

# Historia de la Mastozoología en Latinoamérica, las Guayanas y el Caribe

Editado por  
Jorge Ortega,  
José Luis Martínez y  
Diego G. Tirira



**HISTORIA DE LA MASTOZOLOGÍA EN  
LATINOAMÉRICA, LAS GUAYANAS  
Y EL CARIBE**



# **HISTORIA DE LA MASTOZOLOGÍA EN LATINOAMÉRICA, LAS GUAYANAS Y EL CARIBE**

---

**Editado por  
Jorge Ortega,  
José Luis Martínez y  
Diego G. Tirira**

**Editorial Murciélago Blanco y  
Asociación Ecuatoriana de Mastozoología**

**Quito y México DF  
2014**

Todos los derechos reservados. Se prohíbe su reproducción total o parcial por cualquier mecanismo, físico o digital.

© Editorial Murciélago Blanco, Quito, Ecuador, 2014.

Por favor, se sugiere que cite esta obra de la siguiente manera:

Si cita toda la obra:

ORTEGA J, JL MARTÍNEZ y DG TIRIRA (eds.). 2014. Historia de la mastozoología en Latinoamérica, las Guayanas y el Caribe. Editorial Murciélago Blanco y Asociación Ecuatoriana de Mastozoología, Quito y México, DF.

Si cita un artículo:

AUTOR(ES). 2014. Título del capítulo. Pp. 000–000, *en*: Historia de la mastozoología en Latinoamérica, las Guayanas y el Caribe (J Ortega, JL Martínez y DG Tirira, eds.). Editorial Murciélago Blanco y Asociación Ecuatoriana de Mastozoología, Quito y México, DF.

Esta publicación puede ser obtenida mediante intercambio con publicaciones afines, o bajo pedido a:

Editorial Murciélago Blanco  
info@murcielagoblanco.com  
www.editorial.murcielagoblanco.com

Editores: Jorge Ortega, José Luis Martínez y Diego G. Tirira  
Artes y diagramación: Editorial Murciélago Blanco

Ilustraciones: Portada: *Hippocamelus antisensis*, tomada de *Voyage dans l'Amérique Méridionale* (Alcide d'Orbigny, 1847).  
Página 1: *Cebus fulvus*, tomada de *Voyage dans l'Amérique Méridionale* (Alcide d'Orbigny, 1847).  
Contraportada: *Caluromys lanatus*, tomada de *Rerum Naturalium Thesauri* (Albertus Seba, 1734–1765)

Impresión: PubliAsesores Cía. Ltda.

ISBN: 978-9942-20-026-6

Quito y México DF, agosto de 2014

IMPRESO EN ECUADOR

# HISTORY OF MAMMALOGY IN BELIZE

## HISTORIA DE LA MASTOZOLOGÍA EN BELICE

**Bruce W. Miller and Carolyn M. Miller**

Neotropical Bat Risk Assessments Project, 11384 Alpine Road,  
Stanwood, MI 49346, USA.  
[batsncats@gmail.com]

### ABSTRACT

Formally known as British Honduras, early reference to Belize often caused confusion with collection records. Some trade skins may have been labeled “Honduras” or “Belize” reflecting the port of origin of Belize City rather than the origin of the collection location. Scant early collections and records from the mid-1800s exist with more focused collecting in the mid-1930s to early 1940s. Collecting increased sporadically in the 1970s with more focused work in the early to mid-1980s. With increased interest and efforts dedicated toward conservation, the establishment of protected areas and evaluation of wildlife corridors, there was a large expansion of multi-taxa surveys throughout the country. Many surveys focused on the charismatic mammals such as jaguar, tapir, manatee, primates, and also bats. Those efforts began in the late 1980s and continue to the present time. Unlike its Central American neighbors, Belize does not have a national repository or collections of specimens and all are in other collections.

**Key words:** bats, big cats, British Honduras, mammals, small mammals.

### RESUMEN

Antiguamente conocida como Honduras Británica, la referencia de Belice causa confusión en sus registros. Algunos tratantes de pieles simplemente la llamaban “Honduras” o “Belice”, como reflejo del puerto del mismo nombre para hacer referencia a todo un país. Pocos registros y colecciones datan de mediados del siglo XIX, mientras que las colecciones se incrementaron notablemente entre mediados de la década de 1930 y principios de la década siguiente. Un nuevo incremento, aunque esporádico, fue evidente en la década de 1970, mientras que se dio un incremento considerable a partir de la década de 1980, debido a interés progresivo y a esfuerzos de colección dedicados a la conservación y al establecimiento de áreas protegidas, así como a la evaluación de corredores de fauna silvestre, además de la búsqueda de varios taxones específicos a lo largo de todo el país. Muchos trabajos se enfocaron en animales carismáticos, como el jaguar, tapir, manatí, primates y algunos murciélagos. Estos esfuerzos comenzaron a finales de la década 1980 y continúan hasta el presente. En comparación con sus vecinos centroamericanos, Belice no tiene un depositario nacional o una colección de especímenes dentro de su territorio; por lo tanto, este material se encuentra depositado en instituciones en el exterior.

**Palabras clave:** grandes felinos, Honduras Británica, mamíferos, murciélagos, pequeños mamíferos.

---

*Historia de la mastozoología en Latinoamérica, las Guayanas y el Caribe*  
(Jorge Ortega, José Luis Martínez y Diego G. Tirira, eds.).  
Editorial Murciélago Blanco y Asociación Ecuatoriana de Mastozoología.  
Quito y México DF (2014:51–68).

## INTRODUCTION

Belize is situated in northern Central America, south of the Mexican states of Quintana Roo and Campeche and east of the Department of Petén, in Guatemala. Belize lies between 15° and 19° N latitude and is considered to be subtropical (Hartshorn *et al.*, 1984).

The first recorded European settlement was established by shipwrecked English seamen in 1638 and over the next 150 years, more English settlements were established (USDS, 2012). At the time present-day Belize was recognized as the Settlement of Belize in the Bay of Honduras prior to 1862 and British Honduras from 1862–1973 (USDS, 2012). The official name of the territory was changed from British Honduras to Belize in June 1973, and full independence was granted on September 21, 1981. Many early collectors did not differentiate between the “British settlement in Honduras” and the Republic of Honduras or “Spanish Honduras”, but recorded only “Honduras” or “Bay of Honduras” without additional locality data (McCarthy, 1987) leading to confusion as to which early records actually were from present day Belize.

The varied geology has provided a wide variety of habitats for species distributions within this small country (8,867 sq miles [22,966 km<sup>2</sup>]). The limestone shelf of northern Belize has geological affinities with the Yucatán Peninsula (Wright *et al.*, 1959). The southern limit of this peninsula can be considered the fault line extending from north of the Maya Mountains westward through the northern shore of Lake Petén-Itza, El Petén (Wadell, 1938; West, 1964). Effectively, the northern plain of Belize and northern Petén are part of the Yucatán Peninsula.

The southern mainland is dominated by the low Maya Mountains. The Maya Mountains represent a heavily eroded Paleozoic formation that now ranges at the top from 671 to 853 m in elevation, with the highest peak at 1,113 m (Wright *et al.*, 1959). Geologically and biologically, the Maya Mountains and its subregion, the Mountain Pine Ridge, are unique in Central America. During the Cretaceous period, when mainly limestones were deposited, a part of the ancient Permian landscape of the original Maya Mountains stood above the level of the Cretaceous ocean as a low island, giving rise to the oldest land surface in Central America (Hartshorn *et al.*, 1984). The geological origin is unclear, but this former island apparently “slammed” into the Central American land mass during active phases of continental drift. Geologically, the northern portions which include the Mountain Pine Ridge area has been referred to as “suspect terrane”, distinct from the surrounding area. This area was a fragment of land disassociated from other land masses for a long geological time; this insular area may have promoted the evolution in isolation of some plants and animals and was likely an important focus of Central American endemism (Means, 1997). While this may be the case for some plants and amphibians, it does not appear to be the case for mammals.

It has also been suggested that the hardwood riparian corridors found along the steep sided ravines of the Honduran pine dominated Mountain Pine Ridge may have been Pleistocene forest refuges (Meave *et al.*, 1991; Meave and Kellman, 1994) and are perhaps some of the oldest habitats in Belize. The surrounding karst topography that encompasses these ravines was derived from limestone and is the dominant geologic feature, common on the perimeter of the granitic Maya Mountains (Hartshorn *et al.*, 1984). This karst area includes a rich distribution of caves that serve as roost and maternity sites for many bat species (Miller B.W., 2009).

In this summary we endeavored to cite the major publications with the descriptions of new species, significant collections, checklists, and primary research from an historical perspective. Unlike its Central American neighbors Belize does not have a national repository or collections of specimens and all are in other collections. As this disparate mammal collection information is now generally accessible via the Global Biodiversity Information Facility and the Mammal Networked Information System (GBIF, 2013; MANIS, 2013), we have not included a list of specimens in those collections. The national on-line Biodiversity & Environmental Resource Data System of Belize (BERDS, 2013) provides extensive records where voucher specimens have not been collected. While not exhaustive, the bibliography includes recent taxonomic changes as a foundation for future work within the country.

One of the main goals of mammalian ecologists in the tropics has been to assess species richness and density of tropical-forest species in communities at several sites (Mares and Ernest,

1995). With the exception of a few “charismatic” taxa, such as Jaguar (*Panthera onca*), West Indian Manatee (*Trichechus manatus*), Baird’s Tapir (*Tapirus bairdii*), bats (Chiroptera) and primates (Primates), there have been few country wide inventory efforts documenting the mammalian fauna within Belize. Such inventory efforts have only been undertaken over the past 20 years. This was in part due to the fact that until recently there has been an absence of Belizean academics, and much of the early history of mammalogy in Belize has been dominated by foreign or overseas researchers.

Many of the early mammal records were the result of limited surveys at specific locations, others were linked to endeavors such as archaeological excavation (e.g., the Royal Ontario Museum, ROM) and human disease vector studies such as leishmaniasis (Disney, 1968). While many of the bird records from investigations at archeological sites were published (e.g., Barlow *et al.*, 1970), there were no specific papers relating to the 1,437 mammal specimens collected and housed in the ROM. Over the past twenty years, there have been accelerated field research and inventory efforts that centered on the establishment of protected areas, biological corridors and other conservation related endeavors. We provide a review of the historical work and follow with summaries of more recent work grouped by broad taxa.

