

MINI REVIEW

Review of mammalogical research in the Guianas of northern South America

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Abstract

Research on mammals in the Guianas of northern South America has had a checkered history. In this review, I summarize the notable contributions to mammalogical study in Guyana, Suriname and French Guiana. These studies began in the mid-18th century with the binomial nomenclature system of scientific classification created by the Swedish naturalist Carl Linnaeus, who described 23 species new to science based on holotype specimens from the Guianas. Notwithstanding popular accounts by amateur naturalists visiting this region, over the next 7 decades there was only sporadic taxonomic work done on Guianan mammals primarily by researchers at European museums. The first comprehensive biological exploration took place in the 1840s during a geographic survey of the boundaries of British Guiana. However, it was not until almost half a century later that scientific publications began to regularly document the increasing species diversity in the region, including the prodigious work of Oldfield Thomas at the British Museum of Natural History in London. Another lull in the study of mammals occurred in the mid-1910s to the early 1960s after which foreign researchers began to rediscover the Guianas and their pristine habitats. This biological renaissance is still ongoing and I give a prospectus on the direction of future research in one of the last frontiers of tropical rainforest. An initiative that would be greatly beneficial is the establishment of a university network in the Guianas with graduate-based research to develop a cadre of professional experts on biodiversity and evolution as seen in other countries of South America.

Key words: French Guiana, Guyana, history, Mammalia, Suriname

INTRODUCTION

The Guianas of northern South America has one of the last remaining tracts of intact tropical rainforest on

Earth (Myers 1988). It has the lowest population density, with most people inhabiting the coastline, and the smallest economy in South America. For mammals, this area also harbors a high level of species diversity, especially when compared to other areas in the world outside of the Amazon basin (Voss & Emmons 1996). However, the Guianas is a poorly known region even on its own continent, primarily because of language barriers with the dominant Latin American countries, and this is also true in terms of barriers to the exchange of biological research.

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The Guianas is defined as the countries wholly within the Guiana Shield region: Guyana, Suriname and French Guiana (but excluding Amapa, which is a Brazilian state situated entirely north of the Amazon River). Other than French Guiana, which is still an overseas department of France, Guyana and Suriname are independent states that were previously British and Dutch colonies, respectively. Although the tropical rainforest is contiguous with and dwarfed by the vast Amazonian forest, the Guianas is geographically delineated as the Atlantic coast watershed situated between the Amazon and Orinoco River drainage basins.

The objective of this review of mammalogical research in the Guianas is to put into biological perspective the history of scientific discovery in this poorly studied area of South America. It is expanded upon from a recent historical summary by Lim and Catzefflis (2014) that focuses separately on each of the 3 countries. However, instead of an annotated listing of discoveries based on the scientific literature, a more interpretive approach is taken to identify eras in the study of mammalogy in the Guianas, and their biological significance to our understanding of Neotropical biodiversity and evolution is discussed.

MATERIALS AND METHODS

Since the most recent annotated checklist (Lim 2012), new country records, taxonomic revisions, revised occurrence data and descriptions of species new to science have contributed to the present total of mammalian diversity in the Guianas. (1) The widely distributed Heller's broad-headed bat (*Platyrrhinus helleri* Peters, 1866) was restricted to west of the Andes from western Ecuador to Mexico and 3 sympatric but genetically divergent species were identified in the Guianas, including *Platyrrhinus incarum* Thomas, 1912, and 2 new species (*Platyrrhinus fusciventris* and *Platyrrhinus guianensis*) described by Velazco *et al.* (2010) and Velazco and Lim (2014), respectively. (2) The Sinnamary brush-tailed rat (*Isothrix sinnamariensis* Vié, 1996) and Oyapock fishing rat (*Neusticomys oyapocki* Dubost and Petter, 1978) were documented for the first time from Suriname during a biodiversity survey of the southern region of the country (Lim & Joemratie 2011). (3) Velazco and Patterson (2013) restricted the widely occurring yellow-shouldered bat (*Sturnira lilium* Geoffroy St.-Hilaire, 1810) to the south-eastern Brazilian Shield and identified "*Sturnira* new species 3" as undescribed from the Amazon basin, Venezuela, Trinidad

