An adult male *Norops loveridgei* (USNM 578755), a giant anole endemic to the Cordillera Nombre de Dios in the Northern Cordillera of the Chortís Block Biogeographic Province. This canopy-dwelling species is considered Endangered by the IUCN due to continued loss of its Premontane Wet Forest habitat. La Liberación, Refugio de Vida Silvestre Texíguat, Departamento de Atlántida, Honduras, elev. 1,090 m.

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Mesoamerican Herpetology
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# Characterizing the Chortís Block Biogeographic Province: geological, physiographic, and ecological associations and herpetofaunal diversity

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ABSTRACT: The geological history of Central America is remarkably complex, as the region has served as the biological dispersal route between North and South America, and also has been the site of extensive in situ evolution. Nuclear Central America is recognized as a region of high biodiversity, and the eastern portion of Nuclear Central America (the Chortís Block) largely has been overlooked as a biodiversity hotspot. In this paper, I present a characterization of geological, physiographic, and ecological associations to define the Chortís Block Biogeographic Province. The Chortís Block is partitioned into the Caribbean and Pacific Lowlands and the Northern, Central, and Southern cordilleras, which in turn are delimited into 24 distinct highland areas and 14 intermontane valleys. I provide contextualized definitions of ecological formations and identify six lowland-associated habitats, of which four habitats are shared between lowlands and highlands, and 10 habitats are associated with highlands areas. I present a summary of the diversity, distribution, and conservation status of the herpetofauna of the Chortís Block, using a combination of the published literature and results from 19 expeditions to over 60 localities from 2006 to 2014. The Chortís herpetofauna is characterized by a high degree of endemism (38% of all species are endemic) and equally high extinction risk (42% threatened, including 94% of endemic species). Endemism is highest among the salamanders (86%), followed by the lizards (43%), the anurans (38%), and the snakes (23%).

**Key Words:** Amphibian, biogeography, Central America, CSS, El Salvador, endemism, EVS, geomorphology, Guatemala, Honduras, IUCN, Nicaragua, reptile

RESUMEN: Centro América tiene una historia geológica extraordinariamente compleja, ha servido como ruta de dispersión biológica entre América del Norte y América del Sur, y es el sitio de extensa evolución in situ. Centroamérica Nuclear es reconocida como una región de elevada biodiversidad, y la porción oriental de América Central Nuclear (el Bloque Chortís) ha sido en gran parte pasado por alto como un hotspot de biodiversidad. En este artículo, presento una caracterización de asociaciones geológicas, fisiográficas y ecológicas para definir la Provincia Biogeográfica del Bloque Chortís. El Bloque Chortís se dividen en Tierras bajas del Caribe y del Pacífico y las Coordilleras del Norte, Centro y Sur, las que a su vez están delimitadas en 24 zonas distintas de tierras altas y 14 valles intermontanos. Proporciono definiciones contextualizadas de formaciones ecológicas, identificando seis hábitats asociados a tierras bajas, de los cuales cuatro hábitats están compartidos entre tierras bajas y las tierras altas, y 10 hábitats asociados a zonas altas. Proporciono un resumen de la diversidad de herpetofauna, distribución y estado de conservación del Bloque Chortís, utilizando una combinación de la literatura publicada y los resultados de 19 expediciones a más de 60 localidades entre el 2006 y 2014. La herpetofauna Chortís se caracteriza por un alto grado de endemismo (38% de todas las especies son endémicas) y riesgo de extinción igualmente elevado (42% amenazado, incluyendo 94% de las especies endémicas). El endemismo es más alto entre las salamandras (86%), seguidas por las lagartijas (43%), los anuros (38%), y las serpientes (23%).

**Palabras Claves:** Anfibio, biogeografía, Centroamérica, CSS, El Salvador, endemismo, EVS, geomorfología, Guatemala, Honduras, Nicaragua, reptil, UICN

**Citation:** Townsend, J. 2014. Characterizing the Chortís Block Biogeographic Province: geological, physiographic, and ecological associations and herpetofaunal diversity. Mesoamerican Herpetology 1: 204–252.

**Received:** 17 November 2014; **Accepted:** 30 November 2014; **Published:** 26 December 2014.

## INTRODUCTION

The formation of the Central American land bridge and subsequent interchange of previously isolated organisms of Laurasian and Gondwanian origin has been the object of biogeographic inquiry since the founding of the discipline (Wallace, 1876; Stehli and Webb, 1985). The geological history of Central America has been remarkably complex, owing in large part to its position as the contact zone for four of the world's 14 major tectonic plates: the Caribbean, Cocos, North American, and South American plates (Fig. 1; Bird, 2003). Central America not only has served as the dispersal route between North and South America, but the region's extreme topographical and ecological heterogeneity also has fuelled significant in situ diversification, particularly associated with the disjunct highland areas of Nuclear Central America and southern Central America (Savage, 1966, 1983; Wake and Lynch, 1976; Wake 1987).

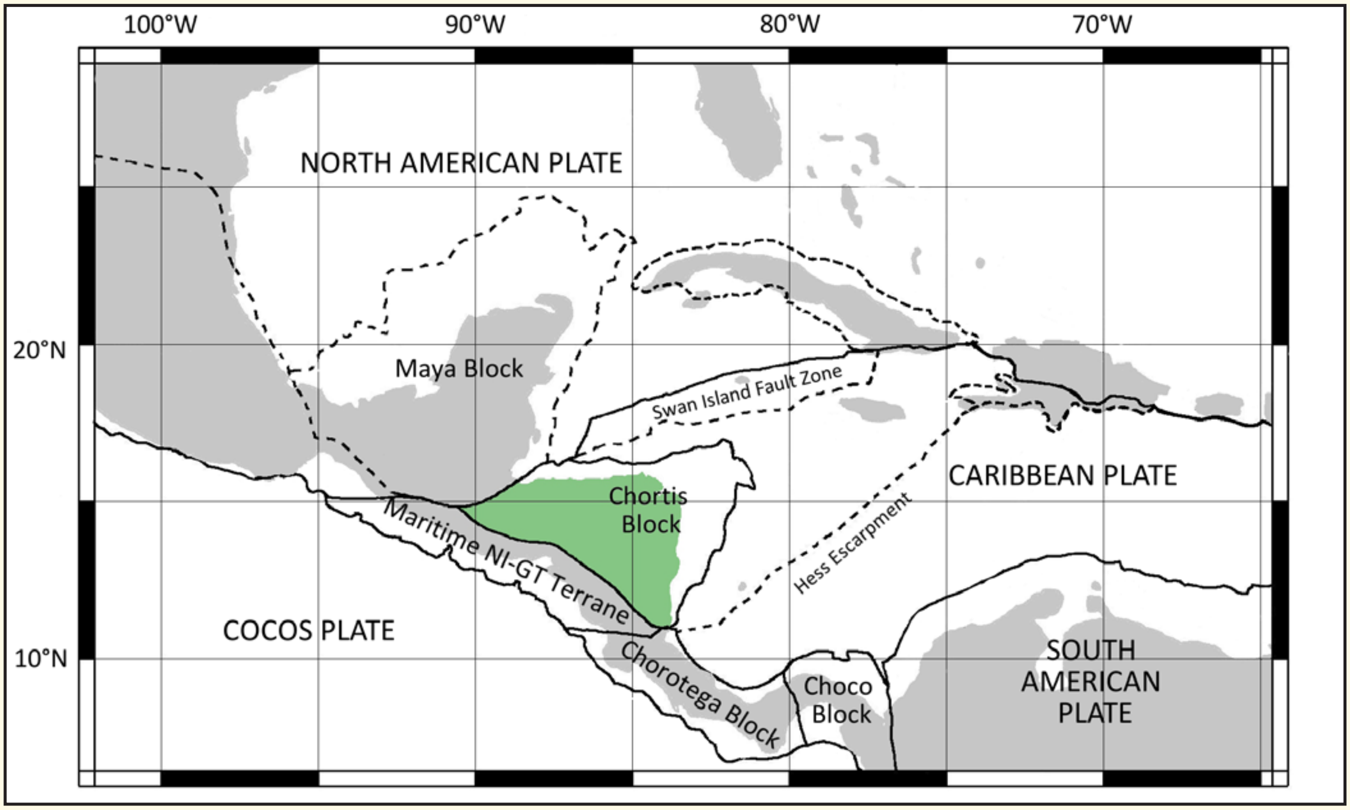

**Fig. 1.** Relative contemporary locations of four major tectonic plates and selected elements of the Central American Isthmus are indicated, with the present-day position of the Chortís Block highlighted in green (map generated using ODSN Plate Tectonic Reconstruction Service and modified by author).

Whereas Nuclear Central America long has been accepted as a region of high biodiversity, some observers have recognized the western and eastern portions of this highland block as distinct biogeographic entities (Johnson, 1989; Campbell, 1999; Townsend 2006, 2009). Eastern Nuclear Central America, corresponding to the Chortís Block tectonic formation (Fig. 1), has been shown to have a distinctive component of endemic biodiversity, particularly in amphibians and reptiles (Wilson and Johnson, 2010).

In previous works, I favored the use of "Eastern Nuclear Central America" biogeographic province (Townsend 2006, 2009; Townsend and Wilson, 2010a) in order to set this region apart from proximate regions, in recognition of its distinctiveness. Geographically, this region is analogous to the Chortís Block, an allochthonous geological formation that today forms the only modern continental portion of the Caribbean Tectonic Plate and the largest terrestrial segment of the contemporary Central American land bridge (Rogers, 2003; Marshall, 2007). The history of the Chortís Block is challengingly complex and recently has been the subject of increased focus, and sometimes-contentious debate, within the geological research community (James, 2007; Mann et al., 2007; Ortega-Gutiérrez et al., 2007; Silva-Romo, 2008; Morán-Zenteno et al., 2009).

Politically, the contemporary region I refer to as the Chortís Block includes all of the country of Honduras, the northern portion of El Salvador, eastern Guatemala, and northern Nicaragua (Fig. 2). Without including the associated lowlands, Campbell's (1999: 116) concept of Eastern Nuclear Central America is synonymous with the highlands of the Chortís Block, referred to collectively as the *serranía* (Carr, 1950) or the Chortís Highlands (Marshall, 2007). I include the associated coastal plains, with the western extent of the Chortís Block at the edge of the Río Motagua Valley (the eastern edge of the Polochic-Motagua fault complex) to a north-south line roughly extending through Zacapa, Chiquimula, Concepcíon Las Minas, and the Guatemalan-El Salvador border at the Pacific coast. The region extends eastward to include all of Honduras and El Salvador, and south to a line roughly between Lago Xolotlán (= Lago de Managua) and Lago Colcibolca (= Lago de Nicaragua) in northern Nicaragua (Fig. 3).

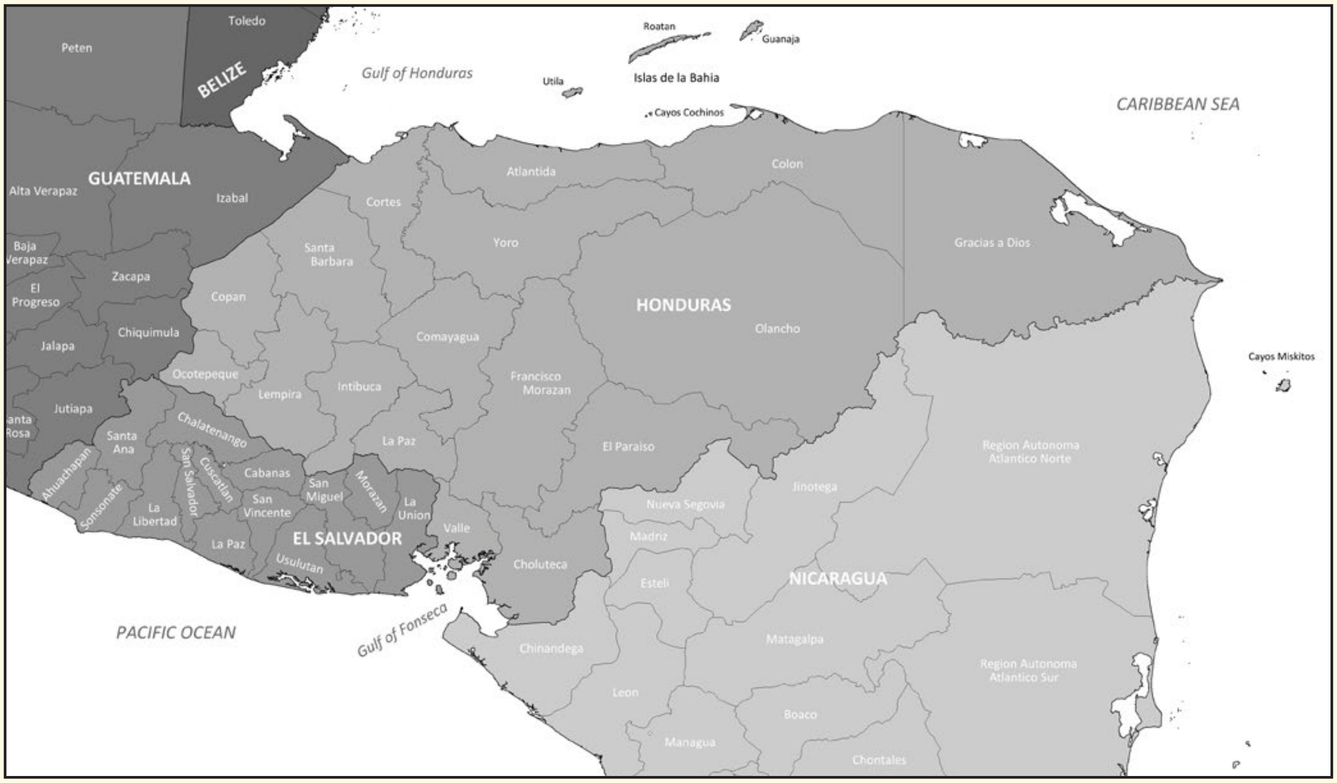

**Fig. 2.** Political divisions of the Chortís Block; countries are shaded differently and labeled in all capital letters, while departments are labeled in sentence-case in a smaller font.

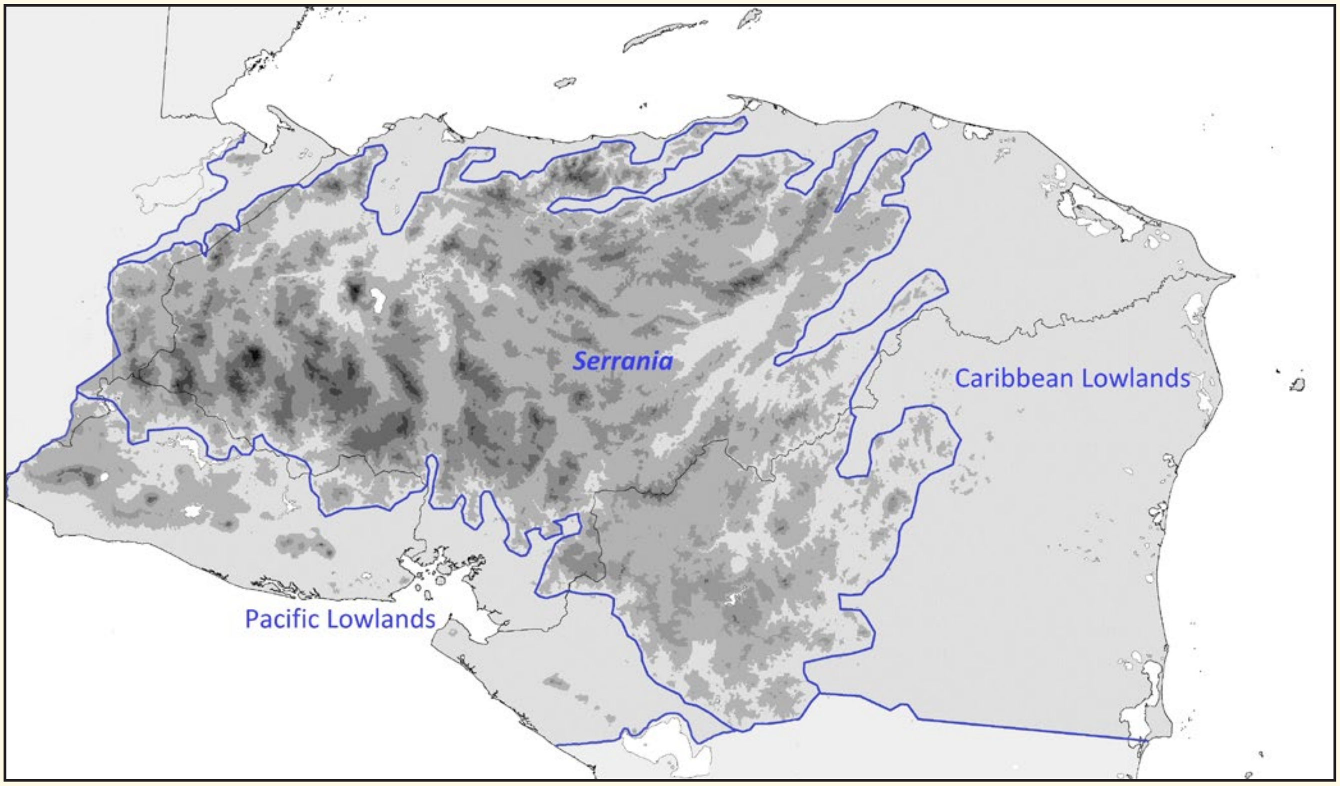

**Fig. 3.** Major physiographic regions and limits of the Chortís Block (after Carr, 1950).

The purpose of this contribution is to present an integrative definition of the Chortís Block Biogeographic Province, combining an ecological and biodiversity-based framework used to delineate Eastern Nuclear Central America with that of a physiographically and tectonically-defined Chortís Block. Within this context, I include an overview of the amphibian and reptile diversity, distribution, and conservation status within the Chortís Block Biogeographic Province, while also providing a comparative baseline for future research in this region.