## HISTORY

The oldest mammalian records for Belize are fossils. The caves within the Maya Mountains karst topography provided fossil records that include *Tremarctos floridanus*, the Florida Cave Bear (Miller T.E., 1989). These caves also provided the second records of fossil bats for Central America (Czaplewski *et al.*, 2003). Among these records are the extinct Giant Vampire Bat (*Desmodus draculae*), recovered from a corridor of Cebada Cave, a segment of the Chiquibul Cave System. Thousands of other complete bat skeletons were found in the same cave corridor and represent several probable Holocene records. These include at least six phyllostomids: *Tonatia saurophila*, *Carollia subrufa* or *C. brevicauda*, *Sturmira* sp., *Artibeus lituratus*, *Dermanura* sp., and *Centurio senex*; and two vespertilionids: *Lasius blossevillii*, and *L. ega* (Czaplewski *et al.*, 2003). These are the only fossil vertebrates known from Belize (Spencer *et al.*, 2007).

Within historical times the other extinction was *Monachus tropicalis*, the Caribbean Monk Seal (Kenyon, 1977). The last authentic record of the species was an observation by C. Bernard Lewis (Rice, 1973), in 1952, of a small colony on Seranilla Bank, a group of coral islands between Jamaica and Honduras. Historical locations include México, Guatemala, Honduras, Colombia, Jamaica, Dominican Republic, Bahamas, Cuba and both Texas and Florida in the United States (Timm *et al.*, 1997). Given a group of off shore small islands called Seal Cays it is likely this species was once within Belizean waters. This is corroborated by the account reported by Rice (1973) from Archie Carr, “...seals are once in a great while seen between Belize, British Honduras, and the Yucatán Channel and the son of the Director of the Natural History Museum in Mérida, Yucatán, had recently seen a seal at Isla Mujeres.” (Knudsen, 1977). Knudsen (1977) also reported that the species had been seen between Punta Gorda (Belize) and Livingston (Guatemala).

The earliest published mammal records for Belize was a short account of the occurrence of *Eira barbara* and *Panthera onca* seen by Joseph Leyland in 1855 and 1856, from Honduras and Belize, published by Moore (1859). Other survey expedition reports list species that were hunted (Miller W., 1887): “Although game of all kinds was met with all along the line it was not so plentiful as might be supposed. The following species were shot at different times: antelope [= Brocket Deer, *Mazama americana*], peccary [= White-collared Peccary, *Pecari tajacu*], waree [= White-lipped Peccary, *Tayassu pecari*], gibnut [= Paca, *Cuniculus paca*], baboons [= Black Howler Monkey, *Alouatta pigra*], quash [= White-nosed Coati, *Nasua narica*], and armadilla [= armadillo, Dasypodidae].” The White-lipped Peccary (“warree”) was first reported from Belize (Temple, 1860).

Another early report from the former colony reported two notable species, Baird’s Tapir (*Tapirus bairdii*) and Peccary (*Pecari tajacu*) and interestingly noted that at the time Belize was considered poorly known: “Strange as it may seem in a colony so old, and only eighteen days from England, the interior is less known than Central Africa” (Bellamy, 1889).

One of the early collectors in Belize was Francois J. S. Blancaneaux, who collected for Osbert Salvin (1835–1898). Blancaneaux’s records were incorporated into *Biologia Centrali-Americana*

(Alston, 1879–1882; Godman and Salvin, 1915). Among his mammal records were *Sciurus deppei*, *Hesperomys sumichrasti* [= *Heteromys sumichrasti*] with no locality information other than Belize, British Honduras. This likely referred to Belize City that was the point of embarkation to the British Museum and did not include specific collection locations.

The earliest bat record appears to have been a specimen of *Artibeus perspicillatus* [= *A. jamaicensis*] collected by O. Salvin on Half Moon Caye (Salvin, 1864) while collecting sea birds and was subsequently reported by George Edward Dobson (1845–1895; Dobson, 1878).

Additional early published mammal records include an observation of *Rhynchonycteris naso*: “In September, 1875, whilst paddling in a dory through a narrow and dark creek leading from Belize River, Honduras [sic], to Reid’s Lagoon, we disturbed a number of small bats which were clinging to the trunks and branches of the mangroves overhanging the water... These bats were about six inches [152 mm] in expanse and of a grey color so exactly corresponding with that of the trees on which they settled as to be with difficulty distinguishable even at a distance of only a few feet. They invariably clung to the trunk or bough with wings expanded, and were never, so far as I noticed, suspended from the branches” (Archer, 1877).

Gaumer (1917) noted a few mammals in northern Belize incidental to his mammal survey of the Yucatán in México. These included the tapir observed along the Río Hondo and at Orange Walk occurrences of the Jaguar (*Panthera onca*), Puma (*Puma concolor*) and Tayra (*Eira barbara*). It was not until the 1930s that further mammal study was undertaken. The Museum of Zoology of the University of Michigan mounted an expedition to Guatemala arriving January 26, 1931 at Belize [= Belize City], British Honduras (Murie, 1935). The expedition included Adolph Murie (1899–1974) who collected mammals, a botanist Harley Harris Bartlett (1886–1960), and an ornithologist Josselyn Van Tyne (1902–1957). While their primary goal was to complete a survey at Uaxactun, the Department of Petén, northern Guatemala, they also collected in Belize. Initially Murie spent about two weeks collecting on the outskirts of Belize City. Held up from continuing to Uaxactun due to rains, he also collected for a month south of El Cayo [= San Ignacio] in the Mountain Pine Ridge. Here he collected and subsequently described a new subspecies *Oryzomys couesi pinicola* (Murie, 1932) and Burt (1937) described a new subspecies *Heterogeomys hispidus cayoensis*, based on his collection. This collection site was near the old camp of F. Blancaneaux, who collected for Salvin in British Honduras. Much of Blancaneaux’s collections also came from this area later designated as the Blancaneaux Enclave. This is now the site of Francis Ford Coppola’s Blancaneaux Lodge. This expedition appears to have been one of the first to use mist nets for bats, although these were only used at Uaxactun in Guatemala (Murie, 1935).

During early 1935, the Carnegie Museum mounted the first biological expedition into the Cockscomb Basin including the Maya Mountains and the adjacent coastal region of Belize, with E. R. Blake and C. T. Agostini. Although this expedition was primarily ornithological in nature, reptiles and mammals were also collected (McCarthy *et al.*, 1993).

The next collecting effort was undertaken in September 1939 and included the largest and most representative collection of mammals made from British Honduras at that time. This was by I. T. Sanderson who collected mammals in British Honduras under the auspices of the Linnaean Society of London and the British Museum. He spent six months collecting in the coastal area from Punta Gorda in the south to Chetumal Bay, along the northern border. Unfortunately, the rodents, which were being held for shipment until after the war, were destroyed by a hurricane (Hershkovitz, 1951). Sanderson subsequently published a popular account of the collecting expedition (Sanderson, 1941).

Among the noteworthy specimens collected by Sanderson was the only record of *Centronycteris maximiliani* [= *C. centralis*] for the country. Hershkovitz (1951) included a map that erroneously showed Double Falls, where this specimen was collected, as being located on the Sittée River. Sanderson (1941) did not provide adequate details to determine where his collecting locations were. We subsequently determined the correct location of Double Falls based on a survey map (anonymous map, 1890) that we located in the Belize Archives. Once this survey map from the 1890s was georeferenced and imported into a GIS, we were able to accurately determine that these falls were within the Mayflower Bocawina National Park and now called Bocawina Falls. The derived coordinates facilitated mapping records for



that location from Sanderson's collection. Hershkovitz (1951) subsequently published the notable mammal accounts from this collection.

Sanborn (1941) studied the collections made by Blake and Agostini, and Sanderson. He reported the first records of *Trachops coffini* [= *T. cirrhosus*] for Belize and were the first records published since the original description of that species. Additionally, he noted that the *C. centralis* specimen collected from a tree trunk in daylight represented a range extension north of Guatemala. Two other species, *Tonatia amblyotis* [= *Tonatia evotis*] collected at Freetown on the Sittie River, and *Thyroptera tricolor*, collected 15 miles (24 km) west of All Pines in what is now the Cockscomb Basin Wildlife Sanctuary were also reported.

A substantial number of mammals were collected primarily in the Cayo District during epidemiology studies of dermal leishmaniasis (Lainson and Strangways-Dixon, 1964; Disney, 1968); however, only preliminary identifications of these mammals were published (McCarthy *et al.*, 1993). Similarly, Pedro N. Acha with the Pan American Health Organization investigated mammals for the incidence of rabies in western Cayo District, during 1961 and 1962 (McCarthy *et al.*, 1993).

The first records of *Cyclopes didactylus* was reported by Jones and Carter (1972). These records were based on a British Museum specimen collected at Mopan in 1888, and another obtained by R. H. Disney in 1964 at Santa Familia, near present day San Ignacio.

In 1975, Ralph D. Kirkpatrick and Anne M. Cartwright prepared the first mammal checklist (Kirkpatrick and Cartwright, 1975) from the literature, consulting people who were working in Belize and from their own collections made during the summers of 1972 and 1973. They did not include marine mammals known to occur in Belizean waters of the Caribbean. This list totaled of 89 species representing 11 orders and 28 families. Cartwright (1977) continued collecting bats and studying reproduction and ecology. Additional bat records were subsequently published from bat collections they made at a number of caves. These included the first records for *Balantiopteryx io* and *Peropteryx kappleri*, and noted the occurrence of several other species: *Desmodus rotundus*, *Glossophaga soricina*, *Rhogeessa tumida* and *Myotis keaysi* (Kirkpatrick *et al.*, 1975; Cartwright and Kirkpatrick, 1977). They also reported snap trapping several rodents with a new record, *Oryzomys fulvescens mayensis*, for Belize along with *Sigmodon hispidus* and *Oryzomys palustris* (Kirkpatrick *et al.*, 1975).

