A Survey of Bats in Northern Trinidad Late in the Rainy Season

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Abstract

Located off the northeastern coast of Venezuela, Trinidad is a small tropical island with a rich diversity of bats. Although 66 species have been documented, few inventories have published information on community structure of bats in the diverse habitats of the island. Here we report on composition, abundance, and natural history of species captured primarily in the Northern Range at the end of the rainy season (late December - early January). We captured 789 individuals representing 30 species in six families, including 672 bats in nets at ground level and 117 associated with roosts. Our capture rates in ground-level mist nets were substantially higher than other surveys reported from Trinidad. In ground-level nets, *Carollia perspicillata*, *Artibeus jamaicensis*, *Uroderma bilobatum*, *Platyrrhinus helleri*, and *A. glaucus* composed 79.8% of captures, and those species were present at most sites. Bats in the family Phyllostomidae accounted for 91% of captures and 59% of species. By feeding guild, captures were comprised of frugivores (86%), aerial insectivores (7%), nectarivores (3%), omnivores (3%), and gleaning animalivores (2%). We observed reproductive activity in only seven species, but this represents new seasonal information for Trinidad. Our study reports on the natural history of Trinidad's unique and diverse chiropteran fauna during a time of year when little information is available.

Key words: bats, Northern Range, reproduction, species abundance, species composition, Trinidad

Introduction

Trinidad is a relatively small tropical island (4,769 km²) in the Caribbean with a rich diversity of bats (66 species; Clarke et al. 2005b), including nearly half of the 146 species of Neotropical bats (Simmons and Voss 1998). Located about 11 km northeast of the Venezuelan coast, Trinidad has been connected to mainland South America by land bridges at least five times in the past 140,000 years (see Murphy 1997). Many genera from South America, including *Choeroniscus*, *Desmodus*, *Diclidurus*, *Furiptera*, *Mimon*, *Rhynchonycteris*, *Thyroptera*, *Tonatia*, *Trachops*, *Uroderma*, and *Vampyrum*, occur on Trinidad but not farther northward on Tobago or islands in the Lesser Antilles (i.e., excluding fossil records; Goodwin and Greenhall 1961; Baker and Genoways 1978; Koopman 1989). Larger Caribbean islands are depauperate in diversity of bats relative to Trinidad; Cuba (110,860 km^2) and Hispaniola (76,480 km^2) only have 26 and 18 species, respectively (Genoways et al. 2005). Trinidad's diverse chiropteran fauna has been attributed to both its historical connection to South America and overall ecological richness (Koopman 1958; Genoways et al. 1998). Genoways et al. (1998) proposed a zoogeographic boundary of chiropteran fauna that separates species with origins in the West Indies from those in South America; this is referred to as "Koopman's Line." The islands of Trinidad, Tobago, and Grenada lie south of Koopman's Line because their chiropteran fauna originated in South America and lacks endemic species known from the Lesser Antilles.

Trinidad contains a variety of habitats, including rainforests, deciduous forests, swamps, marshes, agricultural areas, and urban areas (Beard 1946; Goodwin and Greenhall 1961). Three mountain ranges traverse the width of the island, with the most expansive range located in northern Trinidad, the Northern Range. The tallest peak, El Cerro del Aripo, is located in the Northern Range at an elevation of 940 m. Trinidad has two seasons – a rainy season May - December and a dry season January - May (Goodwin and Greenhall 1961; Clarke and Downie 2001). Annual rainfall varies from 356 cm in northeastern portions of the Northern Range to 127 cm in western parts of the island (Goodwin and Greenhall 1961). Although the island contains about 1.25 million people, many forested regions remain across the country.

Researchers have conducted surveys of Trinidad's bats for over a century. Goodwin and Greenhall (1961) first summarized the diversity and ecology of 58 species from the island. Subsequent surveys recorded several additional species, as well as aspects of their natural history (Goodwin and Greenhall 1962, 1964; Genoways et al. 1973; Carter et al. 1981; Clarke and Racey 2003). Furthermore, the island has been a field site for research of chiropteran behavior (e.g. Kunz and McCracken 1996; Kunz et al. 1998; Davidson and Wilkinson 2004) and physiology (e.g. Heideman et al. 1992; Rasweiler and Badwaik 1997; Porter and Wilkinson 2001). Recently, researchers have addressed applied questions, including how bats respond to trails or logging in forests (Clarke and Downie 2001; Clarke et al. 2005a, 2005b).

