs. 8 and 19 were taken on the same occasion). Males have a costal fold, and can be readily separated from those of *S. kayei* by the minimal orange scaling of the dorsal head and head, and the white dots in fore wing spaces 2, 3, 6–8 and cell (Figs. 19, 19, 20). Females have variable white dots in fore wing spaces 1A, 1B, 2, 3, 6–8 and cell (Figs. 17, 18, 21); the sub-basal spots in spaces 1A and 1B distinguish this species from heavily marked female *S. kayei* when present (Figs. 7, 9), but they are not always present or may be inconspicuous (Fig. 6). The two dark discal bands on both wings upper side and the lack of white shading at the tornus UNH should separate this species from female *S. kayei*.

I have found and reared a larva of this species on *Alternanthera tenella* at Brasso, central Trinidad (1.x.1994, 94/45) which I described in Cock (1996). Here I include images of the caterpillar (Fig. 22) and pupa (Fig. 23) of collection 94/45, which was reared through. Re-examination of the caterpillar remains indicates that they are indistinguishable from those of *S. kayei*, except that in this individual there were only five small contiguous domes dorsolaterally on the face. The pupa is covered with white waxy powder rather than the erect extrusions noted in S. kayei, but the latter would probably rapidly abrade to a powder-like texture.

A caterpillar found on *A. philoxeroides* at Sangre Grande, Sans Souci Estate, 23 January 1982 (88/38B) died before pupation, but would have been a *Staphylus* sp., probably *S. lenis*.

Fig. 16. Male *Staphylus lenis*, Rio Claro – Guayaguayare Road, milestone 4.5–5.5, 1 October 1994.

Fig. 17. Female *Staphylus lenis*, Brigand Hill, 6 April 1982.

Fig. 18. Female *Staphylus lenis*, Curepe, 3 May 1982 (Cock 1996, Plate 6).

Fig. 19. Male *Staphylus lenis*, Rio Claro – Guayaguayare Road, 9 October 2011. The forewing costal fold indicates that it is a male, and the dark dorsal head and scattered white spots distinguish it from male *S. kayei* in Trinidad.

Fig. 20. Male *Staphylus lenis* reared from caterpillar collected on *Alternanthera tenella*, Brasso, 1 October1994; photographed 19 October 1994; MJWC 94/45.

Fig. 21. Female *Staphylus lenis*, Diego Martin, July-August 2012 (photo P.Geerah). The absence of a costal fold indicates this is a female; the white spots are similar to those of *S. kayei* (see Fig. 9), but note the two dark discal bands on both wings.

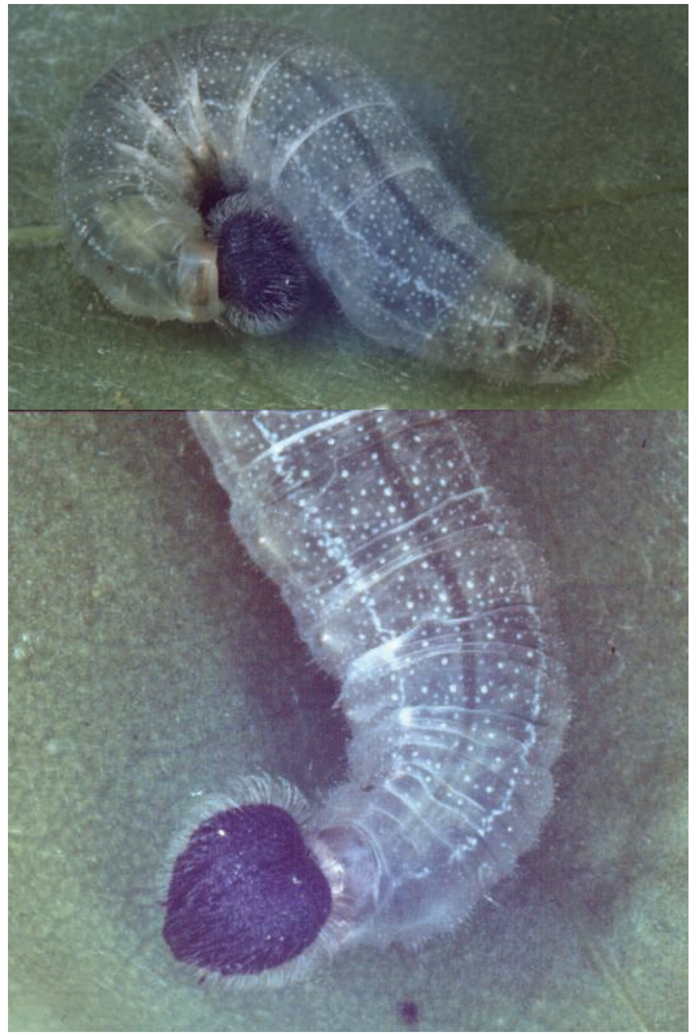

Fig. 22. Final instar caterpillar of *Staphylus lenis*, collected on *Alternanthera tenella*, Brasso, 1 October 1994; photographed 1 October; pupated 7 October; MJWC 94/45.

Staphylus tyro **Mabille**

Cock (1981) reported the original capture of a pair on Chacachacare Island. These specimens are illustrated here (Figs. 24 and 26). Since then, SAS has collected five males and five females, all from Chacachacare Island apart from single specimens from Point Gourde and Morne Catherine in north-west Trinidad.

At present, this is the only *Staphylus* sp. known from the Bocas Islands, and only in north-west Trinidad may *S. tyro* co-occur with the other two species of *Staphylus* found in Trinidad. In Cock (1996) I indicated that the males have no spots, but subsequent collecting by S. Alston-Smith indicates they may have three apical spots (Fig. 25). Males have a costal fold; the absence of orange scales on the dorsal head and palpi and the absence of white dots on the fore wing discal area (Figs. 24–25) separate this species from the other two *Staphylus* spp. known from the island of Trinidad. The female has small subapical spots in forewing spaces 6–8, which may resemble the markings of some female *S. kayei* (Fig. 26), or may be more elongate

Fig. 23. Pupa of *Staphylus lenis*, collected as final instar caterpillar on *Alternanthera tenella*, Brasso, 1 October 1994; pupated 7 October; photographed 7 October; adult 19 October; MJWC 94/45.

(Fig. 27), but the UNH lacks the white suffusion at the tornus characteristic of *S. kayei* (Figs. 6–7).

No food plants have been reported for *S. tyro*, but it is likely to be a species of Amaranthaceae, perhaps *Iresine angustifolia* which in Trinidad and Tobago is restricted to the Bocas Islands (Simmonds 1964).

Fig. 24. Male *Staphylus tyro*, Chacachacare Island, lighthouse track, M.J.W. Cock and J.O. Boos, 15 January 1980 (Cock 1996, Plate 8).

Fig. 25. Male *Staphylus tyro*, Chacachacare Island, (photos S. Alston-Smith).

Fig. 26. Female *Staphylus tyro*, Chacachacare Island, Rusts's Bay, M.J.W. Cock and J.O. Boos, 15 January 1980 (Cock 1996, Plate 9).

Fig. 27. Female *Staphylus tyro*, Chacachacare Island, S. Alston-Smith (photos S. Alston-Smith).

DISCUSSION

At the moment, *S. kayei* is known from *Pfaffia iresinoides* and *Cyathula achyranthoides* and *S. lenis* from *Alternanthera tenella*. Observations from *Achyranthes aspersa* and *Alternathera philoxeroides* are provisionally allocated to *S. kayei* and *S. lenis* respectively. I can see no useful distinguishing characters to separate the early stages of *S. kayei* and *S. lenis*, although more careful examination of additional material may help in this regard. Accordingly all *Staphylus* spp. should be reared through to confirm the host plant records, until we have enough to see whether there is a clear division of host plants as appears to be the case at the moment, or whether there are shared food plants.

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Comparative Activity Patterns of Some Neotropical Bees in a Suburban Area in Trinidad, West Indies

Donna-Marie Alexander and Christopher K. Starr[1]

Department of Life Sciences, University of the West Indies, St. Augustine, Trinidad and Tobago
1. *ckstarr@gmail.com*

ABSTRACT

Flower visitation rates of five common bees to *Antigonon leptopus* are compared during an early morning and a late morning period in Trinidad, West Indies. Throughout the day three highly social bees (*Apis mellifera*, *Partamona nigrior* and *Trigona nigra*) were more abundant, overall, at flowers than two solitary bees (*Ceratina* sp. and *Pereirapis* sp.). As predicted, there was a significant proportional shift from the social to the solitary species between the early and late morning. In contrast, there was a significant shift from smaller to larger bees between the early and late morning, which is contrary to the prediction. This however, is considered inconclusive, as the large bees comprised a single highly social species.

Key words: *Antigonon leptopus*, *Apis mellifera*, *Ceratina*, *Partamona nigrior*, *Pereirapis*, *Trigona nigra*.

INTRODUCTION

Bees predominate among animals that visit flowering plants to collect pollen and nectar, which form the mainstay of their diet. Bees also account for the majority of flowering-plant pollination, which is key to the relationship from the plants' point of view. Most plants make their pollen and/or nectar available in the daytime, so that most bees are diurnal and stop foraging during rain. Competition among bees is evidently intense, but as a strong general rule this is scramble, or pre-emptive competition, rather than interference, or aggressive competition (Roubik 1989).

Pollen and nectar from a given plant species are not uniformly available during all daylight hours. This poses for the bees the strategic question of how best to allocate foraging effort for maximum return, in view of how plants schedule the availability of resources and the activities of other bee species. Roubik (1989: Figs. 2.35-2.39) shows the daily pattern of 17 tropical bee species. For the most part, these show foraging throughout the day, with a peak in the early or mid-morning. The emerging general pattern (Roubik 1989 and references therein) is of a shift in proportions throughout the day a) from social bees capable of nestmate recruitment to solitary and other bees, and b) from larger to smaller bees. This is thought to be due to social and/or larger bees successfully monopolising floral resources in the early period.

Here we examine whether bee visits to one common tropical plant conform to this pattern.

METHODOLOGY

Observations were made in suburban St Augustine, Trinidad and Tobago, during October-November 1999. Preliminary observations identified three plants as broadly attractive to bees in this habitat: the wayside herbaceous plants *Antigonon leptopus* (Polygonaceae) and *Tagetes* sp. (Compositae) and the ornamental palm *Adonidia merrillii* (Palmae). Further observations showed that the first of these was most reliable in attracting various bees, so that it became the main focus.

Preliminary observations also showed five bee species as most abundant at these plants: a) *Ceratina* sp. (Apidae: Xylocopinae), solitary, body length <5mm, b) *Pereirapis* sp. (Halictidae), solitary, body length <5mm, c) *Partamona nigrior* (Apidae: Meliponini), highly social, body length about 5mm, d) *Trigona nigra* (Apidae: Meliponini), highly social, length about 5mm, and e) the introduced honey bee *Apis mellifera* (Apidae: Apini), highly social, body length about 11mm. Two *Ceratina* species are known from Trinidad, *C. chloris* and *C. minima* (Starr and Hook 2003), and our records may represent a mixture of the two. The *Pereirapis* sp. is presumably *P. semiaurata*, the only species recorded from Trinidad (Starr and Hook 2003).

We tabulated bee visits to the three plants during two periods: 07:00-09:00 (early, on three days) and 11:00-13:00 (late, on four days) when there was no significant rain. It is assumed that all visiting bees were female. Attention to *Antigonon* consisted of watching a particular patch about 20-30 cm wide for 15 min, then switching to a different patch for 15 min. Table 1 shows the data for *Antigonon.* Most of our records from *Adonidia* and *Tagetes* are of a single species, *A. mellifera*, and thus much less informative.

RESULTS and DISCUSSION

Whilst 57% of recorded social-bee visits to *Antigonon* flowers were during the early period, this was the case for only 14% of solitary-bee visits, a highly significant difference (χ^2 test with Yates's correction for continuity, $p<0.01$). The data corroborate the predicted proportional shift from social to solitary bees over the course of the day.

If we divide the bee species into large (*A. mellifera*) and small (all others), we find that 38% of large-bee visits

Table 1. Visits by five bee species to flowers of *Antigonon leptopus* in St Augustine, Trinidad and Tobago during three (early period) and four (late period) days, October-November 1999. Further explanation in text.

Period	Species					Total
	***Ceratina* sp.**	***Pereirapis* sp.**	***Partamona nigrior***	***Trigona nigra***	***Apis mellifera***	
early	0	7	214	3	21	245
late	18	25	143	2	34	222
Total	18	32	357	5	55	467

were during the early period, versus 54% of small-bee visits. This significant difference ($p<0.05$) is contrary to the expected proportional shift from larger to smaller bees. However, because the large-bee category in our results comprised a single, highly social species, this result must be regarded as tentative.

ACKNOWLEDGEMENTS

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Notes on Colony Composition in the Social Wasp *Mischocyttarus baconi* (Hymenoptera: Vespidae)

Andrea A. Scobie[1] and Christopher K. Starr[2]

Department of Life Sciences, University of the West Indies, St Augustine, Trinidad and Tobago
1. Present address: Department of Biology, University of the Southern Caribbean, Maracas St Joseph, Trinidad and Tobago; an8scobie@yahoo.com.
2. *ckstarr@gmail.com*

ABSTRACT
Aspects of colony composition during the founding stage of the colony cycle are described for *Mischocyttarus baconi*, based on 20 colonies studied in Trinidad, West Indies. About half of our colonies were founded by a single adult female, the others by up to five females. Colony growth in this stage is slow, with a high rate of failure. We found no evidence that larger founding groups build larger nests, on average.

Key words: Founding stage

INTRODUCTION

Mischocyttarus is a New World genus of about 250 species of social wasps (Silveira 2008). In the English-speaking West Indies, *Mischocyttarus* and the more familiar *Polistes* are commonly known as Jack Spaniards. The nesting biology of four *Mischocyttarus* species have been studied in depth (Jeanne 1972; Litte 1977, 1979, 1981).

As in *Polistes*, a new *Mischocyttarus* colony is founded by one or several queens without the aid of workers (Jeanne 1980, Gadagkar 1991). The emergence of the first workers marks the end of the founding stage and the start of the growth stage of the cycle. Emergence of the first males and gynes (new queens) marks the start of the reproductive stage towards the end of the cycle. Males typically begin emerging before gynes and are physically distinguishable from them, so that the start of the reproductive stage can be known with some exactness.

Also in common with other independent-founding polistines, typical *Mischocyttarus* colonies are small, and the nest is a single uncovered comb of cells. *Mischocyttarus baconi* is found throughout Trinidad, West Indies and may have an extensive distribution in northern South America east of the Andes. In Trinidad it commonly nests in and on buildings. *M. baconi* co-occurs in Trinidad with *M. trinitatis* (formerly regarded as a form of *M. alfkenii*; Silveira 2013). The two are virtually indistinguishable, except that they build two distinct types of nests (O'Connor *et al.* 2011; Scobie and Starr 2012).

The founding stage is expected to be an especially testing time, with implications for the colony's ultimate reproductive success and a high rate of colony failure. Our purpose here is to record the first information on *M. baconi* in this part of the cycle.

METHODOLOGY

Twenty colonies of *M. baconi*, situated under the concrete eaves of a building were examined and the following noted: a. nest size in the founding stage, and censuses of b. adult females in the founding stage, c. eggs hatched, d. larvae pupated, and e. adults eclosed. Full censuses were taken on three occasions during the study, supplemented by 34 partial censuses during July and September 2000. We did not mark wasps for individual recognition, thus turnover among foundresses may have been missed.

RESULTS AND DISCUSSION

The composition of founding-stage *M. baconi* colonies examined are provided in Table 1. The number of foundresses varied between one and five. Eleven of the 20 colonies never had more than one foundress during the founding stage. Six of these were censused on one day, the others on up to 27 of 37 census days. There was a weak positive correlation between number of founding females and nest size (Spearman's rho = 0.33; $p>0.05$). In the absence of direct observations of rates of nest growth, this is consistent with the hypothesis that colony growth is limited by factors other than the number of available nest builders. The production of new adults was slow, with just 24 emerging in 254 colony-days.

In *Mischocyttarus* and other independent-founding wasps, survivorship and productivity of multiple-foundress colonies tend to be higher than those founded by single females (Gadagkar 1991, Reeve 1991). Our results corroborate this tendency for *M. baconi*. Six of nine multi-foundress colonies survived to the end of the observation period, significantly greater than the two out of 11 single-foundress colonies that survived (Table 1; χ^2 test, $p < 0.05$). Except for one single-foundress colony (F3), those that survived to the end of the observation period were the same as those that produced adult offspring, so that multi-foundress colonies likewise performed better by this index.

In four colonies (A9, B1, B7, and B8) some larvae and

Table 1. Composition of founding-stage *Mischocyttarus baconi* colonies. Colony numbers match those of Scobie and Starr (2012). Nest size is expressed as number of cells at the end of the 37-day observation period. The number of foundresses is the maximum number of adult females observed on the nest during the founding stage. Duration is the number of days that wasps were present in the observation period. Survival is expressed as the last day of the observation period on which adult wasps were present; a double asterisk indicates that adults were present to the end (day 37). Emerged adults are expressed as females + males.

Colony	Nest size	Foundresses	Duration (days)	Survival	Eggs hatched	Larvae pupated	Adults emerged
E1	2	1	3	19			
G3	3	2	2	16			
A3	3	1	1	6			
F3	5	1	16	**			
B7	5	1	27	**	6	4	1+0
A9	5	2	31	**	8	3	1+0
B2	5	2	30	**	5	4	4+0
B4	6	2	1	8			
C8	7	1	1	6			
B1	8	5	32	**	7	5	2+1
A4	9	1	1	8			
D1	12	1	9	22			
C10	16	5	30	**	5	5	2+3
G2	18	3	30	**	10	10	8+1
A8	20	1	1	15			
C11	24	1	5	31			
C1	29	1	1	27			
B5	56	4	2	8			
B8	60	3	30	**	2	1	1+0
D2	68	1	1	8			
Mean	18.1	2.0					
Total					43	32	19+5

pupae went missing. There was no indication whether these fell victim to predators or were aborted by adults.

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

Joe Morpeth[2], Jo-Anne Nina Sewlal[1*] and Christopher K. Starr[1]

1. Department of Life Sciences, University of the West Indies, St Augustine, Trinidad and Tobago
2. 37 Limethwaite Road, Windermere, Cumbria, LA23 2BQ, United Kingdom
*Corresponding author: *joannesewlal@gmail.com*

ABSTRACT

Three photographic surveys were conducted during the period; 2010 to 2011, 2013 and 2014, and supplemented by physical sampling for a one-week period in January 2015, in a wide variety of habitats on the island of St. Eustatius, West Indies, for the presence of spiders. Seventeen localities were surveyed from 15 habitats, including five man-made habitats. Twenty-four families representing 53 species were collected. Members of the family Araneidae comprised almost a quarter of the species found. More species in natural than in human-made or highly disturbed habitats.