The next mammal list published was an appendix included in a summary of Belize's natural features and was compiled under the auspices of the United States Agency for International Development (USAID) program (Hartshorn *et al.*, 1984). This list included marine mammals and local common names, totaling 115 species representing 11 orders and 31 families. The late Timothy J. McCarthy (1947–2011) worked in Belize from 1974 to 1993 contributing to the knowledge of mammals in Belize (González-Ruiz and Arroyo-Cabrales, 2011). Initially he worked as a consultant to the Ministry of Agriculture and Fisheries on Education of Agricultural Officers for the control of vampire bats. McCarthy was well known for his bat studies beyond the vampire control program as he continued field work regionally and within Belize (McCarthy, 1982a, 1987; McCarthy and Blake, 1987; McCarthy *et al.*, 1993). He also completed the first checklist of the bats for Belize, totaling 66 species (McCarthy, 1976).

Aside from McCarthy's bat work, much of the baseline knowledge of the mammals of Belize through the mid-1980s was based on his work. In addition to peer-reviewed publications, he also contributed to educating the public about Belizean mammals through the Belize Audubon Society publications and other national publications (McCarthy, 1976, 1979, 1980a, b, 1983a, 1986a, 1986b).

Among these publications was the compilation of a complete mammal checklist (McCarthy, 1983b) and notes on records of specific taxa that included *Chironectes minimus* (Didelphidae), *Cabassous centralis* (Dasypodidae), *Cyclopes didactylus* (Cyclopedidae), *Heteromys gumeri* (Heteromyidae), *Puma yagouaroundi* (Felidae), and *Bassariscus sumichrasti* (Procyonidae) occurrences (McCarthy, 1982b; Izor and McCarthy, 1984; McCarthy, 1986b, 1992). In an early paper he speculated on the possibility of *Cebus capucinus* occurring in Belize (McCarthy, 1982b) which will be addressed further in the review of erroneous records.

McCarthy (1983a) provided the first critical review of mammal related publications such as the mammal checklist included in Hartshorn *et al.* (1984) noting that several important references,

i.e., Hollister (1914a, b), Hershkovitz (1951), Gardner (1973), Eger (1974), and Kirkpatrick and Cartwright (1975), were overlooked and not taken into consideration.

During the late 1980s and early 1990s there were countrywide conservation efforts to develop management plans, establish new protected areas and consider establishment of biological corridors. Some of these first efforts included critical habitat reviews and sparked a flurry of baseline faunal inventories of existing and potential protected areas. These frequently focused on the charismatic taxa such as primates (Primates), big cats (Felidae) and the manatee (*Trichechus manatus*).

Mammal monitoring protocols were developed for the Selva Maya (Miller B.W. and Miller C.M., 1999) but funding was never available to implement either regional or countrywide mammal monitoring programs. Several pilot projects evaluating the efficacy of using acoustic monitoring for bats were completed. One in 2006 included collaborating with conservation non-governmental organizations (NGOs) at four locations from north to south and in 2010, another at the Río Bravo Conservation Management Area (RBCMA). An acoustic monitoring program for bats that began in 2011 in the Toledo District is ongoing. A three year (2001–2003) dusk to dawn acoustic bat monitoring program in the Gallon Jug Estate compared bat activity with moon phase illumination and weather variables including wind speed, temperature and rainfall (B. W. Miller, unpublished data).

What follows are reviews of broader taxa groups beginning with bats. The first bat record was a report of *Rhynchonycteris naso* on a small creek from the Belize River to Reid's Lagoon (Archer, 1877). Other early papers with information on bats in Belize include (Sanborn, 1937, 1941; Hershkovitz, 1951; Peterson, 1965; LaVal, 1973; Eger, 1974).

Bats were collected in Belize during the summers of 1972, 1973, 1975, and 1976 using a variety of collecting techniques by Cartwright (1977). These collections provided data for the examination of reproduction patterns and was one of the first long term bat studies in the country. McCarthy subsequently focused on bats within Belize (McCarthy, 1976, 1987; McCarthy and Blake, 1987; McCarthy *et al.*, 1993) including the first checklist of bats (McCarthy, 1980a).

The first community study of bats was based on mist netting in southern Belize's Toledo District, suggesting that species diversity indices changed seasonally and generalized that the bat community consisted of a few common and several uncommon species (Serach *et al.*, 1981). Netting surveys at what is now the Blue Hole National Park, 20 miles (32 km) south of the capital Belmopan resulted in 32 specimens collected representing nine species, including the first record of *Mimon crenulatum* (Ruiz, 1983). Another study explored whether bats could be used as environmental indicators within a managed forest was completed in the RBCMA (Smith, 1984). A detailed bat community study and landscape assessment of the bats of Belize was completed in 2003 (Miller B.W., 2003a) followed by a risk assessment (Miller B.W., 2009).

A landscape level assessment looked at distributions of the two species of short-tailed fruit bats (*C. perspicillata* and *C. sowelli*) in relation to the distribution of 23 species of plants in the genus *Piper* for which they are the primary seed dispersers was completed. It was found that these two closely related bat species are not using the same *Piper* resources equally: *P. jacquemontianum* was found to contribute nearly 19% to the ecological niche distribution model of *C. perspicillata*, while for *C. sowelli* only 4%. Conversely, *P. yucatanense* contributed 17% to the niche distribution model of *C. sowelli*, while it was less than 3% for *C. perspicillata* (B. W. Miller and C. M. Miller, unpublished data).

Bats were included during environmental impact studies prior to the construction of the Chalillo Dam on the Belize River, as well as biodiversity reconnaissance in the Chiquibul Forest Reserve, Chiquibul National Park, Cuevas and Puente Natural and Shipstern Nature Reserve. Other environmental appraisals included surveys at Las Sierritas, Toledo District with karst hills replete with caves destined to be blasted and used for fill for the Southern Highway road construction, and post Chalillo Dam construction assessment of the adjacent forest (B. W. Miller and C. M. Miller, unpublished data).

Beginning in 1995 there were countrywide bat surveys utilizing mist nets, harp traps and acoustic methods (Miller B.W., 2001a, b, 2003a, b, 2009, 2011; O'Farrell and Miller, 1997, 1999). New country records from acoustic surveys included *Pteronotus gymnotus* (Miller B.W., 2003a) and

*Eumops hansae* netted on the Gallon Jug Estate (Reid, 2009). Many of these surveys were referenced in popular articles (Miller, 1997; Zorpette, 1999; Ebersole, 2000; Guynup, 2000).

While the archeological site of Lamanai is known for primate studies, a number of bat studies were undertaken there as well (Fenton *et al.*, 2000; Fenton *et al.*, 2001; Biscardi and Orprecio, 2002). Other bat work was completed at Possum Point Biological Station on the Sittee River (Higdon and Forbes, 2002) and in 2008 at the Las Cuevas Field Station.

Taxonomic updates subsequent to Simmons (2005) include recently recognized species that changes the known bat fauna for Belize. These include *Carollia sowelli*, as a separate species from what was considered *C. brevicauda* (Baker *et al.*, 2002); *Rhogeessa aeneus*, as distinct from *R. tumida* (Baird *et al.*, 2008, 2009); *Molossus alvarezii*, previously recognized in Belize as *M. sinaloae* (González-Ruiz *et al.*, 2010); and *Natalus mexicanus*, previously assumed to be *N. stramineus* (López-Wilchis *et al.*, 2012).

Other large mammals studied include *Trichechus manatus* and *Tapirus bairdii*. The first, *T. manatus* assessments were those of Charnock-Wilson (1968, 1970), and Bengston and Magor (1979). Aerial surveys for manatees in Belize were undertaken by O'Shea and Salisbury (1989, 1991). The Belize population of *T. manatus* constitutes the largest extant population in the Caribbean (O'Shea and Salisbury, 1991). Within Belize, *T. manatus* occurs throughout the coastal zone (Bengston and Magor, 1979; O'Shea and Salisbury, 1991). Platt *et al.* (2000) reported completing surveys of Turneffe Atoll that had not been included in previous surveys. Solitary individuals were encountered in Northern Lagoon (1996 and 1997), Central Lagoon (1994), and a group of three were noted in Southern Lagoon (1995) (Platt *et al.*, 2000). Currently, International Union for Conservation of Nature and Natural Resources (IUCN) considers the Belize population likely decreasing and vulnerable with a population estimates of 700 animals (Deutsch *et al.*, 2008).

*Tapirus bairdii* is one of the other charismatic large mammals, occurring within Belize and is the "National Mammal". Studies focusing on this species began with the ecology and impact of hunting (Fragoso, 1983, 1987, 1991). Matola *et al.* (1997) discussed the status of *T. bairdii* in Belize with population estimates between 680 to 3,300 individuals. Additional, notes on conservation and distribution of *T. bairdii* have been subsequently published (Matola, 2002; Caro *et al.*, 2004).

There have been a number of carnivore studies in addition to the two big cats, *Panthera onca* and *Puma concolor* within Belize. We discuss the focal studies on the two large cats separately. One of the first carnivore studies was a comparison of four species of sympatric carnivores, three felids *Leopardus pardalis*, *L. wiedii*, and *Puma yagouaroundi*, and the Tayra (*Eira barbara*), in the Cockscomb Basin in 1985–1986. No significant habitat associations were found for these species (Konecny, 1989). Mammals were included in broad wildlife surveys of the Río Bravo Conservation Management Area in 1990 (Haysmith *et al.*, 1990). Another study examined habitat use of four carnivores in the Mountain Pine Ridge Forest Reserve (Davis *et al.*, 2011). These four were *Leopardus pardalis*, *Puma concolor*, *Panthera onca* and *Urocyon cinereoargenteus*. They suggest that these predators do not spatially partition habitat (Davis *et al.*, 2011).

Seven camera-trap surveys combining mark-recapture statistics across two habitat types in western Belize determined that *Leopardus pardalis* were active mostly at night and they travelled on roads more than established and newly cut trails (Dillon and Kelly, 2007). Trap success was reported to be relatively high in the rainforest (2.1–6.2 captures per 100 trap nights) and low in the pine forest (0.1–0.2 captures per 100 trap nights). Camera trap density estimates were 25.8–25.9 per 100 km<sup>2</sup> in the broad-leaf, versus 2.3–3.8 per 100 km<sup>2</sup> in the pine forest (Dillon and Kelly, 2007).