and the Guianas. (4) Olingos were taxonomically revised by Helgen *et al.* (2013) and *Bassaricyon beddardi* Pocock, 1921 (with type locality in Guyana) was synonymized under *Bassaricyon alleni* Thomas, 1880 from Peru. (5) A new species of mouse opossum (*Marmosops pakaraimae*) was described from the Pakaraima highlands of Guyana and Venezuela (Voss *et al.* 2013). (6) The widely distributed short-tailed opossum *Monodelphis breviceaudata* Erxleben, 1777 was restricted to the western Guiana Shield, *Monodelphis touan* Shaw 1800 to the eastern Guiana Shield, and a new species (*Monodelphis arlindoi*) was described from the central Guiana Shield (Pavan *et al.* 2012). (7) The genus of nectar-feeding bats *Lonchophylla* Thomas, 1903 was found to be paraphyletic based on molecular data and a new genus (*Hsunycteris*) was described by Parlos *et al.* (2014) with *Hsunycteris thomasi* Allen, 1904 occurring in the Guianas. (8) Parnell's moustached bat (*Pteronotus parnellii* Gray 1843) was restricted to Jamaica and 3 genetically distinct species were recognized in the Guianas as *P. rubiginosus* Wagner, 1843, "*P. parnellii* PS2," and "*P. parnellii* PS3" (Clare *et al.* 2013; Thoisy *et al.* 2014). (9) The presence of the cotton rat *Sigmodon alstoni* (Thomas, 1881) and an unidentified species of the opossum *Cryptonanus* Voss *et al.* 2005 in French Guiana were noted in Baglan and Catzefflis (2015). (10) Removal of *Diclidurus albus* Wied-Neuwied, 1820 from French Guiana because the only previous specimen was misidentified and is *Diclidurus scutatus* Peters, 1869 (F. Catzefflis, pers. comm., 30 March 2015). (11) Removal of *Myotis albescens* (Geoffroy, 1806) from French Guiana because no specimen could be found to document this species (F. Catzefflis, pers. comm., 30 March 2015). (12) Separation of *Mazama nemorivaga* (Cuvier, 1817) from the parapatrically distributed *Mazama gouazoubira* (Fischer, 1814) based on genetic distinctions (Duarte *et al.* 2008). (13) Consideration of *Sphig-gurus* F. Cuvier, 1825 as a junior synonym of *Coendou* Lacépède 1799 and the use of *C. melanurus* Wagner, 1842 as recommended by Handley and Pine (1992) and Voss *et al.* (2001) because of a lack of diagnosable characters at the level of genus.

Although there are several earlier anecdotal accounts and travel dairies from naturalists, the adoption of the binomial nomenclature system for the scientific classification of animals in the 10th edition of *Systema Naturae* by Carl Linnaeus (1758) is taken as the starting point for biological research in South America (Baker 1991). Most of the published data for studies of Guianan mammals in the first 2 centuries are papers on taxonomy or

distributional occurrence (Lim & Catzefflis 2014; this study). These over 200 citations are the most exhaustive compilation of literature references and are used to track the chronological trends in species discovery in this area and function as a standardized surrogate of mammalogical research. Ecological references for the Guianas do not regularly appear in the literature until the 1960s (Lim & Catzefflis, 2014).

RESULTS

There are currently 239 species of mammals in 12 taxonomic orders documented from the Guianas, including 226 species from Guyana, 196 species from Suriname and 185 species from French Guiana (Table 1). The increase in species richness is positively correlated to the total area of each country (Lim 2012). For similar sized areas in South America, Guianas has an area (470 000 km²) slightly larger than Paraguay (410 000km²), which has 156 species of mammals (Myers 2002). The overwhelming majority (78%) of species are small-sized mammals averaging <1 kg in body mass, including all bats (131 species), all marsupials (21 species) and most rodents (35 of 41 species). Large mammals such as carnivores and primates are less numerous at 17 and 8 species, respectively, and the remaining 7 orders comprise 5 or fewer species.

Seven eras of mammal research were identified in the Guianas beginning with the taxonomic work of Linnaeus in the last half of the 18th century. Since this time (over 250 years ago), 239 currently recognized species of mammals have been documented in this region of northern South America. The first report of a species of mammals in the Guianas has been referenced in more than 100 scientific publications during these 250 years (Lim & Catzefflis 2014). A general pattern of alternating periods of high followed by low discovery of species diversity has been a common trend in the Guianas over time (Fig. 1). These eras are generally based on influential biologists or institutions based in the western hemisphere that have contributed the most to research on mammals in the region. A rate of species discovery >1 per year is considered a period of high activity, whereas <1 per year is considered a period of low activity of species discovery in the Guianas.