Trinidad is undergoing rapid economic growth, fueled by the country's rich supplies of natural resources (e.g. petroleum and natural gas). As agriculture and urban development expand into montane regions, bats will be affected by habitat alterations as they have elsewhere (Fenton et al. 1992; Wilson et al. 1996; Medellin et al. 2000). Few inventories in Trinidad, however, contain information on structure of bat communities. Therefore, we present this paper as a reference for community structure of bats from northern Trinidad at the end of the rainy season. We conducted surveys in late December and early January, a period when few records have been reported for the island. We present data on community composition and rates of capture, as well as provide details on reproductive activity, morphology, and distribution. As stressed by Simmons and Voss (1998), it is important for all bat researchers to archive information about methods and captures so that baseline information about communities is available. Therefore, our main objective was to contribute information for future comparative studies involving this diverse chiropteran fauna.

METHODS

From 20 December 2007 to 1 January 2008, we captured bats by various techniques at 10 locations in northern Trinidad (Fig. 1, Appendix). Seven sites were in the Northern Range, and three were in lowlands between the Northern and Central ranges. Coordinates of localities were determined with hand-held global positioning systems (GPS; Garmin GPS 12, Garmin International, Inc., Olathe, KS, USA) using North American Datum 1983. Elevations were determined by plotting coordinates in Google Earth (v3.0; http://earth.google.com). General descriptions of habitats at sites are provided in the Appendix.

For most field efforts, we deployed mist nets ranging in length from 2.6 to 18 m (Avinet Inc., Dryden, NY, USA) at ground level along roadways and trails in forests, over watercourses, in plantations, and around buildings where we expected bats to occur. Details of

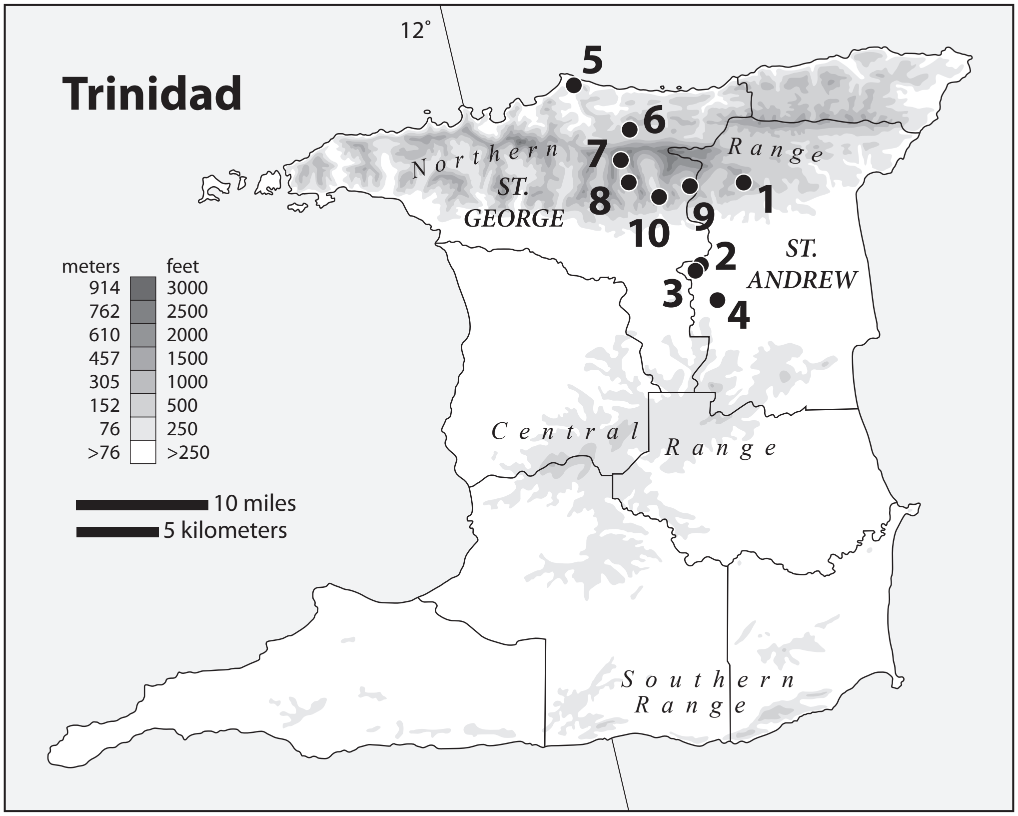

Figure 1. Map of capture sites for bats in northern Trinidad, West Indies from 20 December 2007 to 1 January 2008. For precise locations, see corresponding numbers in the Appendix.

the number of nets, net lengths, and hours of deployment are included in the Appendix. When sampling roost sites located in buildings, we used small hand nets to capture bats as they roosted or as they exited the roost. An additional bat was captured during the day on 20 December with a hand net, while it foraged in an unobstructed flyway above a roadway.