Key words: *Anapidae, Araneidae, Barychelidae, Clubionidae, Corinnidae, Filistatidae, Gnaphosidae, Lycosidae, Mimetidae, Miturgidae, Mysmenidae, Ochyroceratidae, Oecobiidae, Oxyopidae, Pholcidae, Salticidae, Scytodidae, Sicariidae, Sparassidae, Tetragnathidae, Theridiidae, Theridiosomatidae, Thomisidae, Theraphosidae.*

INTRODUCTION

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

Spiders have a worldwide distribution, occupying all land environments except at the polar extremes. Currently almost 46,058 species of spiders are described (World Spider Catalog 2016), representing what is believed to be roughly one-fifth of the total in the world. The spider fauna of the neotropics remains relatively unknown. Currently, the islands of Barbados (G. Alayón and J. Horrocks, unpubl.), St. Vincent and the Grenadines (Simon 1894; de Silva *et al.* 2006), Anguilla (Sewlal and Starr, 2010), Antigua (Sewlal 2009a), Nevis (Sewlal and Starr 2007), St. Kitts (Sewlal 2008), Grenada (Sewlal 2009b), Montserrat (Sewlal 2010a), St Lucia (Sewlal 2011) and Great Inagua, Bahamas (Sewlal and Starr 2011) are the only islands in the Caribbean whose spider fauna has been documented at the species level, although this has been done at the family level for Trinidad (Cutler 2005; Sewlal and Cutler 2003; Sewlal and Alayón 2007; Sewlal 2009c, 2010b).

The overall goal of the project was to collect and document a substantial part of the total species present in a broad range of habitats, both natural and those influenced by human activities. This paper forms an addition to the series of papers, listed above, documenting the spider fauna of islands in the Caribbean region.

METHODS

Photographic surveys of the spider fauna of St Eustatius were conducted between 2010 and 2011, 2013 and 2014. This data was supplemented by a survey that took place 10-17 January 2015 utilising specialised techniques aimed at collecting spiders. The sampling methodology was unstandardised with respect to sampling techniques, collecting team and sample period, and took place over a five-year period.

St Eustatius lies at 17°30′N 62°58′W in the northern Leeward Islands of the West Indies, southeast of the Virgin Islands and immediately northwest of Saint Kitts and Nevis. The island is a saddle shape, with two elevations. "The Quill" to the southeast reaches an altitude of 602m and a collection of hills to the northeast, known as the Northern Hills, have a maximum altitude of 289.4m (Madden and Esteban 2008). St Eustatius provides a range of habitats including deciduous and semi-evergreen seasonal forest, dry evergreen forest, montane thickets, thorny woodland, and elfin forest. The selection of habitats and localities for this survey were on consultation with staff at (St. Eustatius National Parks) STENAPA and Caribbean Netherlands Science Institute (CNSI) (Fig. 1).

The photographic surveys of 2010 to 2011 were carried out by Morpeth primarily involving searching for specimens within all microhabitats of the sample site (e.g. under rocks, within soil and leaf litter, under bark, within vegetation and on/in webs). Both diurnal and nocturnal sampling was done for this survey. All specimens were collected in jars and photographed by Hannah Madden (STENAPA National Park Ranger/Education Officer), either in the field or after collection. Whenever possible a photo was taken to see the eye pattern of the spider, which is an important identification characteristic. Some individuals could not be identified due to their extremely small size, and thus difficult to photograph; these were omitted from the study. After being photographed, the spec-

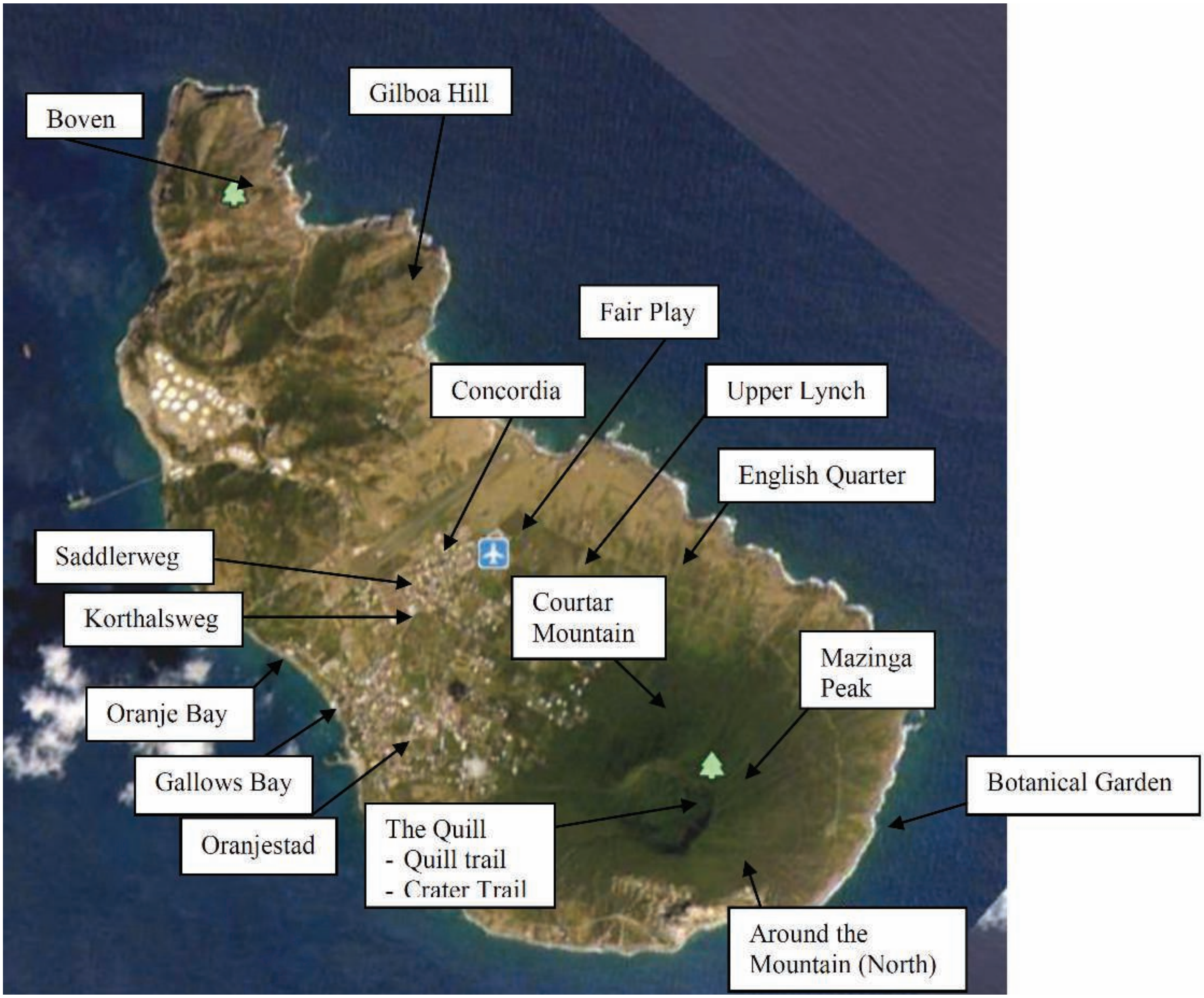

Fig. 1. Localities sampled in St. Eustatius for the period 2010, 2011, 2013, 2014 and 2015. Map taken from Google Maps.

imens were released at the location at which they were found. These photographs were sent to Dr. Rolando Teruel at BIOECO (Museo 'Tomas Romay') for identification. Dr Teruel was able to identify 75% of the spiders photographed.

Brief photographic surveys were carried out in 2013 and 2014 each lasting for five days. Photos during these surveys were taken by Mark Yokoyama (Les Fruits de Mer, St Maarten).

Supplementary sampling of the main vegetation types was carried out by Sewlal and Starr during the period 10-17 January 2015. The main collecting methods employed were sweep-netting and visual searches, both at ground level and above ground, including shrubs and low trees. Both collecting methods were employed at each site visited. The former concentrated on dislodging any individuals resting or hiding in the vegetation, whilst the latter relied on visual cues in addition to the orb-webs to find old webbing or retreats or silk threads that could lead to the retreats of nocturnal species. Cryptic microhabitats, such as under rocks, rotting logs and bark were also searched. No nocturnal surveys were conducted as these were deemed too dangerous. All specimens were stored in glass vials in 95% alcohol.

Nests of the mud-dauber wasp *Sceliphron* cf. *assimile* (Sphecidae) were found in abundance under a rocky outcrop at the base of the Boven National Park. This genus is known to exclusively use spiders to provision their nests (Iwata 1976). Therefore active and recently sealed nests were collected as a potential additional source of spiders.

Specimens from the 2015 survey are deposited in the Land Arthropod Collection of the Zoology Museum at the University of the West Indies, St Augustine, Trinidad and Tobago.

RESULTS

During this study, 17 localities (Fig. 1) covering 15 habitat types were sampled, including six that were man-made or heavily influenced by human activities. The sampling effort produced a total of 53 species from 24 families. Since sampling effort was not standardised comparisons of species richness between habitats/locations must be made with caution. The results showed that overall the natural habitats (31 species) and habitats occupied by humans or influenced by human activities (38 species) contained similar numbers of species (Table 1). The dry scrubland habitat yielded 24 species; whilst the garden habitat produced 19 species (Fig. 2). However, of the habitats sampled, the two altered habitats (abandoned storage shed and ruins) yielded only one and two species respectively (Table 1). Araneidae was the dominant family, yielding 13 species. Araneidae and Tetragnathidae were the two most ecologically diverse families containing species collected from nine and seven habitats respectively. Species from 12 families were found in only one habitat, five of which were collected from dry scrubland (Fig. 3), indicating that this habitat had a unique species composition. However, this is a preliminary survey and with further sampling more species from those families could be found in other habitats on the island.

DISCUSSION

Based on sampling efforts conducted on other islands in the region, it was not surprising that the thorny scrubland on Gilboa Hill proved particularly speciose in terms of web-building spider species. The thorny vegetation provides increased points of attachment which are more stable for web construction. However, the grass and understory vegetation in some places provides pockets of microhabitat suitable for non-web-building species for example, those of the family Salticidae and Miturgidae. In this locality, we found two aggregations of the leaf litter dwelling species *Aleimosphenus licinus* (Tetragnathidae). It was observed that this species shared its microhabitat with many lizards of the species *Anolis* sp. a known predator of spiders. This observation led to the hypothesis that this species' bright red colour is aposematic, the testing of which requires further research.

In terms of habitats modified by human activities, garden yielded the most species. This may be as they have similar conditions as thorny scrubland that favour web-building spider species which comprised a majority of the species recorded in this habitat. The pathways and gaps in gardens allow prey in particular, flying insects which can be blown into webs. Another feature of most altered habitats is the presence of artificial lighting during the night which attracts flying insects, so that nocturnal species have a relatively steady food supply.

The two habitats yielding the least number of species were ruins (two species) and abandoned buildings (a single species). *Oecobus* sp. (Oecobiidae) which is commonly found on ruins in other islands were found on the ruins of a sugar plantation building on the eastern side of the island, but not the western coast along Gallows and Oranje Bays. Their absence could be due to the fact that most of the ruins were located at the waters' edge and thus subjected to constant wave action. The presence of the second species found in this habitat - *Kukulcania hibernalis* (Filistatidae)

Sampling efforts yielded three species of the family Pholcidae commonly called Cellar Spiders or Daddy Long-legs. In forested habitats the space between buttress roots, (referred to as "buttress notches") a common spider microhabitat, was consistently empty throughout the island, probably because they were not deep enough to provide shelter and protection from the elements or predators. Semi-evergreen forest habitat yielded three species. However, the conditions inside the crater were closest to a rainforest and individuals of the genus *Modisimus* were observed. It is expected that this habitat contains a fairly rich spider fauna however, the trail proved too challenging to proceed very far inside as it has become degraded over the years especially during a period of very heavy rain in 2010 (Jessica Berkel, pers. comm.).

Along the trails on Gilboa Hill in the northern part of the island, which is considerably drier, pholcid spiders were found between the stem and the base of the leaves of the terrestrial bromeliad *Bromelia humilis*. This sturdy and thorny vegetation would prevent easy access by predators like birds and lizards. The single species detected from an abandoned storage facility approximately 100m from the airport was *Smeringopus pallidus* (Pholcidae). This species is documented from caves and abandoned houses in Anguilla (Sewlal and Starr 2010).

Despite the known association between the wasp *Sceliphron* cf. *assimile* and spiders, their nests yielded no spiders or their exoskeletons. Further sampling of nests during nesting season, suspected to be during the late northern summer, might be more fruitful.

With respect to human health, the species *Latrodectus geometricus* (Theridiidae), commonly called the Brown Widow, and those belonging to the infraorder Mygalomorphae, commonly referred to as "tarantulas" should be approached with caution but are not regarded as fatal. Although no specimens of this infraorder were collected from this survey, their presence was confirmed by the presence of the tarantula-hunting wasp *Pepsis ruficornis* (Pompilidae).

Table 1. Araneomorphae and Mygalomorphae spiders for each habitat sampled in St. Eustatius for the period 10-17 January 2015. *NOTE*: Sampling effort was not standardised so any comparisons of species richness between habitats/locations must be made with caution.

Families and Species	**Garden**	**Roadside**	**In and on Buildings**	**Pasture land**	**Ruins**	**Abandoned storage facility**	***Sceliphron* sp nests**	**Coastal Vegetation**	**Thorny woodland**	**Dry evergreen forest**	**Semi-evergreen forest**	**Montane thickets**	**Elfin woodland**	**Deciduous forest**	**Dry scrubland**
Anapidae															
Sp A		✓													
Araneidae															
Argiope argentata	✓	✓						✓	✓						✓
Gasteracantha cancriformis	✓			✓				✓	✓	✓				✓	✓
Metepeira compsa	✓	✓		✓				✓	✓					✓	✓
Neoscona oaxcensis		✓													
c.f. *Eustala anastera*	✓			✓				✓	✓	✓					✓
Cyclosa caroli	✓	✓							✓			✓			✓
Cyclosa walkenaeri	✓													✓	✓
Mecynogea lemniscata															✓
Metazygia sp.	✓							✓						✓	
Araneilla sp.	✓									✓					
Araneid sp A															✓
Araneid sp B										✓					
Eriophora sp.									✓						
Barychelidae															
Sp A															✓
Clubionidae															
Sp A															✓
Coriniidae															
Sp A														✓	
Filistatidae															
Kukulcania hibernalis					✓										
Gnaphosidae															
Sp A															✓
Sp B															✓
Herpyllus sp.	✓														
Lycosidae															
Sp A	✓														
Mimetidae															
Sp A															✓
Miturgidae															
Sp A	✓	✓						✓		✓					✓
Teminius sp.			✓												
Mysmenidae															
Sp A									✓			✓			
Ochyroceratidae															
Sp A												✓			
Oecobiidae					✓										✓
Sp A															
Oxyopidae															
Peucetia viridens															✓
Pholcidae															
Smeringopus pallidus						✓									✓
Modisimus sp											✓	✓			
cf *Physocyclus globosus*			✓												

Table 1. Continued. Araneomorphae and Mygalomorphae spiders for each habitat sampled in St. Eustatius for the period 10-17 January 2015. *NOTE*: Sampling effort was not standardised so any comparisons of species richness between habitats/locations must be made with caution.

Families and Species	Garden	Roadside	In and on Buildings	Pasture land	Ruins	Abandoned storage facility	*Sceliphron* sp nests	Coastal Vegetation	Thorny woodland	Dry evergreen forest	Semi-evergreen forest	Montane thickets	Elfin woodland	Deciduous forest	Dry scrubland
Salticidae															
Sp A				✓											✓
Sp B	✓														
Hentzia sp.															✓
Menemerus bivittatus			✓												
Lyssomanes sp				✓								✓			
Scytodidae															
Scytodes fusca												✓			
Scytodes longipes			✓												
Sicariidae															
Loxosceles caribbaea															✓
Sparassidae															
Olios sp.									✓						
Theridiidae															
Sp. A										✓					
Anelosimus studiosus	✓														
Latrodectus geometricus	✓														
Argyrodes elevatus	✓														✓
Faiditus sp.	✓														
Theridiosomatidae															
Sp A				✓									✓		
Tetragnathidae	✓										✓		✓		
Leucauge argyra															
Leucauge regyni	✓								✓	✓		✓	✓		✓
Aleimosphenus licinus													✓		✓
Tetragnatha sp.															✓
Theraphosidae															
Cyrtopholis sp.											✓				
Thomisidae															
Misumenops bellulus	✓														
TOTAL (number of species)	19	6	4	6	2	1	0	6	9	7	3	7	4	5	24

CONCLUSION

This study documents a substantial part of the spider diversity of St Eustatius from a range of natural habitats and habitats influenced by human activities. This study therefore serves as a baseline study for the spider fauna of the island and forms part of a series of papers documenting the spider fauna of islands in the Caribbean region. Together they help to build a picture of the biodiversity and biogeography of the Caribbean region. In addition to standardising sampling effort in future surveys, nocturnal sampling should be included to detect species which escape detection during the day.

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Apparent Absence of Chytrid Infection in Trinidad's Frogs

Ruth Shepherd[1], Paul A. Hoskisson[2] and J. Roger Downie[1]

1. School of Life Sciences, Graham Kerr Building, University of Glasgow, Glasgow G12 8QQ
2. Strathclyde Institute of Pharmacy and Biomedical sciences, University of Strathclyde, 161 Cathedral Street, Glasgow G4 0RE

Corresponding author: *Ruthshep91@hotmail.co.uk*

ABSTRACT

Frogs were sampled for the presence of the pathogenic chytrid fungus, *Batrachochytrium dendrobatidis* at nine sites across Trinidad. No chytrid was detected amongst 245 individuals, of 15 species sampled. These results, together with the negative findings from Greener *et al.* (2017) who sampled 116 stream frogs, *Mannophryne trinitatis* from six sites in the Northern Range, suggest that the low level chytrid infection detected in stream frogs in 2007 and 2009 may have died out, or at least is not spreading through Trinidad's frog populations. Possible explanations are discussed and the need for continued vigilance stressed.

Key words: amphibians, chytridiomycosis, Trinidad

INTRODUCTION

The Global Amphibian Assessment found 32.5% of species threatened with extinction compared to 12% of birds and 23% of mammals (Stuart *et al.* 2004). Although habitat loss and change were identified as major problems for amphibians, as for other groups, a particular concern for amphibians was the high proportion of 'enigmatic' cases where populations were reported to be declining in what appeared to be good quality habitat. One of the factors driving these enigmatic declines has been identified as the chytrid fungus *Batrachochytrium dendrobatidis (Bd)* which infects and damages amphibian keratinised skin, often leading to fatal electrolyte imbalances (Kilpatrick *et al*. 2010). Although *Bd* infections have proved fatal to many individuals and may have been the principal cause of some amphibian extinctions, some individuals and species show either resistance or tolerance to the infection. Infected but tolerant individuals can pose a danger to others, as carriers (Venesky *et al.* 2014).