## MATERIALS AND METHODS

### Field Sampling

From June 2006 to June 2014, I made 19 fieldtrips totaling over 2,760 person-hours of effort (over 13,120 person-hours were logged by expedition participants) over the course of 302 field-days in Honduras and Nicaragua, sampling over 60 localities in the Chortís Block (Table 1). Voucher specimens were preserved in 10% formalin solution and later transferred to 70% ethanol for permanent storage. Tissue samples were taken from freshly euthanized vouchers and stored in SED buffer (250 mM EDTA/20% DMSO/saturated NaCl; Seutin et al., 1991; Williams, 1997). Vouchers were deposited in the Carnegie Museum of Natural History (CM), Florida Museum of Natural History, University of Florida (UF), the Museum of Vertebrate Zoology, University of California, Berkeley (MVZ), and the National Museum of Natural History, Smithsonian Institution (USNM).

### Taxonomic Scope and Standards

I recognize a Chortís Block herpetofauna inclusive of species that occur south or east of the Río Motagua and north of a latitudinal line across the northernmost edge of Lago Xolotlán (= Lago de Managua). I included taxa from the Islas de la Bahía and Cayos Miskitos, as they are continental islands of Chortís Block origin, but not the offshore islands of Belize, the smaller cays far offshore from eastern Honduras and Nicaragua, or the Islas del Cisne, as they are neither geological nor biogeographically related directly to the Chortís Block. I excluded marine taxa (sea turtle

**Table 1.** Summary of fieldwork undertaken in the Chortís Block, 2006–2014.

| Dates | Localities | Participants |
|---|---|---|
| 3–18 Jun 2006 | PN Montaña de Yoro: Cataguana | JHT, Larry David Wilson |
| 2–10 Dec 2006 | PN Cerro Azul Meámbar: Los Pinos | Brian Campesano, Lorraine Ketzler, Scott Travers, JHT, Steve Townsend |
|  | PN La Tigra | "   " |
| 8–20 Mar 2007 | PN Montaña de Yoro: Cataguana | Jason Butler, Lorraine Ketzler, Scott Travers, JHT, Larry David Wilson, et al. |
|  | RB Cerro Uyuca | Jason Butler, Lorraine Ketzler, Scott Travers, JHT |
| 7–29 Jun 2007 | Biosfera Bosawas (7 localities) | Lenin Obando, Javier Sunyer, Scott Travers, JHT, Larry David Wilson, et al. |
| 13–21 Jul 2007 | PN Cerro Azul Meámbar: Los Pinos | Lorraine Ketzler, JHT, Larry David Wilson |
|  | RB Cerro Uyuca | "   " |
|  | RB Yerbabuena | "   " |
|  | Cerro Zarciadero | "   " |
| 11–23 Aug 2007 | León | Scott Travers, JHT, Katielynn Townsend |
|  | Selva Negra | Scott Travers, JHT, Katielynn Townsend |
| 20 Jan–5 Feb 2008 | PN Montaña de Comayagua: La Okí | Lorraine Ketzler, Ileana Luque-Montes, JHT, Larry David Wilson |
|  | PN Montaña de Santa Bárbara: El Cedral | "   " |
|  | Marcala | "   " |
|  | San Pedro La Loma | "   " |
|  | Los Naranjos | Ileana Luque-Montes, JHT, Larry David Wilson |
|  | Montaña Macuzal | Ileana Luque-Montes, JHT, Larry David Wilson |
|  | Yeguare Valley | Ileana Luque-Montes, JHT, Larry David Wilson |
| 4–20 Apr 2008 | PN Cerro Azul Meámbar: Los Pinos | Carlos Andino, César Cerrato, Gabriela Diaz, Lorraine Ketzler, Ileana Luque-Montes, Melissa Medina-Flores, Aaron Mendoza, Wendy Naira, JHT, Larry David Wilson |
|  | PN Cerro Azul Meámbar: Aldea Cerro Azul | César Cerrato, Ileana Luque-Montes, Melissa Medina-Flores, JHT, Larry David Wilson |
|  | PN Montaña de Comayagua: Río Negro | Ileana Luque-Montes, Melissa Medina-Flores, JHT, Larry David Wilson |
|  | RVS Texíguat: La Fortuna | Jason Butler, Lorraine Ketzler, Nathaniel Stewart, JHT, Larry David Wilson |
|  | Montaña Macuzal | "   " |
| 14–28 May 2008 | PN Montaña de Comayagua: Río Negro | James Austin, Lorraine Ketzler, JHT, Larry David Wilson |
|  | RB Guajiquiro | César Cerrato, Lorraine Ketzler, Ileana Luque-Montes, JHT, Larry David Wilson |
|  | Los Naranjos | James Austin, Lorraine Ketzler, JHT, Larry David Wilson |
| 12 Jun–29 Jul 2008 | PN Celaque | Lorraine Ketzler, Ileana Luque-Montes, JHT, Larry David Wilson |
|  | PN Cerro Azul Copán: Quebrada Grande | Ileana Luque-Montes, JHT, Larry David Wilson |
|  | PN Pico Pijol: Quebrada Las Payas | "   " |
|  | PN Montaña de Comayagua: Río Negro | "   " |
|  | PN Cerro Azul Meámbar: Aldea Cerro Azul/ Varsovia | Ileana Luque-Montes, JHT |

| | | |
|---|---|---|
| | RB Güisayote | Lorraine Ketzler, Ileana Luque-Montes, Melissa Medina-Flores, JHT, Larry David Wilson |
| | Copán Ruinas | Lorraine Ketzler, Ileana Luque-Montes, Melissa Medina-Flores, JHT, Larry David Wilson |
| | La Esperanza area (3 localities) | Lorraine Ketzler, Ileana Luque-Montes, JHT, Larry David Wilson |
| 14 Aug–1 Oct 2008 | PN Cerro Azul Meámbar: Aldea Cerro Azul/ Varsovia | Ileana Luque-Montes, JHT |
| | PN Cusuco | César Cerrato, Ileana Luque-Montes, Melissa Medina-Flores, JHT, Larry David Wilson |
| | PN Montaña de Yoro: above Guaymas | Ileana Luque-Montes, JHT, Larry David Wilson |
| | PN Pico Pijol: Pino Alto | César Cerrato, Ileana Luque-Montes, JHT, Larry David Wilson |
| | RB El Pital | César Cerrato, Melissa Medina-Flores, Larry David Wilson |
| | RB Güisayote | " " |
| | RB Mixicuri | " " |
| | Erandique | " " |
| | La Esperanza area | " " |
| 10–20 Apr 2009 | PN Montaña de Comayagua: Río Negro | Sergio Gonzalez, Christina Martin, Mario Solis, JHT, Rony Valle, Christopher Wolf |
| 25 Nov–6 Dec 2009 | PN Cerro Azul Meámbar: Los Pinos | César Cerrato, Vladlen Henriquez, JHT |
| | PN Cusuco | " " |
| | PN Pico Bonito | " " |
| 1–26 Jun 2010 | RVS Texíguat: La Liberación | Benjamin Atkinson, César Cerrato, Luis Herrera, Mayron McKewy-Mejía, JHT, Larry David Wilson, et al. |
| | JB Lancetilla | Benjamin Atkinson, César Cerrato, Luis Herrera, Mayron McKewy-Mejía, Ciro Navarro, JHT |
| 20 Jul–21 Aug 2010 | PN Cerro Azul Meámbar: Los Pinos | Anne Donnelly, Matthew Donnelly, Ileana Luque-Montes, JHT |
| | RVS Texíguat: La Liberación | Levi Gray, Luis Herrera, Melissa Medina-Flores, Alexander Stubbs, JHT, etc. |
| | JB Lancetilla | " " |
| | Roatán | Anne Donnelly, Matthew Donnelly, Yensi Flores, Ileana Luque-Montes, Melissa Medina-Flores, Sandy Pereira, JHT |
| | Utila | Anne Donnelly, Matthew Donnelly, Ileana Luque-Montes, Melissa Medina-Flores, Sandy Pereira, JHT |
| 5–16 Nov 2010 | PN Cerro Azul Meámbar: Los Pinos | James Austin, Luis Herrera, Melissa Medina-Flores, JHT |
| | PN Montaña de Santa Bárbara | James Austin, Luis Herrera, JHT, Alicia Ward, et al. |
| | San José de Texíguat | James Austin, Luis Herrera, JHT |
| 7–22 Apr 2011 | PN Montaña de Botaderos | Christopher Begley, Mark Bonta, Robert Hyman, David Medina, Melissa Medina-Flores, Onán Reyes, Fito Steiner, JHT |
| | PN Pico Bonito | Robert Hyman, David Medina, Melissa Medina-Flores, Fito Steiner, JHT |
| | RB Colibrí Esmeralda | Robert Hyman, Fito Steiner, JHT |
| | Montaña de Jacaleapa | Mark Bonta, Onán Reyes, JHT |
| | Río Grande, Valle de Agalta | Christopher Begley, Mark Bonta, Robert Hyman, David Medina, Melissa Medina-Flores, Onán Reyes, Fito Steiner, JHT |
| 6–22 Jan 2013 | Cerro Corre Viento | Jason Butler, Luis Herrera–B., Sandy Pereira, JHT |
| 11–25 Jun 2014 | Isla del Tigre | Thomas J. Firneno, Michael Itgen, Fatima Pereira, JHT |

families Cheloniidae and Dermochelyidae and the sea snake *Hydrophis platurus*) and introduced species, as well as taxa known only from the Salvadoran Cordillera or the southwestern Salvadoran coastal plain, as I do not consider them as part of the Chortís Block. The nomenclature used follows that of Solís et al. (2014), with the following exceptions/additions: recognizing *Trachemys emolli*, *T. grayi*, and *T. venusta* as valid taxa occurring within the study region, following Parham et al. (2013); recognizing *Oedipina chortiorum* and *O. motaguae*, following Brodie et al. (2012); and recognizing *Heloderma charlesbogerti* as a full species, following Reiserer et al. (2013).

### Conservation Status of the Chortís Herpetofauna

I used three different measures to assess the conservation status of the herpetofauna of the Chortís Block: IUCN Red List categorization, Environmental Vulnerability Scores (Wilson and McCranie, 2003), and Conservation Status Scores (Wilson and Townsend, 2010).

I obtained the IUCN Red List categorizations from one of three sources: the IUCN Red List of Threatened Species (2014) for amphibians, marine turtles, crocodilians, and some squamates; Townsend and Wilson (2010a) for Honduran reptiles, and Sunyer and Köhler (2010) for Nicaraguan reptiles. I assessed species not previously evaluated by the IUCN or other authors by using the standard criteria of the IUCN (2001).

The Environmental Vulnerability Scores (EVS) are primarily from Townsend and Wilson (2010a). I evaluated species not assessed in that study by using the methodology developed and refined by Wilson and McCranie (2003, 2004a), which is calculated by taking the total of three rankings: (1) the extent of geographic range, (2a) the degree of specialization of reproductive mode for amphibians or (2b) the degree of persecution by humans for reptiles, and (3) the extent of ecological distribution in Honduras; EVS scores from 10 to 13 indicate medium vulnerability, and scores from 14 to 19 high vulnerability (Wilson and McCranie, 2003).

Wilson and Townsend (2010) developed Conservation Status Scores (CSS) to provide a simple measure for assessing the conservation status of amphibians and reptiles across Mesoamerica. The CSS represents a sum of the individual scores for (1) numbers of countries, (2) physiographic regions, and (3) vegetation zones occupied by a given species of amphibian or reptile. The country score ranges from 1 to 8 (the number of countries of Central American plus Mexico), the physiographic region score ranges from 1 to 21, and the vegetation zone score from 1 to 15 (Wilson and Townsend, 2010). Given this, the CSS can range from 3 (the most restricted endemic species, inhabiting a single vegetative zone in a single physiographic region in a single country) to the theoretical maximum of 44 (for a species found literally everywhere in Mexico and Central America).

## GEOMORPHOLOGY OF THE CHORTÍS BLOCK

The history of the Chortís Block is characterized in large part by its eastward movement along a series of strike-slip faults on the southern margin of the North American Plate (Fig. 4; Dengo 1969; Donnelly et al., 1990; Gordon, 1992; Rogers et al., 2007). As recently as the K-T Boundary (65 million years before present [mybp]; Fig. 4), the Chortís Block was located somewhere south of modern south-central Mexico, as it moved along a west-to-east trajectory around 200 km into its current position as the principal surface area of the Central American land bridge and the modern territory of Honduras, El Salvador, eastern Guatemala and northern Nicaragua (Fig. 1; Rogers, 2003; Ortega-Gutiérrez et al., 2007).