We deployed mist nets before dusk and monitored them continually for ≤6.5 h. On two nights at the William Beebe Field Station, we reopened and monitored nets for about 1.5 h before dawn—once because heavy rains hampered efforts during the night and once to attempt to capture individuals in the early morning. We identified individuals to species and held individuals in soil sample bags (12.7 x 17.8 and 8.9 x 12.7 cm, Hubco Protexo and Sentry sample bags, Hutchinson Bag Corp., Hutchinson, KS, USA) for <1 h. On most nights, we marked individuals with a spot of black ink before release to determine whether subsequent captures that evening represented new individuals or recaptures. All data hereafter represent unique individuals; we occasionally recaptured individuals but did not keep track of those data in field notes. For many individuals we recorded sex, length of forearm, body weight, age (adult or young based on cartilage in epiphyses in wings), and reproductive status. Body weights reported herein represent only those measured in the field shortly after capture as we collected data on bite-force for many individuals shortly after removal from mist nets (Freeman et al. in preparation). For data regarding bite-force, we used equipment and followed procedures outlined by Freeman and Lemen (2008). Once we obtained sufficient data on bite force for a species, subsequent individuals were released immediately after removing them from mist nets without measurement of body weight and length of forearm or recording sex, age, and reproductive status. Most bats were released at site of capture in < 30 min, but a few individuals were kept overnight to retest bite force, photograph, verify species, or retain as voucher specimens. Voucher specimens of each species were prepared as standard skins and skeletons. Specimens and field notes are archived in natural history collections in the Division of Zoology, University of Nebraska State Museum, Lincoln, NE, USA.

We followed Simmons and Voss (1998) for identification of some species and assignment to general feeding guilds. Other regional field guides were used for aid in identification of species (Goodwin and Greenhall 1961; Eisenberg 1989; Reid 1997; Gardner 2007). Capture rates were reported as bats captured per 10 net-meter-hours, that is, number of bats captured per 1 m of net per 10 hrs, or equally, bats captured per 10 m of net per hr, following methods reported by Simmons and Voss (1998). Descriptive statistics were calculated in SPPS version 12 (Chicago, IL, USA). Extreme outliers (> 3 x interquartile range from 1st or 3rd quartile) were removed from analyses because they likely reflect errors in collecting and recording data.

RESULTS

We captured 789 individuals representing 30 species, including 672 bats in nets near ground level (Table 1) and 117 associated with roosts (Table 2). We deployed 44 mist nets at ground level (not associated with roosts) for a cumulative 2,239 net-meter-hours (net-m-hr) and captured 3.0 bats/10 net-m-hr. In ground-level nets, *Carollia perspicillata*, *Artibeus jamaicensis*, *Uroderma bilobatum*, *Platyrrhinus helleri*, and *Artibeus glaucus* composed 79.8% of bats, and those species were present at most sites. Five other species were caught at >50% of sites, including *Chiroderma villosum*, *Glossophaga soricina*, *Phyllostomus hastatus*, *Sturnira lilium*, and *Sturnira tildae*. The one individual captured in a hand net was *Saccopteryx leptura*. We captured bats representing six families in ground-level nets (Emballonuridae, Mormoopidae, Phyllostomidae, Thyropteridae, Vespertilionidae, and Molossidae), with Phyllostomidae accounting for 91% of captures and 59% of species (17 of 29 species, Table 1). Frugivores (86%, 576 individuals) were most abundant, followed by aerial insectivores (7%, 44), nectarivores (3%, 19), omnivores (3%, 17), and gleaning animalivores (2%, 16; Table 1). Ten species were captured rarely (< 0.5% of total captures) in mist nets (Table 1). We observed eight species in a total of 10 roost sites in various natural and man-made structures (Table 2). Of note, *Pteronotus parnellii* was observed roosting in a large and abandoned, two-story concrete building that contained many large rooms with little or no sunlight; individuals were observed hanging from ceilings in a number of rooms. In this building, we also captured *C. perspicillata*, *Mormoops megalophylla*, and *P. hastatus*. We summarized details of body weight and length of forearms for each species captured (Table 3). Of note, all 11 *Micronycteris megalotis* were male. We observed both males and females for all other species where we recorded the sex for >2 individuals.

We observed seven species with evidence of current or recent reproductive efforts (*Anoura geoffroyi*, *Molossus molossus*, *Phyllostomus discolor*, *Rhynchonycteris naso*, *S. lilium*, *S. tildae*, and *Vampyrodes caraccioli*). On 24 December, we captured a lactating *A. geoffroyi*, and on 1 January, we captured two pregnant females; one contained a fetus with crown-rump (CR) length of 26 mm. On 26 December and 1 January, we captured pregnant individuals of *P. discolor*; the female in December contained a single fetus with CR of 20 mm. On 24 December, we captured pregnant females of *S. lilium* and *S. tildae*; each contained a single fetus (CR = 28.5 and 20 mm, respectively). On 31 December, a female *V. caraccioli* had a single fetus with CR of 18 mm. We captured flying young of *M. molossus* (26 December) and *R. naso* (29 December). One adult male *R. naso* had enlarged testes that measured 7 x 4 mm on 29 December.