In Trinidad and Tobago, *Bd* infections have been reported by Alemu *et al.* (2013, 2008). Their observations were as follows: In Tobago, *Bd* was present in 21/84 individual *Mannophryne olmonae* sampled from several locations in 2006, though no individuals showed signs of clinical disease; Alemu *et al*. (2008) also tested 36 other individuals from four species (mainly *Rhinella marina*) but none were found to be positive for *Bd*; in Trinidad (sampled in 2007, with a follow-up in 2009), *Bd* infection was found in two out of 12 *Mannophryne trinitatis* populations (11 in the Northern Range, one in the Central Range; infections found only in the Northern Range). The *M. trinitatis* surveys included 120 individuals tested in 2007 and 60 in 2009, with positive samples being found in 8/40 and 2/40 over the two years at the two sites. No other Trinidad frog species were tested by Alemu *et al.*(2013).

As part of an evaluation of the conservation status of *M. trinitatis*, Greener *et al*. (2017) re-assessed this species for the presence of *Bd*. They tested 116 individuals from six populations, including one population on the Blanchisseuse Road where Alemu *et al*.(2013) had found *Bd* present, but obtained no evidence for the continuing presence of *Bd*.

In this report, we present results from *Bd* sampling of 15 other Trinidad frog species. We sampled from sites where single species predominated and from sites where several species occurred together, to test the possibility that *Bd* can be spread between individuals where multiple species occur, or the alternative 'dilution effect' where the presence of resistant species reduces transmission in multispecies communities (Venesky *et al.* 2014).

METHODS

Site and species selection

Chytrid swabbing was conducted in Trinidad between June and mid-August 2014. A total of nine sites were visited (Table 1; Fig. 1). At four of these sites only a single species was sampled and at five sites more than one species was sampled (mixed species and breeding assemblage sites).

Single species sample sites

The four single species sampling sites were known sites for amphibians (Downie, personal observations). These sites included drainage ditches along the Caura Valley specifically to swab *Hypsiboas crepitans*, University of West Indies (St. Augustine Campus) to swab *Rhinella marina*, Simla Research Station (Arima valley) to swab *Phyllomedusa trinitatis* and Austin Trace, Cedros to swab *Scarthyla vigilans*.

Mixed species and breeding assemblage sample sites

Sites known to contain multiple species or breeding

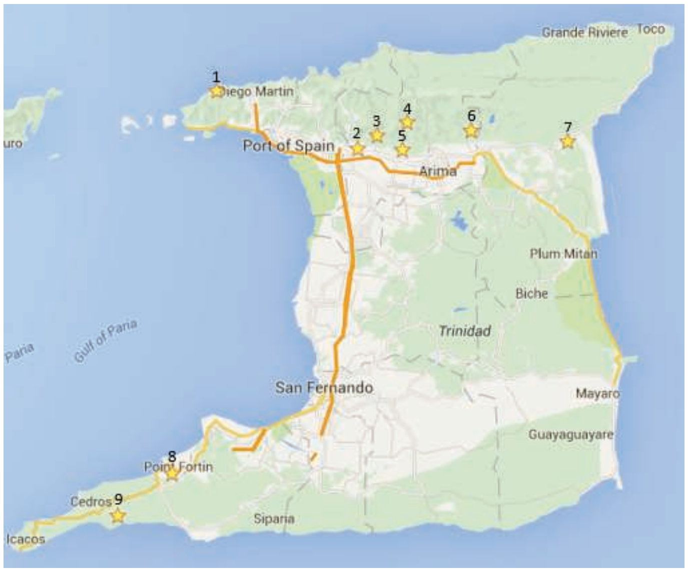

Fig. 1. Map showing the sample sites, numbered as in Table 1.

assemblages (Downie and members of the Trinidad and Tobago Field Naturalists' Club, personal communications) were also sampled. The aim was to collect samples widely across the island so as to sample from a broad range of species and populations. The sites sampled included Point Fortin (south-west), the Bamboo Cathedral, Chaguaramas (north-west), Toco Main Road (north-east) and two sites in the Northern Range – a site close to a Chicken farm in the Lopinot Valley and the garden of an abandoned house in Lopinot village.

Sampling methods

The frog species sampled in this study are all nocturnally active and are most easily found around breeding sites (ponds, ditches) on nights following wet days. Frogs were caught by hand or with the aid of hand nets and transferred to individual polythene bags. The collection team were all trained in frog identification by JRD and had a copy of Murphy (1997) available whenever there was any doubt. Frogs were sampled for chytrid close to the collection site so that they could be immediately returned to their habitat. To allow effective sampling at night, we set up a sheltered illuminated work table in the field.

Amphibians were caught and swabbed following the standard chytrid protocol (Brem *et al*. 2007)**.** The swabs used were clinical grade sterile Deltalab single-packed swabs, routinely used for the collection of microbiological samples that are later subjected to PCR analysis. All equipment was sanitised in 0.5% sodium hypochlorite bleach solution following each site visit or, for nets, after each use. Samples were stored at -20 ^{o}C in 95% ethanol in Trinidad, transported to the UK on ice, and transferred to -80 ^{o}C storage thereafter. DNA was extracted using Phenol-Chloroform extraction (Sambrook and Russell 2001). A standardised PCR analysis was then used to look for the presence or absence of *Bd* in each sample. The primers used were BOB5 and BOB6 (Boyle *et al*. 2004) and a positive control DNA for *Bd* was supplied by Prof Andrew Cunningham, Institute of Zoology, London.

RESULTS

Out of the 245 amphibians sampled, no chytrid- positive individuals were detected at any single species site (*H. crepitans, R. marina, P. trinitatis* or *S. vigilans*), mixed species, or breeding assemblage site. In addition, we saw no individuals visibly suffering from the symptoms of chytrid infection. A sample PCR gel is illustrated in Fig. 2. DNA quality control using 16s rDNA universal primer

Table 1. Results from swabs of single species samples and mixed species and breeding assemblage sites showing the total number swabbed at each site. No positive individuals were found for any species or site.

Site and GPS co-ordinates	Species	Total number swabbed
Caura Royal Road (3) 10°40'18.4"N, 61°22'03.5"W	*Hypsiboas crepitans*	19
University of West Indies Campus (2) 10°38'33.1"N 61°24'02.0"W	*Rhinella marina*	20
Simla Research Station, Arima Valley (6) 10°40'45.5"N, 61°13'29.0"W	*Phyllomedusa trinitatis*	19
Austin Trace, Cedros (9) 10°05'53.3"N, 61°45'52.1"W	*Scarthyla vigilans*	7
La Fortunee Dam, Point Fortin (8) 10°09'41.9"N, 61°40'54.7"W	*Scarthyla vigilans*	5
	Dendropsophus microcephalus	7
	Hypsiboas punctatus	8
Bamboo cathedral, Chaguaramas (1) 10° 43'08.5''N 61° 37' 29.0''W	*Pristimantis urichi*	5
	Rhinella marina	8
	Dendropsophus microcephalus	1
Chicken farm, Lopinot Valley (5) 10°38'59.9"N 61°19'48.4"W	*Engystomops pustulosus*	12
	Leptodactylus fuscus	13
	Trachycephalus typhonius	4
	Leptodactylus validus	1
	Hypsiboas crepitans	2
	Scinax ruber	11
	Dendropsophus microcephalus	27
	Rhinella marina	5
Abandoned house, Lopinot (4) 10°41'27.0"N 61°19'19.9"W	*Engystomops pustulosus*	10
	Leptodactylus fuscus	5
Toco Main Road (7) 10°39'55.4"N, 61°04'21.1"W	*Dendropsophus microcephalus*	17
	Elachistocleis ovalis	1
	Hypsiboas punctatus	2
	Leptodactylus fuscus	4
	Rhinella beebei	4
	Sphaenorhynchus lacteus	1
	Scinax ruber	25
	Rhinella marina	2

pair and chytrid-specific primer pair control are shown in Fig. 3 and 4 respectively.

Single species sample sites

At each single species sample site (rows 1-4 Table 1) a target of 20 individuals were sampled, to ensure that chytrid would be detected, if present. At three locations 19 or 20 individuals were successfully sampled, but at Austin Trace, Cedros, only seven *Scarthyla* were swabbed due to time constraints.

Mixed species and breeding assemblage sites

Results from mixed species sites and breeding assemblages can be found in Table 1 showing species and numbers caught at each site.

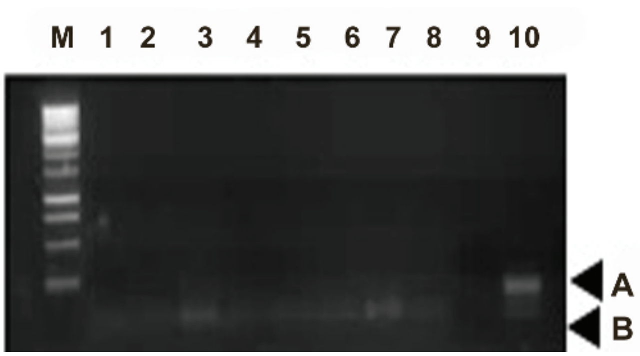

Fig. 2. Gel electrophoresis of swab samples using Chytrid-specific primer pair. Lane 1 to 8 show swab extractions showing no positives. The negative control is present in lane 9 and positive 2 ng *B. dendrobatidis* DNA control is present in lane 10. Lane M shows the 100 bp Markers (Promega).

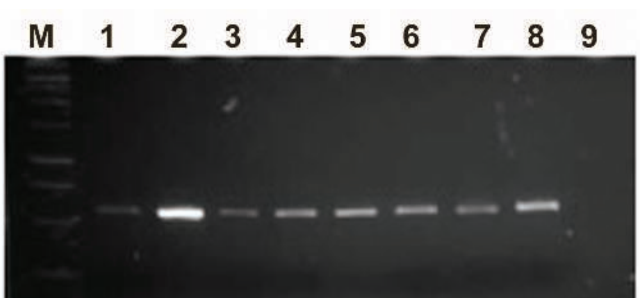

Fig. 3. DNA Extraction and PCR quality DNA Control 16s rDNA Universal primer pair. Lane 1 to 8, taken from 8 randomly selected samples, show positive results for the presence of PCR quality frog DNA that can be amplified by PCR. Negative control is present in lane 9. Lane M shows the 100 bp Markers (Promega).

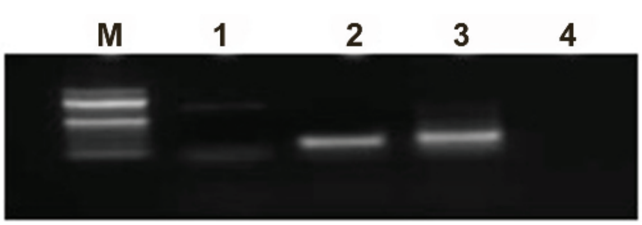

Fig. 4. Chytrid-specific primer pair control. Lane 1: *Mannophryne trinitatis* DNA, lane 2: 2 ng *B. dendrobatidis* DNA, lane 3: 10 ng *B. dendrobatidis* DNA and lane 4: negative control. Lane M shows the 100 bp Markers (NEB).

DISCUSSION

We found no positives for chytrid (*Batrachochytrium dendrobatidis*), out of the 245 individuals from 15 species sampled.

All protocols, including collecting skin swabs, storing swabs, extracting DNA and PCR analysis were followed rigorously and controls were included in the analysis. Furthermore, as no visibly diseased amphibians were found at any site and the recommended minimum sample size (about 20) for detection of chytrid at single species swabbing sites was achieved in most cases, it is highly unlikely that chytrid was present in the samples collected.

At some of the mixed species/breeding assemblage sites the sample size for some species was very small (in six species, five or fewer sampled). In such species we cannot be sure that chytrid is not present. However, as there were no positive individuals for chytrid at any site, and Greener *et al*.(2017) found no chytrid infection in a sample of 116 *Mannophryne trinitatis*, where chytrid was detected in 2007 and 2009 (Alemu *et al*. 2013), the likelihood of one species having chytrid and not another at the same site is small. Seasonal variation is unlikely to be a factor since Alemu *et al*.'s samples were taken at the same time of year as ours.

Although chytrid infection has been reported from many Caribbean islands (Olson *et al.* 2013) and from nearby Venezuela (Hanselmann *et al*. 2004), the danger posed by chytrid to Caribbean amphibians is less clear. Recent work emphasises that although some species are devastated by the arrival of chytrid, in other cases chytrid has been present for decades without causing significant mortality, because species are tolerant or resistant to the infection (Venesky *et al*. 2014). Alemu *et al*.(2008, 2013) found chytrid present in the *Mannophryne* species endemic to Tobago and Trinidad respectively, but not at high rates of prevalence and with no signs of clinical disease, possibly indicating resistance. In Trinidad, but not in Tobago, chytrid infection appeared to be associated with populations at the highest altitude sampled. In Trinidad, we have found no chytrid some years after Alemu *et al*.'s survey either in *M. trinitatis* (Greener *et al*. 2017), including at one of the higher altitude sites sampled by Alemu *et al*.(2013), or in 15 other species. It would be surprising if all these species were resistant. Perhaps the environmental conditions that favour the spread of chytrid are currently absent in Trinidad. Whatever the underlying cause of our results, there is no reason for complacency. Regular sampling for chytrid in both Trinidad and Tobago should be instituted and care taken, through biosecurity measures as detailed in the sampling methods section, to avoid any spread of the disease.

ACKNOWLEDGEMENTS

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Activity Patterns of Terrestrial Mammals at Springhill, Arima Valley, Trinidad

Mike G. Rutherford[1] and Kimberly Chu Foon[2]

[1]The University of the West Indies Zoology Museum,
Department of Life Sciences, The University of the West Indies, St. Augustine, Trinidad and Tobago
[2]Asa Wright Nature Centre, Springhill Estate, Arima, Trinidad and Tobago
Corresponding author: *mike.rutherford@sta.uwi.edu*

ABSTRACT
Camera-traps were used to record terrestrial mammals over a period of 19 months at the Springhill Estate, Arima Valley, Trinidad. Eleven species or taxonomic groups were recorded during 925 trap nights. We describe the activity patterns with respect to time of day and lunar cycle for several of these species. Although these patterns mostly reflect current knowledge of the behaviour of these species based on existing literature, we found some minor differences.

Key words: Camera-trapping, mammals, Trinidad, activity patterns, tropical forests.

INTRODUCTION

The terrestrial mammals of Trinidad are well known and are a subset of those mammals occurring on the South American mainland (Allen and Chapman 1893) (Alkins 1979). However, knowledge of the behaviour of many of these species is still limited. Camera trapping provides a relatively simple way of discovering more about many of these often nocturnal and elusive species.

The use of camera-traps to monitor mammals has become widespread over the last few decades and as the technology has become cheaper and more reliable, the techniques used have been refined and the information gained has expanded (M. Tobler, Carrillo Percastegui, Leite Pitman, Mares and Powell 2008) (Ahumada *et al.* 2011). As well as being a technique to survey diversity, many other aspects of an animal's life can be studied, including daily activity patterns, breeding seasons, feeding behaviours, and territorial behaviour. The influence of factors such as temperature, season and moonlight has also been more closely examined. Some nocturnal animals exhibit changes in behaviour due to the phase of the moon, with either more or less activity on full moon nights; others show no change (Michalski and Norris 2011). Obtaining data to examine these changes in behaviour would be difficult and time consuming if individual animals had to be tracked and monitored. The use of camera traps is one manner in which the data can be gathered more efficiently.

In September 2013, three camera traps were initially placed on trails surrounding the Asa Wright Nature Centre (AWNC) on the Springhill Estate, Arima Valley, Trinidad, as part of a "Bioblitz" event (Rutherford 2014). After the three nights of this event, preliminary results were limited to a single agouti record. Following the event, we decided to continue monitoring the area to ascertain the other mammal species that could be recorded. The Arima Valley has been well surveyed in the past with William Beebe recording 19 small to medium mammals (Beebe 1952) but there had been no recent general surveys. This study aims to give an update on the diversity and activity patterns of small to medium mammals.

MATERIALS AND METHODS

Study Site

The study occurred on the Springhill Estate in the Arima Valley on the southern slopes of the Northern Range in Trinidad. The forest is originally classified as tropical premontane moist forest (Nelson and Nelson 2008), but is actually a mix of lower montane forest, young secondary forest, and abandoned or semi-active woody agriculture (Helmer *et al.* 2012).

Camera Placement

On 18 October 2013, we placed five cameras at various locations around the AWNC, including both on and off trail sites, and retrieved them on 3 November 2013 to review the results and evaluate our overall success. The four cameras that were placed at off-trail sites had very low detection rates, but the one camera placed on a trail performed comparably better, recording six species. Based on this, we decided to place cameras at two locations along one section of trail for continued functioning.

Two sites on the Bamboo Valley Trail were almost continuously monitored from October 2013 to May 2015; for short periods, cameras were reserviced or temporarily reassigned to other projects. At Site 1 (UTM 20P, 686314, 1185231; elevation 326 metres), the camera was mounted on a small tree at approximately 60cm above the ground. The tree was at a bend in the path on a steep uphill section of the trail surrounded by cocoa trees and prickly palms. The start date for Site 1 was 18 October 2013 and the stop date was 29 May 2015. The Site 2 (UTM 20P, 686320, 1185302; elevation 337 metres) camera was also mounted on a small tree at a height of 60cm pointing slightly uphill and surrounded by clumps of invasive giant bamboo *Bambusa vulgaris* in the immediate vicinity and secondary forest (Fig. 1). The start date for Site 2 was 22 November 2013 and the stop date was 20 March 2015. We used Bushnell 6MP Trophy Cams for the duration of the project. This model has a passive infrared sensor with a night vision infrared LED flash. They were set up to take three shots, approximately once per second, per triggering event, and were set at the highest level of sensitivity.

In addition to the cameras mentioned, we set up two extra cameras operating from 22 November 2013 to 22 December 2013, and from 16 January 2014 to 20 March 2014. These were placed at the same sites and facing the same direction, but set to record 20s video clips.

Data Processing and Analysis

We used an automated, open source camera-trap data processing software to assist with organising and analysing our records (Sanderson and Harris 2013). A period of sixty minutes was used to assume independent pictures of a species at a location. Microsoft Excel was used for graphs and analysis. The frequency of a species' activity during each hour of a 24 hour period was examined to ascertain whether they were chiefly nocturnal, diurnal or crepuscular. We also investigated each species activity during full moon and new moon periods (full moon activity was measured as the number of records five days before and five days after a full moon, likewise for new moon activity). Two-sample t-tests, assuming unequal variances, were conducted to determine whether there were significant difference between these periods.