***Origin and Cenozoic development of the Chortís Block.***—The Chortís Block represents the only exposed Precambrian and early Paleozoic continental crust on the contemporary Caribbean Plate (DeMets et al., 2007). The oldest exposed geological formation of the Chortís Block is Precambrian in age and of Rodinian derivation, originating during the Grenville orogeny (1,017 ± 20 mybp or 1,400 mybp, depending on dating methods) contemporaneously with the Appalachian and Adirondack mountains of eastern North America and the Llano Plateau of Texas and northeastern Mexico (Manton, 1996; Gordon et al., 2010). Today, this ancient formation is visible as a 60 km-long series of exposed outcrops along the Jocotán-Ceiba Fault in the department of Yoro, Honduras (Gordon et al., 2010). While most geologists generally accept that the Chortís Block originated approximately 1,100 km west of its current position and became detached during the Eocene, sliding and rotating along the Motagua-Polochic Fault Complex at the southern margin of the stationary North American Plate, there are two competing hypotheses regarding the Chortís Block's origin (reviewed by Rogers et al., 2007). The first hypothesis places the Chortís Block along the southwestern margin of the North American Plate and physically contiguous with Mexico, and is

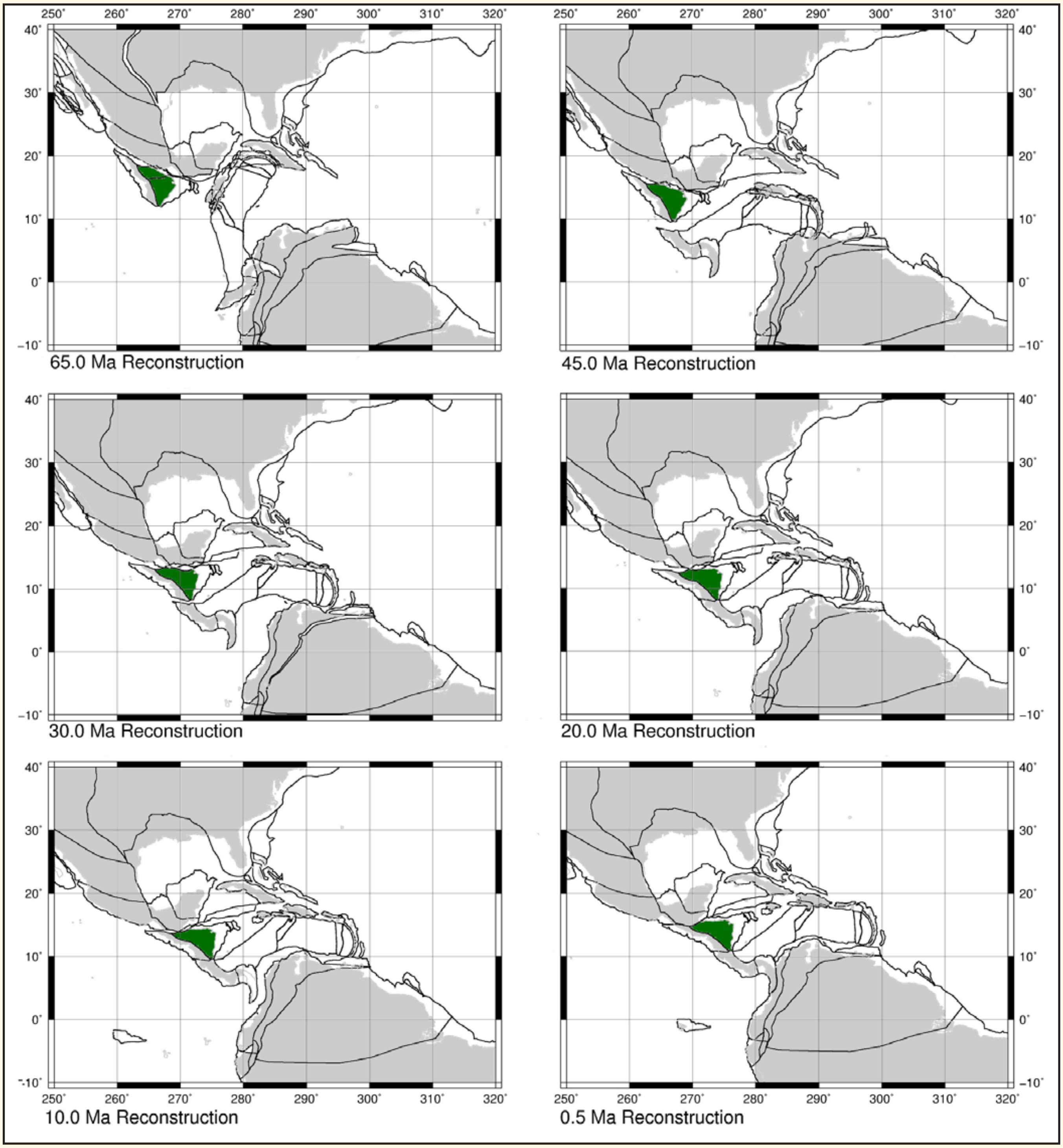

**Fig. 4.** Tectonic plate reconstructions showing the relative position and movement of the Chortís Block (shaded green) during the Cenozoic. Maps follow the generally accepted tectonic model of Hay et al. (1999); alternative models reviewed in Rogers et al. (2007), with black lines representing tectonic boundaries and gray shading delineating modern-day shorelines and landmasses (maps generated using ODSN Plate Tectonic Reconstruction Service and modified by author).

supported by the existence of similarly aged Precambrian and Paleozoic rock formations, potential aligned fault systems in present day Honduras and southwestern Mexico, and geological evidence that the Chortís Block rotated 30–40° counterclockwise while sliding eastward (Fig. 4; Gose, 1985, Silva-Romo, 2008). The second hypothesis places the Chortís Block's original position some 700–800 km south of Mexico, with it moving northeastwardly while rotating 40° clockwise (Keppie and Moran-Zenteno, 2005). A third but less accepted hypothesis holds that the Chortís Block has remained virtually in the same position relative to the North American Plate, and that structures and evidence to the contrary essentially have been misinterpreted (James, 2007).

The relatively dramatic Cenozoic tectonic history of the Chortís Block was dominated by what can only be described as catastrophic, prolonged, and repeated volcanism as the block slid and rotated its way eastward. The beginning of this extended period was the mid-Eocene (ca. 55 mybp), following initial detachment of the Chortís Block from its parent structure (Jordan et al., 2008). A second flare-up took place during the mid-Oligocene (ca. 40 mybp), and the third, and largest, flare-up took place during the early to middle Miocene (Jordan et al., 2008).

***Miocene Ignimbrite Flare-up and subsequent uplift.***—The Mesozoic history of the Chortís Block features an approximately 10 million year period of intense explosive volcanism along the margins of the Chortís Block and Central American Volcanic Front, considered the second largest ignimbrite event in the known geological history of Earth (Jordan et al., 2008). During the mid-Miocene over 5,000 $km^3$ of ignimbrites up to 2,000 m thick were deposited on top of the low-relief surface of the southern and western Chortís Block, and tens of thousands of square kilometers were covered repeatedly in thick layers of ash (Williams and McBirney, 1969; Rogers et al., 2002; Jordan et al., 2008). The most intense period of the ignimbrite flare-up lasted from around 20 mybp to 15 mybp, with activity ceasing approximately 10.5 mybp (Gordon and Muehlberger, 1994). This period is well documented by a series of deep-sea sediment cores from sites in the western Caribbean Sea (Jordan et al., 2008). The site of a fissure-like volcano that was "ground zero" for the Miocene Ignimbrite Flare-up is represented today by the Padre Miguel Group geological formation in southwestern Honduras and peripherally in El Salvador and Guatemala (Rogers, 2003). Under these circumstances, it would seem unlikely that extant terrestrial organisms and ecosystems on the Chortís Block are survivors of this extreme volcanism, suggesting a model of post-volcanic colonization and diversification of the terrestrial biota. Following the Miocene flare-up and up and until approximately 3.8 mybp, the Chortís Block went through a period of rapid uplift driven by the detachment and subsequent subduction of a portion of the Cocos Plate, which induced upwelling in the mantle that raised the Chortís Block up to 1,100 m in elevation (Rogers et al., 2002).

***The contemporary Chortís Block.***—The Chortís Block presently continues its eastward movement along the strike-slip faults of the Motagua-Polochic Fault Zone and Swan Island Fault Zone, interacting in the continental context with the Maya Block of the North American Plate to the north and the Chorotega Block to the south, albeit interrupted by the Nicaraguan Depression (Fig. 1; Rogers, 2003, Marshall, 2007). Marshall (2007) defined 15 physiographic provinces in Central America, of which four (the Chortís Highlands, Chortís Volcanic Front, Chortís Fore Arc, and Mosquitia Coast Lowlands) are geomorphological associates of the Chortís Block.

The *Chortís Highlands Province* consists of a large dissected plateau that forms the greater part of the Chortís Block and includes the majority of the territory of the countries of Honduras and El Salvador, as well as western Guatemala and northern Nicaragua (Marshall, 2007). The Chortís Highlands Province is subdivided into four regions: the Western Rifted Highlands, the Central Chortís Plateau, the Eastern Dissected Highlands, and the Honduran Borderlands. The *Chortís Volcanic Front Province* is an active volcanic front that borders the southern margins of the Chortís Highlands Province, and includes two regions: the Guatemalan Cordillera, which borders the western margin of the Chortís Highlands Province; and the Salvadoran Cordillera, which borders the Median Trough, an elongate graben that extends along the boundary faults at the margin of the active Nicaraguan Volcanic Front (Marshall, 2007). The Chortís Volcanic Front Province represents part of the proverbial "Ring of Fire," a loose chain of active volcanoes and tectonic plate subduction zones that rings the Pacific Ocean. The *Chortís Fore Arc Province* encompasses the Pacific coastal plain of the Chortís Volcanic Front Province, and similarly is subdivided into the Guatemalan Coastal Plain and Salvadoran Coastal Plain (Marshall, 2007). The *Mosquito Coast Lowlands Province* is the wide alluvial plain along the eastern Caribbean slope of Honduras and Nicaragua, a region also referred to as *La Mosquitia*. The *Mosquito Coast Lowlands Province* is dominated by a massive paleo-Coco/Patuca river delta built up during the glacial cycles of the Pliocene-Pleistocene (Marshall, 2007).

The aforementioned Chortís Highlands Province and its four constituent subregions are of principal interest for this paper, and I describe these subregions in detail below.

The *Western Rifted Highlands* region of southeastern Guatemala, southwestern Honduras, and northern El Salvador is a west-to-east oriented plateau, generally exceeding 1,000 m in elevation, which is interrupted by a series of independent, north-to-south oriented rift valleys featuring flat, xeric valley floors (Marshall, 2007). The rift valleys, or grabens, of the Western Rifted Highlands include the contemporary Comayagua Valley and Otoro Valley. This region corresponds to the Padre Miguel Group, a 1,000–2,000 m thick layer of mid-Miocene ignimbrites laid down during the super-volcanic eruptions along the margin of the Chortís Highlands and Chortís Volcanic Front. Those super-eruptions essentially reset the landscape, allowing the development of new meandering river drainages as the rift valleys began spreading following the end of the Miocene ignimbrite flare-up around 10.5 mybp (Gordon and Muehlberger, 1994; Rogers et al., 2002).

The *Central Chortís Plateau* region of the Honduran interior represents the most tectonically stable portion of the Chortís Highlands, forming an essentially level plateau with little dissection or embedding by rivers (Marshall, 2007). The Central Chortís Plateau lies atop of Paleozoic bedrock overlain with layered Cretaceous-aged sedimentary deposits (Rogers et al., 2002; Marshall, 2007).

The *Eastern Dissected Highlands* region of eastern Honduras and Nicaragua includes the lower elevation, higher relief mountains bordering the Mosquito Coast Lowlands, and features three large, deeply embedded river drainages that drain a large portion of the Chortís Highlands Province (Marshall, 2007).

The *Honduran Borderlands* region lies along the northern margin of the Chortís Highlands, and is characterized by five major west-to-east trending faults that border major mountain ranges, including the Cordillera Nombre de Dios in northern Honduras (Rogers, 2003; Marshall, 2007). One large graben valley, the Sula Graben, extends north-to-south from the Caribbean coast to the north end of Lago de Yojoa, and today contains the lower courses of two of the largest watersheds in the Chortís Block: the Río Chamelecón and the Río Ulua.

## CONTEMPORARY ECOPHYSIOGRAPHY

Carr (1950), in his pioneering classification of Honduran ecological associations, recognized three principal ecophysiographic components that make up the Chortís Block: the Caribbean versant lowlands, the Pacific versant lowlands, and the mountainous interior region known as the *serranía* (Fig. 3). Carr's ecophysiographic regions correspond well with the geologically-based physiographic provinces of Marshall (2007; described in the previous section), with the *serranía* being congruent with the Marshall's Chortís Highlands Physiographic Province. Subsequently, from this point forward I use the name "Chortís Highlands" analogously with the *serranía*. Carr (1950) further subdivided the Chortís Highlands into the Northern Cordillera, the Southern Cordillera, and the Pacific Colinas. Wilson and Meyer (1985), McCranie and Wilson (2002), and others also have used this arrangement. Mejía-Ordóñez and House (2002) introduced a modified arrangement, based on their comprehensive evaluation of the ecosystems of Honduras using the UNESCO system of Physiognomic-Ecological Classification of Plant Formations of the Earth (Mueller-Dombois and Ellenberg, 1974), which recognized a *Cordillera del Norte*, *Cordillera Central*, and *Cordillera del Sur*. This arrangement is preferable and used here as the basis for describing the ecophysiography of the Chortís Block, which I divide into three principal regions: the Caribbean Lowlands, the Pacific Lowlands, and the Chortís Highlands, which itself subsequently is subdivided into the Northern, Central, and Southern Cordilleras.

***Northern Cordillera of the Serranía.***—As first defined by Mejía-Ordóñez and House (2002) and expanded here, the Northern Cordillera consists of the following mountain ranges and groups of ranges:

The *Cordillera (or Sierra) Nombre de Dios* (Figs. 5-1, 6A) stretches west-to-east across the departments of Atlántida, Colón, and Yoro, Honduras, and includes the cloud forest protected areas of Refugio de Vida Silvestre (RVS) Texíguat (maximum elevation 2,208 m) at the western end and Parque Nacional (PN) Pico Bonito (2,435 m) and PN Nombre de Dios (1,725 m) in the central portion, with a few scattered low peaks extending to the east, terminating with PN Capiro y Calentura (1,235 m) near Trujillo. Based on my preliminary observations, I consider the Sierra de Mico Quemado, a north-to-south oriented range in western Yoro, to be the western terminus of the Cordillera Nombre de Dios. Mejía-Ordóñez and House (2002) considered this range, which includes Zona de Reserva Ecológica (ZRE) Montaña de Mico Quemado y Las Guanchias, as part of the Central Cordillera.

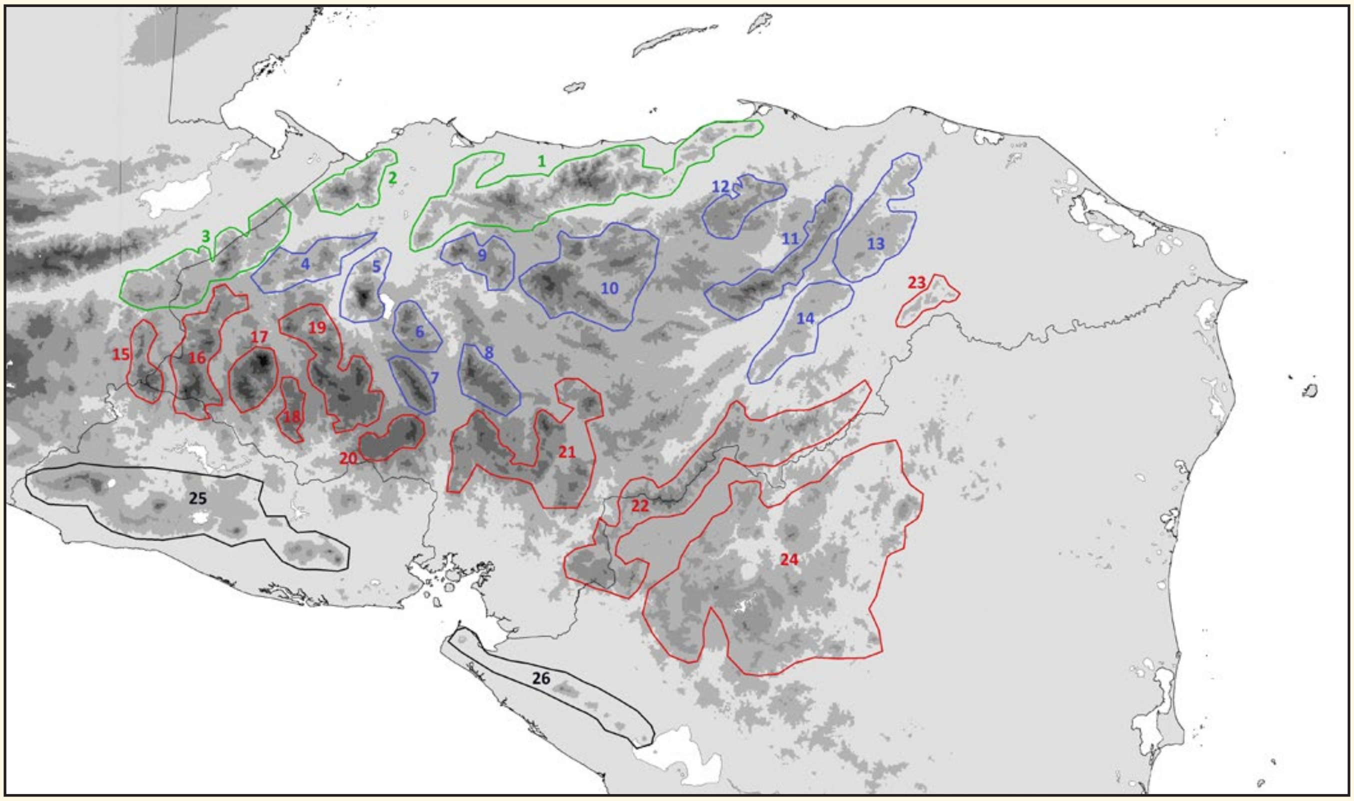

**Fig. 5.** Map showing mountain ranges of the Chortís Block (green outlines correspond to the Northern Cordillera, blue to the Central Cordillera, red to the Southern Cordillera, and black to ranges extralimital to this study): 1 = Sierra Nombre de Dios, 2 = Sierra de Omoa, 3 = Sierra de Espíritu Santo, 4 = Sierra de Joconal, 5 = Montaña de Santa Bárbara, 6 = Montañas de Meámbar, 7 = Sierra de Montecillos, 8 = Sierra de Comayagua, 9 = Sierra de Sulaco, 10 = Cordillera de La Flor-La Muralla, 11 = Sierra de Agalta, 12 = Sierra de Botaderos, 13 = Sierra Punta Piedra, 14 = Montañas de Patuca, 15 = Sierra de Montecristo, 16 = Sierra del Merendón, 17 = Sierra de Celaque, 18 = Sierra de Erandique, 19 = Sierra de Puca-Opalaca, 20 = Montaña de la Sierra, 21 = Sierra de Lepaterique, 22 = Sierra de Dipilto, 23 = Montaña de Colón, 24 = Cordillera Dariense, 25 = Salvadoran Cordillera, 26 = Cordillera de Las Marabios.