We observed two species with brown and orange color morphs (*C. perspicillata* and *Pteronotus parnellii*). Abundance of orange-colored individuals of *C. perspicillata* varied between two neighboring valleys in the Northern Range. In the Arima Valley, we captured only a single orange morph out of 105 individuals, but we captured about 10 orange-colored individuals of various shades out of 59 individuals at one site in the Guanapo Valley.

Table 1. Species of bats captured in nets near ground level (mist nets and hand net) not associated with roosts in northern Trinidad 20 December 2007-1 January 2008. Feeding guild, number of each species, percentage of total individuals, and number of sites where each species was captured (8 sites total are possible) also are reported. Captures of bats at the William Beebe Field Station on 5 nights represent a single site.

Species	Feeding guild[1]	Number of individuals	Percentage of individuals	Number of sites
Carollia perspicillata	F	295	43.9	8
Artibeus jamaicensis	F	88	13.1	5
Uroderma bilobatum	F	87	12.9	8
Platyrrhinus helleri	F	46	6.8	5
Artibeus glaucus	F	21	3.1	6
Pteronotus parnellii	AI	13	1.9	4
Chiroderma villosum	F	13	1.9	5
Micronycteris megalotis	GA	12	1.8	4
Sturnira lilium	F	12	1.8	5
Phyllostomus hastatus	OM	11	1.6	5
Anoura geoffroyi	N	11	1.6	2
Glossophaga soricina	N	8	1.2	5
Rhynchonycteris naso	AI	8	1.2	1
Sturnira tildae	F	8	1.2	5
Molossus molossus	AI	6	0.9	2
Phyllostomus discolor	OM	6	0.9	4
Saccopteryx bilineata	AI	5	0.7	2
Artibeus lituratus	F	4	0.6	3
Saccopteryx leptura	AI	4	0.6	3
Mormoops megalophylla	AI	3	0.4	2
Pteronotus davyi	AI	2	0.3	2
Trinycteris nicefori	GA	2	0.3	2
Chiroderma trinitatum	F	1	0.1	1
Eptesicus brasiliensis	AI	1	0.1	1
Micronycteris minuta	GA	1	0.1	1
Mimon crenulatum	GA	1	0.1	1
Myotis nigricans	AI	1	0.1	1
Thyroptera tricolor	AI	1	0.1	1
Vampyrodes caraccioli	F	1	0.1	1
TOTAL		672	99.4	

[1]Feeding guilds: AI, aerial insectivore; F, frugivore; N, nectarivore; GA, gleaning animalivore; and OM, omnivore.

Table 2. Species of bats captured associated with roosts in northern Trinidad 21 December 2007-1 January 2008.

Species	Number of individuals	Number of roosts observed	Type of structure
Molossus molossus	57	3	narrow attic of buildings
Carollia perspicillata	15	6	large concrete building, small building with dark areas, small cave, and hollow tree
Molossus ater	13	1	narrow attic of residential building
Mormoops megalophylla	12	1	large concrete building
Phyllostomus hastatus	10	2	large concrete building, hollow tree
Pteronotus parnellii	8	1	large concrete building
Glossophaga soricina	1	1	small cave
Saccopteryx bilineata	1	1	small building with open doors and windows

Table 3. Mean body weight (g) and mean length of forearms (mm) of bats in northern Trinidad 20 December 2007 - 1 January 2008. Body weights represent only those measured in the field shortly after capture. Numbers in parentheses represent sample size, and numbers below means represent minimum-maximum values.

	Body weight		Length of forearm	
Species	male	female	male	female
Anoura geoffroyi	14.1 (4)	15.7 (6)	41.5 (4)	42.8 (5)
	12.5-16.0	14.0-18.0	40.0-43.0	39.0-45.0
Artibeus glaucus	13.5 (5)	13.8 (10)	40.2 (5)	41.3 (8)
	11.5-15.0	11.0-16.0	39.0-42.0	40.0-43.0
Artibeus jamaicensis	37.3 (9)	42.8 (3)	56.4 (9)	58.4 (5)
	34.0-41.5	36.0-46.5	55.0-58.0	55.0-61.0
Artibeus lituratus	70.0 (3)	70.0 (1)	70.0 (3)	73.0 (1)
	66.0-77.0	--	66.0-75.0	--
Carollia perspicillata	16.3 (14)	16.9 (13)	41.6 (17)	41.6 (11)
	11.0-20.0	14.0-20.0	39.0-44.0	40.0-43.0
Chiroderma trinitatum	--	18.0 (1)	--	41.0 (1)
Chiroderma villosum	25.6 (7)	28.0 (4)	47.4 (7)	48.5 (4)
	23.0-30.0	26.0-30.0	45.0-50.0	48.0-49.0
Eptesicus brasiliensis	--	9.0 (1)	--	43.0 (1)
Glossophaga soricina	9.3 (5)	10.3 (2)	35.5 (4)	35.5 (2)
	8.5-10.0	8.5-12.0	35.0-36.0	35.0-36.0
Mimon crenulatum	11.5 (1)	--	48.0 (1)	--
Micronycteris megalotis	6.1 (9)	--	33.7 (10)	--
	5.0-7.0	--	31.0-35.0	--