Video clips were also sorted to species and the behavioural activity of the animal was noted: the categories were: moving (animal travelled through the site with no significant pause); foraging (animal actively moved leaf litter or vegetation); feeding (animal eating); social interaction (animal interacting directly with another conspecific); territorial (scent marking/sniffing). Photo subjects were identified to species whenever possible using suitable field guides (Eisenberg 1989; Emmons and Feer 1997); small rodents could not be positively identified beyond the family level, and so were grouped together for analysis.

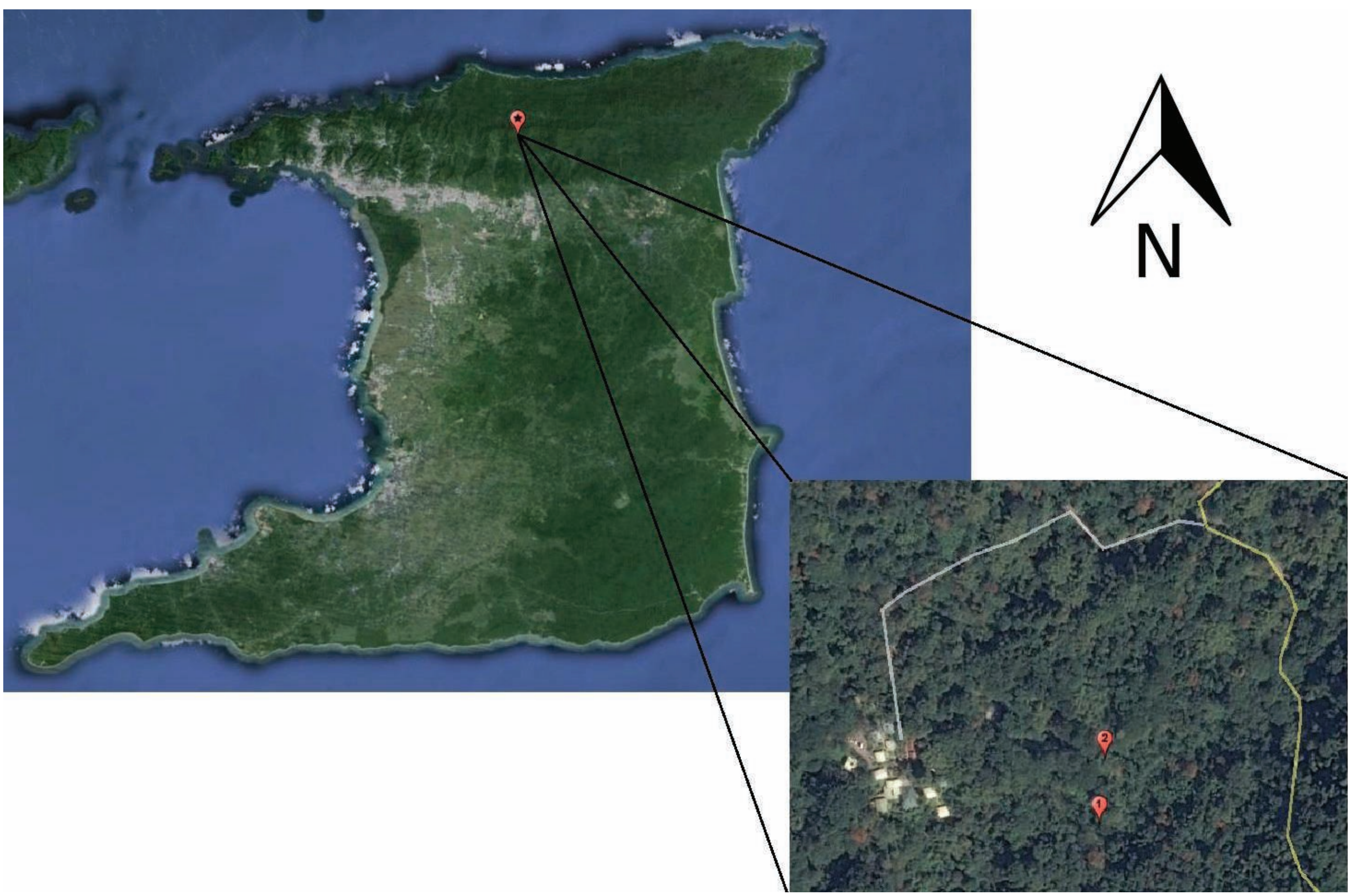

Fig. 1. Map showing location of Springhill Estate in the Northern Range, Trinidad and (inset) Sites 1 and 2 along the Bamboo Valley Trail east of the Asa Wright Nature Centre (Google Earth)

RESULTS

Overall, 506 camera trap nights were logged for Site 1 and 419 for Site 2. Discrepancies in total number of nights were due to battery failures, camera malfunctioning, and the temporary reassignment of the cameras to other projects. Overall 1696 images were used for analysis. Eleven different mammal species/taxonomic groups were identified from the images (Plates 1 and 2). During our survey, sunrise ranged from 0542 to 0629h, whilst sunset ranged from 1739 to 1832h.

Red-rumped agouti *Dasyprocta leporina* (Plate 1a) was the species most recorded, (n =1014 independent detection events), and comprised 59.8% of the total records. They were exclusively diurnal. Their activity occurred over a 14 hour span (0534 - 1843 h; Fig.2a), and there was no significant difference (t_{46}=0.21, p =0.415) in activity between full moon and new moon periods (Fig.3a). The majority of photo events were of a single agouti but there were 18 instances where two individuals were recorded together in the same photo; of these, 11 appeared to be of an adult female and a juvenile based on the size difference between the animals. There were 70 video clips of agouti which showed a range of behaviours: moving (51%), territorial (32%), foraging (10%), feeding (6%), and social interaction (1%).

The second most numerous taxa recorded included all small rodents combined (Plate 1b) (n = 373), which together comprised 21.9% of the total independent records. It was impossible to confirm which species of rat or mouse was recorded, as the image resolution was often too low and/or the animals too small. In addition, defining species-specific features were not generally visible. As there was a wide range in the sizes of individuals we recorded, it is quite likely they represented several different species. They were active during a 14 hour span (1754 - 0615h; Fig.2b) making them almost entirely nocturnal.There was no significant difference (t_{45}=0.39, p =0.347) in the activity of small rodents between full moon and new moon periods (Fig.3b). The majority of the photos were of a single rodent, but there were eight photos when two individuals were recorded together. Some of these photos could have included two different species, as the rodents were sometimes a sufficient distance apart as to be not aware of or interacting with each other. One video clip showed an adult foraging with two small juveniles following behind; other video clips showed foraging and feeding behaviour.

Common opossum *Didelphis marsupialis* (Plate 1c) records comprised 8.8% of the total number of records (n = 150) and were active during a 12 hour period (1804 - 0540h; Fig.2c) making them nocturnal. There was no significant difference (t_{39}=0.97, p =0.169) in the activity of opossums between full moon and new moon periods (Fig.3c). The majority of sightings were of single adult individuals, but there were four photos of an adult carrying a single juvenile on her back, and one occasion of an adult with three juveniles on her back. These occurred in April, May and July. One photo showed two adult or sub-adult opossums walking together. The video clips showed foraging behaviour (with several individuals observed searching through the leaf litter), feeding behaviour, and movement through the site.

Lowland paca *Cuniculus paca* (Plate 1d) constituted 6% of the total records (n =102); they were entirely nocturnal and only active during 12 of 24 hours (1819 - 0529h; Fig.2d). There was no significant difference (t_{42}=0.77, p=0.222) in the activity of paca between full moon and new moon periods (Fig.3d). There were three events where two paca were in the same image and the difference in size indicated that it was a mother and juvenile pairing. The video clips just showed paca moving through the site with no other activity, although one mother and juvenile pairing did seem to notice the infrared flash of the camera as they both turned to look directly towards the camera before continuing on.

Nine-banded armadillo *Dasypus novemcinctus* (Plate 1e) represented 1.8% of the total (n = 31) and were always nocturnal being active in 11 of 24 hours (1817 - 0505h; Fig.2e). There was a significant difference in the activity of armadillo during different phases of the moon with more activity during a new moon than a full moon (Fig.3e) using the two-sample t-test for unequal variances (t_{29}=2.17, $p<0.05$). Most armadillo records were of individual animals but there was one record of two moving together and one of four animals together. Three video clips showed armadillos foraging in the leaf litter and moving through the site.

Ocelot *Leopardus pardalis* (Plate 1f) were recorded only 11 times, constituting 0.6% of the total records. They were recorded during 8 of 24 hours, with a range through the night from 2020 to 0528h and a single sighting at 1310h (Fig.2f) making them mostly nocturnal. There were not enough samples to examine any differences in the activity of ocelot between full moon and new moon periods (Fig.3f). An adult female and a juvenile, about half the size of the adult, were seen together in late May 2014.

Several species were seen in such low numbers that they were not included in the statistical analysis. Southern tamandua *Tamandua tetradactyla* (Plate 2g) were recorded at both sites on nine occasions through the night between 1927h and 0857h. Red-tailed squirrel *Sciurus granatensis* (Plate 2h) were recorded at both sites on four separate occasions all in the morning. A lone red brocket deer *Mazama americana* (Plate 2i) was recorded once at Site

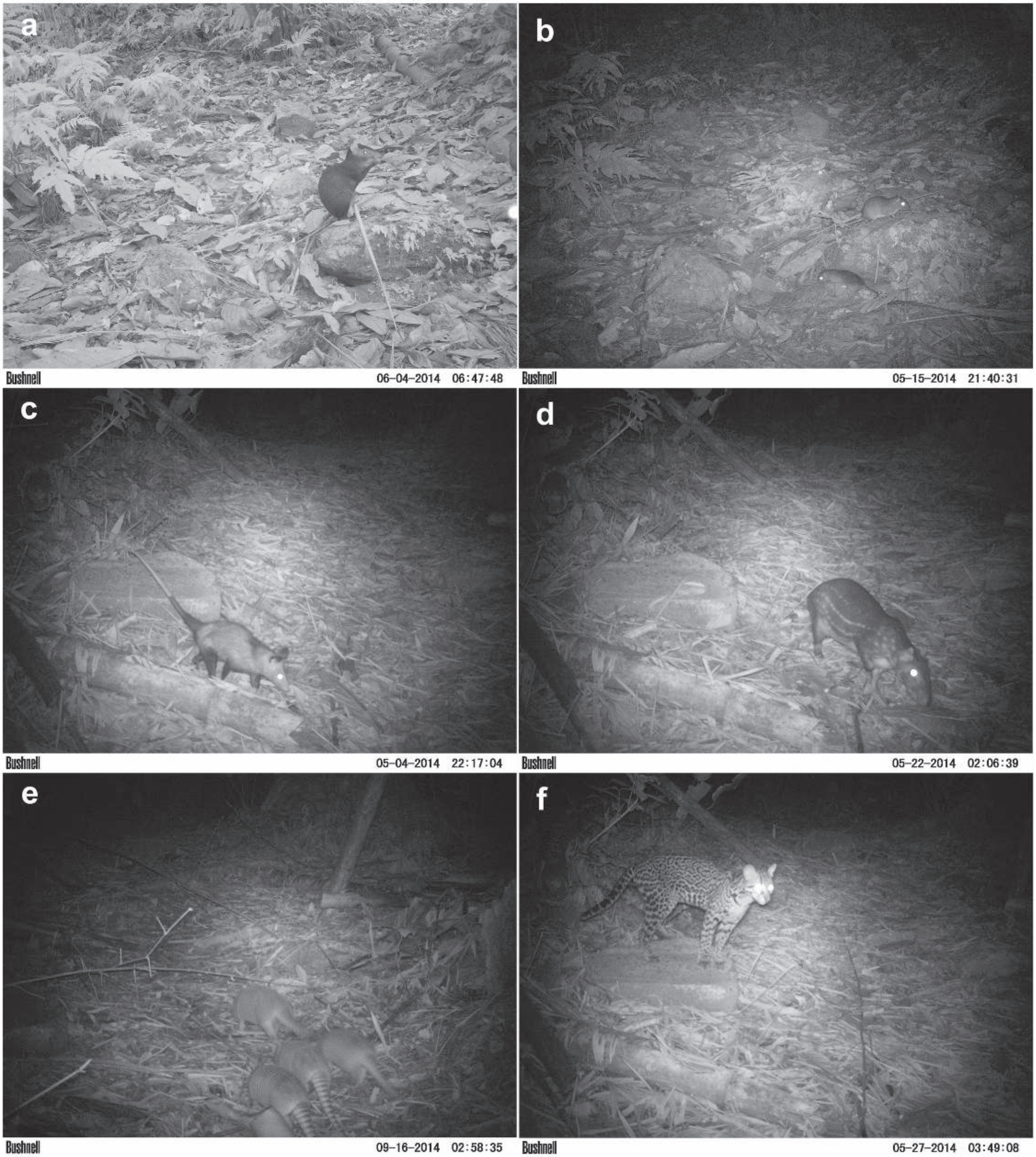

Plate 1. Species detected in camera traps at Spring Hill: a. Agouti, *Dasyprocta leporina*; b. small rodents, c. Black-eared Opossum, *Didelphis marsupialis*; d. Lowland Paca, *Cuniculus paca*; e.Nine-banded Armadillo, *Dasypus novemcinctus*; f. Ocelot, *Leopardus pardalis*. Spring Hill.

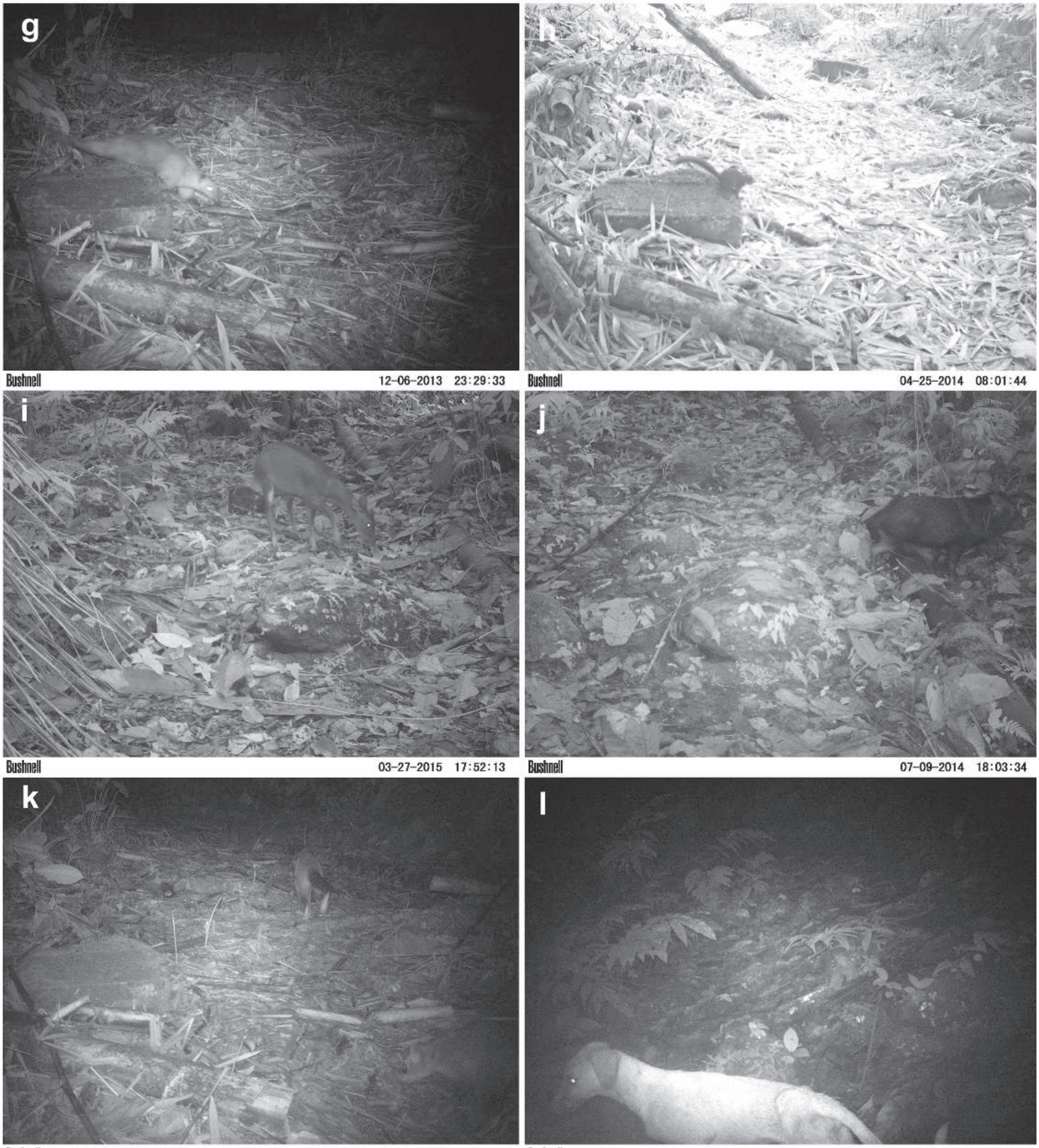

Plate 2. Species detected in camera traps at Spring Hill: g. Southern Tamandua,*Tamandua tetradactyla*; h. Red-tailed Squirrel, *Sciurus granatensis;* i. Red Brocket Deer, *Mazama americana*; j. Collared Peccary, *Pecari tajacu;* k. Crab-eating Raccoon, *Procyon cancrivorus*; l. Domestic Dog. Spring Hill.

Fig. 2. Activity over a 24 hour period for 6 mammal species/groups based on camera trapping data from October 2013 to May 2015 at Springhill Estate, Trinidad.