The *Sierra de Omoa* (Figs. 5-2, 6B) lies in the departments of Cortés and Santa Bárbara, Honduras, and contains the cloud forest protected area PN Cusuco (2,242 m), as well as the Área de Producción de Agua Merendón (1,749 m).

The *Sierra de Espíritu Santo* (Figs. 5-3, 6C) lies in the departments of Copán and Santa Bárbara, in Honduras and Izabal and Zacapa in Guatemala, and includes the cloud forest reserve PN Cerro Azul Copán (2,285 m), as well as unprotected highland forests at Río Amarillo (1,479 m) in Copán, Honduras, and Cerro del Mono (1,653 m) in Zacapa, Guatemala.

***Central Cordillera of the Serranía.***—I follow Mejía-Ordóñez and House (2002) in recognizing a Central Cordillera made up of the remaining Caribbean versant *serranía*, otherwise included in Carr's (1950) Northern Cordillera.

The *Sierra de Joconal* (1,688 m; Fig. 5-4) extends roughly west-to-east from the eastern part of the department of Copán (municipalities of Nueva Arcadia and San Nicolás), across the department of Santa Bárbara, and into the western portion of the department of Cortés (municipality of Villanueva).

*Montaña de Santa Bárbara* (2,744 m; Figs. 5-5, 6D) is an isolated karstic massif rising from the southern terminus of the Ulúa-Chamelecón Plain to the west of Lago de Yojoa; its unique ecological communities are wholly contained within the boundaries of PN Montaña de Santa Bárbara.

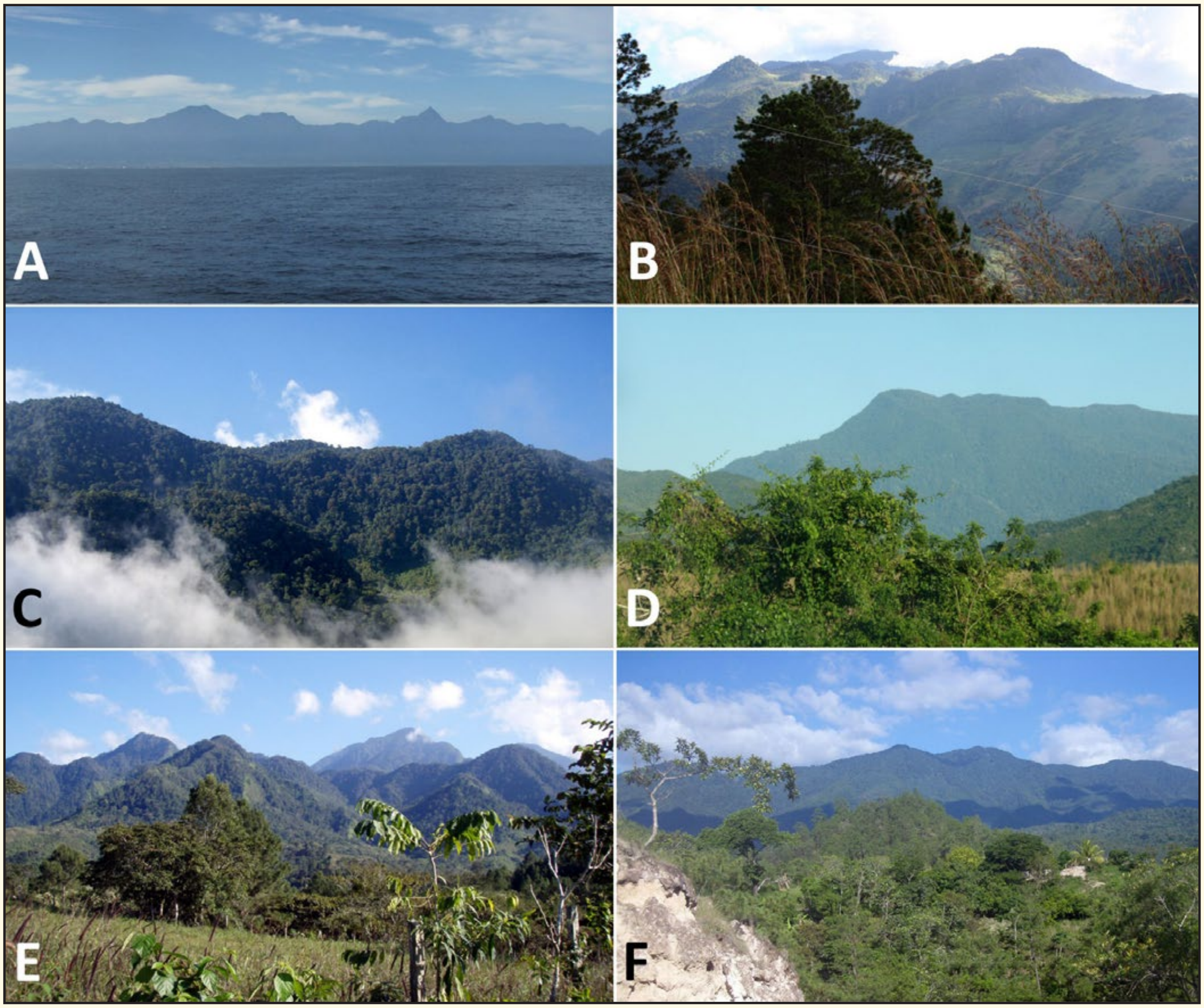

**Fig. 6.** Mountain ranges of the Chortís Block I. (A) Cordillera Nombre de Dios, seen from offshore looking south; Cerro Búfalo is the tallest mountain on the left (east) side, and Pico Bonito is the sharp peak on the right (west) side. (B) Sierra de Omoa, seen from near Buenos Aires de Bañaderos looking east-northeast. (C) Southern slopes of Cerro Azul de Copán in the Sierra de Espíritu Santo, seen from Quebrada Grande. (D) Montaña de Santa Bárbara, seen from the road west of Peñas Blancas looking south-southwest. (E) Montañas de Meámbar, seen from the road south of Santa Elena looking south. (F) Sierra de Comayagua, seen from road south of San Jerónimo looking south.

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The *Montañas de Meámbar* (2,080 m; Figs. 5-6, 6E), also called the Montañas de Yule, are a rugged set of peaks on the eastern side of Lago de Yojoa on the border between the departments of Cortés and Comayagua, primarily contained within PN Cerro Azul Meámbar. Mejía-Ordóñez and House (2002) apparently included this group of mountains in the Sierra de Montecillos, but I consider it a separate formation.

The *Sierra de Montecillos* (Fig. 5-7) is one of two roughly parallel mountain ranges that are oriented northwest-southeast and form the margins of the "Honduran Depression" in central Honduras. Some of the highest portions of this mountain range, which straddle the border between the departments of Comayagua and Intibucá, make up RB Montecillos (2,459 m).

The *Sierra de Comayagua* (Figs. 5-8, 6F) is oriented roughly parallel to the Sierra de Montecillos, separated by the dry intermontane Comayagua Valley, and extends over 130 km north-to-south along the border between the departments of Comayagua and Francisco Morazán. The highest portions of this range are found within PN Montaña de Comayagua (2,407 m) and RVS Corralitos (2,117 m).

The *Sierra de Sulaco* (Figs. 5-9, 7A) extends roughly west-to-east in the southwestern part of the Departamento de Yoro, and includes the highlands of PN Pico Pijol (2,282 m) at the western end of the range and Montaña Macuzal (1,945 m) at the eastern end.

The *Cordillera de La Flor-La Muralla* (Fig. 5-10) stretches across the northern part of the department of Francisco Morazán, the southern portion Yoro, and into western Olancho, with highland forest protected areas PN Montaña de Yoro (2,245 m), RVS La Muralla (2,064 m), Reserva Forestal Anthropológica (RFA) Montaña de la Flor (1,637 m), RB El Cipresal (1,930 m), and RB Misoco (2,153 m).

The *Sierra de Agalta* (Fig. 5-11) in central Olancho is a long, relatively narrow and steep range that includes, from west to east, the protected areas Monumento Natural Boquerón (1,261 m), PN Sierra de Agalta (2,335 m), Reserva Anthropológica El Carbón (1,817 m), and PN Sierra de Río Tinto (1,925 m).

The *Sierra de Botaderos* (Figs. 5-12, 7B) is located in northern Olancho along the border with the department of Colón, and includes Cerro Ulloa (1,735 m) and Cerro Azul (1,433 m) within the highland reserve PN Montaña de Botaderos, as well as the lower mountains of the Sierra de La Esperanza.

The *Sierra Punta Piedra* (Fig. 5-13) is a relatively low elevation range in the departments of Colón and Gracias a Dios, and includes Montaña Punta Piedra (1,500 m), Cerro Antílope (1,075 m), Cerro Mirador (1,200 m), and Cerro Baltimór (1,082 m). These mountains are found in Reserva de Hombre y la Biosfera Río Plátano.

The *Montañas de Patuca* (1,155 m; Fig. 5-14) in Olancho are located between the Río Guayape, which flows directly southwest to meet the Río Guayambre and form the Río Patuca, and a lower course of the Río Patuca that flows northeast to the Caribbean Sea. The southeastern portion of this range is found within PN Patuca.

***Southern Cordillera of the Serranía.***—The Southern Cordillera is a geomorphologically linked series of mountain ranges extending from the vicinity of the El Salvador-Guatemala-Honduras border region east-southeast into northern Nicaragua.

The highest elevations of the *Sierra de Montecristo* (Fig. 5-15) are located at the point where El Salvador, Guatemala, and Honduras meet, in a tri-nationally managed protected area called Montecristo Trifinio (2,419 m). Most of this range is found in Guatemala, where it extends northward into the department of Chiquimula.

The *Sierra del Merendón* (Fig. 5-16) is a north-south oriented range that extends from Guatemala (Chiquimula, Zacapa) across Honduras (Copán, Ocotepeque, Lempira) and into El Salvador (Chalatenango), and includes the following cloud forest areas: RVS Erapuca (2,380 m), Cerro El Pital (2,730 m), Cerro Sumpul (2,167 m), and Reserva Biológica (RB) Güisayote (2,310 m),

The *Sierra de Celaque* (Figs. 5-17, 7C) is a north-south oriented range located in Lempira and easternmost Ocotepeque, and contains the highest elevations in the Chortís Highlands in PN Celaque (including peaks of 2,849 m, 2,825 m, and 2,804 m in elevation) and RB Volcán Pacayita (2,516 m).

The *Sierra de Erandique* (2,134 m; Fig. 5-18) is a north-south oriented range in southeastern Lempira, extending from the municipality of La Campa at the northern end to the municipality of Piraera in the south.

The *Sierra de Puca-Opalaca* (Fig. 5-19) is located in Intibucá, northeastern Lempira, and extreme southern Santa Bárbara, and includes cloud forest areas found in RC Cordillera de Opalaca (2,390 m), RVS Puca (2,234 m), RVS Mixcure (2,312 m), and RVS Montana Verde (2,127 m).

The *Montaña de la Sierra* (Fig. 5-20) is found in the department of La Paz and extreme southern Intibucá, and includes a number of peaks and high plateaus, including a number within RB Guajiquiro (2,265 m), RB El Chiflador (1,811 m), RB El Pacayal (1,955 m), RB Mogola (1,648 m), RB Sabanetas (2,047 m), RB San Pablo (1,741 m), and RB San Pedro (1,719 m).

The *Sierra de Lepaterique* (Fig. 5-21) is the roughly U-shaped range that borders the southern side of the upper Choluteca Valley, which also is the valley containing the Honduran capital, Tegucigalpa. This range includes

**Fig. 7.** Mountain ranges of the Chortís Block II. (A) Looking northwest along the spine of the Sierra de Sulaco, taken from the top of Montaña Macuzal, with Pico Pijol being the largest peak in the distance. (B) Southeastern reaches of the highest peak in the Sierra de Botaderos. (C) The Sierra de Celaque viewed from the east, with the tallest peak in the Chortís Block, Cerro de la Minas, visible as the peak in the middle of the photograph.

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PN La Tigra (2,290 m), RB Yerba Buena (2,243 m), RB Cerro Uyuca (2,006 m), RB El Chile (2,190 m), and RB Monserrat-Yuscarán (1,825 m).

The *Sierra de Dipilto* (Fig. 5-22) extends over 300 km west-to-east from PN La Botija (1,710 m) in Choluteca, to the Cordillera Entre Ríos in PN Patuca, straddling the Honduras-Nicaragua border and including Reserva Natural (RN) Cerro Mogotón (2,106 m), which includes the highest point in Nicaragua.

The *Montaña de Colón* (Fig. 5-23) is a low (maximum elevation 941 m), isolated karstic range located in southeastern Olancho and adjacent Gracias a Dios, and lies primarily within the Reserva de Biosfera Tawahka-Asangni.

The *Cordillera Dariense* (Fig. 5-24) is a collection of cloud forested peaks and highland areas in northern Nicaragua, in the departments of Jinotega, Matagalpa, and Región Autónoma Atlántico Norte, including Reserva Natural (RN) Apante (1,442 m), RN Cerro Musún (1,438 m), RN Dantalí-El Diablo (1,680 m), RN Kilambé (1,755 m), RN Peñas Blancas (1,744 m), RN Saslaya (1,658 m), and RN Volcán Yali (1,709 m).

***Intermontane Valleys and Plains.***—In addition to its mountains, the Chortís Highlands also can be characterized for its valleys; the isolated mountains form "islands" of cool mesic habitat and the subhumid intermontane valleys represent isolated areas of hot, dry habitat. Aspects of the physiography, ecological associations, and biogeography of these subhumid valleys were studied by Stuart (1954), Johannessen (1963), Wilson and McCranie (1998), Sasa and Bolaños (2004), and Townsend and Wilson (2010b).

The *Middle Motagua Valley* is among the driest areas in Central America, along with the Middle Aguán Valley in Honduras. This valley lies between the Sierra de las Minas (extralimital to the Chortís Highlands) and the Sierra Espíritu Santo.

The *Sula Valley* in northwestern Honduras is formed from combined drainages of two large watersheds, the Río Chamelecón and Río Ulúa, which have courses that flow closely together in their lower reaches into the Caribbean Sea. The Sula Valley is a north-to-south oriented graben valley that has been spreading since the late Miocene.