Table 3. (cont.)

	Body weight		Length of forearm	
Species	male	female	male	female
Micronycteris minuta	6.0 (1)	--	34.0 (1)	--
Molossus ater	20.8 (2) 19.0-22.5	22.6 (9) 21.0-24.0	48.5 (2) 48.0-49.0	48.3 (9) 48.0-50.0
Mormoops megalophylla	15.5 (2) 15.0-16.0	16.0 (3) 16.0-16.0	58.0 (2) 57.0-59.0	57.2 (3) 56.6-58.0
Molossus molossus	11.7 (17) 9.0-14.2	9.5 (21) 7.5-11.5	38.6 (17) 37.0-40.5	37.6 (20) 35.0-39.0
Myotis nigricans	4.0 (1)	--	36.0 (1)	--
Phyllostomus discolor	34.9 (4) 31.0-39.0	33.5 (2) 31.0-36.0	60.4 (4) 58.5-61.0	61.0 (2) 60.0-62.0
Phyllostomus hastatus	85.1 (5) 80.0-93.0	-- --	82.3 (6) 81.0-84.0	82.0 (2) 80.0-84.0
Platyrrhinus helleri	13.0 (11) 11.0-15.5	13.3 (7) 9.5-16.0	38.6 (11) 35.0-41.0	39.0 (8) 38.0-40.0
Pteronotus davyi	-- --	10.5 (2) 10.0-11.0	-- --	47.5 (2) 47.0-48.0
Pteronotus parnellii	21.2 (6) 19.5-23.0	19.0 (7) 16.5-26.5	61.5 (6) 61.0-63.0	61.3 (8) 58.0-63.0
Rhynchonycteris naso	3.9 (4) 3.5-4.0	4.0 (1) --	37.0 (4) 36.0-38.0	38.0 (1) --
Saccopteryx bilineata	7.5 (2) 7.2-7.7	7.5 (1) --	47.5 (2) 47.0-48.0	47 (1) --
Saccopteryx leptura	4.6 (3) 4.4-5.0	-- --	39.3 (3) 39.0-40.0	-- --
Sturnira lilium	19.5 (2) 19.0-20.0	19.3 (8) 13.0-24.0	43.0 (2) 42.5-43.5	42.5 (9) 41.0-44.0
Sturnira tildae	24.2 (3) 20.5-27.0	23.4 (5) 21.5-24.5	46.3 (3) 45.0-47.0	45.8 (5) 45.0-46.0
Thyroptera tricolor	--	3.2 (1)	--	35.0 (1)
Trinycteris nicefori	11.8 (1)	--	38.5 (1)	--
Uroderma bilobatum	16.6 (9) 12.5-19.0	17.4 (17) 11.5-20.5	41.4 (9) 39.0-44.0	43.0 (16) 41.0-46.0
Vampyrodes caraccioli	--	33.0 (1)	--	50.0 (1)

Discussion

We captured 672 bats representing 29 species in ground-level nets in only 11 nights (Table 1), representing an unusually large number of captures. Our capture rates (3.0 bats/10 net-m-hr) were greater than those in Mora forests of southern Trinidad (0.5 bats/10 net-m-hr, Clarke and Downie 2001; 0.5-2.2 bats/10 net-m-hr, Clarke et al. 2005a, 2005b) and rainforests of Paracou, French Guiana (0.98 bats/10 net-m-hr; Simmons and Voss 1998). Our high rates of capture may reflect greater abundances or seasonal differences of bats in the Northern Range compared to Mora forests in southern Trinidad. We rapidly accumulated a high diversity of species because of our high frequency of captures (Fig. 2). Rates of species accumulation were similar to surveys in primary forests of southern Trinidad (Clarke et al. 2005b) and to surveys across all habitats in Paracou (Simmons and Voss 1998), based on numbers of individuals captured in ground-level nets. By sampling with ground-level nets, we missed capturing species active above the canopy or that readily sense and avoid nets, including some Emballonurids, Phyllostomines, and Molossids (Simmons and Voss 1998). Additional surveys in northern Trinidad that include searching for roosts (Carter et al. 1981), using high nets (Simmons and Voss 1998), and increasing nights of effort would yield more species in the area.