Canid related papers have been limited to *Urocyon cinereoargenteus* examining diets (Novaro *et al.*, 1995). There are anecdotal reports of the coyote (*Canis latrans*) seen in Belize with the first verified record was the capture of an individual 15 June 1996 on the Gold Button Ranch in northern Belize, along the Río Hondo (Platt *et al.*, 1998). While not widespread this species appears to have arrived from Mexico and may use roads as corridors. We have subsequently observed sporadic occurrences repeated over the course of several years of coyotes in the Gallon Jug area in northwest Belize preyed upon deer.

Big cat studies, primarily the Jaguar (*Panthera onca*), have been a focus within Belize since Rabinowitz's initial work in the Cockscomb Basin (Rabinowitz and Nottingham, 1986) and included

discussion of the first livestock predation issues (Rabinowitz, 1986). Watt (1987) completed a study of jaguar scat and parasites and published a popular account (Watt, 1989) of her experiences living and studying jaguars in the jungles of Belize, including an account of a bicycle race across the country as the first effort to raise funds for jaguar conservation.

Camera trap and density estimates for jaguars became a focus as conservation management moved to the forefront during the late 1990s and 2000s. Follow up jaguar surveys included the Cockscomb Basin Wildlife Sanctuary (Silver and Ostro, unpublished data, 2000), Gallon Jug Estate in northwest Belize (C. M. Miller, unpublished data, 2005) and the Chiquibul National Park (Silver *et al.*, 2004; Kelly *et al.*, 2008).

Subsequent studies included scat sniffing dogs in conjunction with camera traps (Wultsch, 2008) and a study in the Gallon Jug Estate where jaguar track measurements were investigated as a potential survey method (C. M. Miller, unpublished data). The result of this study determined that it was not possible to identify individuals based on tracks. A number of subsequent papers examined jaguar and live stock issues (Miller C.M., 2002).

As one of the big cats, pumas (*Puma concolor*) were frequently recorded during camera trap based studies prompting attempts to quantify their densities as well (Kelly *et al.*, 2008). Comparisons of habitat use and temporal interactions between jaguars and pumas were also studied (Harmsen *et al.*, 2009; Foster *et al.*, 2010; Harmsen *et al.*, 2010). Wultsch (2008) worked on developing a standardized protocol for large-scale molecular scatology study including all of the cat species, examining the genetic structure and variation of cat populations and connectivity of populations. She used molecular scatology approach to estimate population densities and sex-ratios of feline species across multiple protected areas compare two noninvasive monitoring techniques in cat conservation: genotyping feces and remote camera tracking (Wultsch, 2008).

Primates have attracted considerable attention within Belize. There have been focused many studies of two species: Yucatán Black Howler Monkey (*Alouatta pigra*) and Geoffroy's Spider Monkey (*Ateles geoffroyi*). One of the first noteworthy reports was a population reduction of both species in southern Belize as the result of a yellow fever outbreak in 1957–1958 (Frost, 1977). Among the first focal studies were Horwich and Johnson (1984, 1986) and a series of 23 field surveys that included behavioral studies, review of the taxonomic and conservation status and first *Alouatta pigra* relocation project (Dahl, 1984, 1986, 1987; Dahl and Hemingway, 1989). Additional translocations of *Alouatta pigra* into the Cockscomb Basin followed (Ostro *et al.*, 1999; Ostro *et al.*, 2000; Kleiman *et al.*, 2002; Strum, 2005).

Twenty-nine locations were surveyed in and around the Chiquibul Forest, the Bladen Nature Reserve, and in the Dolores Estate, in the extreme south-west of Belize, focusing on *Ateles geoffroyi* (JF Dahl, K N Karas, and P S Durham, unpublished records). Dahl concluded that the two subspecies *Ateles vellerosus yucatanensis* and *A. v. pan* comprised distinct species within *A. vellerosus vellerosus* group and emphasized that the biota of the Toledo District of Belize and the Petén refugia are unique. The remnant populations of *A. v. yucatanensis* are restricted to relatively small areas of primary forest in the Chiquibul and the more extensive Bladen area warranting protection as a large biological corridor. Seasonal variation in sexual segregation in spider monkey was later studied by Hartwell *et al.* (2011).

Other recent primate work includes: Bolin (1981), Cornick and Markowitz (2002), and Notman *et al.* (2011). The population in the Lamanai Archaeological Reserve in northwestern Belize has also been the focus on a number of studies (e.g., Grossberg *et al.*, 2003; Ostro *et al.*, 2001; Arrowood *et al.*, 2003; Gavazzi *et al.*, 2008). Numerous other studies of *A. pigra* were conducted within the Community Baboon Sanctuary (James *et al.*, 1997; Silver *et al.*, 1998) as well as those leading to conservation of the species (Horwich, 1990; Bruner, 1993; Horwich and Lyon, 1995; Marsh, 1999; Alexander, 2000).

Inventory efforts of small mammal studies in the tropics are often difficult. Trapping small mammals in tropical forests is difficult, in part due to low densities. Researchers often use less time-consuming methods to sample ever larger areas to maximize both number of species and total captures, but unavoidably obtaining less data on individuals even in well-defined areas (Mares and Ernest, 1995).

Many, if not most, small mammals in tropical forests are either partially or primarily arboreal. Thus, protocols designed to sample a broad spectrum of species become increasingly difficult to conduct. While small mammals have not received a large amount of attention within Belize there have been several studies.

These include documentation of *Heteromys gaumeri* in riparian, deciduous seasonal forest at Honey Camp Lagoon, Orange Walk District (Izor and McCarthy, 1984). Karyotypes and chromosomal banding patterns of six species of small mammals (*Marmosa robinsoni*, *Heteromys desmarestianus*, *Oryzomys couesi*, *Ototylomys phyllotis*, *Peromyscus mexicanus*, and *Sigmodon hispidus*) from Belize were compared to those presented in the literature (Burton *et al.*, 1987). The role of small mammals as seed dispersers has also studied in southern Belize (Brewer and Rejmánek, 1999).

A study on trapping success included three metrics that were evaluated in the Bladen Nature Reserve in southern Belize. Sampling was comprised of walking transects and live trapping with Sherman and Tomahawk traps resulting in documenting 33 non-volant mammal species (Caro *et al.*, 2001a).

Comparisons of the small mammal fauna were made between the Chiquibul Forest Reserve and other three sites within the Maya Mountains to determine how sampling results varied between locations within the same habitat (Caro *et al.*, 2001b). They suggested mammal sampling should focus on sampling at multiple sites, rather than increasing time at a single site as they found a disparity of species between sites within what they assumed to be the same habitat. This variation would better be explained had they understood that the landscape sampled was comprised of vastly different habitats rather than assuming sampling it was all the same under the generic classification of subtropical wet forest. Small mammal (less than 1,500 g) diversity and density were examined by grid trapping in four trapping sessions over a two year time period at Las Cuevas Research Station with the resulting effort indicating low densities of small (less than 200 g) mammals in the area (Kelly and Caro, 2003).

Marine mammal work within Belize has been scant. Dudzinski *et al.* (1995) documented the behavior and investigated human interaction of a solitary female *Tursiops truncatus* that had remained for at least eight years in waters surrounding Northern Two Cay, Lighthouse Reef Atoll. Site preference and habitat use by *T. truncatus* at Turneffe Atoll was investigated using survey routes and counts of animals seen. Ten sites were the focus of a study that covered a range of locations throughout the southern two-thirds of Turneffe Atoll and encompassing four key habitat types. Data were collected from fall 1995 through spring 1996 (Grigg and Markowitz, 1997).

There have been many generalized surveys and inventories across the county that included mammals. These were not necessarily linked to the protected area network *per se* and frequently were the result of required environmental impact assessments (EIA) in areas slated for development. One of the most prolific in conducting such assessments that included mammals has been Jan Meerman (Meerman 1993, 1995a, b; Meerman and Boomsma, 1995; and other unpublished documents).

Additional surveys in Belizean mammalogy include: Bengtson and Magor (1979), McCarthy (1986a), Morales-Vela *et al.* (2000), Platt *et al.* (2000), Bowen-Jones (2001), and Engilis *et al.* (2012).

## DISCUSSION

There are 28 families, 92 genera and 122 species of mammals documented from Belize. Bats make up 28% of the families, 51% of the genera and 59% of the species. While not linked to a landscape level distribution assessments the varied species occurrences from environmental impact assessments and surveys noted above have provided a general understanding of the distribution of key mammal species within the country. Distribution information compiled from these reports has been used for national conservation planning (e.g., B.W. Miller and C.M. Miller, 1995; Meerman, 2005a, b; Briggs *et al.*, 2013) and compiled in the on-line Biodiversity and Environmental Resource Data System of Belize (BERDS, 2013). This website provides the most comprehensive database within Belize.

While there have been errors in identifications in published accounts and a number of recent taxonomic changes noted above that redefine the occurrence of recognized species within Belize, two remain persistent on varied lists of mammals (*Myrmecophaga tridactyla* and *Cebus capucinus*). We discuss the origins of these in detail below.

The occurrence of the Giant Anteater (*Myrmecophaga tridactyla*) in Belize has been traced back to anecdotal reports and conjecture. The northernmost report from southern Belize near Punta Gorda was based on an undocumented personal communication (Alston, 1879–1882). This was a third hand report of the Giant Anteater by a Mr. Sarg who related an anecdotal observation to Godman and Salvin (1915) that one had been killed near Punta Gorda, on the coast of the Bay of Honduras. This has been the basis for the assumption that at one time this species did occur within Belize.

The first verified record of the Giant Anteater from Honduras was an adult captured in the lowland tropical rainforest in 1996 by a Miskito Indian (McCain, 2001). During a 3.5 year (2001–2005) Honduran Program of Biological Monitoring, four new records of the Giant Anteater were verified in the Honduran Mosquitia (Reyes *et al.*, 2010). Based on the results of this program it was suggested that the Giant Anteater may have been eradicated from the Honduran Caribbean and within Honduras it is only extant in La Mosquitia (Reyes *et al.*, 2010).