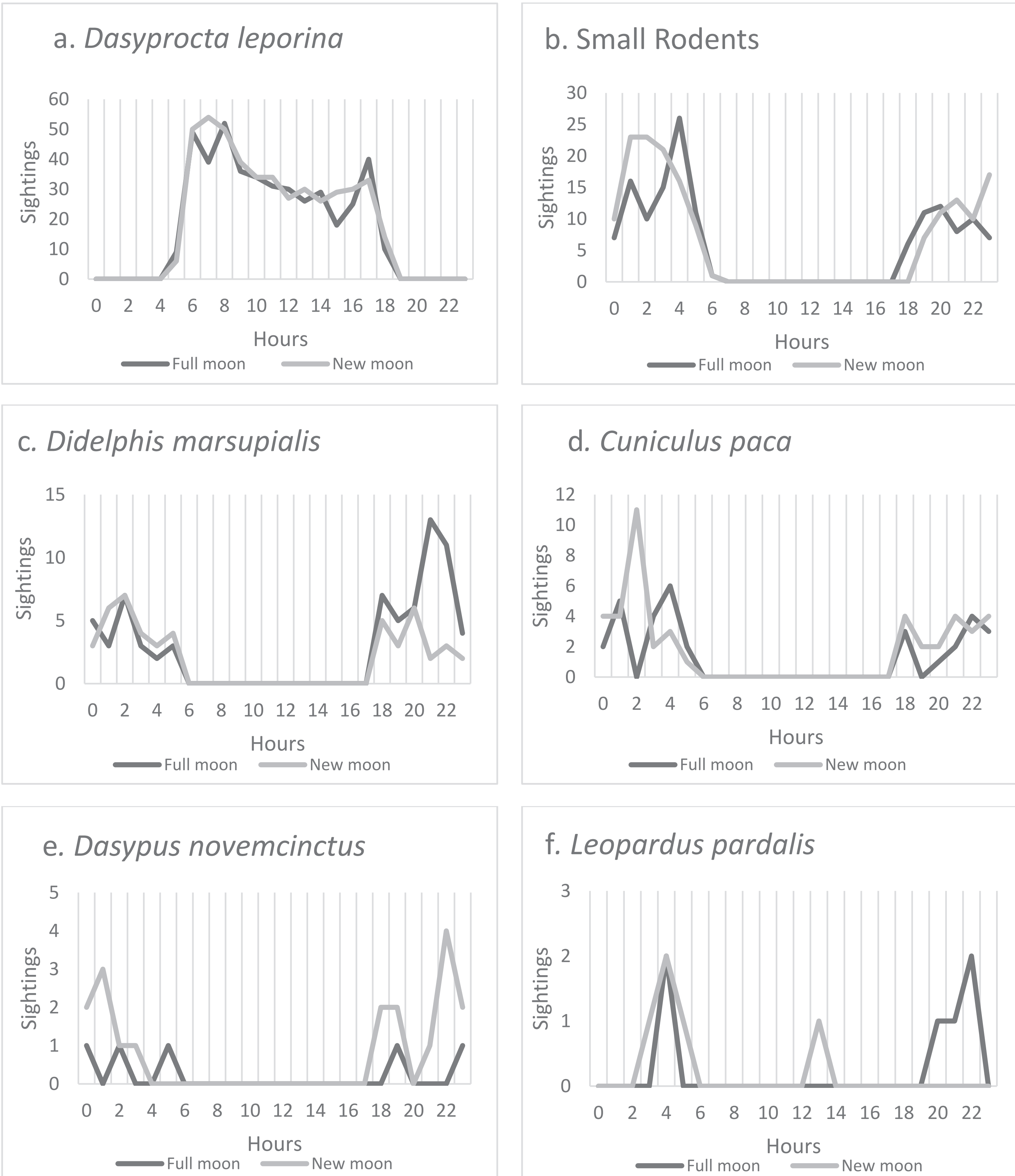

Fig. 3. Activity over 24 hour period for 6 mammal species/groups during full and new moons based on camera trapping data from October 2013 to May 2015 at Springhill Estate, Trinidad.

1 in March 2015 around dusk 1752h. Collared peccary *Pecari tajacu* (Plate 2j) were recorded once at Site 1 in July 2014 around dusk 1803h; one individual was photographed clearly, and a partial photo of a second animal was also taken. Three crab-eating raccoons *Procyon cancrivorus* (Plate 2k) were recorded once at Site 2 in November 2013 just after dusk at 1822h.

In addition to mammals, we recorded other animals on camera. The most common of these was the large terrestrial tegu lizard *Tupinambis cryptus,* a common resident around Springhill and often encountered during the day. A single photo was also taken of a green iguana *Iguana iguana*, and several birds were recorded as well, including great antshrike *Taraba major*, grey-fronted dove *Leptotila rufaxilla* and cocoa thrush *Turdus fumigatus*. Domestic dogs, consisting of several different individuals, were seen on 11 occasions (Plate 2 l).

DISCUSSION

Previous surveys recorded 19 different medium-large mammals in the Arima Valley (i.e., not including bats, rats, and mice) (Beebe 1952). Of these 19, Beebe classified nine as terrestrial and ten as arboreal. During this survey, we recorded all of the terrestrial mammals with the exception of the small Asian mongoose *Herpestes javanicus* and otter *Lontra longicaudis*, whereas we also recorded three of the arboreal mammals.

The diurnal pattern of activity of the agouti corresponds with previous reports in that we observed a peak of early morning and late afternoon activity (Dubost 1988). However, reports that agouti may be active on bright moonlit nights (Emmons and Feer, 1997) were not supported by our study, as not a single agouti photo occurred at night regardless of moon phase. The majority of the behavioural activities caught on the video clips showed individual agouti moving through the sites and occasionally stopping to scent mark or sniff at certain rocks, this territorial behaviour is well known in agouti

We believed that combining small rodent records into one group was necessary, as positive identification of all individuals to species level would not only be very time consuming, but also likely impossible. From previous studies however we can at least suggest which species are most likely to be present at these sites. During a live-trapping study at Springhill (2005), several large-headed rice rats (*Hylaeamys megacephalus* - named as *Oryzomys capito* in the paper) were captured very near these camera-trapping sites (Nelson and Nelson 2008). In addition, during night walks on the estate, MGR took colour photographs of a rat on trails near the camera trapping sites which were later identified as *Proechimys trinitatis* (Fiona Reid, per.com.). In an older trapping study in Turure Forest (in the Guiaco-Valencia Reserve near Sangre Grande, north-east Trinidad) 40.9% of the rodents trapped were *P. trinitatis* and 28.6% were *H. megacephalus* (Everard and Tikasingh, 1973), the authors also mentioned that *H. megacephalus* were the most abundant of the small ground dwelling rodents in the forests of northeastern Trinidad. However they then went on to state that *P. trinitatis* were only abundant in the seasonal marsh-forest typified by Turure Forest. It is therefore possible that these two nocturnal species (Eisenberg 1989) accounted for many of the sightings in this study although the majority are perhaps more likely to be *H. megacephalus*.

Common opossum were strictly nocturnal, with activity high in the early part of the night and then tailing off towards dawn. This is consistent with the results of a study in Venezuela which used radio-tracking to follow common opossums (Sunquist, Austad, and Sunquist 1987).

Paca are known to be nocturnal (Eisenberg 1989) (Emmons and Feer 1997), which is consistent with our study, with no records at all during the day. Although there were more sightings of paca during new moon periods, the difference in frequency compared to full moon periods was not found to be significant, similar to the findings of a study in southern Brazil which found only a slight difference (Michalski and Norris 2011). The images consisting of two paca together were most likely a female adult and a juvenile based on the size difference between the individuals. These sightings were spread throughout the year with one each in May, July and November, consistent with the year round breeding habits of the species (Dubost, Henry, and Comizzoli 2005).

Armadillos showed strictly nocturnal activity, which largely corresponds with their known behaviour (McBee and Baker 1982). The decrease in activity shown by armadillos during periods of the full moon supports other studies (Harmsen, Foster, Silver, Ostro and Doncaster 2011).

Ocelot records were mainly at night, although a single sighting at 1310h suggested that they can be active during the day; similar results were found by other studies (Gómez, Wallace, Ayala and Tejada 2005) (Di Bitetti, Paviolo and De Angelo 2006). The presence of a juvenile in May is not unexpected, as ocelots are thought to lack a distinct breeding season (Haines, Tewes, Laack and Morrison 2005) and a juvenile could be present any time of year, however further research is required to see if this is true of ocelots throughout their range. Camera trapping projects that focus on spotted cats tend to have a pair of cameras set up on each side of a trail; using this approach, images of both flanks of an animal can be captured to allow identification of individuals (Di Bitetti *et al.* 2006). As we were only using single cameras at each site, we did not get photos of each flank, so it was not possible to confirm repeat records of the same ocelot. However, an examination of the photos taken depicting enough of the flank for comparison seemed to suggest that there were three different individuals present.

Historically tamandua were reported as rare in the valley, and generally only observed foraging high in trees (Beebe 1952); therefore, getting photos of them on the ground was fortunate. Surveys in southeastern Brazil reported that although they could be active at all hours, they tend to travel on the ground only under cover of darkness (Trolle 2003). This was mostly the case in our survey, but one individual was seen at 0857h.

The red brocket deer is generally a solitary, secretive animal which forages from evening through early morning (Eisenberg 1989); our single sighting at 1752h was relatively early in the evening. Another camera-trapping activity in the Arima Valley has detected deer both further down the valley nearer human habitation, and at the top of the valley in pristine forest (Luke Rostant pers. com.). Although there is no hunting allowed on the Springhill Estate, poaching is still a problem throughout the Arima Valley, and in areas where there is hunting pressure red brocket deer tend to be more nocturnal (Di Bitetti, Paviolo, Ferrari, De Angelo and Di Blanco, 2008).

Collared peccary have also been recorded at higher elevations in the Arima Valley (Luke Rostant, pers. com.). Beebe mentioned them as being generally rare and occurring more towards the head of the valley (1952). A study in Peru reported that collared peccaries are mostly diurnal (Tobler, Carrillo-Percastegui and Powell, 2009), consistent with our sighting before dusk.

Crab-eating raccoons are generally nocturnal, solitary and most often found near water sources (Emmons and Feer 1997). It was therefore unusual to record three animals together around dusk. The passing of the three raccoons was also caught on video and this allowed a more accurate study of the group, the raccoon in the lead was larger than the two animals following behind. It is most likely that the record was of a female–offspring unit (Eisenberg 1989) moving from one water feature to the next as there are several streams as well as the head waters of the Arima River within 60 metres of the trail. In December 2014, a camera trap, in place for one week, overlooking the stream running into Dunstan's Cave, Springhill Estate recorded several photos of a raccoon foraging in the water.

The presence of domestic dogs can be a problem due to their potential negative impact on wildlife (Bergman, Breck and Bender 2009). Camera trapping results from another group working at AWNC recorded a dog with what looked like a red-tailed squirrel in its mouth giving further evidence of the problem of feral dogs.

The use of video clips provided interesting information that would not have been collected if only stills were taken; however, processing time is longer and more computer memory is required for video footage (Glen, Cockburn, Nichols, Ekanayake and Warburton 2013), so we opted for still photos for the majority of the project. From the clips recorded only the agouti was seen in sufficient enough numbers to allow further analysis.

In order to gain a fuller picture of the status of the mammal species present in Springhill further methods should be employed including, trapping, transects and spotlighting. For future camera trapping projects at Springhill, an interesting avenue of investigation would be to place cameras in the canopy to see if detection of arboreal mammals is effective, although the cameras may have to be set on fruiting trees to increase the likelihood of detection of species. Potential target species include silky anteater *Cyclopes didactylus*, Brazilian porcupine *Coendou prehensilis*, mouse opossum *Marmosa robinsoni* and the bare-tailed woolly opossum *Caluromys philander*. These species have all been recorded in the Arima Valley before (Beebe 1952) but sightings recently are rare. Trinidad's two native species of monkey, the red howler monkey *Alouatta macconnelli*, and the white-fronted capuchin *Cebus albifrons,* were both present in the valley back in the 1950s (Beebe 1952) but there have been hardly any sightings until very, recently when two capuchins were spotted by staff at AWNC on 12 February 2016 (KCF, pers com.).

Future studies could also examine the difference in activity patterns of these common species in relation to forest size, type, and level of disturbance. In a study on Amazonian forest fragments it was found that the size of a patch had a significant effect on the activity of small terrestrial mammals (Norris, Michalski and Peres, 2010). Although the Springhill Estate is mixed secondary forest that is protected from hunting and poaching, there are many other areas in Trinidad and Tobago with differing levels of protection and forest types that would provide for interesting comparisons. Currently, collaborative efforts are being made to bring together the results of camera trapping projects from all over Trinidad and Tobago. This will hopefully lead to a better understanding of the state of the nation's terrestrial mammals, which face heavy pressure from hunting and poaching (The Cropper Foundation, 2010).

For further results from camera trapping in Trinidad and Tobago see www.inaturalist.org/projects/trail-cameras-of-trinidad-tobago.

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Mollusc Shells Findings from the Red House Excavation, Trinidad

Ryan S. Mohammed[1,2] and Lanya Fanovich[2*]

1. Department of Life Sciences, The University of the West Indies (UWI).
2. Environmental Research Institute Charlotteville (ERIC).
corresponding author: *lfanovich@gmail.com*

ABSTRACT

Excavation of units to assess the structural integrity of the Red House's foundation yielded pre-Columbian and pre-Colonial artefacts, including several species of bivalves and gastropods. Identification of these remains using several identification keys and plates produced a checklist of 38 species of which 14 were bivalves belonging to nine families and 24 were gastropods, representing 20 families. Whilst most of the identified molluscs occupy marine environments, species from terrestrial, fresh and brackish water environments were also present. Several of the shells, in particular those belonging to *Crassostrea rhizophorae* as well as *Melongena melongena* bore harvesting holes, implying their possible use as food in nearby settlements. The diversity of species collected from the test units alludes to the rich biodiversity present prior to the infrastructural development of Port of Spain and the construction of the Red House.

Key words:

INTRODUCTION

Shell middens have been studied worldwide, providing insights into the diet and activities of societies in the past (Álvarez *et al*. 2011). They were once sites of processing exploited marine molluscs, particularly gastropods as well as finfish for food (Waselkov 1987, Schapira *et al.* 2009). Molluscs were ideal, opportunistic sources of protein for small settlements since they are either sessile or slow-moving, making them easy pickings. With as many as 300 registered archaeological sites in Trinidad and Tobago, many of which were located in proximity to coastal environments, several have yielded shell middens including the well-known Banwari Trace (Kenny 2008, Boomert 2016). Shell middens have also been recorded at St. John, Ortoire, Palo Seco, Erin and Guayaguayare to name a few (Sued-Badillo 2003, Saunders 2005, Ali 2012, Boomert 2016). In addition to providing data on anthropogenic activities, shell middens are also an archive of past environments and their molluscan biodiversity since it is believed that harvested molluscs were processed from their shells in close proximity to their source, decreasing the burden of transporting heavy shells (Waselkov 1987, Álvarez *et al*. 2011).

One of the most recent sites is the Red House, the House of Parliament for the Republic of Trinidad and Tobago, located in the capital city of Port of Spain which currently stands on reclaimed land which in pre-Columbian and pre-Colonial times, would have been a coastal region. The Red House has been under structural renovations since 2009. During April 2013, test units dug to determine the structural integrity of the building's foundation yielded several Amerindian artefacts and animal remains from approximately the 12th Century (Bharath 2013). The spoils from the test units revealed a high concentration of mollusc shells. This article provides a checklist of mollusc species found at the most recent archaeological site for Trinidad and Tobago.

METHODOLOGY

The sediment spoils from the 14 test units were sifted and various artefacts sorted. Shells were washed and dried, then further sorted. They were identified to species level using picture documentation in Kaplan (1988), Sutty (1990), Tucker Abbott and Morris (1995) and Jones and Jones (2005) with verification of scientific names using MolluscaBase (2016) and the World Register of Marine Species (WoRMS) Editorial Board (2016). The malacology collection of the University of the West Indies Zoology Museum, Department of Life Sciences, St. Augustine Campus, was consulted to identify species not found in the reference text. Shell Diversity Richness was noted and also, the potential habitat where specimens would exist were determined based on current findings of live specimens using references in Palomares and Pauly (2016) and the WoRMS Editorial Board (2016).

RESULTS

From the Red House test units we documented 14 species of bivalves spanning across nine families (Table 1). All bivalves with the exception of the Mangrove oyster *C. rhizophorae,* were inhabitants of marine environments. The oysters were documented as inhabitants of brackish water environments. Whilst most of the marine bivalves were typically benthic species, Thick lucine *Phacoides pectinatus* was the only demersal bivalve.

A larger diversity of gastropods (Table 2) was identified within the test units with 24 species from 20 families, representing various environments. One land snail species, Giant South American snail, *Megalobulimus oblongus*

Table 1. Checklist of bivalves at the Red House excavation site

Family	Scientific Name	Common Name	Environment*
Arcidae (ark clams)	*Anadara notabilis*	Incongruous ark/ Eared ark	Marine; benthic
	Anadara ovalis	Blood ark	Marine; benthic
	Arca imbricata	Mossy arc	Marine; benthic
Cardiidae (cockles)	*Trachycardium muricatum*	American yellow cockle	Marine; benthic
Donacidae (donax clams)	*Donax* sp.	Chip-chip	Marine
Lucinidae (lucina clams)	*Lucinisca muricata*	Spinose lucine	Marine; benthic
	Phacoides pectinatus	Thick lucine	Marine; demersal
Ostreidae (oysters)	*Crassostrea rhizophorae*	Mangrove oyster	Brackish
Solemyidae (awning clams)	*Solemya velum*	Atlantic awning clam	Marine; benthic
Tellinidae (tellins)	*Tellina* sp.	Tellin	Marine
Veneridae (venus clams)	*Chione cancellata*	Beaded venus/ Cross-barred venus	Marine; benthic
	Chionopsis intapurpurea	Lady-in-waiting	Marine; benthic
	Periglypta listeri	Princess Venus	Marine; benthic
Yoldiidae (yoldias)	*Yoldia myalis*	Comb yoldia/ Oval yoldia	Marine; benthic

*Source: Palomares and Pauly 2016; WoRMS Editorial Board 2016

was among the shell remains. Whilst freshwater snails were represented by two species of Ampullariidae snails and Channelled whelk, *Busycotypus canaliculatus* was the lone gastropod exclusively inhabiting brackish water environments; Virgin nerite, *Neritina virginea* is typically an inhabitant of both freshwater and brackish environments. The remaining 18 gastropod species were typically found in marine environments. Knobby keyhole limpet, *Fissurella nodosa* and West Indian chank, *Turbinella angulata* were considered reef-associated species. Nine of the gastropod shells were typically demersal inhabitants, found on the surface of the sea floor whilst four marine gastropods were considered to be benthic in nature.

It should be noted that the depths where shells were found varied in the excavation units but generally they appeared at deeper depths on the southern side of the archaeological site along a gradient.

DISCUSSION

The excavation process is a relatively destructive extraction method, often destroying the brittle shells, making accurate abundance estimations difficult. However, in all the test units, *Crassostraea rhizophorae* was observed as the most abundant molluscan species, possibly contributing to the highest biomass. *Melongena melongena* was the largest mollusc specimen obtained as seen in Figure 1. They were found in large numbers, contributing to the heaviest overall weight among all shell species. In present times, both species are found in similar habitats, usually mud flats and mangrove breakwaters. *C. rhizophorae* is a typical prop-root fauna for mangrove swamps (Kaplan 1988, Carpenter 2002). The high abundance of these two edible species and the presence of muscle-detaching harvest holes in the majority of specimens are evidence towards their possible exploitation as food. No specimens of *C. rhizophorae* were found with both valves intact which could be an effect of the excavation, washing and sorting process or decomposition.