Carollia perspicillata dominated our captures (44%), as it has in other surveys on Trinidad (Clarke and Downie 2001; Clarke et al. 2005a, 2005b). However, we commonly captured several species, *A. jamaicensis*, *U. bilobatum*, and *P. helleri*, that were captured infrequently in Mora forests of southern Trinidad, but we rarely captured *G. soricina*, a species captured frequently in southern Trinidad (Clarke and Downie 2001; Clarke et al. 2005a, 2005b). Dominance of frugivores in our captures from the Northern Range may reflect an abundance of food and roosting sites in this region. In addition, we sampled during a rainy season with relatively low precipitation (Howard Nelson, personal communication), which may have influenced levels of activity or distribution of bats across Trinidad. It is unknown whether bats move seasonally throughout Trinidad or migrate to and from Venezuela.

Reproduction.—Few data are available for reproductive activity of bats in Trinidad at the end of the rainy season (December and early January). Seven species were reproductively active during our survey (*A. geoffroyi*, *M. molossus*, *P. discolor*, *R. naso*, *S. lilium*, *S. tildae*, and *V. caraccioli*). These records expand the known dates of reproductive activity for these seven species on the island. Pregnant females of *A. geoffroyi* were documented previously from late August to mid December (Goodwin and Greenhall 1961; Heideman et al. 1992). This species also appears to give birth late in the wet season in Trinidad (this study), as it does in other Neotropical regions (Wilson 1979). *Molossus molossus* has been reported pregnant in July and August and lactating August, September, and December on the island (Goodwin and Greenhall 1961; Carter et al. 1981). Our capture of a volant young *M. molossus* near the end of December is at the same time of year when lactating females were captured by Goodwin and Greenhall (1961). Pregnant females of *P. discolor* are known from February, March, June, and August (Goodwin and Greenhall 1961). Our data expand known dates of pregnancy for *P. discolor* on Trinidad and suggest this species exhibits an acyclic or continuous pattern of breeding, as documented in other parts of its distribution (Wilson 1979). Pregnant females of *R. naso* have been documented in March, July, and August in Trinidad (Goodwin and Greenhall 1961; Carter et al. 1981). Our capture of a volant young *R. naso* on 29 December suggests that additional surveys will document pregnant females later into the wet season. For *S. lilium*, the only previous record of a reproductively active female was a pregnant individual captured in August (Carter et al. 1981). Pregnant females of *S. tildae* have been reported in March (Goodwin and Greenhall 1961) and August (Carter et al. 1981). Our captures of pregnant females in December expand known dates of pregnancy for both *S. lilium* and *S. tildae* on the island. Further data are needed to comment on the reproductive patterns of both species on Trinidad. Capture of a pregnant *V. caraccioli* in the Northern Range represents the first documentation of reproduction for this species for Trinidad. Observations of pregnant individuals in dry and rainy seasons in other Neotropical regions

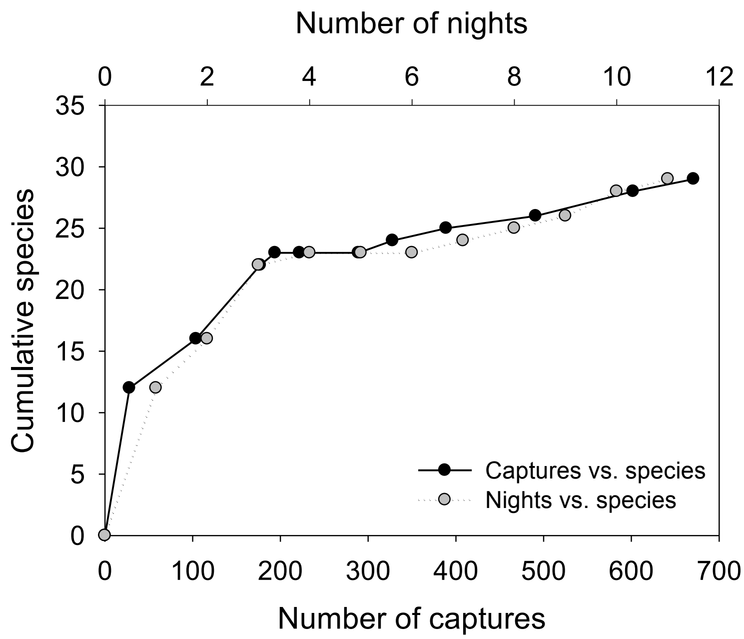

Figure 2. Species accumulation curves for bats captured in northern Trinidad in ground-level mist nets based on number of captures (bottom axis) and number of nights (top axis) from 21 December 2007 to 1 January 2008. Data do not include individuals or species captured in roosts or the single individual captured by a hand net not associated with a roost.

suggest *V. caraccioli* exhibits a pattern of bimodal polyestry exhibited by many tropical species of bats (Wilson 1979).