The *Otoro Valley* is a moderately high elevation subhumid graben valley (lowest elevations 500–600 m) lying in a narrow upper portion of the Sula Valley, which contains a distinctive ecological character from that of the broader middle Sula Valley.

The *Comayagua Valley* (Fig. 8A) is a relatively high subhumid graben valley (lowest elevations 580–680 m) that forms a principal portion of the Honduran Depression, lying between the Sierra de Montecillos to the west and the Sierra de Comayagua to the east. This valley, like the Otoro Valley to the west, actually is a narrow upper portion of the Sula Valley, distinctive enough in character to warrant recognition.

The *Middle Aguán Valley* is a west-to-east oriented fault valley that lies in the rain-shadow of the Cordillera Nombre de Dios in Yoro, and is one of the driest areas in the Chortís Block.

The *Siria-Talanga Valley* (Fig. 8B) is a high plain (lowest elevations 620–720 m) in the central part of the department of Francisco Morazán that contains the headwaters of two of the largest watersheds in the Chortís Highlands, the Río Guayambre/Río Patuca and the Río Ulúa.

The *Olancho Valley* (or *Guayape–Guayambre Valley*) is a large valley in central Olancho surrounded by several mountain ranges, including the Sierra de Agalta, Cordillera de La Flor-La Muralla, and Montañas de Patuca, which form the headwaters of the Río Patuca.

The *Agalta Valley* (Fig. 8C), also referred to as the "San Esteban Valley" by various authors (Wilson and McCranie, 1998; McCranie and Wilson, 2002; Townsend and Wilson, 2010b), is found between the Sierra de Botaderos and Sierra de Agalta in central Olancho. The lowest elevations of this relatively high subhumid intermontane valley, formed by the Río Grande (a river whose name changes to Río Sico, Tinto, and Negro downstream), are 550–650 m.

The *Middle Lempa Valley* lies on a west-to-east orientation in central El Salvador, between the Southern Cordillera of the Serranía and the Salvadoran Cordillera.

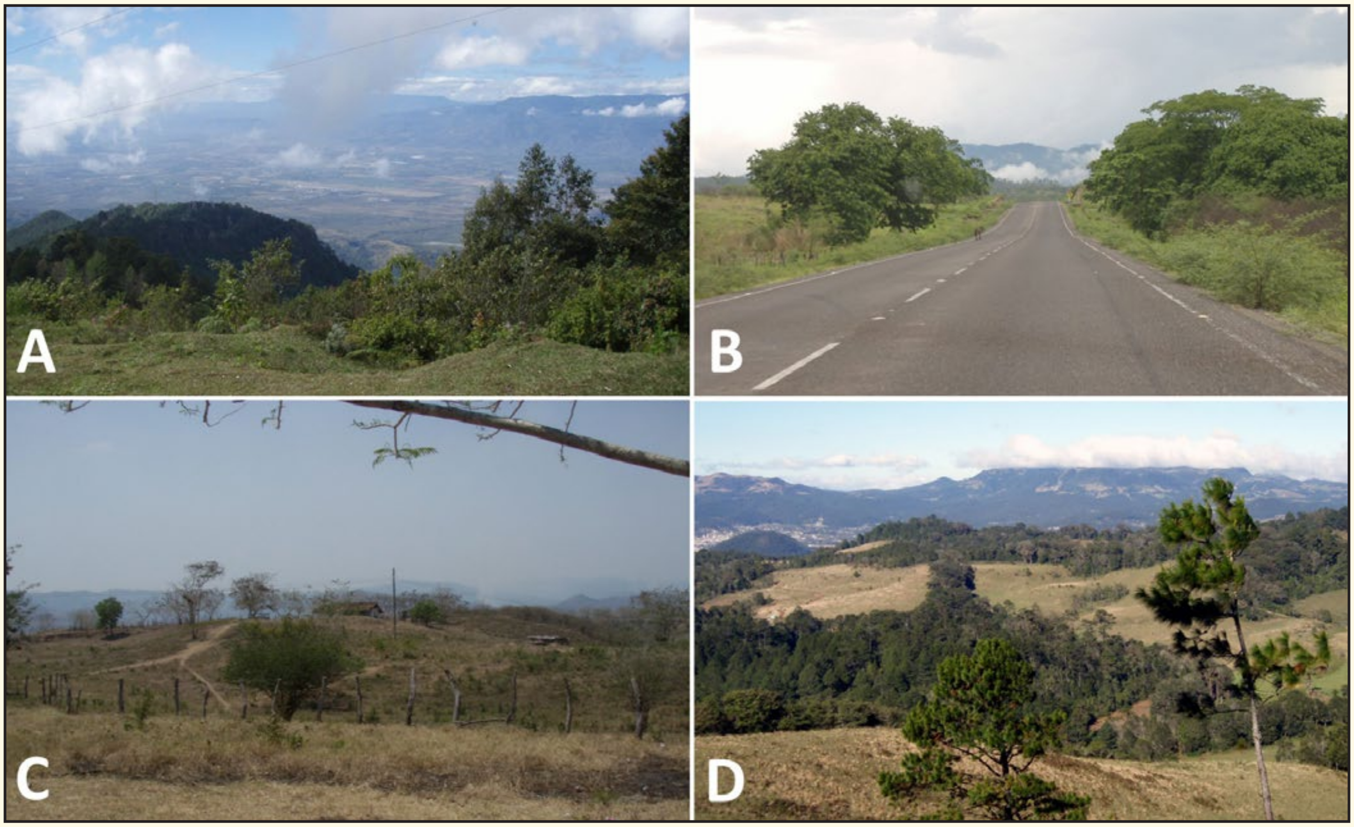

**Fig. 8.** Intermontane valleys and plains of the Chortís Block. (A) Looking northwest at the Comayagua Valley, taken from the top of Montaña La Oki in the Sierra de Comayagua. (B) Northern view along a highway through the Siria-Talanga Valley towards the Cordillera de La Flor-La Muralla. (C) The Agalta Valley to the east of Gualaco. (D) The Meseta de La Esperanza, with the city of La Esperanza on the far left, seen from Cerro San Pedro la Loma.

The *Upper Segovia Valley* in Nicaragua is a subhumid region located along the headwaters of the Río Coco (the upper reaches are also called the Río Segovia, and the lower river is called the *Wangki* by the indigenous Miskitu).

The *Choluteca Valley* is the only major subhumid intermontane valley on the Pacific versant, and initially is oriented south-to-north from the headwaters of the Río Choluteca in the Sierra de Lepaterique, before curving around the north side of the mountains protected within PN La Tigra and turning south and then southwest on its path to the Pacific Ocean.

The *Meseta de La Esperanza* (Fig. 8D) is the highest plain in the Chortís Highlands, extending 12 km in length across central Intibucá at elevations ranging from 1,800 to 2,000 m.

The *Meseta de Siguatepeque* is located in Comayagua between the Sierra de Comayagua, Sierra de Montecillos, and Montañas de Meámbar at an elevation of around 1,100 m.

The *Meseta de Santa Rosa* is a wide plain in western Copán, on a plateau at about 1,100 m in elevation.

***Caribbean Lowlands***.—Corresponding to the Mosquito Coast Lowlands Physiographic Province of Marshall (2007), the major ecophysiographic regions of the Caribbean lowlands include (McCranie and Wilson, 2002; Wilson and Townsend, 2006): the *Motagua Plain* (lower alluvial plain of the Río Motagua, east of the river and northwest and west of the Sierra de Omoa and Sierra de Espíritu Santo), the *Ulúa-Chamelecón Plain* (large alluvial plain formed by Chamelecón and Ulúa rivers, which drain close to half of the physical territory of Honduras), the *Nombre de Dios Piedmont* (the narrow strip of coastal plain backed by the Cordillera Nombre de Dios), the *Aguán-Negro*

*Plain*, and the wide expanse of the *Mosquitia* (broad alluvial plain essentially lying between the Sico-Paulaya watershed in Honduras and the Río Grande de Matagalpa watershed in Nicaragua). Two climatic regimes are present in the Caribbean Lowlands (McCranie and Wilson, 2002; Wilson and Townsend, 2006): the Lowland Wet climate is found on the Caribbean coastal plain from sea level to about 600 m in elevation, with a mean annual precipitation exceeding 2,000 mm and a mean annual temperature exceeding 24°C. Important protected areas for the Caribbean Lowlands ecosystems include: Parque Nacional (PN) Cuyamel-Omoa, PN Jeannette Kawas, Refugio de Vida Silvestre (RVS) Cuero y Salado, PN Punto Izopo, Jardín Botánico Lancetilla, RVS Laguna de Guaymoreto, Reserva de Hombre y la Biosfera Río Plátano, PN Patuca, PN Warunta, Reserva Biológica (RB) Rus Rus, RB Laguna de Karataska, PN Río Kruta, Reserva de Biosfera Tawahka-Asangni, Reserva de Biosfera Bosawas, Reserva Natural (RN) Cabo Viejo-Tela Sulumas, RN Laguna Bismuna-Raya, and RN Laguna Pahara.

***Pacific Lowlands.***—Corresponding to the Salvadoran Coastal Plain of the Chortís Fore Arc Physiographic Province of Marshall (2007), the Pacific versant lowlands consist of a relatively broad coastal plain extending from the western to the southern limits of the Chortís Highlands Province, becoming narrowest around the Golfo de Fonseca. These lowlands constitute a single ecophysiographic region with a relatively homogenized biota (Wilson and McCranie, 1998; Sasa and Bolaños, 2004; Townsend and Wilson, 2010b). The Pacific Lowlands are subject to the Lowland Dry climate regime (Wilson and Meyer, 1985), found from sea level to about 600 m in elevation, with mean a annual precipitation below 2,000 mm and a mean annual temperature exceeding 24°C. Important protected areas for the Pacific Lowlands ecosystems include: Área Protegida con Recursos Manejados Barra de Santiago, Parque Privada Walter T. Deininger, Área de Protección y Restauración (APR) Nancuchiname, Área de Manejo Laguna El Jocotal, APR Conchagua, Área de Manejo de Habitát de Especie (AMHE) Bahía de Chismuyo, AMHE Bahía de San Lorenzo, AMHE Las Iguanas-Punta Condega, AMHE Los Delgaditos, AMHE El Jicarito, AMHE La Berbería, AMHE San Bernardo, and RN Delta de Estero Real.

***Salvadoran Cordillera.***—The Salvadoran Cordillera is not geomorphologically part of the the Chortís Highlands, but instead constitutes the Chortís Volcanic Front and is dominated by more recent Pliocene and Quaternary volcanic deposits (Marshall, 2007). I include the Salvadoran Cordillera for the sake of completeness in this discussion, given its position across the Pacific Lowlands of El Salvador and putative inclusion in the Eastern Nuclear Central America biogeographic province of Campbell (1999; as expanded upon by Townsend, 2006). This west-to-east oriented range is a continuation of the Guatemalan Cordillera, and is made up of several dozen volcanic cones and peaks, including Santa Ana (2,365 m), San Vincente (2,182 m), and San Miguel (2,130 m).

***Cordillera Los Marabios.***—Like the Salvadoran Cordillera, geomorphologically this range is not not part of the Chortís Highlands, and is represented by a string of northwest-to-southeast oriented Quaternary (and in some cases active) volcanic cones arising from the Pacific Lowlands of northwestern Nicaragua. Volcanoes in this cordillera include Cosigüina (858 m), San Cristóbal (1,745 m), Casita (1,405 m), Telica (1,060 m), Cerro Negro (726 m), El Hoyo (1,079 m), and Momotombo (1,279 m).

***Watersheds.***—Major river systems on the Caribbean versant of the Chortís Block include: Motagua (485 km in length), Chamelecón (200 km), Ulúa (300 km), Leán (60 km), Aguán (225 km), Sico or Tinto or Negro or Grande (215 km), Plátano (85 km), Sikre (70 km), Patuca (500 km), Warunta (85 km), Mocorón (92 km), Nacunta (65 km), Kruta (125 km), Coco or Segovia or Wangki (550 km), Wawa (160 km), Kukalaya (140 km), Prinzapolka (330 km), and Grande de Matagalpa or Awaltara (430 km). Major Pacific versant watersheds include Estero Real (137 km), Negro (85 km), Choluteca (250 km), Nacaome (90 km), Goascorán (115 km), Lempa (422 km), and Paz (134 km).

***Lakes and coastal lagoons.***—Few large inland water bodies are present in the Chortís Block, of which the most notable is Lago de Yojoa (700 m elevation) in central Honduras. The two other large bodies of freshwater, Embalse El Cajón (285 m) in Honduras and Lago de Apanás (970 m) in Nicaragua, both are reservoirs created by hydroelectric dams. A number of large coastal lagoons and lagoon complexes are present on the Caribbean coast, including Los Micos, Guaymoreto, Ibans, Brus, Tilbalakan, Laguntara, Warunta, Tansín, Karataska, Kohunta, Bismuna, Pahara, Karatá, Huouhnta, and Laguna de Las Perlas. I consider Lago de Izabal in Guatemala and Lago Xolotlán (= Lago de Managua) in Nicaragua extralimital to the Chortís Block and do not include them.

***Islands.*** The principal islands associated with the Chortís Highlands include the Honduran Islas de la Bahía (Utila, Roatán, Guanaja, and Cayos Cochinos), the Cayos Miskitos of Nicaragua, and Isla El Tigre and other small islands in the Golfo de Fonseca.

## Holdridge Forest Formations

The forest formations described below follow the system developed by Holdridge (1967), as applied to Honduras in previous works (Meyer and Wilson, 1971, 1973; Wilson and Meyer, 1985; Wilson and McCranie, 1998; Wilson et al., 2001; McCranie and Wilson, 2002). The widely used Holdridge (1967) system uses climatic, edaphic, and atmospheric conditions to define and determine the distribution of terrestrial ecosystems. A wide range of climatic and elevational regimes typifies the Chortís Block, resulting in the recognition of nine Holdridge forest formations within this region. I am using this system (described below) to partially define Chortís Block ecosystems, supplemented with other published reports, gray literature, and my own observations.

***Lowland Moist Forest.***—Commonly referred to as lowland rainforest, the Lowland Moist Forest (LMF) formation is defined by a high mean annual temperature (> 24°C), high mean annual precipitation (> 2,000 mm; no month of the year with precipitation < 50 mm), and extending at elevations from sea level to about 600 m. In the Chortís Block, the LMF formation is restricted to the Caribbean versant, with the majority of the remaining intact forest found in the vast region of eastern Honduras and Nicaragua known as *La Mosquitia*. In addition to lowland rainforest, the pine savannas in La Mosquitia and open woodlands intersected by veins of gallery forest are found within the Lowland Moist Forest formation. Intact LMF is characterized by the presence of a heterogeneous canopy dominated by evergreen broadleaf trees that regularly reach a height of 30–40 m (Agüdelo C., 1987).

***Lowland Dry Forest***.—The Lowland Dry Forest (LDF) formation includes habitat commonly referred to as scrub forest, and is defined by high mean annual temperature (> 24°C), moderate but seasonally variable annual precipitation (1,000–2,000 mm; at least 3–4 months with precipitation < 50 mm), and an elevational range extending from sea level to about 600 m. In the Chortís Block, the LDF formation is found on the Pacific versant and in several interior valleys. Intact LDF is characterized by the presence of a heterogeneous canopy dominated by deciduous trees that typically reach a height of around 25 m (Agüdelo C., 1987).

***Lowland Arid Forest.***—The Lowland Arid Forest (LAF) formation, commonly called thorn forest, is defined by high mean annual temperature (> 24°C), low annual precipitation (500–1,000 mm; at least 3–4 months with precipitation < 50 mm), and an elevation range extending from sea level to approximately 600 m. This formation is one of the most limited in the Chortís Block, known only from the Middle Aguán Valley and the Upper Motagua Valley. Intact LAF is characterized by the presence of a low, heterogeneous canopy dominated by deciduous trees that typically reach a height of around 10 m, with the vegetation dominated by xeric-adapted plants such as cacti (Agüdelo C., 1987).