Linnaeus (1758–1771)

The Guianas figured prominently in the early descriptions of new species from South America and accounted for more than one-third of the type localities of mammals from South America (Baker 1991). Most of these were named in 3 editions of *Systema Naturae* spanning 14 years (Linnaeus 1758, 1766, 1771) and include a varied array of iconic Neotropical species, such as the

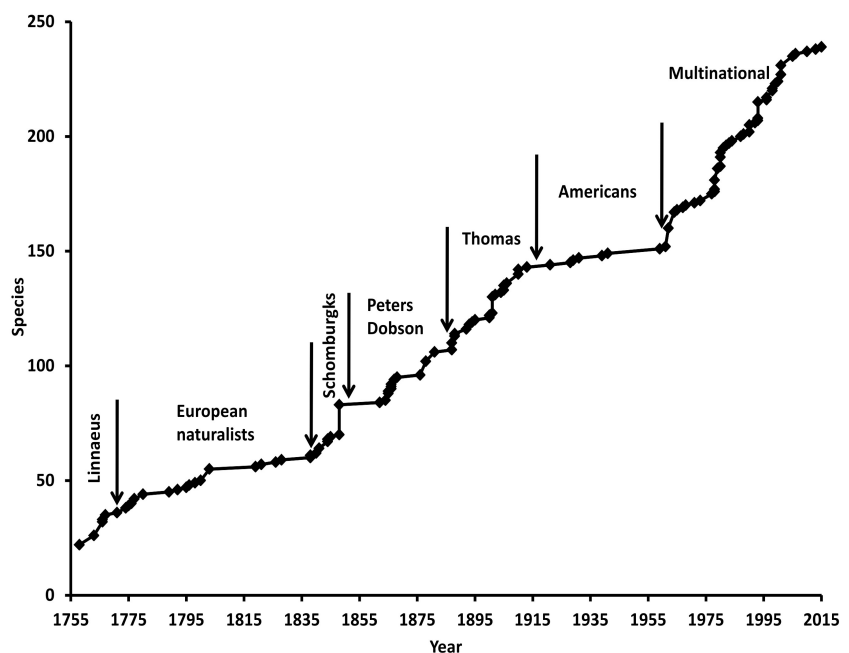


Figure 1 Accumulation curve of species of mammals documented from the Guianas (Guyana, Suriname and French Guiana) since Linnaeus (1758). Major periods of mammalogical research are identified and discussed in the text.

Table 1 Species of mammals documented from the Guianas (Guyana, Suriname and French Guiana) arranged by the taxonomic rank of order

Species	Guyana	Suriname	French Guiana
DIDELPHIMORPHIA (21)	18	14	14
<i>Caluromys lanatus</i>	G		
<i>Caluromys philander</i>	G	S	F
<i>Chironectes minimus</i>	G	S	F
<i>Cryptonanus</i> sp.			F
<i>Didelphis imperfecta</i>	G	S	F
<i>Didelphis marsupialis</i>	G	S	F
<i>Gracilinanus emiliae</i>	G	S	F
<i>Hyladelphys kalinowskii</i>	G		F
<i>Lutreolina crassicaudata</i>	G	S	
<i>Marmosa lepida</i>	G	S	F
<i>Marmosa murina</i>	G	S	F
<i>Marmosops pakaraimae</i>			
<i>Marmosops parvidens</i>	G	S	F
<i>Marmosops pinheiroi</i>	G	S	F
<i>Metachirus nudicaudatus</i>	G	S	F
<i>Micoureus demerarae</i>	G	S	F
<i>Monodelphis arlindoi</i>	G		
<i>Monodelphis touan</i>			F
<i>Monodelphis brevicaudata</i>	G	S	
<i>Monodelphis reigi</i>	G		
<i>Philander opossum</i>	G	S	F
PILOSA (5)	5	5	5
<i>Bradypus tridactylus</i>	G	S	F
<i>Choloepus didactylus</i>	G	S	F
<i>Cyclopes didactylus</i>	G	S	F
<i>Myrmecophaga tridactyla</i>	G	S	F
<i>Tamandua tetradactyla</i>	G	S	F
CINGULATA (5)	5	5	4
<i>Cabassous unicinctus</i>	G	S	F
<i>Dasypus kappleri</i>	G	S	F
<i>Dasypus novemcinctus</i>	G	S	F
<i>Euphractus sexcinctus</i>	G	S	
<i>Priodontes maximus</i>	G	S	F
CHIROPTERA (131)	124	108	101
<i>Centronycteris maximiliani</i>	G	S	F
<i>Cormura brevirostris</i>	G	S	F
<i>Cyttarops alecto</i>	G	S	F
<i>Diclidurus albus</i>	G	S	
<i>Diclidurus ingens</i>	G		F