Comments on Prior Research Expeditions to Trinidad.—Carter et al. (1981) reported on the distribution, reproduction, and morphology of bats collected as voucher specimens from three surveys on Trinidad in the late 1970s. We contacted R. J. Baker (Texas Tech University, Lubbock, Texas, USA) to obtain further details of those surveys because the authors did not present details of field efforts or whether individuals reported represented all captures. We learned that many individuals of a number of species were released and efforts consisted of searching for roosts as well as deploying mist nets. Thus, specimens examined in their manuscript reflect species richness, but not abundances of individuals, at sites across Trinidad.

Conclusions.—Our intent was to report on community structure and notes on natural history from a time of year when few surveys have been conducted on an island where economic development is increasing because of a rich supply of petroleum in the region. Our limited survey was not intended to explain the complete community of bats in the Northern Range. However, by publishing details of our survey, we aim to assist future researchers in conducting comparative studies within Trinidad, as well as across the Neotropics. All field studies potentially contain important data on natural history that could be gleaned for publication, as ours did. Trinidad provides a location to examine community structure and interactions among a unique cohort of Neotropical bats.

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Appendix

Localities of capture sites for bats in northern Trinidad 20 December 2007-1 January 2008. Parishes are given in all capitals. Dates of capture are followed by parentheses that contain the number and size of nets (or type, i.e., hand nets) deployed; general habitats; cumulative meter-net-hours; and number of each species captured. Abbreviations for species are as follows: *Anoura geoffroyi* (ANGE), *Artibeus glaucus* (ARGL), *A. jamaicensis* (ARJA), *A. lituratus* (ARLI), *Carollia perspicillata* (CAPE), *Chiroderma trinitatum* (CHTR), *C. villosum* (CHVI), *Eptesicus brasiliensis* (EPBR), *Glossophaga soricina* (GLSO), *Micronycteris megalotis* (MIME), *M. minuta* (MIMI), *Mimon crenulatum* (MICR), *Molossus ater* (MOAT), *M. molossus* (MOMO), *Mormoops megalophylla* (MOME), *Myotis nigricans* (MYNI), *Phyllostomus discolor* (PHDI), *P. hastatus* (PHHA), *Platyrrhinus helleri* (PLHE), *Pteronotus davyi* (PTDA), *P. parnellii* (PTPA), *Rhynchonycteris naso* (RYNA), *Saccopteryx bilineata* (SABI), *S. leptura* (SALE), *Sturnira lilium* (STLI), *S. tildae* (STTI), *Thyroptera tricolor* (THTR), *Trinycteris nicefori* (TRNI), *Uroderma bilobatum* (URBI), and *Vampyrodes caraccioli* (VACA). Catalog numbers of voucher specimens at the University of Nebraska State Museum (UNSM) are given in brackets. Numbers in bold before localities refer to numbers in Fig. 1.

ST. ANDREW: **(1)** Cumaca Road, 10°41.509′N, 061°09.771′W, 319 m elev. (along edge of rainforest), 27 December (one 2.6-m in front of small cave; 13 m-net-h; CAPE 5, GLSO 1), 27 December (one 9-m, two 18-m; 225 m-net-h; ARGL 5, CAPE 37, PHHA 1, SALE 1, STLI 6, STTI 2, URBI 15); **(2)** N of Cumuto, Aripo River, 10°36.052′N, 061°12.781′W, 34 m elev. (near and over river), 28 December (two 12-m, two 18-m; 210 m-net-h; ARGL 2, CAPE 17, GLSO 1 [UNSM 29134], SALE 1, MOME 2, MOMO 3 [UNSM 29135], PLHE 2 [UNSM 29136], PTDA 1 [UNSM 29133], STLI 1, URBI 9 [UNSM 29137]); **(3)** S of Waller Field, 2 km N of Cumuto, 10°36.035′N, 061°12.850′W, 35 m elev. (building in lowlands), 22 December (hand nets; CAPE 10, MOME 12 [UNSM 29102, 29104], PHHA 10 [UNSM 29103, 29105], PTPA 8); and **(4)** 0.2 km E of Cumuto Road on Little Coora Road, 10°33.806′N, 061°11.494′W, 48 m elev. (building in low hills), 23 December (hand nets; MOAT 13 [UNSM 29127, 29128, 29129, 29130], MOMO 5 [UNSM 29131]).