***Premontane Wet Forest.***—The Premontane Wet Forest (PWF) formation, sometimes called highland rainforest (McCranie and Wilson, 2002), is defined by a moderate mean annual temperature (18–24°C), high annual precipitation (> 2,000 mm), and an elevational range extending from approximately 600 to 1,500 m. The PWF formation bridges the LMF with higher elevation montane forests, and thus contains characteristics of both. Intact PWF is characterized by the presence of a closed canopy dominated by evergreen broadleaf trees typically reaching 25–30 m in height, but sometimes reach 40 m (Agüdelo C., 1987).

***Premontane Moist Forest.***—The Premontane Moist Forest (PMF) formation, commonly referred to as upland pine-oak forest, is defined by a moderate mean annual temperature (18–24°C), moderate annual precipitation (1,000–2,000 mm), and an elevational range of about 600 to 1,850 m. The PMF formation is relatively widespread in the Chortís Highlands, particularly on interior slopes. Various habitat types are found within the PMF, and are defined below following the classification system of Carr (1950).

***Premontane Dry Forest.***—The Premontane Dry Forest (PDF) formation, which can be termed "upland scrub forest," is defined by moderate mean annual temperature (18–24°C), low annual precipitation (500–1,000 mm), and an elevation range of approximately 600 to 1,250 m. This habitat generally is limited to the upper periphery of some xeric interior valleys that otherwise support LDF or LAF, two formations with which PDF shares its typical characteristics.

***Lower Montane Wet Forest.***—The Lower Montane Wet Forest (LMWF) formation is defined by a low mean annual temperature (12–18°C), high annual precipitation (> 2000 mm), and an elevational range of approximately 1,500 to 2,700 m (note: habitat typical of this formation also can occur at lower elevations, particularly in the Cordillera Nombre de Dios). In the Chortís Highlands, LMWF primarily is distributed on the Caribbean versant, and is replaced by Lower Montane Moist Forest (below) in the somewhat drier Pacific versant highlands. Intact LMWF is characterized by the presence of a closed canopy dominated by evergreen broadleaf trees reaching 50 m in height (Agüdelo C., 1987).

***Lower Montane Moist Forest*.**—The Lower Montane Moist Forest (LMMF) formation, also referred to as cloud forest or montane forest, is defined by a low mean annual temperature (12–18°C), moderate annual precipitation (1,000–2,000 mm), and an elevation range of approximately 1,500 to 2,700 m. In the Chortís Highlands, LMMF is distributed in highland areas, typically on the Pacific versant and on the leeward slopes of some of the interior-most Caribbean versant peaks. The LMMF formation contains both pine and broadleaf dominated habitats (better characterized using the classification system of Carr, 1950).

***Montane Rainforest*.**—The Montane Rainforest (MRF) formation is defined by a very low mean annual temperature (6–12°C), high annual precipitation (> 2,000 mm), and an elevational range above approximately 2,700 m. This formation is the most geographically limited in the Chortís Highlands, and is restricted to the highest slopes of Cerro Celaque (Honduras; maximum elevation 2,849 m), Cerro Santa Bárbara (Honduras; maximum elevation 2,744 m), and Cerro El Pital (El Salvador and Honduras; maximum elevation 2,730 m).

## CHARACTERIZING ECOLOGICAL ASSOCIATIONS: UPDATING AND OPERATIONALIZING THE CARR (1950) SYSTEM FOR CLASSIFYING HONDURAN ECOSYSTEMS

Based on four years of first-hand observation during his time as a professor at Escuela Agrícola Panamericana (Zamorano), Carr (1950) presented a preliminary characterization of the ecosystems of Honduras. Carr's initial interest was in "determining and attempting to define herpetological habitats," which expanded to generalize the habitats so as to "help the visiting naturalist in his preliminary reconnaissance and shorten his orientation period" (Carr, 1950: 569). This work was the first to classify ecological associations in Honduras, and the accuracy of Carr's observations allowed for his "outline" to be developed into an operational system for classifying animal habitats in Honduras and the greater Chortís Block. As opposed to the Holdridge (1967) system, the Carr (1950) system is descriptive and was designed with the intent of being modified and contextualized by specialists to fit their particular study system or taxonomic group. I developed such an operational system, which I refer to as the Carr Classification System for Honduran Ecological Associations or simply the Carr System, based on a synthesis of the available literature and my own observations from 1999 to 2014.

### Lowland-associated Habitats

***Selva or Lowland Broadleaf Rainforest*** (Fig. 9A)**.**—Found primarily within the Lowland Moist Forest (LMF) formation in the Caribbean Lowlands, *selva* is characterized by a tall, multi-layered, closed-canopy that is dominated by evergreen broadleaf trees, with upper canopy trees normally reaching a height of 30–40 m (Agüdelo C., 1987; Mejía-Ordóñez and House, 2002), but in some areas reaching 60 m (Carr 1950; Wilson and Meyer 1985). Large expanses of *selva* are found within Reserva de Hombre y la Biosfera Río Plátano, PN Patuca, PN Warunta, Reserva Biológica (RB) Rus Rus, Reserva de Biosfera Tawahka-Asangni, and Reserva de Biosfera Bosawas. Mejía-Ordóñez and House (2002) listed the following tree species as typical of Honduran *selva*: *Brosimun alicastrum*, *Bursera simarouba*, *Calophyllum brasiliense*, *Cedrela odorata*, *Coccoloba anisophylla*, *Cordia alliodora*, *Ficus colubrinae*, *Ficus insipida*, *Ficus tonduzii*, *Guarea grandifolia*, *Hernandia stenura*, *Licania platypus*, *Luehea candida*, *Nectandra* sp., *Ocroma pyranidale*, *Pithecoellobium donnel-smithii*, *Pouteria campechiana*, *Pouteria sapota*, *Rinorea guatemalensis*, *Symphonia globulifera*, *Swietenia macrophilla*, *Tabebuia chrysantha*, *Terminalia amazonia*, *Virola koshnyi*, and *Vochysia hondurensis*; the relatively open understory is made up of palms (*Acoelorrhaphe wrightii*, *Chamaedorea* spp., *Bactris* spp., and *Geonoma* spp.), woody plants (*Cespedesia macrophylla*, *Isertia haenkeana*, *Piper* spp., *Cephaelis* spp., and *Psychotria* spp.), and herbaceous plants (*Adiantum* spp., *Polypodium* spp., *Begonia* spp., *Selaginella* spp., *Philodendron* spp., and *Syngonium* spp.).

***Mosquitia Pine Savannas*** (Fig. 9B)**.**—Although wholly classified as a rainforest area by Wilson and Townsend (2006) due to being found within the Lowland Moist Forest formation, the Mosquitia of eastern Honduras and Nicaragua supports large areas of *Pinus caribaea* savanna that bear a stronger resemblance to subhumid ecosystems than to rainforests (Parsons, 1955; Zamora Villalobos, 2000; Townsend and Wilson, 2010b). The Mosquitia pine

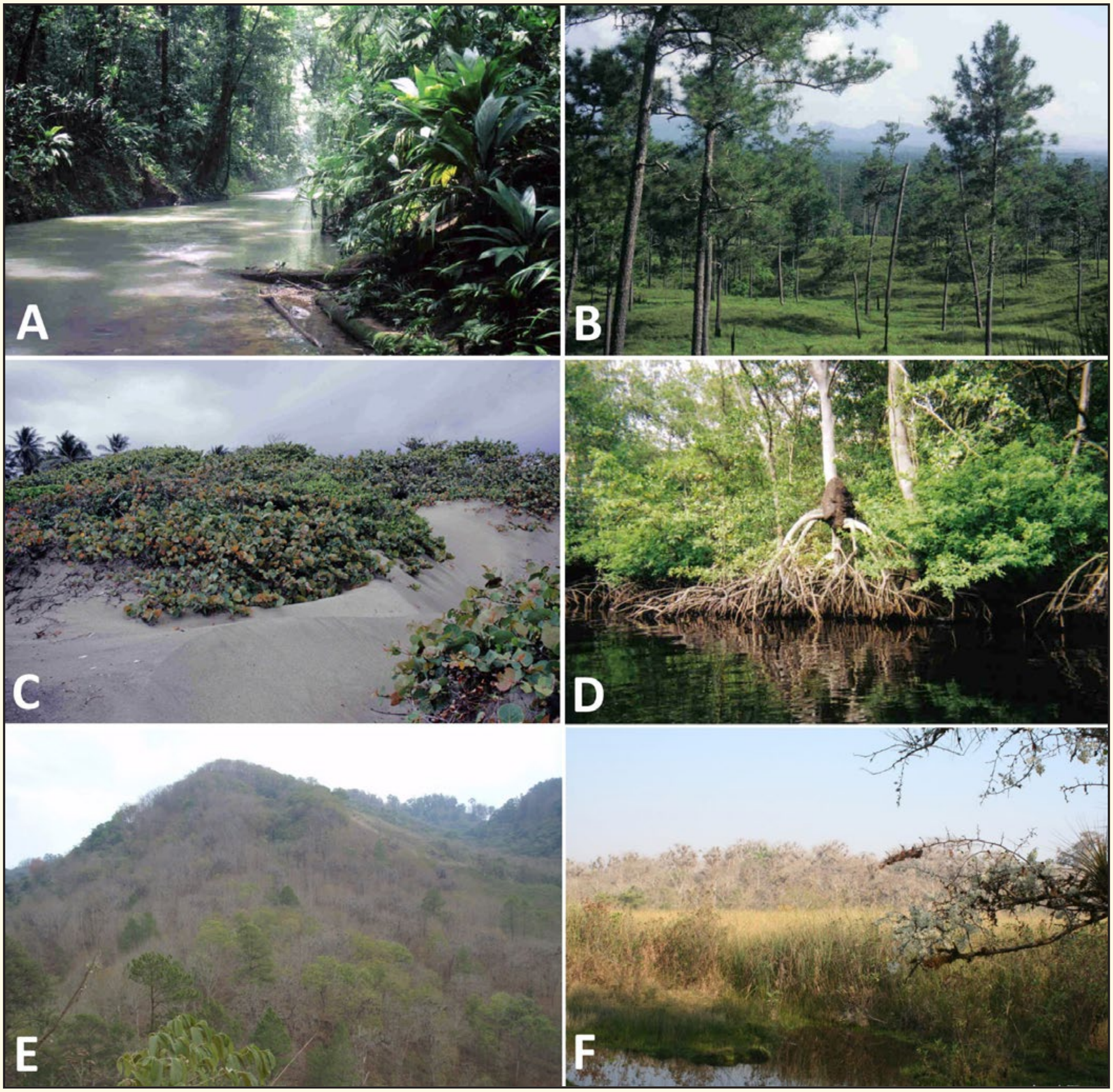

**Fig. 9.** Ecological associations of the Chortís Block I. (A) Selva or Lowland Broadleaf Forest; Río Tapalwás, Reserva Biológica Rus Rus, Depto. Gracias a Dios, elev. 180 m; Lowland Moist Forest formation. (B) Mosquitia Pine Savanna; between Rus Rus and Awasbila, with the Montañas de Colón in the background, Depto. Gracias a Dios, elev. 200 m; Lowland Moist Forest formation. (C) Coastal Scrub; Caribbean coast near Kaukira, Depto. Gracias a Dios; Lowland Moist Forest formation. (D) Mangrove Swamp, near mouth of the Río Kruta, Depto. Gracias a Dios; Lowland Moist Forest formation. (E) Seasonal Deciduous Forest; near Teocintecito, Depto. Olancho, elev. 690 m; Premontane Dry Forest formation. (F) Freshwater Swamp in Seasonal Deciduous Forest; seepage bog in the upper Valle de Agalta, northeast of Saguay, Depto. Olancho, elev. 570 m; Premontane Dry Forest formation. © Josiah H. Townsend

savannas resemble an open woodland dominated by *P. caribaea*, with a mix of broadleaf trees and shrubs including *Agarista mexicana* var *pinetorum*, *Amaioua corymbosa*, *Arthrostemma ciliatum*, *Arundinella deppeana*, *Byrsonima crassifolia*, *B. verbasifolia*, *Calea integrifolia*, *Cecropia peltata*, *Cephaelis tomentosa*, *Chamaecrista nictitans*, *Clethra calocephala*, *Clidemia sericea*, *Cococypsellum* sp., *Cuphea pinetorum*, *Davilla kunthii*, *Guazuma ulmifolia*, *Gnaphalium semiamplexicaule*, *Lasianthaeas fruticosa*, *Lobelia laxiflora*, *Miconia albicans*, *M. glaberrima*, *Myrica cerifera*, *Psychotria suerrensis*, *Quercus oleoides*, *Salvia* sp., *Vernonia agyropappa*, *Vigna vexillata*, and *Xylopia frutescens*, with an open understory of fire-tolerant grasses (Poaceae) and sedges (Cyperaceae), particularly *Paspalum pectinatum*, *Blechnum serrulatum*, *Rhynchospora rugosa*, *Rhynchospora bulbosa*, *Scleria cyperina*, and *Setaria geniculata* (Parsons, 1955; Zamora Villalobos, 2000; Mejía-Ordóñez and House, 2002). Herpetofaunal diversity present in the Mosquitia pine savannas is almost completely congruent with that of the subhumid forests of the intermontane valleys (Townsend and Wilson, 2010b), and phylogenetic analyses of subhumid-specialized taxa support conspecific relationships among Pacific and pine savanna populations (*Incilius coccifer*, Mendelson et al., 2005; *Porthidium ophryomegas*, Castoe et al., 2005). Townsend and Wilson (2010b: 702) presented two principal, and as-yet untested, hypotheses for explaining the apparent continuing connectivity between the Pacific lowlands, subhumid intermontane valleys, and Mosquitia pina savannas:

(1) The existence of a subhumid "corridor" located in Nicaragua between the southern end of the Nuclear Middle American highlands and Lago de Nicaragua, allowing for dispersal of subhumid species from the Pacific Lowlands of Honduras, El Salvador, and Nicaragua to the pine savannas of the Nicaraguan Mosquitia, which is contiguous with pine savannas extending to the northern coast of Honduras.

(2) Utilization of open areas along large rivers (Patuca, Coco, and Grande de Matagalpa) that have their upper reaches in subhumid areas as routes for dispersal. These rivers originate in subhumid intermontane valleys in the Chortís Highlands, flowing through extensive areas of broadleaf rainforest and on through pine savannas of La Mosquitia. Secondary connectivity also may occur through coastal strand habitat, which creates a network among individual river drainages at or near their mouths.

***Broadleaf Swamp Forest.***—These swamp forests are found along poorly-drained margins and backwater areas of large rivers, with notable expanses of Broadleaf Swamp Forest found along the Río Patuca in Reserva de Hombre y la Biosfera Río Plátano, as well as along Río Kruta and in PN Jeannette Kawas. While riverine swamp forests are restricted to the LMF in the Caribbean Lowlands, a broadleaf swamp forest also is present at the northern and southern ends of Lago de Yojoa (700 m elevation), at the lower edge of the Premontane Wet Forest (PWF) formation. Mejía-Ordóñez and House (2002) listed the following species from permanently inundated broadleaf swamp forest: the trees *Crias cauliflora*, *Pachira aquatica*, *Pterocarpus hayesii*, and *Pterocarpus officinalis*, and the palms *Roystonea dunlapiana*, *R. regia* var *hondurensis*, *Acoelorrhaphe wrightii*, and *Desmoncus orthacantus*. The following are found in seasonally inundated broadleaf swamp forest: the trees *Castilla elastica*, *Coccoloba* sp., *Combretum cacoucia*, *Symphonia globulifera*, and *Vochysia ferruginea*; and in the flooded forests at the northern end of Lago de Yojoa are found the tree *Erythrina fusca* and an understory including *Calathea* spp., *Costus* spp., *Heliconia* spp., *Hymenocallis litoralis*, *Maranta* spp., *Thalia geniculata*, *Smilax* spp., *Philodendron* spp., and *Syngonium* spp.