Species	Guyana	Suriname	French Guiana
<i>Diclidurus isabellus</i>	G		
<i>Diclidurus scutatus</i>	G	S	F
<i>Peropteryx kappleri</i>	G	S	F
<i>Peropteryx leucoptera</i>	G	S	F
<i>Peropteryx macrotis</i>	G	S	F
<i>Peropteryx trinitatis</i>			F
<i>Rhynchonycteris naso</i>	G	S	F
<i>Saccopteryx bilineata</i>	G	S	F
<i>Saccopteryx canescens</i>	G	S	F
<i>Saccopteryx gymnura</i>	G	S	F
<i>Saccopteryx leptura</i>	G	S	F
<i>Noctilio albiventris</i>	G	S	F
<i>Noctilio leporinus</i>	G	S	F
<i>Pteronotus gymnonotus</i>	G	S	F
<i>Pteronotus parnellii</i> PS2	G		
<i>Pteronotus parnellii</i> PS3	G	S	F
<i>Pteronotus rubiginosus</i>	G	S	F
<i>Pteronotus personatus</i>	G	S	F
<i>Chrotopterus auritus</i>	G	S	F
<i>Glyphonycteris daviesi</i>	G	S	F
<i>Glyphonycteris sylvestris</i>	G	S	F
<i>Lampronnycteris brachyotis</i>	G	S	F
<i>Lonchorhina inusitata</i>	G	S	F
<i>Lophostoma brasiliense</i>	G	S	F
<i>Lophostoma carrikeri</i>	G	S	F
<i>Lophostoma schulzi</i>	G	S	F
<i>Lophostoma silvicolium</i>	G	S	F
<i>Macrophyllum macrophyllum</i>	G	S	F
<i>Micronycteris brosetti</i>	G		F
<i>Micronycteris hirsuta</i>	G	S	F
<i>Micronycteris megalotis</i>	G	S	F
<i>Micronycteris minuta</i>	G	S	F
<i>Micronycteris schmidtorum</i>			F
<i>Mimon bennettii</i>	G	S	F
<i>Mimon crenulatum</i>	G	S	F
<i>Phylloderma stenops</i>	G	S	F
<i>Phyllostomus discolor</i>	G	S	F
<i>Phyllostomus elongatus</i>	G	S	F
<i>Phyllostomus hastatus</i>	G	S	F
<i>Phyllostomus latifolius</i>	G	S	F
<i>Tonatia saurophila</i>	G	S	F
<i>Trachops cirrhosus</i>	G	S	F

Table 1 Continued

Species	Guyana	Suriname	French Guiana	Species	Guyana	Suriname	French Guiana
<i>Trinycteris nicefori</i>	G	S	F	<i>Natalus tumidirostris</i>	G	S	F
<i>Vampyrum spectrum</i>	G	S	F	<i>Furipterus horrens</i>	G	S	F
<i>Anoura caudifer</i>	G	S	F	<i>Thyroptera discifera</i>		S	F
<i>Anoura geoffroyi</i>	G	S	F	<i>Thyroptera devivoi</i>	G		
<i>Anoura latidens</i>	G			<i>Thyroptera tricolor</i>	G	S	F
<i>Choeroniscus godmani</i>	G	S		<i>Eptesicus andinus</i>	G		
<i>Choeroniscus minor</i>	G	S	F	<i>Eptesicus brasiliensis</i>	G	S	
<i>Glossophaga longirostris</i>	G			<i>Eptesicus chiriquinus</i>	G	S	F
<i>Glossophaga soricina</i>	G	S	F	<i>Eptesicus furinalis</i>	G	S	F
<i>Lichonycteris obscura</i>	G	S	F	<i>Lasiurus atratus</i>	G	S	F
<i>Lionycteris spurrelli</i>	G	S	F	<i>Lasiurus blossevillii</i>	G	S	F
<i>Hsundaycteris thomasi</i>	G	S	F	<i>Lasiurus ega</i>	G	S	
<i>Carollia brevicauda</i>	G	S	F	<i>Lasiurus egregius</i>		S	F
<i>Carollia perspicillata</i>	G	S	F	<i>Myotis albescens</i>	G	S	
<i>Rhinophylla pumilio</i>	G	S	F	<i>Myotis nigricans</i>	G	S	F
<i>Ametrida centurio</i>	G	S	F	<i>Myotis riparius</i>	G	S	F
<i>Artibeus amplus</i>	G	S		<i>Rhogeessa hussoni</i>		S	
<i>Artibeus bogotensis</i>	G	S		<i>Rhogeessa io</i>	G		
<i>Artibeus cinereus</i>	G	S	F	<i>Cynomops abrasus</i>	G	S	F
<i>Artibeus concolor</i>	G	S	F	<i>Cynomops greenhalli</i>		S	F
<i>Artibeus gnomus</i>	G	S	F	<i>Cynomops paranus</i>	G	S	F
<i>Artibeus lituratus</i>	G	S	F	<i>Cynomops planirostris</i>	G	S	F
<i>Artibeus obscurus</i>	G	S	F	<i>Eumops auripendulus</i>	G	S	F
<i>Artibeus planirostris</i>	G	S	F	<i>Eumops nanus</i>	G		
<i>Chiroderma trinitatum</i>	G	S	F	<i>Eumops glaucinus</i>	G	S	
<i>Chiroderma villosum</i>	G	S	F	<i>Eumops hansae</i>	G		F
<i>Mesophylla macconnelli</i>	G	S	F	<i>Eumops maurus</i>	G	S	F
<i>Platyrrhinus aurarius</i>	G	S		<i>Eumops trumbulli</i>	G	S	
<i>Platyrrhinus brachycephalus</i>	G	S	F	<i>Molossops neglectus</i>	G	S	
<i>Platyrrhinus fusciventris</i>	G	S	F	<i>Molossops temminckii</i>	G		
<i>Platyrrhinus guianaensis</i>	G	S		<i>Molossus barnesi</i>			F
<i>Platyrrhinus incarum</i>	G	S	F	<i>Molossus coibensis</i>	G		
<i>Sturnira lilium sp3</i>	G	S	F	<i>Molossus molossus</i>	G	S	F
<i>Sturnira tildae</i>	G	S	F	<i>Molossus pretiosus</i>	G		
<i>Uroderma bilobatum</i>	G	S	F	<i>Molossus rufus</i>	G	S	F
<i>Uroderma magnirostrum</i>	G			<i>Molossus sinaloae</i>	G	S	F
<i>Vampyressa bidens</i>	G	S	F	<i>Molossus sp.</i>	G		
<i>Vampyressa brocki</i>	G	S	F	<i>Neoplantomys</i>	G		
<i>Vampyressa thylene</i>	G			<i>matogrossensis</i>			
<i>Vampyrodes caraccioli</i>	G	S	F	<i>Nyctinomops laticaudatus</i>	G	S	F
<i>Desmodus rotundus</i>	G	S	F	<i>Nyctinomops macrotis</i>	G	S	
<i>Diaemus youngi</i>	G	S	F	<i>Promops centralis</i>	G	S	F