All of the other identified bivalves and gastropods, though in significantly lower numbers were potentially edible. *Neritina virginea* is typically found in a freshwater system in close proximity to brackish water interfaces with an estuary (Kaplan 1988, Palomares and Pauly 2016). The low abundance of this shell species is perhaps a result of the shells being flushed into the estuary or being disposed of in that area. *N. virginea* were possibly collected from an

Table 2. Checklist of gastropods at the Red House excavation site

Family	Scientific Name	Common Name	Environment*
Ampullariidae (apple snails)	*Marisa cornuarietis*	Giant Ramshorn snail	Freshwater
	Pomacea glauca	Apple snail	Freshwater
Buccinidae (true whelks)	*Gemophos tinctus*	Granada's cantharus Tinted cantharus	Marine; demersal
Bullidae (bubble snails)	*Bulla striata*	Striate bubble	Marine; demersal
Busyconidae (busycon whelks)	*Busycotypus canaliculatus*	Channelled whelk	Brackish; benthic
Conidae (cone snails)	*Conus* sp.	Cone shell	Marine
Cypraeidae (cowries)	*Cypraea* sp.	Cowrie	Marine
Fissurellidae (keyhole limpets)	*Fissurella nodosa*	Knobby keyhole limpet	Marine; reef-associate
Haminoeidae (haminoeid bubble snails)	*Haminoea succinea*	Amber glassy bubble	Marine; demersal
Littorinidae (periwinkles)	*Nodilittorina* sp.	Periwinkle	Marine
Megalobulimidae	*Megalobulimus oblongus*	Giant South American snail	Terrestrial
Melongenidae (crown and melon conchs)	*Pugilina morio*	Giant Hairy melongena	Marine, demersal
	Melongena melongena	West Indian crown conch	Marine; demersal
Muricidae (rock snails)	*Chicoreus brevifrons*	West Indian murex	Marine; demersal
	Stramonita floridana	Florida rock shell Red-mouthed rock shell	Marine; benthic
Nacticidae (moon snails)	*Natica marochien*	Morocco moon snail	Marine; demersal
Neritidae (nerites)	*Neritina virginea*	Virgin nerite	Freshwater, brackish; benthic
Olividae (olive snails)	*Americoliva reticularis*	Netted olive	Marine; demersal
	Americoliva sayana	Lettered olive	Marine; benthic
Orthalicidae (orthalicid land snails)	*Orthalicus undatus*	Wavy orthalicus	Terrestrial
Ranellidae (tritons)	*Cymatium* sp.	Triton	Marine
Strombidae (true conchs)	*Lobatus gigas*	Caribbean queen conch	Marine; benthic
Tegulidae (tegulas)	*Cittarium pica*	West Indian top shell/ whelk	Marine; demersal
Turbinellidae (chanks)	*Turbinella angulata*	West Indian chank	Marine; reef-associate

*Source: Palomares and Pauly 2016; WoRMS Editorial Board 2016

independent site, cracked open and the shell disposed of. At several other middens [eg.Caparo site (personal observations)], these small shells were found, implying inland transportation for food and nearby disposal by resident communities (Boomert 2016).

Of the two terrestrial gastropods found, the Giant South American snail, *Megalobulimus. oblongus* bore harvesting holes similar to *M. melongena* suggesting

Fig. 1. The Large West Indian Crown Conch, *Melongena melongena* with harvest holes.

their potential use as food. Interestingly *M. oblongus* is not typically found near estuaries (Agudo-Padrón 2012). Similarly, the Knobby keyhole limpet *Fissurella nodosa,* a rocky shore and reef-associated species, is a unique find to the site since it was the lone identified marine species that is not typically estuarine (Kaplan 1988, Rodríguez-Sevilla, Vargas and Cortés 2009).

The excavated species suggest that the Red House site was likely once in very close proximity to a natural estuarine habitat such as a mud flat with mangrove forest. The presence of reef-associated species such as *F. nodosa* and *Turbinella angulata* could be indicators of a nearby reef or rocky shore, with individual shells being washed ashore, or incidentally collected and transported to the Red House site. However, it is not unlikely for *T. angulata* to be present in mudflats (Olsson and McGinty 1958; Garcia, Olsson and McGinty 2004). The varying depths of shell deposition observed on the walls of the test units also give an inclination of the landscape's southward sloping topography. The molluscan remains bearing harvest holes may imply that a settlement of sort was present in the vicinity of the shells' location.

Whilst the excavation's initial objective was to investigate the structural integrity of the Red House and therefore lacked the systematic removal of earth layers, resulting in the mixing of contexts and its associated artefacts, the abundance and high biomass of molluscan remains, particularly *C. rhizophorae* and *M. melongena* with harvest holes lends credence to the site's use as a disposal ground for the shellfish remains. It would have been illogical for settlers to walk far distances with large, collected shellfish such as *M. melongena* or for disposal of the shells with limited transport technology (Waselkov 1987). It was more energy efficient to either locate the settlement close to the wetland or, to process the meat by removing it from the shells and returning to the village, leaving behind the discarded remains (Waselkov 1987).

Often easily identified by the uniform dark-coloured layer with contrasting white shells, other features that are sometimes used to characterise a shell midden in contrast to a natural shell bed includes the presence of charcoal, burnt or blackened shells, non-molluscan terrestrial fauna with tool markings, fragments of tools as well as pottery sherds (Attenbrow 1992, Boomert 2016). However, the absence of these does not imply the absence of a midden, nor does their presence rule out the occurrence of a natural shell bed (Attenbrow 1992). In this case, the proportion of edible species bearing signs of meat extraction is the most reliable diagnostic feature (Attenbrow 1992). A Lettered Olive, *Americoliva sayana* shell with evidence of human workings (Figure 2) was recovered, indicating that shell deposits may not have been natural but were impacted by humans.

The earth layers present a timeline which makes it possible to date the shells based on the presence of various artefacts such as tools, metals and pottery sherds as well as the use of carbon dating, provided that there was little natural or anthropogenic disturbance to the contexts (Attenbrow 1992, Álvarez *et al.* 2011, Boomert 2016). This can provide insight into the possible habitants responsible for the creation of the middens. The excavation operation at the time of sample processing unfortunately mixed the various contexts, making deductions of the possible users of the middens difficult. However, the presence of both pre-Columbian and pre-Colonial artefacts verifies the use of the Red House site by both indigenous and European habitants.

Not all shells gathered had harvest holes or tool markings to suggest their use as a food source. The mixing of the contexts due to the excavation made it difficult to determine if several unmarked molluscan fauna may have been a part of the shell midden. Natural environmental and geological events such as flooding, or environmental alterations due to European settlement as well as disturbance of the earth due to development and eventual construction of the Red House may also contribute to the diversity found in various units.

Identification of the shell species were based on sev-

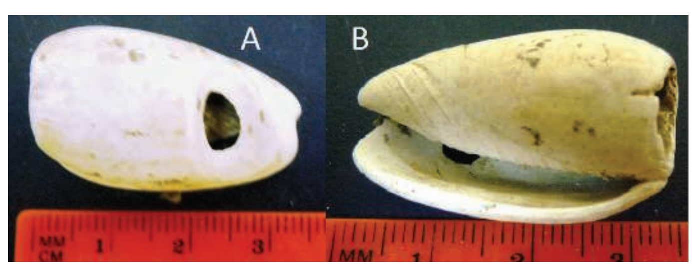

Fig. 2. The Lettered olive, *Americoliva sayana* shell with evidence of human workings, (A) on dorsal shell whorl and (B) spire removed.

eral features such as shell shape, sculpture patterns, hinge teeth, spire lengths and aperture size. The excavated shells would have been heavily weathered over time and damaged due to the excavation, washing and sorting process. The loss of the periostracum, damage to spires, and weathering away of other key diagnostic features would have made identification of some shells to species level difficult.

In conclusion, the diversity of molluscan fauna identified, alludes to the site formerly being a natural wetland prior to European settlement. The presence of several shells bearing harvest holes indicates the opportunistic harvesting of molluscs, theirutilisation as food and deposition of their remains in close proximity to both their natural habitats and possibly a human settlement. The high frequency of large shells alludes to the possibility that the aquatic faunal population particularly the molluscan fauna was high, which requires a very productive ecosystem such as that provided by estuarine conditions to facilitate such a large number of large gastropods and several species of bivalves. These findings further add to the knowledge pool of the potential food sources of Trinidad's indigenous peoples and perhaps pre-Colonial settlers.

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Sightings of Capybara, *Hydrochoerus hydrochaeris* in the Caroni River System, Trinidad

The occasional presence of capybaras in Trinidad is well known (Kenny, 2008) but most reports suggest that they are found in the southwest peninsula of the island and have arrived there naturally after having swum or been washed across the Columbus Channel. However, over the last few years there have been anecdotal reports of capybaras being seen in the Caroni River basin (Mark Charran and Shawn Madoo, personal communication). A comprehensive review of the scientific literature found no record of capybaras at this location. Here I report on the results of a short term camera trapping project.

Following rumours of sightings of capybara near the Caroni Cremation Site (between the Caroni Savannah Road and the Caroni River) I visited the area and found evidence of their presence indicated by droppings and footprints in the thick vegetation next to the river and also on the grass lawn at the site. To get further confirmation I set up two Bushnell Trophy Cam camera traps with infrared sensor and invisible nighttime flash able to take colour pictures in the daytime and black and white pictures at night. They were set to take three photographs one second apart per triggering. The first was on a tree approximately 10m from the river bank at UTM 20P 673628, 1174102 and the second in a clump of bamboo at UTM 20P, 673654, 1174071 (Datum: WGS84).

The cameras ran from 11 -17 October 2015. At the first site near the river, capybara were recorded on 14 and 17 October. At the second site in the bamboo, capybara were recorded every day that the camera was operating. The vast majority of the sightings were nocturnal (2036 h; 2222 h; 0102 h; 0420 h; 0456 h; 0505 h; 0519 h) but one sighting was in daylight at 0659 h. Although capybara are generally diurnal in their activity, in areas where they are persecuted by hunting they can be more active at night (Emmons and Feer, 1997). The photos showed lone individuals most of the time but one set of photos showed a large group of at least six individuals (Fig. 1), which is a more typical capybara family group size (Emmons and Feer, 1997).

Fig. 1. Capybara, *Hydrochoerus hydrochaeris*. Caroni River, Trinidad. October 2015.

Several photos from the study were posted on the University of the West Indies Zoology Museum Facebook page (www.facebook.com/uwizoologymuseum) for the purpose of gathering information about other sightings and assessing current awareness of the presence of capybaras by members of the public. The post reached almost 27,000 people and many of the comments were reports of capybara sightings in and around the Caroni River basin some dating back several years. There were also several comments relating to hunting of capybara and anecdotal accounts suggest that the capybara in the Caroni area were originally brought over and released for the purpose of hunting.

It is also possible that the original source of this population was from an attempt around 1995 to farm capybara. A small colony of animals, which originated from the Emperor Valley Zoo, were farmed at Carapichaima but during a flood in 2000 four of the animals escaped. The project did not turn out to be financially viable on the scale it was being conducted and so closed down (Kamal Hakim, personal communication).

Further studies are needed to ascertain the range and abundance of capybara in Trinidad and to find out if they pose a threat as an invasive species or if they are merely a missing part of the original biota of Trinidad.

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

First Record of Autotomy in the Neotropical Scorpion *Ananteris cussinii* Borelli, 1910 in Trinidad, W.I.

Autotomy is the behaviour whereby an animal voluntarily sheds or discards one or more of its own appendages, usually as a self-defence mechanism, to elude a predator's grasp or to distract the predator and thereby allow escape. It is observed in a variety of invertebrate and vertebrate taxa (Fleming *et al.* 2007; Bateman and Fleming 2009), and in some instances the lost body part may be subsequently regenerated. Autotomy of a body part therefore serves as an effective anti-predator defence mechanism (Flemming *et. al* 2007). As it pertains to scorpions, autotomy has only been reported to occur in the neotropical buthid Genus *Ananteris* Thorell, 1981, where detachment of the metasoma meets the criteria for defensive autotomy (Wilkie 2001); Fleming *et al.* 2007), and as such, enables the prey to escape from predation (Arnold 1988; Fleming *et al.* 2007). This however, is not without consequence as Maginnis (2006) points out that autotomy may also be particularly detrimental in species where the autotomized limb functioned as predator defence because predators often prefer prey missing their defensive limbs due to these individuals being easier to handle during foraging. This therefore suggests that autotomized scorpions would be especially predisposed to attack as Brownell and Polis (2001) indicated that all scorpions use their stings as their major defence mechanism.

The evolutionary significance of this mechanism occurring exclusively in this genus currently comprising 79 known species remains unknown. This phenomenon was first reported by Mattoni *et al.* (2011) where the authors investigated 14 species of *Ananteris*. Subsequently, Lira *et al.* (2013), reported on metasomal autonomy occurring in *Ananteris mauryi* Lourenço, 1982, which was a first report for this species. The number of species of this genus capable of performing metasomal autotomy has therefore not been exhausted and this paper further adds to this, as it serves as a first report of metasomal autonomy occurring in yet another species, *Ananteris cussinii* Borelli 1910. This species, originally described from Cagua in Venezuela is the only member of the genus *Ananteris* present in Trinidad (Lourenço *et al.* 1999; Prendini, 2001).

The observation of autotomy in this species was made while conducting a nighttime field survey of scorpions in the Bush Bush Forest Reserve, Trinidad, W.I. (10° 22' N, 61° 02' W). Two adult *A. cussinii* specimens were observed with the posterior part of the metasoma (tail) missing, inclusive of the telson (stinger), with the point of breakage on the metasoma of both scorpions seemingly healed from injury. These observations, in addition to the observations of the behaviour of these scorpions in the field, suggest that autotomy had previously occurred in both of these specimens. The first specimen was alert and responsive as it was observed scurrying through leaf litter in the pathway under ultraviolet light (wavelength 395 nm). Approximately 100 metres along the same pathway another specimen of *A. cussinii* was observed with its telson missing. This specimen was very active and the behaviour was similar to that of the first. An attempt was made to collect this specimen with the use of a forceps by gently clasping the most distal segment of the metasoma. As the scorpion was elevated, the metasomal segment that was clasped with the forceps detached from the remainder of the scorpion and both the scorpion and metasomal segment fell to the floor as a second autotomy of the metasoma was performed (fig. 1). The scorpion attempted to escape, while the metasomal segment that fell to the floor writhed consistently for approximately 15 seconds as this would undoubdtly serve as a distraction to a would-be predator as with shed appendages of other animals that perform autotomy. This observation therefore fits the

Fig. 1. *Ananteris cussinii* Borelli 1910, with autotomized metasoma after second autotomy was performed (carapace to start of metasoma, 8 mm in length).

criteria used by Mattoni *et al.* (2015) for autotomy in this genus. The specimen was deposited the Zoology Museum, UWI St Augustine, and is numbered UWIZM.2016.36.

It would be of interest to investigate why autotomy has evolved in this particular genus as opposed to others, especially in an area where several genera are known to coexist and are undoubtedly subjected to similar predation pressures, which according to Fleming *et al.* (2007), regularly favours the evolution of appendage detachment in prey.

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Rakesh Bhukal[1, 2]

1. Department of Life Sciences, Faculty of Science and Technology, UWI, St. Augustine

2. School of Veterinary Medicine, Faculty of Medical Sciences, UWI, St. Augustine

rbhukal101@gmail.com

The discovery of Cuvier's Dwarf Caiman, *Paleosuchus palpebrosus* (Reptilia: Alligatoridae) in Trinidad

Trinidad has a rich diversity of reptiles. Murphy (1997) reported 91 species of reptiles including introduced species, species of questionable occurrence, and waifs. The 1997 summary also included a discussion of three species of crocodilians possibly present on Trinidad. The Spectacled Caiman, *Caiman crocodilus* is the only crocodilian known to have established populations on both Trinidad and Tobago. It can be found in most swamps and water courses from the southern versant of the Northern Range to the south coast (Gerard 1991, Mohammed 2015). Speculation over the past century has suggested that two crocodiles, the American Crocodile, *Crocodylus acutus* and the Orinoco Crocodile, *C. intermedius* may occur as waifs in Trinidad and Tobago waters. However, the evidence for this is scant and summarized in Murphy (1997).

During a herpetofaunal survey of the South Central District of Trinidad, for the Petroleum Company of Trinidad and Tobago Limited, a team led by SHA and two field assistants Daryl Abraham and Darius Baldeo, discovered a specimen of Cuvier's Dwarf Caiman *Paleosuchus palpebrosus* (Fig. 1.). The caiman was found in a tractor wheel track on a logging trail in the Erin Central Field (Grid Reference UTM 20-n 648556m E, 1120213m N) on 26 April 2012. The caiman measured 34 cm in total length. The caiman was identified using the keys in Grenard (1991).

During subsequent surveys at the same location, any caimans found in the surrounding waterways, ponds and swampy areas were closely examined. Three other specimens were found on 11 November 2013, two of which were collected and measured (58 and 53cm). One specimen was deposited in the Zoology Museum, UWI St Augustine (UWIZM.2016.35) and a tissue sample for DNA was collected.

Fig. 1. Cuvier's Dwarf Caiman *Paleosuchus palpebrosus*, Erin, 6 December 2016. Photographed by Saiyaad Ali.

Two *Paleosuchus palpebrosus* were collected at Granville in 2014. These were both very young individuals caught in a stream between Austin Coromandel North and Syfo Trace, Granville in southwestern Trinidad (Grid Reference UTM 20-n 632730m E 1118206m N). One was approximately 25cm long, and caught about 2315 h on 22 February 2014. The second was approximately 26.5cm long, caught at 2105 h on 1 March 2014. Finally, a female, 86.5cm long, was discovered on 11 October 2016 at 2245 h at the Iros Forest between Chattam North Trace and Point Coco Trace Ext. (UTN 20-n 635028m E, 1121110m N).

These are the first reports of this species for Trinidad and Tobago. The first and second sites are almost 16km apart, thus there are at least two colonies, probably three, inhabiting the island. *Caiman crocodilus* were observed inhabiting the same small water courses and thus the

Fig. 2. The distribution of the Dwarf Caiman, *Paleosuchus palpebrosus*. Adapted from Magnusson and Campos (2010).

species are sympatric on Trinidad as they are over much of their overlapping distributions. Figure 2 shows the distribution of *P. palpebrosus*.

The Neotropical Dwarf Caimans (*Paleosuchus*) and the African Dwarf Crocodile (*Osteolaemus*) are considered to be the smallest crocodilians, with adult sizes between 1.0 and 2.1 m (Campos et al. 2010). In the Amazon, *P. palpebrosus* inhabits a number of aquatic habitats, including flooded forests near the major rivers and lakes (Vasconcelos and Campos, 2007). The species occurs in headwater rivers and streams of ridges with waterfalls around the Pantanal where it faces habitat loss due to mining activities, deforestation, erosion, pollution, hydroelectric dams, urbanization and hunting (Campos *et al.* 1995, Campos and Mourão 2006).