***Palm Swamp.***—A variety of palm-dominated swamp forests occur in coastal areas. *Tique* palm swamps are dominated by the *tique* (*Acoelorrhaphe wrightii*), or paurotis palm, in association with *Annona glabra*, *Chrysobalanus icaco*, *Coccoloba uvifera*, *Conocarpus erectus*, *Dalbergia ecastaphylla*, *Dalbergia monetaria*, *Davilla kunthii*, *Morinda citrifolia*, *Doliocarpus guianensis*, *Eugenia aeruginea*, *Henriettea succosa*, *Miconia glaberrima*, *Miconia albicans*, *Montrichardia arborescens*, *Myrmecophila wendlandii*, *Palicourea tripilla*, *Symphonia globulifera*, *Terminalia bucidoides*, *Thrinax parviflora*, *Tococa guianensis*, *Clidemia sericea*, *Acrocomia mexicana*, *Bursera simaruba*, *Casearia sylvestris*, *Chrysophyllum mexicanum*, *Cordia alliodora*, *C. curassavica*, *Hibiscus tiliaceus*, and *Ochroma pyramidala* (Mejía-Ordóñez and House, 2002). Seasonally inundated mixed broadleaf-palm swamps near the Río Kruta and Cabo Gracias a Dios can have a 40–50 m high canopy dominated by the palm *Roystonea dunlapiana* and the understory palm *Acoelorrhaphe wrightii*, as well as *Mimosa schomburki*, *Psychotria* spp., *Alibertia edulis*, *Spondias mombim*, *Pachira aquatica*, *Desmoncus orthacantus*, *Bactris* sp., *Ficus* sp., *Calophyllum brasiliense*, *Coccoloba schiedeana*, *Hirtella racemosa*, *Xylopia frutescens*, *Dialium guianensise*, *Virola koschnyi*, *Annona glabra*, *Grias integrifolia*, *Dalbergia ecastaphyllum*, and *Trophis racemosa*. In defining the *Huiscoyol Swamp* as a habitat, Carr (1950: 587) described thick stands of slender *Bactris* palms (called *huiscoyol* in Costa

Rica) with "ghastly, glass-hard stem spines" and recounts one of his most "harrowing misadventures" when being lost in the "dreary and forbidding environment" of a *Bactris* swamp.

***Coastal Scrub*** (Fig. 9C)**.**—A heterogeneous habitat association found above the beach-line along the Caribbean coast, Islas de la Bahía, Cayos Cochinos, and Cayos Miskitos, Coastal Scrub includes low coastal strand forest (typical plants include: *Cannavalia maritima*, *C. rosea*, *Euphorbia buxifolia*, *Ipomoea pescaprae*, *Sesuvium portulacastrum*, *Sporobolus virginicus*, *Chrysobalanus icaco*, *Coccoloba uvifera*, *Citharexylum caudatum*, *Hybiscus tiliaceus*, and *Phyllanthus acidus*) and its associated grass-covered dune system (typical ground cover includes *Andropogon brevifolius*, *Aristida* sp., *Eleocharis* sp., *Eragrostis* sp., *Fimbristylis spadicea*, and *Paspalum* sp.). This association is found in relatively long, undisturbed extensions along essentially the entire Caribbean coast of the Chortís Highlands (Mejía-Ordóñez and House, 2002). Carr (1950) described the somewhat peculiar and specialized coastal scrub habitat found on Isla El Tigre in the Golfo de Fonseca and a few exposed hillsides facing the gulf as a distinctive habitat association: *Sea-Breeze Scrub Forest.* While this forest lies within the Lowland Dry Forest (LDF) formation, the forest receives most of its moisture in the form of occult precipitation brought in on Pacific winds. Common plant species include *Bursera simarouba*, *Cresentia alata*, *Enterolobium saman*, *Spondias purpurea*, *Prosopis juliflora*, *Acacia* spp., *Heamatoxilon brasiletti*, and *Zizyphum* sp.

***Mangrove Swamp*** (Fig. 9D)**.**—These estuarine swamp forests are found along both the Caribbean and Pacific coasts. Mangrove swamp communities on both coasts typically include the mangroves *Avicennia germinans* and *Rhizophora mangle*, with Caribbean swamps including salt-tolerant species such as *Laguncularia racemosa*, *Acrostichum aureum*, *Cecropia* spp., and *Coccoloba uvifera*, and Pacific mangroves similarly accompanied by *Sesuvium portulacastrum*, *Sporobolus virginicus*, *Acrostichum aureum*, *Cecropia* spp., *Coccoloba uvifera*, *Conocarpus erectus*, and *Laguncularia racemosa* (Mejía-Ordóñez and House, 2002).

## Habitats Shared Between Lowlands and the Chortís Highlands

***Vegas and Gallery Forest.***—This association is found on rich alluvial soils along stream and river courses, and in areas of low relief around the confluence of two streams (a *vega*). I tentatively include Carr's (1950) habitat classes *Dry Gullies and Fence Rows* and *Hondonadas* in this category, recognizing that all of the constituent associations essentially are arteries of mesic habitat, often through comparatively xeric areas. Frequent plants of Caribbean Lowland *vegas* and gallery forests include *Carapa guianensis*, *Hirtella racemosa*, *Xylopia frutescens*, *Dentropanax arboreus*, *Dialium guianense*, *Ficus* sp., *Licania platipus*, *Ochroma lagopus*, *Pterocarpus rohrii*, *Symphonia globulifera*, *Vochysia hondurensis*, *Schizolobium parahybum*, *Cecropia obtusifolia*, *Hyeronima alcornoides*, *Lacmellea panamensis*, *Prioria copaifera*, *Enterolobium schomburki*, *Apeiba membranaceae*, *Casearia sylvestris*, *Cedrela macrophilla*, *Dendropanax arboreus*, *Vismia macrophylla*, *Xylopia frutescens*, and *Zuelania guidonia* (Mejía-Ordóñez and House, 2002).

Carr (1950: 588) observed that these types of alluvial forest appeared to serve as "mesic highways for the rainforest biota," that might "afford often contiguous connection between lower tropical rainforest and upper tropical cloud forest," and therefore "must be of prime importance in the ecology of the region." In light of over 60 years of advancement in our knowledge and understanding, Carr's insights are still grounds generating biogeographic hypotheses testable with modern molecular methods.

***Seasonal Deciduous Forest*** (Figs. 9E, 9F)**.**—Called *Monsoon forest* by Carr (1950) and commonly referred to as tropical dry forest, the distribution of this habitat is limited to the Lowland Dry Forest and Premontane Dry Forest formations in the intermontane valleys and on the Pacific Lowlands. Mejía-Ordóñez and House (2002) reported the following species as frequent in Seasonal Deciduous Forest: *Enterolobium cyclocarpun*, *Bursera simarouba*, *Ceiba pentandra*, *Cordia alliodora*, *Lysiloma auritum*, *Lysiloma seemanii*, *Samanea saman*, *Swetenia macrophylla*, *Cochlospermum vitifolium*, *Gyrocarpus americana*, *Apeiba membranacea*, *Alvaradoa amorphoides*, *Calycophylum candidissimum*, *Tabebuia neochrysanta*, *Samanea saman*, *Spondias mombin*, *Lonchocarus minimiflorus*, and *Guazuma ulmifolia.*

***Thorn Scrub Forest*** (Fig. 10A)**.**—This low (< 4 m in canopy height) habitat is dominated by cacti such as *Pachycereus* sp., *Hylocereun* spp., *Mammillaria* spp., and *Opuntia* spp., and dry tolerant shrubs and herbaceous plants like *Ananas* sp., *Argyreia especiosa*, *Cnidoscolus tubulosus*, *Digitaia insularis*, *Epidendrum xipheses*, *Evolvulus* sp., *Gonolobus* sp., *Acacia farnesiana*, *Albizzia neopoides*, *Combretum fruticosum*, *Diphysa ribinoides*, *Jacquinia macricarpa*, *Karwinskia calderonii*, *Lepidagastris alopecuroidea*, *Loeselia* sp., *Melanthera nivea*, *Thouviinidium decandrum*, and *Watheria americana* (Mejía-Ordóñez and House, 2002). Thorn Scrub Forest is restricted to the Lowland Arid Forest and Lowland Dry Forest formations in the intermontane valleys of the Chortís Highlands.

***Pantano or Freshwater Marsh*** (Figs. 9F, 10B)**.**—Freshwater marshes dominated by *Typha domingensis*, *Phragmites australis*, and/or *Thalia geniculata* form an expansive habitat association in some areas, especially the wide alluvial plains of La Mosquitia (Carr, 1950; Zamora Villalobos, 2000; Mejía-Ordóñez and House, 2002). Other grasses present include *Andropogon brevifolius*, *Aristida* sp., *Eleocharis* sp., *Eragrostis* sp., *Fimbristylis spadicea*, and *Paspalum* sp. (Mejía-Ordóñez and House, 2002). In La Mosquitia, the character of the vast *pantanos* is similar to that of the Florida Everglades, including being dotted with islands of pine (*Pinus caribaea,* vs. *P. elliotii* in the Everglades) or paurotis palms (*Acoelorrhaphe wrightii*), with extensive areas of habitat found around the Laguna de Karataska, the Río Kruta, and the lower Río Coco.

## Habitats of the Chortís Highlands

***Ocotal*** (Figs. 10C, 10D)**.**—The ubiquitous Mesoamerican pine-oak forests are found throughout moderate elevation areas of the *serranía* and are dominated by *ocote* pine (*Pinus oocarpa*), with representation from *P. pseudostrobus* and other pines at higher elevations. *Ocotales* are distributed extensively in the *serranía* in the Premontane Moist Forest formation, and peripherally in the Premontane Dry Forest and Lower Montane Moist Forest formations, roughly at elevations from 800 to 1,600 m. *Ocotal* is subject to regular burning by humans, in some areas annually, and thus the biotic composition is limited to species able to tolerate or escape frequent fires. Besides pines, the various species of oaks (*Quercus* spp.) and the hardwood trees and herbaceous plants *Acacia farnesiana*, *Brahea salvadorensis*, *Byrsonima crassifolia*, *Clethra occidentalis*, *Myrica cerifera*, *Enterolobium cyclocarpun*, *Eritrina berteroana*, *Ficus* spp., *Lysiloma auritum*, *Mimosa tenuiflora*, *Psidum guianense*, and *Tabebuia chrysantha* typically are found in *ocotales* (Mejía-Ordóñez and House, 2002). Carr (1950) identified a number of subdivisions of the *Ocotal* habitat, including *shaded ocotal*, *park ocotal*, *ocotal steppe*, and *ocotal-pedregal*, based on edaphic and climatic variation as well as burn frequency.

***Broadleaf Transitional Cloud Forest*** (Fig. 10E)**.**—Also referred to as Premontane rainforest, this high diversity forest blends diversity from both the *selva* below and the cloud forest above, and is found primarily in the Premontane Wet Forest formation at elevations from 500 m to 1,500 m, primarily on the windward slopes of mountains along the Caribbean versant.

***Mixed Transitional Cloud Forest*** (Fig. 10F)**.**—This transitional forest between *ocotales* and cloud forest, which Carr (1950) called *High Ocotal association*, essentially is a humid *ocotal* with higher concentrations of bromeliads and other epiphytes, as well as a denser and more diverse understory. High *ocotales* typically are found within the Premontane Moist Forest and Lower Montane Moist Forest formations, at elavations from 1,000 to 1,500 m on the Caribbean versant and 1,200 to 1,800 m on the Pacific versant. Trees of mixed transitional forest include the pines *Pinus oocarpa*, *P. pseudostrobus*, and *P. tecunumanii*, the hardwoods *Arbutus xalapensis*, *Clethra macrophylla*, *Ficus aurea*, *Heliocarpus apendiculatus*, *Oreopanax lachnocephalus*, *Oreopanax xalapensis*, and *Quercus cortesii*, and an understory that includes *Buddleia americana*, *Conostegia* sp., *Miconia* sp., *Psychotria macrophylla*, *Vernonia arborescens*, *Calyptranthes hondurensis*, *Lobelia laxiflora*, *Piper launosum*, and *Verbesina* sp. (Mejía-Ordóñez and House, 2002). In addition to *High Ocotales*, Carr (1950) identified two other types of transitional forest, *Pinabetales* and "*Diquidambales*" (= *Liquidambales*), which I recognize as distinctive localized associations within *Pinus* and *Liquidambar* Transitional Cloud Forest. *Pinabetales* are ridge-line groves dominated by the *pinabete* pine (*Pinus pseudostrobus*) and with epiphyte and understory communities similar to those of the *High Ocotal* association, but also incorporating representative from higher elevation hardwood forests. *Pinabetales* typically are found at elavtions from 1,200 to 1,600 m within the Premontane Moist Forest and Lower Montane Moist Forest formations. Besides *P. pseudostrobus*, the pines *P. maximinoi* and *P. tecunumanii* also can be present, as might plants otherwise characteristic of both *ocotales* and mixed cloud forest. *Liquidambales* are similar in composition to *Pinabetales*, but are dominated by sweet-gums (*Liquidambar styraciflua*) and are more typical of leeward slopes than exposed ridges.

***Broadleaf Cloud Forest*** (Fig. 11A–C)**.**—This association is considered the "typical" cloud forest of the Lower Montane Wet Forest (LMWF) and Lower Montane Moist Forest (LMMF) formations, and characteristically is found at elevations from 1,500 to 2,300 m on the Caribbean versant and 1,800 to 2,600 m on the Pacific versant. This forest

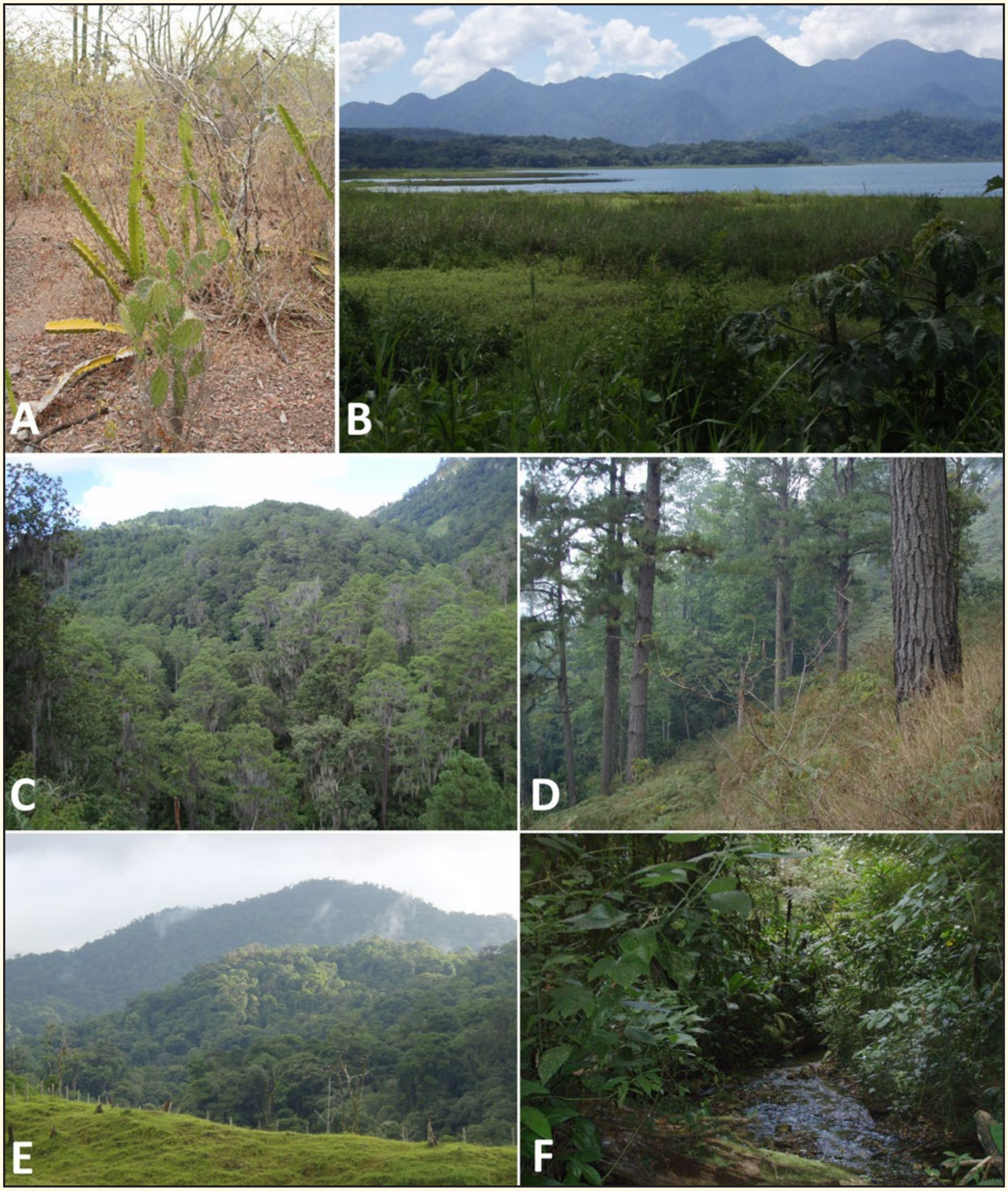

**Fig. 10.** Ecological associations of the Chortís Block II. (A) Thorn Scrub Forest, upper Valle de Aguán, northwest of Coyoles Central, Depto. Yoro, elev. 250 m; Lowland Arid Forest formation. (B) Pantano or Freshwater Marsh, northern end of Lago de Yojoa, with the Montañas de Meámbar in the background, Depto. Cortés, elev. 640 m. (C) Infrequently burned Ocotal, near Guaymas, Depto. Francisco Morazán, elev. 1,450 m; Premontane Moist Forest formation. (D) Frequently burned Ocotal, Cerro de las Cruces, Depto. Olancho, elev. 1,260 m; Premontane Moist Forest formation. (E) Broadleaf Transitional Forest, La Liberación, Refugio de Vida Silvestre Texíguat, Depto. Atlántida, elev. 1,030 m; Premontane Wet Forest formation. (F) Mixed Transitional Forest, Montaña de Jacaleapa, Depto. Olancho, elev. 1,120 m; Premontane Wet Forest formation.