Table 1 Continued

Species	Guyana	Suriname	French Guiana	Species	Guyana	Suriname	French Guiana
<i>Promops nasutus</i>	G	S		<i>Sciurus aestuans</i>	G	S	F
PRIMATES (8)	8	8	8	<i>Holochilus sciureus</i>	G	S	F
<i>Cebus apella</i>	G	S	F	<i>Neacomys dubosti</i>		S	F
<i>Cebus olivaceus</i>	G	S	F	<i>Neacomys guianae</i>	G	S	
<i>Saguinus midas</i>	G	S	F	<i>Neacomys paracou</i>	G	S	F
<i>Saimiri sciureus</i>	G	S	F	<i>Necomys urichi</i>	G		
<i>Alouatta macconnelli</i>	G	S	F	<i>Nectomys melanius</i>	G	S	F
<i>Ateles paniscus</i>	G	S	F	<i>Neusticomys oyapocki</i>		S	F
<i>Chiropotes chiropotes</i>	G	S	F	<i>Neusticomys venezuelae</i>	G		
<i>Pithecia pithecia</i>	G	S	F	<i>Oecomys auyantepui</i>	G	S	F
CARNIVORA (17)	17	15	14	<i>Oecomys bicolor</i>	G	S	F
<i>Cerdocyon thous</i>	G	S		<i>Oecomys rex</i>	G	S	F
<i>Speothos venaticus</i>	G	S	F	<i>Oecomys roberti</i>	G		
<i>Leopardus pardalis</i>	G	S	F	<i>Oecomys rutilus</i>	G	S	F
<i>Leopardus tigrinus</i>	G	S	F	<i>Oecomys trinitatis</i>	G		
<i>Leopardus wiedii</i>	G	S	F	<i>Oligoryzomys fulvescens</i>	G	S	F
<i>Panthera onca</i>	G	S	F	<i>Euryoryzomys macconnelli</i>	G	S	F
<i>Puma concolor</i>	G	S	F	<i>Hylaeamys megacephalus</i>	G	S	F
<i>Puma yagouaroundi</i>	G	S	F	<i>Hylaeamys yunganus</i>	G	S	F
<i>Eira barbara</i>	G	S	F	<i>Podoxymys roraimae</i>	G		
<i>Galictis vittata</i>	G	S	F	<i>Rhipidomys leucodactylus</i>	G		F
<i>Mustela frenata</i>	G			<i>Rhipidomys macconnelli</i>	G		
<i>Lontra longicaudis</i>	G	S	F	<i>Rhipidomys nitela</i>	G	S	F
<i>Pteronura brasiliensis</i>	G	S	F	<i>Rhipidomys wetzeli</i>	G		
<i>Bassaricyon alleni</i>	G			<i>Sigmodon alstoni</i>	G	S	F
<i>Potos flavus</i>	G	S	F	<i>Zygodontomys brevicauda</i>	G	S	F
<i>Nasua nasua</i>	G	S	F	<i>Coendou prehensilis</i>	G	S	F
<i>Procyon cancrivorus</i>	G	S	F	<i>Coendou melanurus</i>	G	S	F
CETACEA (2)	2	1	1	<i>Cavia aperea</i>	G	S	
<i>Sotalia guianensis</i>	G	S	F	<i>Hydrochoeris hydrochaeris</i>	G	S	F
<i>Inia geoffrensis</i>	G			<i>Dasyprocta leporina</i>	G	S	F
SIRENIA (2)	2	1	1	<i>Myoprocta acouchy</i>	G	S	F
<i>Trichechus inunguis</i>	G			<i>Cuniculus paca</i>	G	S	F
<i>Trichechus manatus</i>	G	S	F	<i>Echimys chrysurus</i>	G	S	F
PERISSODACTYLA (1)	1	1	1	<i>Isothrix sinnamariensis</i>	G	S	F
<i>Tapirus terrestris</i>	G	S	F	<i>Makalata didelphoides</i>	G	S	F
CETARTIODACTYLA (5)	5	5	5	<i>Mesomys hispidus</i>	G	S	F
<i>Pecari tajacu</i>	G	S	F	<i>Proechimys cuvieri</i>	G	S	F
<i>Tayassu pecari</i>	G	S	F	<i>Proechimys guyannensis</i>	G	S	F
<i>Mazama americana</i>	G	S	F	<i>Proechimys hoplomysoides</i>	G		
<i>Mazama nemorivaga</i>	G	S	F	LAGOMORPHA (1)	0	1	0
<i>Odocoileus cariacou</i>	G	S	F	<i>Sylvilagus brasiliensis</i>		S	
RODENTIA (41)	39	32	31	TOTAL (238)	226	196	185
<i>Sciurillus pusillus</i>	G	S	F				