Although this species is still included on widely circulated mammal lists for Belize, we concur with McCarthy (1983a) that this species never occurred within Belize and the single record relates to a trade skin possibly from Honduras and was shipped from Belize City with the origin labeled as British Honduras.

The other persistent species found on Belize mammal lists has been the White-throated Capuchin Monkey (*Cebus capucinus*). This apparently stemmed from a report that among the specimens examined for the description of the new subspecies (*C. capucinus limitaneus*) there was a single skin from British Honduras (Hollister, 1914a). As with *Myrmecophaga tridactyla*, this likely was one of the many trade skin tags that were based on the port of origin Belize, British Honduras, and not the collection location. McCarthy (1982b) did suggest that the *Cebus capucinus* might occur in southern Belize and that further documentation was necessary for verification. He cited Handley (1950) who suggested that as the species had been reported from Lake Izabal in Guatemala, it was possible that the species might be found in the heavy forests of the coastal region of southern Belize. In his conjecture, McCarthy (1982b) included two anecdotal observations that while not verified, he considered reliable. One report was a troop of 30–40 individual monkeys seen along the Monkey Tail Branch of the Macal River, in the Cayo District, and the other in the Trio Branch drainage in the Toledo District. With these reports, the possibility of the occurrence of the species suggested a greater survey effort was required for verification (Dahl, 1984).

Subsequent intensive primate surveys in southern Belize failed to detect *Cebus*. Despite numerous informants' enthusiastic reports of "white-faced monkeys," there was no evidence of *Cebus* and careful cross-examination indicated that these sightings were clearly suspect (Dahl, 1987). Throughout Dahl's 23 field surveys in Belize and numerous interviews with local informants, he was unable to find any evidence to support the existence of *Cebus* in Belize (Dahl, 1984, 1986, 1987). The previous reports (McCarthy, 1982b) of this monkey along the Trio Branch and in the Chiquibul Forest could not be substantiated despite surveys conducted in the areas described above (Dahl, 1987).

Over the 25 years that we worked in forested areas throughout Belize, including areas of the anecdotal accounts reported by McCarthy (1982b), we have had no verified sightings. We have also undertaken a number of follow-up field investigations after hearing similar reports and in all cases we encountered *Ateles geoffroyi*. The coloration of this monkey is highly variable between the subspecies (Emmons and Feer, 1997; Reid, 2009). Hall (1981) indicated that the range of *A. geoffroyi yucatanensis* extended through most of the northern and central areas of Belize and *A. geoffroyi vellerosus* occupied southern Belize.

Primates have been well studied as focal taxa within Belize. If *Cebus* was present we are certain this would have been verified. Based on our experience what are reported as "white-faced monkeys" and assumed to be *Cebus* have been *A. geoffroyi*. Dahl who searched specifically for this species commented (in lit.) "Several informants were enthusiastic about having seen what I described as *Cebus* but on more exacting questioning, they were clearly seeing Kinkajous, *Potos flavus* (it has a short nose, it has a prehensile tail, it has grasping hands, is active at night - which is what I suspected this monkey would be doing similar to Howlers)."

Dahl, who now heads the Deep Forest Field School in Atlanta, corroborated our conclusion that *Cebus* does not occur in Belize. "This conclusion is based on survey work in a total of 141 km<sup>2</sup> (12 sites)

between elevations of 15 and 920 m (Dahl, 1984) as well as work on *Ateles* in another 24 areas scattered throughout Belize mostly in the south. The best bet for finding them had they been there was in the extreme southwest, but during the Dolores Expedition I neither saw nor heard signs.”

Another unsubstantiated published record warrants clarification. *Saccopteryx leptura* was reported from Lamanai in the northwestern part of Belize by an unverified visual observation at a roost (Fenton *et al.*, 2001). The vocal signature of this species is readily identified, unmistakable and differentiated from the widespread conspecific *S. bilineata* (O’Farrell and Miller, 1999; O’Farrell *et al.*, 1999; Miller B.W., 2003b, 2004). More than a decade of countrywide acoustic and harp trap surveys and subsequent ecological niche models indicate *S. leptura* is restricted to the wetter southern half of the country (Miller B.W., 2009) and occurs under different ecological conditions and habit types than at the reported Lamanai location. Acoustic surveys at Lamanai indicated that while wide spread habitat generalist *S. bilineata*, was abundant there were no vocal signature recordings matching those of *S. leptura*.

Historically, the peccary has been an important species as a food source for people dating back to the time of the Maya (Fridberg, 2005). General wildlife management of Collared Peccary (*Pecari tajacu*) and White-tailed Deer (*Odocoileus virginianus*) was discussed (Frost 1977, 1981) during a study of hunting of wildlife and early conservation programs in Belize. Altrichter *et al.* (2011) provided a more recent discussion of the conservation status of *Tayassu pecari*.

#### ACKNOWLEDGMENTS

We thank the many researchers past and present who have enabled us to summarize the history of mammalogy in Belize. We thank the Wildlife Conservation Society for long term support of our fieldwork, the Government of Belize, Forest Department which issued research permits, Sir Barry M. Bowen who enabled us to remain in Belize long term and the plethora of colleagues residing in Belize.

#### LITERATURE CITED

- ALEXANDER SE. 2000. Resident attitudes towards protection and black howler monkeys in Belize: the Community Baboon Sanctuary. *Environmental Conservation* 27:341–350.
- ALSTON ER. 1879–1882. *Biologia Centrali-Americana. Zoologia, Class I. Mammalia*. Taylor and Francis, London.
- ALTRICHTER M, A TABER, H BECK, R REYNA-HURTADO, L LIZARRAGA, A KEUROGHLIAN, and EW SANDERSON. 2011. Range-wide declines of a key Neotropical ecosystem architect, the Near Threatened White-lipped Peccary *Tayassu pecari*. *Oryx* 46:87–98.
- ARCHER S. 1877. Mimetic habit of bats. *Nature* 15:313.
- ARROWOOD HC, A TREVES, and NE MATHEWS. 2003. Determinants of day-range length in the Black Howler Monkey at Lamanai, Belize. *Journal of Tropical Ecology* 19:591–594.
- BAIRD AB, DM HILLIS, JC PATTON, and JW BICKHAM. 2008. Evolutionary history of the genus *Rhogeessa* (Chiroptera: Vespertilionidae) as revealed by mitochondrial DNA sequences. *Journal of Mammalogy* 89:744–754.
- BAIRD AB, DM HILLIS, JC PATTON, and JW BICKHAM. 2009. Speciation by monobrachial centric fusions: A test of the model using nuclear DNA sequences from the bat genus *Rhogeessa*. *Molecular Phylogenetics and Evolution* 50:256–267.
- BAKER RJ, S SOLARI, and FG HOFFMAN. 2002. A new Central American species from the *Carollia brevicauda* complex. *Occasional Papers of the Museum of Texas Tech University* 217:1–12.
- BARLOW JC, JA DICK, and E PENDERGAST. 1970. Additional records of birds from British Honduras Belize. *Condor* 72:371–372.
- BELLAMY J. 1889. Expedition to the Cockscomb Mountains, British Honduras. *Proceedings of the Royal Geographical Society and Monthly Record of Geography, New Monthly Series* 11:542–552.
- BENGSTON J, and D MAGOR. 1979. A survey of manatees in Belize. *Journal of Mammalogy* 60:230–232.
- BERDS. 2013. Biodiversity & Environmental Resource Data System of Belize, Belmopan, Belize. Web site: <<http://www.biodiversity.bz>>.

- BERSOT V. 2003. Small mammal inventory in the Shipstern Nature Reserve (Corozal District, Belize, Central America), a preliminary assessment. *Revue Suisse de Zoologie* 110:207–246.
- BISCARDI S, and J ORPRECIO. 2002. Do echolocation calls provide a good indication about which species of bats occur in an area? *Bat Research News* 43:136.
- BOLIN T. 1981. Male parental behavior in black howler monkeys (*Alouatta palliata pigra*) in Belize and Guatemala. *Primates* 2:349–360.
- BOWEN-JONES E. 2001. Belize Lodge Excursions Biodiversity Assessment 44. Fauna & Flora International, Cambridge, UK.
- BREWER SW, and M REJMÁNEK. 1999. Small rodents as significant dispersers of tree seeds in a Neotropical forest. *Journal of Vegetation Science* 10:165–174.
- BRIGS VS, FJ MAZZOTTI, RG HARVEY, TK BARNES, R MANZANERO, JC MEERMAN, P WALKER, and Z WALKER. 2013. Conceptual ecological model of the Chiquibul/Maya Mountain Massif, Belize. *Human and Ecological Risk Assessment* 19:317–340.
- BRUNER GY. 1993. Evaluation of a model of private-ownership conservation: ecotourism in the community baboon sanctuary in Belize. Master Thesis, Georgia Institute of Technology; Atlanta, GA.
- BURT WH. 1937. A new Pocket Gopher (*Heterogeomys*) from British Honduras. *Occasional Papers of the Museum of Zoology, University of Michigan*, 365:1–2.
- BURTON DW, JW BICKHAM, HH GENOWAYS, and TJ MCCARTHY. 1987. Karyotypic analysis of five rodents and a marsupial from Belize, Central America. *Annals of Carnegie Museum* 56:103–112.
- CARO T AE Jr., E FITZHERBERT, and T GARDNER. 2004. Preliminary assessment of the flagship species concept at a small scale. *Animal Conservation* 7:63–70.
- CARO TM, R BROCK, and M KELLY. 2001a. Diversity of mammals in the Bladen Nature Reserve, Belize, and factors affecting their trapping success. *Mammalian Biology/Zeitschrift für Säugetierkunde* 66:90–101.
- CARO TM, MJ KELLY, N BOL, and S MATOLA. 2001b. Inventorying mammals at multiple sites in the Maya Mountain of Belize. *Journal of Mammalogy* 82:43–50.
- CARTWRIGHT AM. 1977. Patterns of Neotropical chiropteran reproduction including histological and ecological aspects of bats collected in Belize. PhD Thesis, Ball State University, Muncie, IN.
- CARTWRIGHT AM, and RD KIRKPATRICK. 1977. A range extension of *Peropteryx kappleri* (family Emballonuridae) in Central America. *Proceedings of Indiana Academy of Sciences* 86:466.
- CHARNOCK-WILSON J. 1968. The manatee in British Honduras. *Oryx* 9:293–294.
- CHARNOCK-WILSON J. 1970. Manatees and crocodiles. *Oryx* 10:236–238.
- CORNICK LA, and H MARKOWITZ. 2002. Diurnal vocal patterns of the Black Howler Monkey (*Alouatta pigra*) at Lamanai, Belize. *Journal of Mammalogy* 83:159–166.
- CZAPLEWSKI NJ, J KREJCA, and TE MILLER. 2003. Late Quaternary bats from Cebada Cave, Chiquibul Cave System, Belize. *Caribbean Journal of Science* 39:23–33.
- DAHL JF. 1984. Primate survey in proposed Reserve area in Belize. *Primate Conservation* 4:28–29.
- DAHL JF. 1986. The status of Howler, Spider, and Capuchin Monkey populations in Belize, Central America. *Primate Conservation* 14:161.
- DAHL JF. 1987. Conservation of primates in Belize, Central America. *Primate Conservation* 8:119–121.
- DAHL JF, and CA HEMINGWAY. 1989. Foraging by howler monkeys at night, thermal conditions, and the prehensile tail. *American Journal of Primatology* 18:141.
- DAVIS ML, MJ KELLY, and DF STAUFFER. 2011. Carnivore co-existence and habitat use in the Mountain Pine Ridge Forest Reserve, Belize. *Animal Conservation* 14:56–65.
- DEUTSCH CJ, C SELF-SULLIVAN, and A MIGNUCCI-GIANNONI. 2008. *Trichechus manatus*. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. Web site: <www.iucnredlist.org>.
- DILLON A, and MJ KELLY. 2007. Ocelot *Leopardus pardalis* in Belize: the impact of trap spacing and distance moved on density estimates. *Oryx* 41:469–477.
- DISNEY RHL. 1968. Observations on a zoonosis leishmaniasis in British Honduras. *Journal of Applied Ecology* 5:1–59.