Throughout its range the Dwarf Caiman is known by a variety of English, Spanish and Portuguese names: Dwarf Caiman, Cuvier's Smooth-fronted Caiman, Jacaré-paguá, Jacaré-preto, Jacaré-ferro, Jacarétiritiri, Cachirre, Musky Caiman, and Cocodrilo (Magnusson and Campos 2010).

The Dwarf Caiman is relatively well-studied despite its secretive nature. The male breeds with multiple females and prefers mating at night in shallow water. Both sexes are involved in building a mound-shaped nest. Females lay 10 – 25 eggs which hatch in 90 days. During incubation the female attends the nest until the eggs hatch and post hatchling for several more weeks. The hatchlings remain in the nest for several days until the female digs them out. Male reaches sexual maturity at 1.1m and females at 1.0m. Dwarf caimans mature slowly and it may take them ten years to reach maturity (Campos *et al.* 2012).

The Neotropics hold 30-50% of the world's herpetofauna (frogs, salamanders, caecilians, turtles, crocodilians, lizards and snakes). However, surprisingly little is known about diversity, systematics, ecology and natural history of many species. Simple, accurate inventories of species for a given area can be misleading and give the impression that we know more than we actually do. This makes planning conservation strategies difficult.

The herpetofauna of Trinidad and Tobago should be considered very well-known compared to many locations on mainland South America. The first list of the islands' herpetofauna was published in 1858 and since that time the number of species reported from the islands has grown. In the 1980's JCM was under impression that it would be possible to develop a complete inventory of the herpetofauna in a half dozen trips for field work and a look at existing museum specimens, considering the combined area of both islands is only about 5000 km^2. This assumption could not have been more wrong.

New species continue to be described from the islands, and records of species previously unknown continue to be reported. The present example is a reminder that these are not all small, secretive species and that we need to continue to take a closer, more thoughtful look at the herpetofauna. Some may argue that these new records are the result of recent dispersal events from the mainland. This may be correct for some, but clearly not all of the recently discovered species on Trinidad and Tobago are recent arrivals.

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Saiyaad H. Ali[1], **Nalini Rampersad-Ali**[1] and **John C. Murphy**[2]
1. The Serpentarium, Trinidad and Tobago
trinisnakehunter@gmail.com
2. Science and Education, Field Museum of Natural History, 1400 S. Lake Shore Drive, Chicago, IL USA 60605.

A live Double-Striped Water Snake *Thamnodynastes ramonriveroi* (Reptilia:Serpentes), from Trinidad

A live specimen of the Double-Striped Water Snake *Thamnodynastes ramonriveroi* was caught in Saint Marie Road towards Galfa Point, Grid Reference 625695E, 1115001 N., at 1845 h on 30 September 2015.

The snake was discovered while conducting a survey of Reptilian and Amphibian fauna on behalf of the Petroleum Company of Trinidad and Tobago Limited. The survey, of the southwestern peninsula of Trinidad from Icacos Point to Galfa Point, was conducted by the author and two field assistants Daryl Abraham and Robert Marks.

The snake was generally light brown. From the neck to upper midbody there was a matted myriad of colours ranging from shiny gold, dark brown black and hues of pale green. Similar to that of *Liophis reginae.* There were distinct longitudinal broken stripes along either sides of the body. From the dorsum and around the eyes were stripes of black radially arranged, thinner from the outline of the eyes and bolder to the upper sides. The belly was pale white with parallel broken lines located mid belly. The broken line appeared to be similar to that of the broken longitudinal stripes observed on the sides of the body. The specimen was female with the following scale counts, subcaudals 70, ventrals 152 and 19 rows of dorsal scales at midbody. The vent to tail length was 127mm, the snout to vent measured 425 mm with the overall length (snout to tail) 552 mm.

Prior to this find, there were four other accounts of the species for Trinidad. Three specimens were discovered dead on the road within the years of 1981,1983 and 1984 (Boos 2001), and a live specimen was found in 2002, in Cedros by a resident of Arima and photographed by Hans Boos (Boos 2016). This is thus the second live specimen recorded and photographed in Trinidad (Fig. 1). The snake was subsequently released.

The genus *Thamnodynastes* geographical distribution occurs in throughout South America Brazil, Argentina, Colombia (Rafael Damasceno 2013) and in the Caribbean Trinidad (Boos 2001).

Snakes of the genus *Thamnodynastes*, are a small to medium sized, viviparous, with dentition in an opisthoglyph arrangement. The pupils are elliptical and aligned vertically which indicate that the species nocturnal and crepuscular. They feed on amphibians, fish, lizards and small mammals.

The authors would like to thank John Murphy for verifying the identity from the photograph.

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Saiyaad H. Ali and **Nalini Rampersad-Ali**
The Serpentarium, Trinidad and Tobago
trinisnakehunter@gmail.com

Fig. 1. Double-Striped Water Snake *Thamnodynastes ramonriveroi.* Saint Marie Road, 30 September 2015.

Common Black Hawk, *Buteogallus anthracinus* predating Oilbird, *Steatornis caripensis* at Cumaca Cave, Trinidad and Tobago

Cumaca Cave, or Oropuche Cave as it is also referred to, is located in the eastern Northern Range, Trinidad and is home to a large colony of Oilbirds *Steatornis caripensis*. The cave has a narrow entrance out of which flows a small river and is surrounded by secondary forest (Comeau, Potter, and Roberts 2006)

On 28 March 2016 at approximately 1100h a Common Black Hawk, *Buteogallus anthracinus* was seen next to the mouth of Cumaca Cave with a dead oilbird chick clutched in its talons. My appearance startled the hawk and caused it to fly off dropping the chick to the ground. The hawk had not had time to start consuming the chick beyond tearing open the lower abdomen and pulling out a length of intestine.

I have been unable to find any references on predation on oilbird chicks by hawks so this is possibly a first record.

The possibility that the hawk had scavenged the chick is unlikely, when recovered from the ground the body was still warm and flexible suggesting it had been recently killed. If the chick had fallen out of its nest it would have fallen into the stream and would have been wet and cold when found. On further investigation of the cave several occupied nests were found close to the entrance with some no more than 2m above the level of the stream. The nests were easily observable in daylight thus the hawk would not have had to enter the dark parts of the cave to grab a chick.

In Trinidad Common Black Hawks are thought to feed almost exclusively on crabs (ffrench 2012) but dietary accounts from throughout their range (Schnell 1994) show that they are opportunistic and will feed on a wide range of vertebrates and invertebrates.

The chick weighed 180g and was approximately 21 days old (Thomas, Bosque, and Arends 1993) but its downy feathers had not yet erupted (Fig. 1). The specimen has been preserved in the University of the West Indies Zoology Museum (accession number UWIZM.2016.11).

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

Fig. 1. Dead Oilbird Chick, preyed upon by Common Black Hawk. Cumaca Cave, 28 March 2016.

Mammal Observations from Camera Trapping in Cat's Hill, Trinidad.

An informal investigation of the wildlife in the Cat's Hill and Inniss Field area of the Victoria Mayaro Reserve was conducted with the use of trail cameras from March 2012 to July 2015. The 2012 camera trapping session involved one camera, a Wildgame Innovations Flash 6 (WGIF6), placed in a variety of habitats; including forest, the banks of forest watercourses and teak fields. It was mounted on a portable metal stand with a plastic rain shield, planted in the soil at approximately two feet above ground level. The stand removed the need to find a suitable tree trunk for placement. Leaf litter was usually piled at the base of the stand to reduce the chances of rain splashing soil onto the camera lens. The results of 2012 proved to be very encouraging with the observation of several species, including agouti *Dasyprocta leporina*, lappe *Cuniculus paca*, red brocket deer *Mazama americana*, and neotropical river otter, *Lontra longicaudis* (Fig1 1). As a result of these positive results, an attempt was made to employ a more structured approach in the following year.

In 2013, two cameras were used. The previous WGIF6 had ceased functioning several months after the 2012 session while employed in the field elsewhere and so a new WGIF6 was used. Additionally, a new HCO Scoutguard SG560C was used. Both cameras used an incandescent flash and were set to capture photographs as long as a target was detected. Starting in March, these cameras were placed within the forests along the Cat's Hill Road, one camera at each site and approximately 0.5km apart and 30 m away from the roadway. The decision as to where to place cameras was based primarally on reducing the likelihood of theft and so were never placed on or overlooking a trail (whether human or animal made). Sites were relatively clear of vegetation and typically flat land. Whilst ridgelines are often utilised for trails by animals, they are also frequented by humans. Natural chokepoints, caused by fallen logs or watercourses, were taken advantage of where available. We had also learnt from 2012 that hunting dogs were sometimes able to find our cameras, presumably detecting traces of our human scent on them, so touching of the camera itself was minimised. The cameras were left for a period of 21 days at these locations before being moved to new locations further along the road, the result being a total of eight survey sites (Table 1), each approximately 0.5km apart and at a duration of 21 days each, for a total of 4,032 hours. The initial site was chosen simply on the basis of being adjacent to one of the productive 2012 sites. In addition, a perfume attractant (name withheld) was used with the intention of determining if ocelots, *Leopardus pardalis*, were present in the area. The attractant was sprayed into the husk of a coconut to facilitate easy removal from the site and also to provide protection from the rain. The observations of 2013 were in a similar vein to that of the previous year, with the aforementioned species being photographed on a regular basis but with the addition of of Tamandua *Tamandua tetradactyla* (Fig 2.) and two different ocelots, distinguished by their coat patterns (see Cover Photo for one of the ocelots).

Table 1. Coordinates of Trap Sites

Site	Coordinates	Notes
Site 1	10°11'49.31N 61°12'59.55W	Relatively flat site. No activity detected in 2013.
Site 2	10°11'49.93N 61°12'42.79W	Slope. Site was cleared of vegetation in 2015
Site 3	10°11'45.92N 61°12'29.32W	Relatively flat site. Choke-point on bank of waterway. Hunting camp nearby.
Site 4	10°12'5.22N 61°12'14.73W	Flat site bound by steep slope. Hunting camp and scaffolding nearby.
Site 5	10°12'11.83N 61°11'55.02W	Relatively flat site, dominated by *Pentaclethra macroloba*
Site 6	10°12'14.28N 61°11'38.22W	Relatively flat site, next to active oil well
Site 7	10°12'15.42N 61°11'22.62W	Relatively flat site. Busy oil facility in vicinity
Site 8	10°12'36.62N 61°11'18.83W	Relatively flat site. Busy oil facility in vicinity

This approach was again employed in 2014 and 2015, at approximately the same time of year, but with fewer locations. Once again, the previous year's WGIF6 had failed and was replaced by another HCO Scoutguard SG560C, so that two of these cameras were now in use. The last two sites (Site 7 and Site 8) were omitted in 2014/2015 as only black eared opossum, *Didelphis marsupialis* had been detected there in 2013 (both sites were close to a very active oil storage facility and so human disturbance was a likely factor). A third ocelot and a crab-eating racoon, *Procyon cancrivorus*, were identified at Site 2 in 2014. A third camera (Bushnell 8MP Trophy Cam with infrared illumination) was introduced in 2015. This camera recorded video observations at the sites in conjunction with one of the other cameras, to determine how animals reacted to the incandescent flash of the other cameras and the perfume attractant. It appeared that most animals (with the exception of small rodents) did not react to the brief incandescent flash but this needs further observation. It was also noted that in addition to ocelot, several mammals were very interested in the attractant as lappe, crab-eating racoon, opossum and agouti were all recorded investigating the perfume. The diversity of species observed in 2015 was similar to the previous year. Unfortunately, much of the vegetation at Site 2 was cleared in 2015, to safeguard nearby power lines, rendering this previously productive site (and at which two ocelots had been recorded) useless. The Bushnell Trophy Cam had been at this site for 30 days prior to its clearance and recorded agouti, deer and lappe. These observations are included in the tabulations below, however, as human disturbance in the area around Site 2 had commenced prior to this session, animal detection is expected to have been negatively impacted and results are not perfectly comparable to that of 2013 and 2014.

Of particular interest in 2013 was the implementation by the government of a two year moratorium on hunting , commencing in September of that year (and therefore after the 2013 session as completed). This offered an opportunity to see what changes might occur in observations during and after the moratorium.

To this end, observations of mammals at all six sites were collated and are presented below, both in terms of the total number of days that species were detected at all sites (Table 2) and in terms of the numbers of sites at which species were detected (Table 3). Black eared opossum, *Didelphis marsupialis* was found to be common to all sites and has been omitted from these tables.

Whilst these are very informal observations, it would appear that there was a detectable change in mammal populations during the hunting moratorium. This is most noticeable in terms of the agouti which increased from 16 detection days at four sites in 2013, to 42 detection days at six sites in 2015. This was to be expected, given that the agouti is the most widely hunted mammal and that they are capable of reproducing more than once a year (Soodnarinesingh 2012). Detections of other species were also relatively better. The authors plan to continue carrying out these investigations and the immediate objective will be to see how these simple detection metrics change after the 2015 hunting season.

Table 2. Total number of detection days at all six sites

Species	2013	2014	2015*
Agouti, *Dasyprocta leporina*	16	43	42
Red brocket deer, *Mazama americana*	1	1	4
Lappe, *Cuniculus paca*	6	5	5
Armadillo, *Dasypus novemcinctus*	1	4	8
Tamandua, *Tamandua tetradactyla*	1	4	1
Ocelot, *Leopardus pardalis*	2	1	0
Crab eating Racoon, *Procyon cancrivorus*	0	2	1

*Site 2 was disturbed by human activity in 2015 which negatively affected animal activity

Table 3. Number of sites at which species were detected

Species	2013	2014	2015*
Agouti, *Dasyprocta leporina*	4	6	6
Red brocket deer, *Mazama americana*	1	1	4
Lappe, *Cuniculus paca*	4	5	5
Armadillo, *Dasypus novemcinctus*	1	2	2
Tamandua, *Tamandua tetradactyla*	1	3	1
Ocelot, *Leopardus pardalis*	2	1	0
Crab eating Racoon, *Procyon cancrivorus*	0	2	1

*Site 2 was disturbed by human activity in 2015 which negatively affected animal activity

Fig. 1. Neotropical river otter, *Lontra longicaudis,* Inniss Field, 20 April 2012

Fig. 2. Tamandua, *Tamandua tetradactyla*, Cat's Hill, Site 3, 29 April 2015

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Kris Sookdeo and **Charles Sookdeo**
511 Clarke Road, Penal
krsookdeo@hotmail.com

Thirteenth Report of the Trinidad and Tobago Birds Status and Distribution Committee Records Submitted During 2015

Martyn Kenefick
36 Newalloville Ave, San Juan, Trinidad
martynkenefick@hotmail.com

INTRODUCTION

The abundance and status of our bird species, especially the common ones, are reasonably well known and described in the available 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 they 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 our rarer species. Now re-named the Birds Status and Distribution Committee, we have assessed all records submitted during 2015. In all 105 records were adjudged, representing 55 different species. Of the submissions assessed, in only eight cases did the Committee find the identification inconclusive. The records presented below follow the nomenclature and taxonomic order of the American Ornithologists Union South American Checklist; February 2016 (Rensen *et al.* 2016).

The Committee comprises the following members: Martyn Kenefick (Secretary), Geoffrey Gomes, Floyd Hayes, Nigel Lallsingh, Bill Murphy, Kris Sookdeo and Graham White. There are instances where we need supporting international expert knowledge to assist us with certain identification issues. We wish to acknowledge the valuable assistance provided by both Richard Fairbank (UK) and James Smith (USA) during 2015.

Archived records including photographic submissions number 1,217 at the end of 2015. Records are held at 36 Newalloville Ave, San Juan. Previous reports of this committee were prepared by Hayes and White, (2000); White and Hayes (2002) and Kenefick (2005, 2007,2008,2009,2010, 2011, 2012, 2013, 2014, 2015).

The list of species considered by the TTBSDC (formerly the TTRBC), together with the Official List of the Birds of Trinidad and Tobago and details of all accepted records by the Committee can be accessed, from our new website at http://rbc.ttfnc.org. We urge finders to document and report their sightings to us.

During 2015, Amethyst Woodstar was accepted as a new species for the country, the Official List total now stands at 481.

RECORDS ACCEPTED

Two **White-faced Whistling-Ducks, *Dendrocygna viduata*** were photographed at Caroni Rice Project on 25 June 2015 (SR) and were seen intermittently until 27 September at least. The dates and location fall within the known occurrence in Trinidad

An adult male **Muscovy Duck, *Cairina moschata*** was photographed, swimming in freshwater marsh close to Icacos on 18 May 2015 (DH). There have been 11 sightings of this wanderer from mainland South America in the last seven years; almost all, understandably, from the south-west peninsula of Trinidad. Of these, eight have been during the period May - September.

An immature/female **American Wigeon, *Anas americana*** was found at Bon Accord sewage ponds, Tobago on 27 November 2015 (MK, NG *et al.*). A second bird was subsequently found two days later. Both remained until the year's end. This brings to eight, the number of documented records of this migrant duck in the last 20 years, all from Tobago.

An immature/female **Lesser Scaup, *Aythya affinis*** was found at Bon Accord sewage ponds on 27 November 2015 (MK). Close by, and on the same day, another three birds in similar plumage were present on the large lake at Tobago Plantations (MK). There have now been 19 birds documented in the last 20 years; all but one of them from south-west Tobago and all sightings have been between 16 November and15 February.

Up to three breeding plumaged male **Masked Ducks, *Nomonyx dominicus*** and at least one female were present at either end of the year at a known breeding location (SL,MK *et al.*).

During the year there was one documented sighting of an adult **White-tailed Tropicbird, *Phaethon lepturus*** flying alongside the seabird cliffs on Little Tobago island on 11 June 2015 (GP).Whilst suspected, breeding remains unproven.

Single **Jabirus, *Jabiru mycteria*** were photographed at Icacos on 11 June 2015 (KS) remaining until 21 June, and at the Caroni Rice Project on 26 July 2015 (FO,WR *et al.*). This latter bird was present for a further three days at least. Once considered exceedingly rare, this species has now been documented in five of the last seven years with all sightings being during the period June - September.

Two immature **Wood Storks, *Mycteria americana*** were seen flying west over Trincity ponds on 15 March

2015 (ASh,IT,PW). However they were never relocated. Another immature was photographed at Sudama Steps on 10 May 2015 (WR). Five days later, three birds were present, with one remaining until 24 May (*RG et al.*). A further bird found close to Icacos on 17 June 2015 (DH) and remained until at least the 24 June. This may well have been one of the May trio. There have been only two other documented sightings in the last 20 years.