howler monkey (*Alouatta macconnelli* Linnaeus, 1766) from Guyana, puma (*Puma concolor* Linnaeus, 1771) from French Guiana and capybara (*Hydrochoerus hydrochaeris* Linnaeus, 1766) from Suriname. However, the Swedish biologist based many of these new species on the natural history plates of Albertus Seba (1734–1765); it was common general practice at that time to reference other works before the concept of a type specimen or locality became the norm (Baker 1991). The Amsterdam-based Seba illustrated his plates with specimens brought back by explorers to the New World. Thomas (1911) restricted the type locality of the majority of Seba's South American mammals to Suriname. Neither Linnaeus nor Seba visited South America to see these animals alive in their native habitat.

Another noted biologist during this era was Peter Simon Pallas, who was a German initially based in the Netherlands. As with Linnaeus and typical of the time, he published monographic works that summarized the natural history of animals as then known, including 2 new species of bats from Suriname (Pallas 1766, 1767). This first period of scientific investigation of the mammals of the Guianas documented 36 species over 14 years in 5 publications, with Linnaeus being the most prolific contributor.

Europeans I (1772–1839)

The tradition of publishing monographic books on animals continued into the next century but only with relatively sporadic descriptions of new species compared to Linnaeus' time and few reports of new country records from the Guianas. During the 68 years from 1772 to 1839, there were 25 species documented from this region in 17 publications by several authors based at European universities or museums studying specimens collected in South America. Germans were dominant early on, including noted taxonomists such as Johann Christian Daniel von Schreber at the University of Erlangen, Christian Polycarp Erxleben at the University of Göttingen and Eberhardt August Wilhelm von Zimmermann at the University of Brunswick. They described new species from both Suriname and French Guiana. By the end of the 18th century and into the next century, there was a shift of influence to French naturalists, including George Cuvier, Étienne Geoffroy Saint-Hilaire and Frédéric Cuvier, who were all based at the Muséum National d'Histoire Naturelle in Paris. As with most other earlier biologists, their work covered mammals in general but descriptions of new species were only from French Guiana.