- DOBSON GE. 1878. Catalogue of the Chiroptera in the collection of the British Museum. Publications of the British Museum (Natural History), London.
- DUDZINSKI KM, TG FROHOFF, and NL CRANE. 1995. Behavior of a lone female Bottlenose Dolphin (*Tursiops truncatus*) with humans off the coast of Belize. *Aquatic Mammals* 21:149–153.
- EBERSOLE R. 2000. The batman of Belize. *Current Science* 86:12–13.
- EGER JL. 1974. A new subspecies of the bat *Eumops auripendulus* (Chiroptera: Molossidae), from Argentina and eastern Brazil. *Life Sciences Contributions of Royal Ontario Museum* 25:1–8.
- EMMONS LH, and F FEER. 1997. Neotropical rainforest mammals: a field guide. 2<sup>nd</sup> edition. The University of Chicago Press, Chicago and London.
- ENGLIS A Jr., RE COLE, and TM CARO. 2012. Small mammal survey of Chiquibul Forest Reserve, Maya Mountains, Belize, 2001. *Occasional Papers of the Museum of Texas Tech University* 308:1–23.
- FENTON MB, MJ VONHOF, S BOUCHARD, SA GILL, DS JOHNSTON, FA REID, DK RISKIN, KL STANDING, JR TAYLOR, and R WAGNER. 2000. Roosts used by *Sturnira lilium* (Chiroptera: Phyllostomidae) in Belize. *Biotropica* 32:729–733.
- FENTON MB, E BERNARD, S BOUCHARD, L HOLLIS, DS JOHNSTON, CL LAUSEN, JM RATCLIFFE, DK RISKIN, JR TAYLOR, and J ZIGOURIS. 2001. The bat fauna of Lamanai, Belize: roosts and trophic roles. *Journal of Tropical Ecology* 17:1–14.
- FOSTER, RJ, BJ HARMSSEN, and CP DONCASTER. 2010. Habitat use by sympatric jaguars and pumas across a gradient of human disturbance in Belize. *Biotropica* 32:1–8.
- FRAGOSO JM. 1983. The ecology and behavior of Baird's Tapir in Belize. BS Thesis, Trent University, Peterborough, ON.
- FRAGOSO JM. 1987. The habitat preferences and social structure of tapirs. Master Thesis, University of Toronto, Toronto, ON.
- FRAGOSO JM. 1991. The effect of selective logging on Baird's Tapir. Pp. 295–304, *in*: Latin American Mammalogy, history, biodiversity, and conservation (MA Mares and DJ Schmidly, eds.). University of Oklahoma Press, Norman, OK.
- FRIDBERG D. 2005. Peccaries in Ancient Maya economy, ideology, and iconography. Harvard University, Cambridge, MA.
- FROST MD. 1977. Wildlife management in Belize: program status and problems. *Wildlife Society Bulletin* 5:48–51.
- FROST MD. 1981. Patterns of human influence on landscape and wildlife: Selected case studies in Belize. *Revista Geográfica* 94:89–100.
- GARDNER AL. 1973. The systematics of the genus *Didelphis* (Marsupialia: Didelphidae) in North and Middle America. *Special Publications of the Museum of Texas Tech University* 4:1–81.
- GAUMER GF. 1917. Monografía de los mamíferos de Yucatán. Talleres Gráficos de la Secretaría de Fomento, México, DF.
- GAVAZZI AJ, LA CORNICK, TM MARKOWITZ, D GREEN, and H MARKOWITZ. 2008. Density, distribution, and home range of the Black Howler Monkey (*Alouatta pigra*) at Lamanai, Belize. *Journal of Mammalogy* 89:1105–1112.
- GBIF. 2013. Data portal of the Global Biodiversity Information Facility. Web site: <<http://data.gbif.org>>.
- GODMAN FD, and O SALVIN. 1915. *Biologia Centrali-Americana*. Zoology, Botany and Archeology. R. H. Porter, London.
- GONZÁLEZ-RUIZ N, and J ARROYO-CABRALES. 2011. Timothy McCarthy. *Therya* 2:295–300.
- GONZÁLEZ-RUIZ N, J RAMÍREZ-PULIDO, and J ARROYO-CABRALES. 2010. A new species of Mastiff Bat (Chiroptera: Molossidae: *Molossus*) from México. *Mammalian Biology* 76:461–469.
- GRIGG E, and H MARKOWITZ. 1997. Habitat use by bottlenose dolphins (*Tursiops truncatus*) at Turneffe Atoll, Belize. *Aquatic Mammals* 23:163–170.
- GROSSBERG R, A TREVES, and L NAUGHTON-TREVES. 2003. The Incidental Ecotourist. Measuring visitor impacts on endangered howler monkeys at a Belizean archeological site. *Environmental Conservation* 2003:40–51.

- GUYNUP S. 2000. The bat detectives. *Wildlife Conservation* 103:28–35.
- HALL ER. 1981. *The mammals of North America*. Wiley-Interscience, New York.
- HANDLEY CO Jr. 1950. Game mammals of Guatemala. Pp. 141–162, *in*: A fish and wildlife survey of Guatemala (GB Saunders, AD Holloway and CO Handley Jr., eds.). US Department of the Interior, Fish and Wildlife Service, Special Publication Report 5.
- HARMSEN BJ, RJ FOSTER, SC SILVER, LE OSTRO, and CP DONCASTER. 2009. Spatial and temporal interactions of sympatric jaguars (*Panthera onca*) and pumas (*Puma concolor*) in a Neotropical Forest. *Journal of Mammalogy* 90:612–620.
- HARMSEN BJ, RJ FOSTER, S SILVER, LE OSTRO, and CP DONCASTER. 2010. Differential use of trails by forest mammals and the implications for camera-trap studies: a case study from Belize. *Biotropica* 42:126–133.
- HARTSHORN GS, L NICOLAIT, L HARTSHORN, G BEVIER, R BRIGHTMAN, J CAL, A CAWICH, W DAVIDSON, R DUBOIS, C DYER, J GIBSON, W HAWLEY, J LEONARD, R NICOLAIT, D WEYER, H WHITE, and C WRIGHT. 1984. Belize Country Environmental Profile, US Agency for International Development, San José, Costa Rica.
- HARTWELL KS, H NOTMAN, and MSM PAVELKA. 2011. Seasonal variation in sexual segregation in spider monkeys (*Ateles geoffroyi yucatanensis*). *American Journal of Physical Anthropology* 144:157.
- HAYSMITH L, M MÁRQUEZ, L WILKINS, J THOMPSON, M SAUREZ, S WALKER, J FRAGOSO, D RUMIZ, C HUNTER, G SILVA-LÓPEZ, and L GROBER. 1990. Wildlife survey of the Río Bravo Conservation and Management Area, Belize. Part II: Small Mammals and Carnivores, Gainesville, FL.
- HERSHKOVITZ P. 1951. Mammals from British Honduras, México, Jamaica and Haiti. *Fieldiana, Zoology* 31:547–569.
- HIGDON JW, and GJ FORBES. 2002. Results of a survey of bats (Chiroptera) at Possum Point Biological Research Station, Sittee River, Belize. University of New Brunswick, New Brunswick, Canada.
- HOLLISTER H. 1914a. Descriptions of four new mammals from tropical America. *Proceedings of Biological Society of Washington* 27:141–144.
- HOLLISTER H. 1914b. Four new mammals for tropical America. *Proceedings of Biological Society of Washington* 27:57–59.
- HORWICH RH. 1990. How to develop a community sanctuary, an experimental approach to the conservation of private lands. *Oryx* 24:95–102.
- HORWICH RH, and ED JOHNSON. 1984. Geographic distribution and status of the Black Howler Monkey. IUCN/SSC Primate Specialist Group Newsletter 4:25–27.
- HORWICH RH, and ED JOHNSON. 1986. Geographical distribution of the Black Howler (*Alouatta pigra*) in Central America. *Primates* 27:53–62.
- HORWICH RH, and J LYON. 1995. Multilevel conservation and education at the Community Baboon Sanctuary, Belize. Pp. 235–253, *in*: *Conserving Wildlife: International Education and Communication Approaches* (SK Jacobson, ed.). Columbia University Press, New York.
- IZOR RJ, and TJ MCCARTHY. 1984. *Heteromys gaumeri* (Rodentia: Heteromyidae) in Northern Plain of Belize. *Mammalia* 48:465–467.
- JAMES RAA, PL LEBRG, JM QUATTRO, and RC VRIJENHOEK. 1997. Genetic diversity in black howler monkeys (*Alouatta pigra*) from Belize. *American Journal of Physical Anthropology* 102:329–336.
- JONES JK Jr., and DC CARTER. 1972. *Cyclopes didactylus* in British Honduras. *Mammalia* 36:535–536.
- KELLY MJ, and TM CARO. 2003. Low density of small mammals at Las Cuevas, Belize. *Mammalian Biology* 68:372–386.
- KELLY MJ, AJ NOSS, MS Di BITETTI, L MAFFEI, RL ARISPE, A PAVIOLO, CD De ANGELO, and YE Di BLANCO. 2008. Estimating Puma densities from camera trapping across three study sites: Bolivia, Argentina, and Belize. *Journal of Mammalogy* 89:408–418.