A sub-adult **Masked Booby, *Sula dactylatra*** was photographed flying over Penal on 27 January 2015, at least 10km from the coast (RG) (see plate). This species, formerly present year round on St Giles Rocks off of the NE coast of Tobago, is now a rare visitor to Trinidad and Tobago. This is the first documented occurrence of one flying over mainland Trinidad.

The **Western Reef-Heron, *Egretta gularis*** first found on 19 December 2014 (Kenefick 2015) remained near Bon Accord, Tobago, until the years end (MW, GP MKe *et al.*) (see plate).

Single **Little Egrets, *Egretta garzetta*** were found at both Bon Accord and Canaan sewage ponds on 9 December 2015, one remaining until the year end (MKe). Historically, one or two could be regularly found in SW Tobago. In recent times, they are seen less than annually.

Glossy Ibis, *Plegadis falcinellus* is no longer the rarity it was ten years ago. It is now becoming truly difficult to know how many individuals were present during 2015. Documented sightings were as follows :- eight flying over Caroni swamp on 10 February (MK); a single bird at Kernaham Settlement on 24 August (NHa); three photographed at Satnurine Trace, Penal on 29 August (RG, NHa, WR); one at Caroni Rice Project 12 September (CC) increasing to five birds there on 24 September. Finally one at Bon Accord, sewage ponds on 17 September 2015 (NB, NBa). The Bon Accord bird was seen on many occasions afterwards, increasing to two birds on 27 November (MK), and they remained until the year's end. Additionally there are numerous undocumented sightings and it may well be that a number of individuals have been present year round.

A **Roseate Spoonbill, *Platalea ajaja*** was photographed in a small lagoon close to the highway at Caroni Swamp on 9 February 2015 (FM, AS). On the following day, three were found and these were seen by numerous observers until18 May, with one bird still showing up until 3 August (see plate). This is only the fourth occurrence in the last 20 years, and the first since a one day sighting back in 2008.

The **Black Kite, *Milvus migrans*** first found on 26 November 2014 at Point a Pierre (Kenefick 2015), was seen intermittently during 2015 until early October.

Two **Crane Hawks, *Geranospiza caerulescens*** were documented during the year with single birds photographed near Penal on 11 June 2015 (KS) and flying over Piparo on 24 December 2015 (RG). Since first being discovered in Trinidad back in 2000, multiple birds have been documented in every month since, bar one.

Caribbean Coot, *Fulica caribaea* has always been considered a fresh water marshland species. It came as some surprise therefore for one to be photographed close to the shoreline at Bloody Bay, Tobago on 17 April 2015 (PN,FS). Another individual was found, this time at Bon Accord sewage ponds on 26 September 2015 (KS). These are just the third and fourth documented records for Tobago in the last 20 years. In Trinidad on 8 August 2015, a single bird was well documented on a flooded field within Caroni Rice Project (FO). This constitutes the first acceptable record for the island. This species breeds as close as Grenada, two separate sightings in one year may well be the precurser of range expansion.

An **American Coot, *Fulica americana*** was found on 27 November 2015 at Bon Accord sewage ponds (MK). Two were photographed there the following day (SR) and they remained until the year end. This is just the sixth documented record of this species, all from Tobago.

Two **Hudsonian Godwits, *Limosa haemastica*** were photographed at Bon Accord sewage ponds on 2 October 2015 (KP). Whilst a regular but scarce migrant to freshwater marshes in Trinidad, this is just the second documented record for Tobago.

A loose flock of 13 **Buff-breasted Sandpipers, *Tryngites subruficollis*** was found on a wet, partly grassed field on the Caroni Rice Project on 3 October (MK, NL) with four remaining until 10 October at least. These dates fall within the known migration period of 17 September - 28 October observed over the last 20 years.

A Wilson's Phalarope, *Phalaropus tricolor* was present on Caroni Rice Project for three days from 24 September 2015 (NL) (see plate). On Tobago, at least two birds were found at Bon Accord sewage ponds on 26 September 2015, present until at least the following day (KS). There have now been 10 of these migrant shorebirds found in Trinidad and Tobago during the last 20 years all seen between 3 August and 1 October.

Pomarine Jaegars, ***Stercorarius pomarinus*** winter in southeastern Caribbean waters and many young birds remain in their "winter quarters" during their first year. An immature was photographed in the Gulf of Paria. on 20 July 2015 (IK) and we belatedly received photographic evidence of a winter plumaged adult from the same area on 13 January 1996 (BM).

On 20 December 2014, a first-winter plumaged **Black-headed Gull, *Chroicocephalus ridibundus*** was photographed at Pigeon Point, Tobago (SL) and an adult was picked out amongst the gull roost at Brickfields on 10 October 2015 (NL). This latter bird remained in the area well into December. Once a major rarity, this species has now been found in six of the last eight years, the majority of sightings being from November - March.

Finding a **Franklin's Gull, *Leucophaeus pipixcan*** amongst the large west coast roost of Laughing Gulls is now becoming almost an annual event thanks to increased observer awareness of the subtle identification separation features between the two species. A first-winter plumaged bird first found on 29 December 2014 at Brickfield (NL), remained until 3 March 2015 at least. At the same site, two first-winter plumaged birds were found on 24 December 2015 (NL) and remained until the year's end.

Nesting **Lined Quail-Doves, *Geotrygon linearis*** were photographed high in the Northern Range on 26 April 2015 (CF). This is possibly the first occasion that this extremely rare and localised resident species has been photographed at a nest site.

Scaled Dove, *Geotrygon linearis* is now firmly established as a resident species in Trinidad, with sightings from five separate locations. Two were found on the Chaguaramas Peninsula on 27 June 2015 (KA) and have been regularly seen since. Elsewhere in south Trinidad, there were three birds together at Icacos on 30 May 2015 (KS, CQ); five at the Pitch Lake on 4 July 2015 (RG) and one photographed at Los Iros on 23 August 2015 (RJ). Finally, two were observed at the Toco Lighthouse on 13 September 2015 (GW).

Two **Fork-tailed Palm-Swifts, *Tachornis squamata*** were seen flying amongst a feeding group of Short-tailed Swifts over the Tobago Plantations estate, Tobago on 27 November 2015 (MK). This species is now quite regularly seen over the wetlands of SW Tobago (NG pers comm).

A **Rufous-shafted Woodstar, *Geotrygon linearis*** spent a few hours feeding on a flowering Vervain bush, seen from the Main House at Asa Wright Nature Centre on 3 May 2015 (BR *et al.*). This is just the fourth documented report of this tiny hummingbird in the last 20 years.

The highlight of the birding year in Trinidad and Tobago was the discovery of no less than three **Amethyst Woodstars, *Calliphlox amethystine***. An immature male was found at Surry Village, Lopinot on 26 May 2015 (GW) (see plate). This was followed by another young male at Asa Wright Nature Centre on 17 June 2015 (RP, GP, BR) and an unsexed immature bird at Yerette, Maracas St. Joseph on 30 June 2015 (TF, WR). This now brings to 18, the number of hummingbird species found in Trinidad and Tobago.

An immature **Aplomado Falcon, *Falco femoralis*** was seen flying high over the Aripo Savannah on 22 November 2014 (NL). Elsewhere, Caroni Rice Project continues to be a favourite hunting ground. During 2015, an immature was photographed on 25 June (SR) and an adult was watched in an aerial tussle with a Crested Caracara on 27 July (NL). Whilst it is recognised that the majority of this species visit Trinidad to prey on migrating shorebirds, they have in fact now been recorded in 10 months of the year.

A pair of **Brown-throated Parakeets, *Eupsittula pertinax*** were photographed at an active nest site in the Aripo Livestock Station on 20 July 2015 (see plate). In south Trinidad, a group of five birds were noisily feeding close to Princes Town on 17 August 2015 (RG).

A **White-eyed Parakeet, *Psittacara leucopthamus*** was found close to Arena forest, near Talparo on 13 September 2015 (KM, FO). This is the second year in a row that the species has been found away from the known small feral flock in north Port of Spain.

Discussion over the status of **Variegated Flycatcher, *Empidonomus varius*** in Trinidad has been gathering momentum in recent years. Further evidence that this species is present year round was documented with the following sightings of single birds: at Brasso Seco on 28 December 2014 (FO), in Caura Valley on 29 December 2014 (RN), at Gran Couva on 30 December 2014 (NL), at Talparo on 13 September 2015 (KM) and at the Aripo Livstock Station on 15 November 2015 (KM).

A **Bank Swallow, *Riparia riparia*** was found amongst a mixed feeding flock of hirundines over Bon Accord sewage ponds, Tobago on 20 October 2015 (KP). This species is found annually in small numbers on passage feeding over freshwater marshes in Trinidad. However this is only the second documented record for Tobago. We are aware of several undocumented sightings of at least one further individual, again from Bon Accord, during late December.

Single **Cliff Swallows, *Petrochelidon pyrrhonota*** were photographed at Brickfields on 4 October 2015 (NL) and over Bon Accord sewage ponds, Tobago from 20-22 October 2015 (KP). Whilst still considered a rare migrant from continental North America, careful study of feeding hirundine flocks has now produced 27 individuals in the last 20 years.

As documented in previous reports, an adult male **Lesson's Seedeater, *Sporophila bouvronides*** was seen, and at least four other birds were heard, from a known breeding site in South Trinidad on 7 June 2015. This location is withheld (KS).

Just two adult male **Summer Tanagers, *Piranga rubra*** have been documented during the year. One at Gran Couva on 20 February 2015 (NL) and one at Goodwood Park on 22 December 2015 (CG). However we are aware of other anecdotal sightings. This species is no longer the rarity it once was deemed to be, with at least 25 records since 1995.

An immature male **Rose-breasted Grosbeak, *Pheucticus ludovicianus*** was photographed at Asa Wright Nature Centre on 20 April 2015 (CW, FM) (see plate). Of the ten spring migrant birds documented in the last 20 years, seven have been found during the period 26 March - 22 April.

An **Ovenbird, *Seiurus aurocapilla*** was mist-netted in the Aripo Savannah on 7 March 2015 (DN). This is just the second documented record of this migrant warbler in the last 20 years, the last being from Tobago in November 2006.

A **Black-and-White Warbler, *Mniotilta varia*** first found on 24 December 2014 at Carli Bay (Kenefick, 2015) remained in the area until 27 January 2015 (NL). On 7 November 2015, presumably the same individual reappeared in exactly the same stretch of mangrove, and was seen until 25 December (NL).

A first-winter plumaged male **Cerulean Warbler, *Setophaga cerulean*** was photographed at Flagstaff Hill, Tobago on 25 October (FA) (see plate). This is the first documented sighting for Tobago and only the third for Trinidad and Tobago. The world population of this migrant warbler is declining at a rapid rate, due to its winter habitat in the northern Andes dwindling. It is cited as "possibly threatened or endangered" by Audubon (Audubon 2016).

A basic plumaged **Bay-breasted Warbler, *Setophaga castanea*** was found feeding in a Silk Cotton tree at Carli Bay on 22 February 2015 (NL). On 8 March 2015, a male bird advancing into alternate plumage was photographed at Chaguaramas (FO). This brings to 12, the number of documented records in just the last three years. Whilst a clearer understanding of basic plumage identification features has obviously helped an increase in sightings, this may indicate a slight change in wintering/migrating distribution.

A **Bobolink, *Dolichonyx oryzivorus*** was found at the Aripo Livestock Station on 12 October 2015 (DR, DRo). On 1 November 2015, a feeding flock of at least 25 birds were photographed at Penal (RG). Of the 17 documented sightings of this species in the last 20 years, all but four have been during the period 1 October to1 November.

ESCAPED CAGE AND AVIARY SPECIES

At least one **White-throated Toucan**, ***Ramphastos tucanus***, was reported from the Talparo area; a **White-winged Dove, *Zenaida asiatica*** was found in a park at Westmoorings; **Red and Green Macaws**, ***Ara chloropterus*** have been occasionally seen near Freeport and between Maracas and Las Cuevas and a **Festive Parrot**, ***Amazona festiva*** was photographed in Port of Spain. A male **Gray Seedeater, *Sporophila intermedia*** was found at Carli Bay and several reports of a male **Chestnut-bellied Seed-Finch, *Sporophila angolensis*** came from the same areas, well known as a gathering for cage-bird lovers. The small flock of **Village Weavers**, ***Ploceus culcullatus*** are still seen in the Caroni Rice Project.

We are also aware of a reintroduction project involving Muscovy Ducks from the Point a Pierre Wildfowl Trust. We cannot exclude the possibility that sightings of this species from the south-west peninsula of Trinidad may involve birds from this scheme

Finally, small groups of **Blue -and-Yellow Macaws, *Ara ararauna*** from the reintroduction project are occasionally being documented from the Plum Mitan area.

ADDITIONAL RECORDS

Acceptable records were also received for a further 19 sightings of the following species the statuses of which have already been established: **Rufescent Tiger-Heron, *Tigrisoma lineatum,*** **Hook-billed Kite, *Chondrohierax uncinatus,*** **Black Hawk-Eagle, *Spizaetus tyrannus,*** **Rufous Crab Hawk, *Buteogallus aequinoctialis,*** **Rufous Nightjar, *Antrostomus rufus*** and **Crested Caracara, *Caracara cheriway.***

INCONCLUSIVE RECORDS

Submissions of the following species were deemed inconclusive: **Striated Heron, *Butorides striata;*** **Gray Heron, *Ardea cinerea;*** **Crane Hawk, *Geranospiza caerulescens;*** **White-tailed Hawk, *Geranoaetus albicaudatus,*** **Lesser Elaenia, *Elaenia chiriquensis;*** **Variegated Flycatcher, *Empidonomus varius;*** **Chestnut-bellied Seed-Finch, *Sporophila angolensis*** and **Bobolink, *Dolichonyx oryzivorus.***

SPECIES REVIEW

Under the terms of our constitution, any committee member can request a review of a single record or indeed records of one or more species. During the year, a review was undertaken of all documented sightings of both **American Coot, *Fulica americana*** and **Caribbean Coot, *Fulica caribaea***. Its purpose was to ensure that the supporting documentation, either written and/or photographic, satisfied the now known identification separation features of these two extremely similar species. As a consequence, four historic reports of Caribbean Coot have now been deemed inconclusive. The current status of both species in our twin islands is stated in the respective individual species comments above.

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LEGEND TO PLATE

a. Western Reef-Heron, Bon Accord, Tobago, June 2015, photographed by Greg Prelich

b. Wilson's Phalarope, Caroni Rice Project, September 2015, photographed by Nigel Lallsingh

c. Roseate Spoonbill, Caroni swamp, February 2015, photographed by Nigel Lallsingh

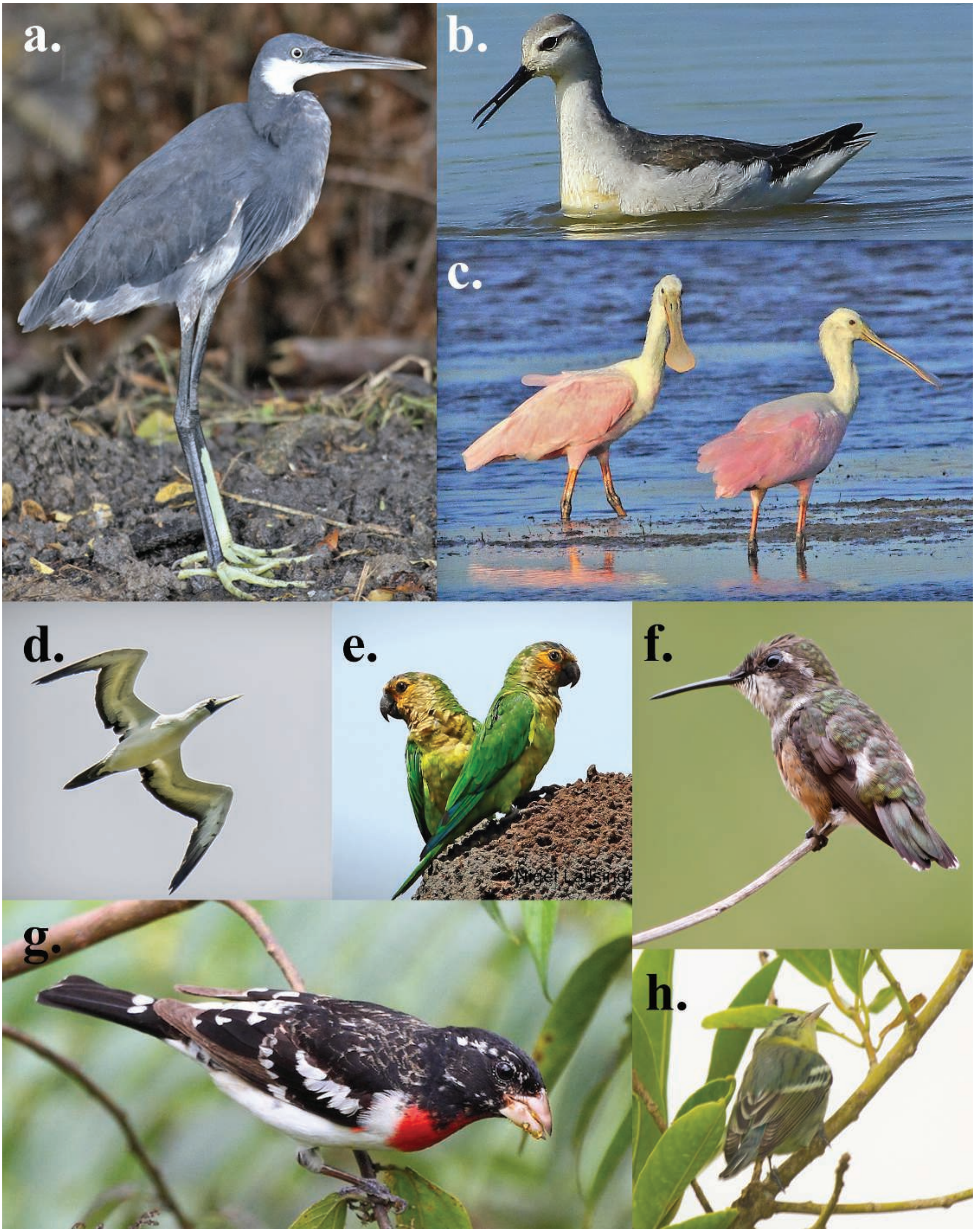
d. Masked Booby, Penal, January 2015, photographed by Rishi Goordial

e. Brown-throated Parakeet, Aripo Livestock Station, July 2015, photographed by Nigel Lallsingh

f. Amethyst Woodstar, Surrey Village, Lopinot, June 2015, photographed by Graham White

g. Rose-breasted Grosbeak, Asa Wright, April 2015, photographed by Fayard Mohammed

h. Cerulean Warbler, Flagstaff Hill, October 2015, photographed by Faraaz Abdool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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**

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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.
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   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.
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