Schomburgk brothers (1840–1849)

The first comprehensive scientific expedition to the Guianas was led by Robert Hermann Schomburgk of Germany from 1835 to 1839 under the auspices of the Royal Geographical Society in London to explore Guyana. The biological discoveries were reported in a series of papers in the scientific journal *Annals of Natural History* (Schomburgk 1840). He received a subsequent commission from the British Government to survey the colonial boundary with Venezuela on a second trip from 1840 to 1844 and was accompanied by his younger brother Richard Schomburgk who had a commission from the King of Prussia to collect specimens of the flora and fauna. The biological results were published in German in 3 volumes by Schomburgk (1848–1849) and translated into English by Roth (1922–1923). The mammal collections were deposited in the zoological museum in Berlin and examined by the ornithologist Jean Cabanis. The explorations by the Schomburgks made Guyana one of the better known countries in South America at the time (Hershkovitz 1987).

At a similar time, a prominent zoologist active in mammalian taxonomy of the Guianas was Coenraad Jacob Temminck at the Rijksmuseum van Natuurlijke Historie in Leiden. Although no new species to science were documented in this decade, 22 species were described in 7 publications as new records for the region, of which the majority were reported by Richard Schomburgk.

Europeans II (1850–1886)

Over the next 37 years from 1850 to 1886, there was a relative lull in mammalogical discovery, with 23 species documented for the first time from the Guianas in 12 publications. However, there were 6 species of bats new to science that were described from Suriname or French Guiana by Wilhelm Peters at the zoological museum in Berlin. Another active researcher was George Edward Dobson, a British Army surgeon associated with the British Museum of Natural History in London, who published the first comprehensive book on the biology of bats, which contained 6 new country records for the Guianas (Dobson 1878). He was also the first museum-based taxonomist to collect specimens in the region during a visit to Guyana in 1873.

Thomas, British Museum of Natural History (1887–1915)

The prominence of mammalogists at the British Museum of Natural History continued into the next century

with the prodigious work of Oldfield Thomas who described 23 new country records for the Guianas, which included 9 species new to science. Fredericus Anna Jentink at the Rijksmuseum van Natuurlijke Historie in Leiden was also active with 6 new country records, including 1 new species. In total, there were 37 species documented for the first time from the Guianas in 20 scientific publications during this 29-year period.

Americans (1916–1961)

The next era is marked by a shift from museum-based taxonomic research to field-based ecological research with the establishment of the Tropical Research Station in Guyana by the New York Zoological Society under the direction of William Beebe (1916). Although mammalogy was not a primary field of study, specimens were collected and deposited at the American Museum of Natural History (AMNH) in New York (Anthony 1921). An increase in American influence in the study of mammals of the Guianas also began during this period, with taxonomic work by curators at the AMNH and the Field Museum of Natural History in Chicago. However, only 9 species were added to the regional list of the Guianas in 8 publications over 46 years, including the description of 3 species new to science.

Multinational (1962–present)

Since the early 1960s, there has been a resurgence in the study of mammals in the Guianas from a multinational contingent of researchers. Antonius Marie Husson (1962, 1978) at the Rijksmuseum van Natuurlijke Historie in Leiden was the most influential in the beginning with 2 monographs on the bats and mammals of Suriname. Interest in this country continued with the Carnegie Museum of Natural History in Pittsburgh conducting fieldwork from 1977 to 1981 by Hugh Genoways and Stephen Williams. This was followed by the Royal Ontario Museum (ROM) in Toronto from 2002 to the present by Burton Lim. Previously, the ROM established an ongoing research program in Guyana that originally began in 1961 and continued until 1975 under the direction of Randolph Peterson before being reinitiated in 1990 to the present by Mark Engstrom and Burton Lim. In French Guiana, the Muséum National d'Histoire Naturelle has been studying mammals since the mid-1960s to the present, including researchers such as André Brosset, Gérard Dubost, Pierre Charles-Dominique and Pierre-Michel Forget. Nancy Simmons and Rob Voss at the AMNH conducted one of the most thorough inventories of mammals at Paracou, French Guiana, from

1991 to 1994 (Simmons & Voss 1998; Voss *et al.* 2001). During the 53 years of this most recent era of study, 86 species of mammals have been added to the list from the Guianas.

DISCUSSION

Early in the modern era of scientific classification starting with the adoption of the binominal nomenclature system in the mid-18th century, the Guianas was prominent in biological discovery. In particular, Suriname was “the great source of all Dutch collections,” which formed many of Linnaeus’s type localities in South America (Thomas 1911). The Netherlands was a hub of activity for explorers returning from the New World, dealers such as Seba acquiring natural history specimens, and taxonomists such as Pallas working on museum collections. This initial flurry of mammal species new to science waned going into the 19th century and there was a shift first to German naturalists that was followed by a dominance of French counterparts based at the Muséum National d’Histoire Naturelle studying specimens primarily from the colony of French Guiana. If not for the objection of Georges Buffon to Linnaeus’s classification system (Sloan 1976), French biologists and French Guiana might have had an earlier influence on Neotropical mammalian taxonomy.