- KENYON KW. 1977. Caribbean Monk Seal Extinct. *Journal of Mammalogy* 58:97–98.
- KIRKPATRICK RD, and AM CARTWRIGHT. 1975. List of mammals known to occur in Belize. *Bitropica* 7:136–140.
- KIRKPATRICK RD, AM CARTWRIGHT, JC BRIER, and EJ SPICKA. 1975. Additional mammal records for Belize. *Mammalia* 39:330–331.
- KLEINMAN DG, BB BECK, JM DIETZ, LA DIETZ, and JD BALLOU. 2002. Translocation of black howler monkeys in Belize. *Re-introduction News, Special Primate Issue* 21:10–12.
- KNUDSEN PM. 1977. The case of the missing Monk Seal. *Natural History* 86:78–83.
- KONECNY MJ. 1989. Movement patterns and food habits of four sympatric carnivore species in Belize, Central America. Pp. 243–264, *in: Advances in Neotropical Mammalogy* (KH Redford, and JF Eisenberg, eds.). Sandhill Crane Press, Gainesville, FL.
- LAINSON R, and J STRANGWAYS-DIXON. 1964. The epidemiology of dermal leishmaniasis in British Honduras: Part II. Reservoir-hosts of *Leishmania mexicana* among the forest rodents. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 58:136–153.
- LaVAL RK. 1973. Systematics of the genus *Rhogeessa* (Chiroptera: Vespertilionidae). University of Kansas Publications, Occasional Papers of the Natural History Museum 19:1–47.
- LÓPEZ-WILCHIS R, LM GUEVARA-CHUMACERO, NA PÉREZ, J JUSTE, C IBÁÑEZ, and IDLA BARRIGA-SOSA. 2012. Taxonomic status assessment of the Mexican populations of funnel-eared bats, genus *Natalus* (Chiroptera: Natalidae). *Acta Chiropterologica* 14:305–316.
- MANIS. 2013. Mammal Networked Information System. Web site: <<http://manisnet.org/manis/>>.
- MARES MA, and KA ERNEST. 1995. Population and community ecology of small mammals in a gallery forest of central Brazil. *Journal of Mammalogy* 76:750–768.
- MARSH LK. 1999. Ecological effect of the Black Howler Monkey (*Alouatta pigra*) on fragmented forests in the Community Baboon Sanctuary, Belize. PhD Thesis, Washington University, St. Louis, MO.
- MATOLA S. 2002. Central American Tapir activity in Upper Macal and Raspaculo River Valley. Tapir Specialist Group, Tapir Conservation Newsletter of the IUCN/SSC 11:16.
- MATOLA S, AD CUARÓN, and H RUBIO-TORGLER. 1997. Status and Action Plan of the Baird's Tapir (*Tapirus bairdii*). *in: Tapirs, status, survey and conservation Action Plan* (DM Brooks, RE Bodmer and S Matola, eds.). IUCN/SSC Tapir Specialist Group. IUCN, Gland, Switzerland, and Cambridge, UK.
- MCCAIN CM. 2001. First evidence of the Giant Anteater (*Myrmecophaga tridactyla*) in Honduras. *The Southwestern Naturalist* 46:252–254.
- MCCARTHY TJ. 1976. The bats of Belize. *Belize Audubon Society Bulletin* 8:3–4.
- MCCARTHY TJ. 1979. The friendly nights of Belize. *Brukdown* 3:18–19.
- MCCARTHY TJ. 1980a. Checklist of the bats known from Belize. *Belize Audubon Society Bulletin* 12:1–2.
- MCCARTHY TJ. 1980b. Mammalogy in Belize. *Belize Audubon Society Bulletin* 12:1–3.
- MCCARTHY TJ. 1982a. Bat records from the Caribbean lowlands of El Petén, Guatemala. *Journal of Mammalogy* 63:683–685.
- MCCARTHY TJ. 1982b. *Chironectes*, *Cyclopes*, *Cabassous*, and probably *Cebus* in southern Belize. *Mammalia* 46:397–400.
- MCCARTHY TJ. 1983a. Mammalogy in Belize: Review, critique and documentation of the fauna. *Belize Audubon Society Bulletin* 15:1–20.
- MCCARTHY TJ. 1983b. Mammals of Belize (checklist). *Belize Audubon Society Bulletin* 15:1–4.
- MCCARTHY TJ. 1986a. The gentle giants of Belize. Part II: distribution of manatees. *Belize Audubon Society Bulletin* 18:1–4.
- MCCARTHY TJ. 1986b. The occurrence of the Tropical Cacomistle (*Bassariscus sumichrasti*) in Belize. *Belize Audubon Society Bulletin* 18:3–5.
- MCCARTHY TJ. 1987. Distributional records of bats from the Caribbean lowlands of Belize and adjacent Guatemala and México. Pp. 137–162, *en: Studies in Neotropical Mammalogy: essays in honor of Philip Hershkovitz* (BD Patterson, and RM Timm, eds.). *Fieldiana, Zoology* 39.

- MCCARTHY TJ. 1992. Notes concerning the Jaguarundi Cat (*Herpailurus yagouaroundi*) in the Caribbean lowlands of Belize and Guatemala. *Mammalia* 56:302–306.
- MCCARTHY TJ, and M BLAKE. 1987. Noteworthy bat records from the Maya Mountains Forest Reserve, Belize. *Mammalia* 51:161–164.
- MCCARTHY TJ, WB DAVIS, JE HILL, JK JONES, and GA CRUZ. 1993. Bat Mammalia: (Chiroptera) records, early collectors, and faunal lists for Northern Central America. *Annals of Carnegie Museum* 62:191–228.
- MEANS DB. 1997. Natural history of Mountain Pine Ridge Belize. Bull Run Overseas Ltd., Belize.
- MEAVE J, and MC KELLMAN. 1994. Maintenance of rain forest diversity in riparian forests of tropical savannas: Implications for species conservation during Pleistocene drought. *Journal of Biogeography* 21:121–135.
- MEAVE J, MC KELLMAN, AK MACDOUGALL, and J ROSALES. 1991. Riparian habitats as Tropical Forest Refugia. *Global Ecology and Biogeography Letters* 1:69–76.
- MEERMAN JC. 1993. Mammals of the Shipstern Nature Reserve. *Occasional Papers of the Belize Natural History Society* 1:83–85.
- MEERMAN JC. 1995a. Terrestrial Biological Survey, Western Long Caye, Glovers Atoll. *Belize Tropical Forest Studies Publication* 4:1–6.
- MEERMAN JC. 1995b. Western Long Caye, Glovers Atoll: Terrestrial Biological Survey. *Belize Tropical Forest Studies Publication* 4:1–9.
- MEERMAN JC, and T BOOMSMA. 1995. False Sittce Point, Stann Creek District, Belize. *Belize Tropical Forest Studies Publication* 2:1–37.
- MILLER BW. 2001a. Beyond mist-nets: What the rest of the bats can tell us about forests. The consequences of timber exploitation for bat communities in tropical America. Pp. 154–156, *in*: *Cutting Edge: Conserving Wildlife in Logged Tropical Forests* (A Grajal and JG Robinson, eds.). Columbia University Press, New York.
- MILLER BW. 2001b. A method for determining relative activity of free flying bats using a new activity index for acoustic monitoring. *Acta Chiropterologica* 3:93–105.
- MILLER BW. 2003a. Community Ecology of the non-phyllostomid bats of Northwestern Belize, with a landscape level assessment of the bats of Belize. Dissertation Thesis, Durrell Institute of Conservation and Ecology, University of Kent, Canterbury, Kent, UK.
- MILLER BW. 2003b. Bat survey during the Columbia River Forest Reserve Little Quartz Ridge Expedition. Pp. 78–83, *in*: *The Columbia River Forest Reserve Little Quartz Ridge Expedition, A Biological Assessment* (JC Meerman, and S Matola, eds.). Wildlife Trust, Columbia University Printing Services, New York.
- MILLER BW. 2004. Acoustic surveys and non-phyllostomid Neotropical bats: How effective are they? Pp. 58–62, *in*: *Bat Echolocation Research: tools, techniques and analysis* (RM Brigham, EKV Kalko, G Jones, S Parsons, and HJGA Limpens, eds.). Bat Conservation International, Austin, TX.
- MILLER BW. 2009. A risk assessment of the bats of Belize, Phase I, in the context of the Selva Maya Region. Neotropical Bat Project and the Critical Ecosystems Partnership Fund, Gallon Jug, Belize.
- MILLER BW. 2011. Key to vocal signatures of the species of the Mormoopidae and Noctilionidae. Web site: <<https://sites.google.com/site/batsoundservices/identification-keys/mormoopidae-and-noctilionidae>> (accessed: 2011-05-01).
- MILLER BW, and CM MILLER. 1995. National protected areas Management Plan, Zoological report. Faunal and site analysis national protected areas aystem Plan for Belize Belmopan. Ministry of Natural Resources, USAID, and Wildlife Conservation Society 3:1–236.
- MILLER BW, and CM MILLER. 1999. Mammal Survey Protocol Biological Monitoring in the Selva Maya. Pp. 53–60, *in*: *U.S. Man and the Biosphere Program Tropical Ecosystem Directorate* (A Carr and ACD Stoll, eds.). Wildlife Conservation Society, Gainesville, FL.
- MILLER CM. 1997. Belize Batbusters. *Wildlife Conservation* 100:6–7.