ST. GEORGE: **(5)** Yarra River, SE of Filette, 10°47.875′N, 061°21.005′W, 13 m elev. (near and over river and in small plantation), 29 December (one 12-m, three 18-m; 297 m-net-h; ARJA 1 [UNSM 29144], CAPE 34 [UNSM 29145], CHVI 2, GLSO 2 [UNSM 29141], MIME 2 [UNSM 29142, 29143], MOME1, PHDI 1, PTPA 6 [UNSM 29146], RHNA 8 [UNSM 29138, 29139, 29140], URBI 4); **(6)** Brasso Seco Village, 10°44.967′N, 061°17.301′W, 104 m elev. (edge of rainforest over stream and in plantations and trails), 26 December (two 6-m, one 9-m, one 18-m; 195 m-net-h; ARLI 1 [UNSM 29149], CAPE 15, GLSO 1, PHDI 2 [UNSM 29126, 29150], PHHA 1, PTPA 3, STLI 2, STTI 1, URBI 2); **(7)** Asa Wright Nature Center, 10°42.981′N, 061°17.895′W, 326 m elev. (on trails in rainforest), 1 January (one 9-m, two 18-m; 112.5 m-net-h; ANGE 8 [UNSM 29161], ARGL 5, ARJA 12, CAPE 23, CHTR 1 [UNSM 29160], CHVI 1, MIME 3, PHDI 2, PLHE 4, PTPA 2, SABI 2, STTI 1, TRNI 1, URBI 4); **(8)** William Beebe Field Station, HQ, 10°41.515′N, 061°17.365′W, 198 m elev. (on trails and small roads in second growth rainforest), 20 December (hand nets; SABI 1, SALE 1), 21 December (two 12-m nets, one 9-m, one 2.6-m; 231.4 m-net-h; ARJA 1, ARLI 1, CHVI 3 [UNSM 29112, 29113], CAPE 13, GLSO 1, MIME 1 [UNSM 29108], MYNI 1 [UNSM 29107], PLHE 2 [UNSM 29110], PTDA 1, SABI 1 [UNSM 29109], URBI 3 [UNSM 29111]), 22 December (two 6-m, one 9-m, one 12-m; 181.5 m-net-h; ARGL 3 [UNSM 29099, 29100], ARJA 20, CAPE 16 [UNSM 29101], EPBR 1 [UNSM 29097], MIME 1, PHHA 2, PLHE 8, PTPA 2 [UNSM 29098], SALE 1 [UNSM 29096], URBI 22 [UNSM 29106]), 23 December (hand net; MOMO 1), 25 December (one 2.6-m, one 9-m; 69.6 m-net-h; CAPE 4 [UNSM 29151, 29152], SABI 1, URBI 3), 26 December (one 6-m by roost in building; MOMO 46 [UNSM 29153]), 26 December (one 2.6-m, one 9-m; 17.4 m-net-h; CAPE 4, GLSO 2 [UNSM 29154], MOMO 2, SABI 1), 30 & 31 December (two 6-m, two 18-m; 234 m-net-h [=30 Dec., 4 h x 48 m-net and 31 Dec., 1.75 h x 24 m-net]; ARGL 1, ARJA 35, CAPE 45 [UNSM 29147], CHVI

1 [UNSM 29159], MIME 2, MOMO 1, PHHA 2, STLI 1, STTI 1, TRNI 1 [UNSM 29148], URBI 12), 30 December (hand net by building; MOMO 5); **(9)** near Aripo, 10°41.272′N, 061°13.318′W, 187 m elev. (edge of second growth rainforest along stream and in small plantation), 24 December (two 9-m, one 18-m; 198 m-net-h; ANGE 3 [UNSM 29116, 29117], ARGL 2, ARJA 1 [UNSM 29119], CAPE 28, CHVI 5, MICR 1 [UNSM 29114], MIMI 1 [UNSM 29115], PHDI 1 [UNSM 29118], PHHA 1, PLHE 20 [UNSM 29125, 29132], STLI 2 [UNSM 29122, 29124], STTI 3 [UNSM 29120, 29121, 29123], URBI 5); and **(10)** near Guanapo River, Heights of Guanapo Road, 10°40.566′N, 061°15.364′W, 177 m elev. (in trails in rainforest), 31 December (one 2.6-m, three 18-m; 254.7 m-net-h; ARGL 3, ARJA 18, ARLI 2 [UNSM 29157], CAPE 59, CHVI 1, GLSO 1, MIME 3, PHHA 4, PLHE 10, THTR 1 [UNSM 29155], URBI 8 [UNSM 29158], VACA 1 [UNSM 29156]).

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