Museum-based research by European taxonomists on miscellaneous specimens acquired from dealers, many with minimal information such as locality (Gray 1843), continued into the beginning of the 20th century. The only notable exception was the Schomburgk brothers, who conducted the first comprehensive biological survey of the Guianas. Following in the tradition of exploration by Alexander von Humboldt to Venezuela (Burnett 2000), they mapped the boundary of Guyana and collected specimens in the early 1840s. It was not until the establishment of the Tropical Research Station in Guyana by the New York Zoological Society in 1916 that ecological studies became of interest in the Guianas and American researchers began exploring this region. However, birds and other organisms were the main groups of study so the renaissance since Linnaeus of mammalian research in the Guianas did not occur until 2 centuries later in the early 1960s.

Husson not only visited Suriname, but continued in the study of Guianan mammals at the Rijksmuseum van Natuurlijke Historie (now Naturalis) begun by Temminck and Jentink. His seminal publications (Husson 1962; 1978) put Suriname back at the forefront of mam-

mammalogical study in South America (Pine 1982). During this time, Peterson at the Royal Ontario Museum began the longest running collecting and research program in the Guianas that is being continued by Burton Lim in Guyana. Although a monographic work has not been written, over 30 scientific papers have been published not only on taxonomy but also the community structure of local mammalian fauna. In French Guiana, ecological studies became prevalent starting in the 1980s. In addition to many papers in peer-reviewed journals, several books have been published including on bats (Charles-Dominique *et al.* 2001) and the plant–animal ecology (Lobova *et al.* 2009) of French Guiana.

Although there has been a resurgence in mammalogical research in the Guianas during the last half century, the contribution from local biologists has been negligible. Unlike their Latin American neighbors who became independent countries in the 1800s and have established research universities and national academic institutions, the Guianas are relatively young countries without extensive post-graduate university programs. Guyana became independent in 1966 and the University of Guyana was established prior to this in 1963. Within the Faculty of Natural Sciences is the Department of Biology that offers a Bachelor of Science degree but no masters program in biology. In addition, the Centre for the Study of Biological Diversity houses on campus a zoological museum and herbarium. Suriname became independent in 1975 and the Antom de Kom University of Suriname was established in 1983. Within the Faculty of Technological Sciences are Bachelor of Science degrees in Environmental Sciences and a recently created Master of Science in Conservation Biology. The National Zoological Collection of Suriname is an institute on the campus of the university. French Guiana is the only state in South America that is not sovereign. There is the Université des Antilles et de la Guyane with a campus in French Guiana that offers a 1-year program in environmental conservation.

One promising opportunity to invigorate home-grown biological research is the recent establishment of the International Biodiversity Society of the Guiana Shield. In addition to the 3 countries of the Guianas, this organization incorporates the larger geological Guiana Shield region that includes neighboring portions of Brazil, Venezuela and Colombia. By pooling academic and student resources from these relatively smaller administrative states, hopefully the economies of scale can be utilized for the benefit of research in biology. The Guianas has high levels of species diversity coupled with large por-

tions of intact natural habitat. It represents one of the last frontiers of biodiversity waiting for new scientific discoveries.

CONCLUSIONS

For mammals, the Guianas was one of the better known areas of the Neotropics when Linnaeus introduced his binominal nomenclature system in the last half of the 1750s, primarily because of his reliance on Seba's plates of species based on biological specimens brought back from Suriname on ships exploring the New World. However, there was a relative lull in scientific discovery for approximately 2 centuries until Hutton began a systematic revision of the mammals of Suriname, which brought the Guianas back to prominence in South America. The earlier taxonomic emphasis on mammalogical research in the Guianas is gradually maturing into synthetic studies such as plant–animal interactions that have implications to conservation of tropical forests. An area that needs improvement is the development of local scientific expertise, which hopefully will see changes with the establishment of the International Biodiversity Society of the Guiana Shield that will pool resources to train a new generation of home-grown biologists.

ACKNOWLEDGMENTS

I thank the Environmental Protection Agency of Guyana and the Nature Conservation Division of Suriname for permission to conduct biodiversity surveys of mammals in the Guianas. Primary funding of my fieldwork and research in Guyana and Suriname has been supported by the Royal Ontario Museum Governors.

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Cite this article as:

Lim BK (2016). Review of mammalogical research in the Guianas of northern South America. *Integrative Zoology* **11**, 151–61.