- MILLER CM. 2002. Jaguares, ganado y humanos: un ejemplo de coexistencia pacífica en el noroeste de Belice. Pp. 477–491, in: El Jaguar en el Nuevo Milenio (RA Medellín, C Equihua, CLB Chetkiewicz, PG Crawshaw Jr., A Rabinowitz, KH Redford, JG Robinson, EW Sanderson, and AB Taber, eds.). Wildlife Conservation Society, Fondo de Cultura Económica, Universidad Nacional Autónoma de México, México, DF.
- MILLER TE. 1989. Chiquibul '88. National Speleological Society News 47:61–66.
- MILLER W. 1887. Notes on a part of the Western Frontier of British Honduras. Proceedings of Royal Geographical Society and Monthly Record of Geography, New Monthly Series 9:420–423.
- MOORE TJ. 1859. List of mammals and birds collected by Mr. Joseph Leyland in Honduras, Belize and Guatemala. Proceedings of the Zoological Society of London 1859:50–65.
- MORALES-VELA B, D OLIVERA-GÓMEZ, JE REYNOLDS, and GB RATHBUN. 2000. Distribution and habitat use by manatees (*Trichechus manatus manatus*) in Belize and Chetumal Bay, México. Biological Conservation 95:67–75.
- MURIE A. 1932. A new *Oryzomys* from a Pine ridge in British Honduras. Occasional Papers of the Museum of Zoology, University of Michigan, 245:1–3.
- MURIE A. 1935. Mammals from Guatemala and British Honduras. Miscellaneous Publications of the Museum of Zoology, University of Michigan, 26:1–30.
- NOTMAN H, K HARTWELL, and MSM PAVELKA. 2011. Seasonal variation in sexual segregation in spider monkeys (*Ateles geoffroyi yucatanensis*) at Runaway Creek Nature Preserve Belize. American Society of Primatologists 43:1–28.
- NOVARO AJ, RS WALKER, and M SUÁREZ. 1995. Dry-season food habits of the Gray Fox (*Urocyon cinereoargenteus fraterculus*) in the Belizean Peten. Mammalia 59:19–24.
- O'FARRELL MJ, and BW MILLER. 1997. A new examination of echolocation calls of some Neotropical bats (Emballonuridae and Mormoopidae). Journal of Mammalogy 78:954–963.
- O'FARRELL MJ, and BW MILLER. 1999. Use of vocal signatures for the inventory of free-flying Neotropical bats. Biotropica 31:507–516.
- O'FARRELL MJ, BW MILLER, and WL GANNON. 1999. Qualitative identification of free-flying bats using the Anabat Detector. Journal of Mammalogy 80:11–23.
- O'SHEA TJ, and CA SALISBURY. 1989. Status of manatees, *Trichechus manatus* (Mammalia, Sirenia), in Belize, with results of a May 1989 aerial survey. IUCN. Sirenia Specialist Group, Gainesville, FL.
- O'SHEA TJ, and CA SALISBURY. 1991. Belize- a last stronghold for manatees in the Caribbean. Oryx 25:156–163.
- OSTRO LE, SC SILVER, FW KOONTZ, TP YOUNG, and RH HORWICH. 1999. Ranging behavior of translocated and established groups of black howler monkeys *Alouatta pigra* in Belize, Central America. Biological Conservation 87:181–190.
- OSTRO LE, SC SILVER, FW KOONTZ, and TP YOUNG. 2000. Habitat selection by translocated black howler monkeys in Belize. Animal Conservation 3:175–181.
- OSTRO LE, SC SILVER, FW KOONTZ, RH HORWICH, and R BROCKETT. 2001. Shifts in social structure of Black Howler (*Alouatta pigra*) groups associated with natural and experimental variation in population density. International Journal of Primatology 22:733–748.
- PETERSON RL. 1965. The genus *Vampyressa* recorded from British Honduras. Journal of Mammalogy 46:676.
- PLATT SG, BW MILLER, and CM MILLER. 1998. First record of the Coyote (*Canis latrans*) in Belize. Vida Silvestre Neotropical 7:139–140.
- PLATT SG, TR RAINWATER, BW MILLER, and CM MILLER. 2000. Notes on the mammals of Turneffe Atoll, Belize. Caribbean Journal of Science 36:168–170.
- RABINOWITZ AR. 1986. Jaguar predation on domestic livestock in Belize. Wildlife Society Bulletin 14:170–174.
- RABINOWITZ AR, and BG NOTTINGHAM Jr. 1986. Ecology and behaviour of the Jaguar (*Panthera onca*) in Belize, Central America. Journal of Zoological Society of London 210:149–159.

- REID FA. 2009. A field guide to the mammals of Central America and Southeast México. 2<sup>nd</sup> edition. Oxford University Press, New York, and Oxford, UK.
- REYES HOP, WA MATAMOROS, and SL GLOWINSKI. 2010. Distribution and conservation status of the Giant Anteater (*Myrmecophaga tridactyla*) in Honduras. *The Southwestern Naturalist* 55:118–120.
- RICE DW. 1973. Caribbean monk seal (*Monachus tropicalis*). Pp. 98–112, *in*: Proceedings of a Working Meeting of Seal Specialists on Threatened and Depleted Seals of the World, held under the auspices of the Survival Service Commission of IUCN. IUCN and University of Guelph, ON.
- RUIZ RG. 1983. *Mimon crenulatum keenani* (Chiroptera) from Belize. *The Southwestern Naturalist* 28:374.
- SALVIN O. 1864. A fortnight amongst the Sea-birds of British Honduras. *Ibis* 6:372–387.
- SANBORN CC. 1937. American bats of the subfamily Emballonurinae. *Fieldiana, Zoology* 20:231–354.
- SANBORN CC. 1941. Descriptions and records of Neotropical bats. *Papers on mammalogy published in honor of Wilfred Hudson Osgood. Field Museum of Natural History, Zoological Series*, 27:371–387.
- SANDERSON IT. 1941. *Living treasure*. The Viking Press, New York.
- SERACH J, J CASSIDY, FJ BONACCORSO, and E DINERSTEIN. 1981. Community structure of bats in a rainforest in Belize, Central America. *Bat Research News* 22:52.
- SILVER SC, LE OSTRO, CP YEAGER, and R HORWICH. 1998. Feeding ecology of the Black Howler Monkey (*Alouatta pigra*) in northern Belize. *American Journal of Primatology* 45:263–279.
- SILVER SC, LE OSTRO, L MARSH, L MAFFEI, AJ NOSS, M KELLY, RB WALLACE, H GÓMEZ, and G AYALA. 2004. The use of camera traps for estimating Jaguar *Panthera onca* abundance and density using capture recapture analysis. *Oryx* 38:148–154.
- SIMMONS NB. 2005. Order Chiroptera. Pp. 312–529, *in*: *Mammal Species of the World, a taxonomic and geographic reference* (DE Wilson, and MD Reeder, eds.). The Johns Hopkins University Press, Baltimore.
- SMITH RL. 1984. Neotropical bats as indicators of environmental disturbance. Master Thesis, University of Kent, Canterbury, Kent, UK.
- SPENCER LG, GE ALVARADO, R GARCÍA, E ESPINOZA, JC CISNEROS, and U MARTENS. 2007. Vertebrate paleontology. Pp. 443–451, *in*: *Central America: Geology, resources and hazards*. Taylor & Francis, London.
- STRUM SC. 2005. Measuring success in primate translocation: a baboon case study. *American Journal of Primatology* 65:117–140.
- TEMPLE R. 1860. Letter to P. L. Sclater, Secretary of the Zoological Society of London. *Proceedings of the Zoological Society of London* 1860:206–207.
- TIMM RM, RM SALAZAR, and AT PETERSON. 1997. Historical distribution of the extinct Tropical Seal, *Monachus tropicalis* (Carnivora: Phocidae). *Conservation Biology* 11:549–551.
- USDS. 2012. Belize country profile. US Department of State. Web site: <<http://www.state.gov/p/wha/ci/bh/index.htm>>.
- WADELL HA. 1938. Physical-geological features of Petén, Guatemala. *Carnegie Institute of Washington* 437:336–348.
- WATT EM. 1987. A scatological analysis of parasites and food habits of jaguar (*Panthera onca*) in the Cockscomb Basin of Belize. Master Thesis, University of Toronto, Toronto, ON.
- WATT EM. 1989. *Jaguar woman*. Key Porter Books, Toronto, ON.
- WEST RC. 1964. Surface configuration and associated geology of Middle America. Pp. 33–83, *in*: *Handbook of Middle American Indians* (RC West, ed.). University of Texas Press, Austin, TX.
- WRIGHT ACS, DH ROMNEY, RH ARBUCKLE, and VE VIAL. 1959. Land in British Honduras, report of the British Honduras land use survey Team Her Majesty's Stationary Office. *Colonial Research Publication* 24, London.
- WULTSCH C. 2008. Noninvasive tracking of jaguars (*Panthera onca*) and co-occurring feline species in Belize by combining molecular scatology, remote camera trapping and GIS: the impact of fragmentation. Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA.
- ZORPETTE G. 1999. Chasing the Ghost Bat. *Scientific American* 280:82–89.



Realmente, tanto los editores como los autores han llevado a cabo un esfuerzo profundo y concienzudo por documentar el estudio de los mamíferos en cada país de Latinoamérica, las Guayanas y el Caribe. Para quien quiera entender la historia de la mastozoología en la región, es obligada la lectura de este libro, de cada capítulo y de cada detalle. Sólo yuxtaponiendo los distintos capítulos en su continuo espacio-temporal podremos comprender cómo hemos llegado hasta aquí, las contribuciones relativas de individuos particulares y cómo cada país ha hecho su esfuerzo para estudiar

a sus propios mamíferos. Para terminar, no puedo menos que recordar un texto de Jorge Luis Borges: “Que otros se enorgullecen por lo que han escrito, yo me enorgullezco por lo que he leído”.

**Rodrigo A. Medellín**

Universidad Nacional Autónoma de México, México DF.