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characteristically contains a high diversity of large canopy trees, with canopy heights regularly reaching 40–50 m. Typical vegetation of Broadleaf Cloud Forest in LMWF includes the trees *Alnus arguta*, *A. jorullensis*, *Cornus* sp., *Prunus* sp., *Olmediella betschieriana*, *Abies guatemalensis*, *Taxus globosa*, *Podocarpus oleifolius*, *Acalypha firmula*, *Bocona glaucifolia*, *Cleyera theaeoides*, *Weinmannia pinnata*, *W. tuerckheimii*, *Daphnopsis strigillosa*, *Fuchsia paniculata*, *F. splendens*, *Hedyosmun mexicanum*, *Hoffmannia lineolata*, *Miconia glaberina*, *Quercus cortesii*, *Q. lancifolia*, *Q. laurina*, *Rondeletia buddleioides*, *R. laniflora*, *Rubus eriocarpus*, and *Saurauia kegeliana*, the herbaceous plants *Senecio jurgensenii*, *Smilax spinosa*, *Ternstroemia megaloptycha*, *Begonia convallariodora*, *B. fusea*, *B. oaxacana*, *Cibotium regale*, *Deppea grandiflora*, *Lobelia nubicola*, *L. tatea*, *Parathesis hondurensis*, and *Peperomia* spp., and the ferns *Adiantum piretii*, *Asplenium harpeodes*, *A. olivaceum*, *A. pterocarpus*, *Blechnum lehmannii*, and *Elaphoglossum eximium* (Mejía-Ordóñez and House, 2002). From Broadleaf Cloud Forest in LMMF on the Pacific versant, Mejía-Ordóñez and House (2002) listed the following species as common in PN La Tigra in the Sierra de Lepaterique: *Mauria sessiflora*, *Ilex chiapensis, Ilex williamsii*, *Oreopanax xalapensis*, *Carpinus caroliniana* var *tropicalis*, *Weinmannia balbisina*, *Hieronyma guatemalensis*, *Hieronyma poasana*, *Quercus cortesii*, *Q. lanciflia*, *Q. laurrina*, *Q. bumelioides*, *Homalium racemosum*, *Olmediella betschieriana*, *Calatola laevigata*, *Nectandra heydeana*, *Ocotea veraguensis*, *Phoebe helicterifolia*, *Magnolia hondurensis*, *Miconia argentea*, *Guarea pittieri*, *Trophis chorizantha*, *Ardisia paschalis*, *Chamaedorea pinnatifrons*, *Clusia rosea*, *Lophosoria quadripionnata*, and *Cyathea mexicana.*

***Mixed Cloud Forest*** (Fig. 11D–G)**.**—Called *Bosque mixto* by Mejía-Valdivieso (2001), Mixed Cloud Forest typically is found within the Lower Montane Wet Forest and Lower Montane Moist Forest formations, at elevations above 1,500 m on the Caribbean versant and 1,800 m on the Pacific versant, to around 2,500 m on both versants. Trees of Mixed Cloud Forest include the pines *Pinus pseudostrobus*, *P. tecunumanii*, and *P. ayacahuite*, with a high diversity of oaks (*Quercus brumeliodes*, *Q. cortesii*, *Q. rugosa*, *Q. sapotifolia*, and *Q. acutifolia*) and other hardwoods including *Arbutus xalapensis*, *Bernoulia flamea, Brunellia mexicana*, *Clusia* spp., *Cornus discifolia*, *Cyrilla racemiflora*, *Dendropanax arboreus*, *Dendropanax hondurensis*, *Hedyosmun mexicanum*, *Magnolia* sp., *Liquidambar styraciflua*, *Myrica cerifera*, *Ocotea* sp., *Oreopanax caspitatus*, *O. xalapensis*, *O. lachnocephalus*, *Picramnia teapensis*, *Symplocos vernicosa*, *Toxicodendron striatum*, *Viasmia baccifera*, and *Weinmannia pinnata* (Mejía-Ordóñez and House, 2002). At elevations exceeding 2,300 m, particularly on Cerro Celaque and Montaña de Santa Bárbara, Laurasian trees at the southernmost extent of their range, such as firs (*Abies guatemalensis*) and yews (*Taxus globosa*), are found syntopically with Gondwanan trees at their northern distributional limit (e.g. *Podocarpus oleifolius*).

***Coniferous Cloud Forest*.**—This rarely encountered association is characterized essentially by pure stands of pines (*Pinus hartwegii*, *P. maximinoi*, and *P. ayacahuite*), as well as other conifers (*Cupressus lusitanica* and *Taxus globosa*), and is recorded from only a few drier, open ridges at elevations above 2,400 m on Cerro Celaque and Montaña de Santa Bárbara (Mejía-Valdivieso 2001). Mejía-Valdivieso (2001) called this association *Bosque de coníferas*, and described these stands as appearing to be subject to natural fires every 3–5 years. I encountered Coniferous Cloud Forest meeting this description at elevations from 1,900 to 2,100 m on the southeastern side of Montaña de Yoro, and within this recently burned high pine forest collected herpetofaunal species otherwise considered endemic to nearby Broadleaf Cloud Forest.

***Montane Mixed Forest*.**—The habitat of the uppermost reaches of LMWF (> 2,600 m) and the Montane Rainforest formation, *Bosque mixto montano alto* Mejía-Valdivieso (2001), is dominated by the primitive conifers *Abies guatemalensis*, *Taxus globosa*, and *Podocarpus oleifolius*, the pines *Pinus ayacahuite*, *P. hartwegii*, *P. maximinoi*, and *P. tecunumanii*, and the broadleaf trees *Alnus arguta*, *Cornus* sp., *Prunus* sp., *Olmediella betschieriana, Oreopanax lempirana*, *Acalypha firmula*, *Alnus jorullensis*, *Bocona glaucifolia*, *Cleyera theaeoides*, *Weinmannia pinnata*, *W. tuerckheimii*, *Daphnopsis strigillosa*, *Fuchsia paniculata*, *F. splendens*, *Hedyosmun mexicanum*, *Hoffmannia lineolata*, *Miconia glaberina*, *Quercus cortesii*, *Q. lancifolia*, *Q. laurina*, *Rondeletia buddleioides*, *R. laniflora*, *Rubus eriocarpus*, and *Saurauia kegeliana* (Mejía-Ordóñez and House, 2002). This habitat is limited to high elevations on Cerro Celaque, Cerro El Pital, and Montaña de Santa Bárbara.

***Hepatic Forest*** (Fig. 11H)**.**—A type of mountain-top dwarf forest, Hepatic or Mossy Forest (*Bosque hepático o musgoso* of Mejía-Valdivieso, 2001) that appears to be restricted to the wet upper slopes of the tallest peaks, including at least Cerro La Picucha (2,100–2,200 m) in the Sierra de Agalta, Cerro Celaque (2,700 m), and Cerro Jilinco

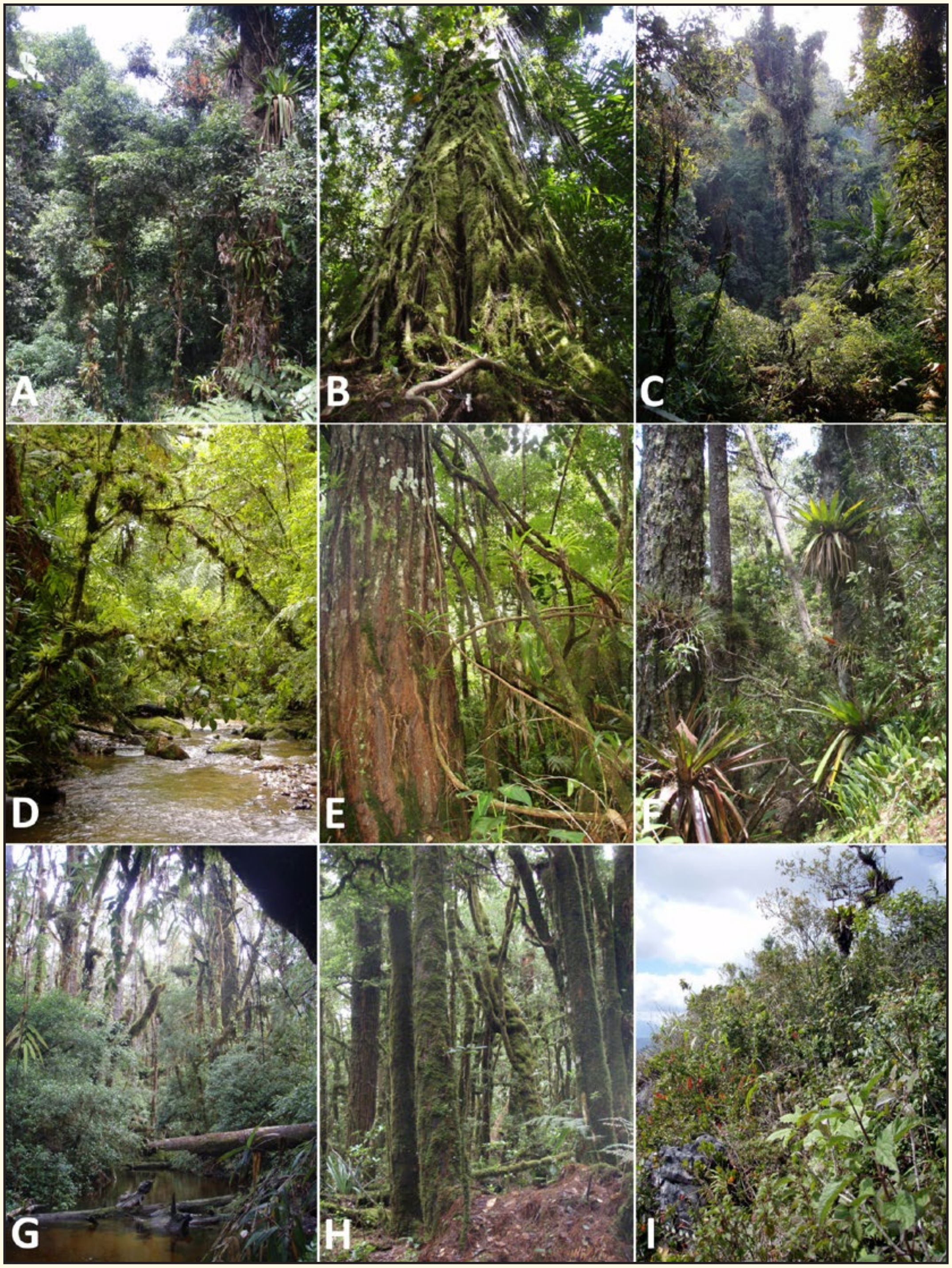

**Fig. 11.** Ecological associations of the Chortís Highlands. (A) Broadleaf Cloud Forest, above Quebrada Varsovia, Montañas de Meámbar, Depto. Comayagua, elev. 1,620 m; Lower Montane Wet Forest formation. (B) Broadleaf Cloud Forest, canyon across top of Montañas de Santa Bárbara, Depto. Santa Bárbara, elev. 2,190 m; Lower Montane Wet Forest formation. (C) Broadleaf Cloud Forest, Montaña de Botaderos, Depto. Olancho, elev. 1,715 m; Lower Montane Wet Forest formation. (D) Mixed Cloud Forest, Quebrada Cataguana, Montañas de Yoro, Depto. Francisco Morazán, elev. 1,860 m; Lower Montane Wet Forest formation. (E) Mixed Cloud Forest, Sierra de Omoa, Depto. Cortés, elev. 1,660 m; Lower Montane Wet Forest formation. (F) Mixed Cloud Forest, Sierra de Celaque, Depto. Lempira, elev. 2,130 m; Lower Montane Moist Forest formation. (G) Río Arcagual in Mixed Cloud Forest, Sierra de Celaque, Depto. Lempira, elev. 2,580 m; Lower Montane Wet Forest formation. (H) Hepatic Forest, Sierra de Celaque, Depto. Lempira, elev. 2,780 m; Montane Rainforest formation. (I) Heather Wind Scrub, Montaña Macuzal, Depto. Yoro, elev. 1,730 m; Lower Montane Wet Forest formation. 📷 © Josiah H. Townsend

(2,200 m) and Cerro Cusuco (1,990 m) in the Sierra de Omoa (Mejía-Valdivieso, 2001, Townsend and Wilson, 2008). The canopy does not exceed 10 m in height and typically is shorter, with trees taking on a twisted appearance. Nearly all of the available surface area is covered, even layered, in epiphytic plants and fungi, of which up to 50% can be liverworts (Marchantiophyta; Mejía-Valdivieso, 2001). In some cases, this luxuriant epiphytic community creates a living exoskeleton that remains long after the death and decay of the tree within. Hepatic Forest often is found in association with Heather Wind Scrub, and appears to be a transitional habitat between the exposed scrub and the cloud forest below.

***Heather Wind Scrub*** (Fig. 11I)**.**—Found on exposed portions of the highest peaks, Carr (1950) termed this wind-swept association as *Peña Wind Scrub* and variously is referred to as elfin forest or dwarf forest (Townsend and Wilson, 2006, 2008), names that somehow reflect the mystic character of these mountain-top ecosystems. Carr's (1950: 582) own description of this habitat artfully captures this character:

> "It is a seemingly incongruous combination of dwarfed and twisted microphyllous and sclerophyllous trees and shrubs, Ericaceae, Myrtiaceae, Myrsinaceae, and the like, implying xeric conditions, but with an astounding array of mosses, filmy ferns, selaginellas, and similar delicate hygrophyllous epiphytes. Although at first glance this is an altogether ill-assorted looking flora, the incongruity is only apparent, since each of the two floristic elements is in its own way adapted to withstand drastic reversals in its water economy. On these peñas the wind blows almost constantly, often violently, and while it usually brings in abundance of moisture, it imposes a heavy penalty when the supply fails for even a short period. The wind-pruned trees meet the situation by conservation of their moisture, while their cryptogamic guests yield freely to desiccation, lapsing into dormancy almost on a moment's notice, and without permanent injury."

As indicated by the name, this habitat is dominated by plants in the family Ericaceae with a 2–4 m tall "canopy," with the thick "understory" being comprised of a bewildering array of bromeliads and other epiphytes. This habitat association is known from Cerro La Picucha (2,200+ m) in the Sierra de Agalta, Cerro Azul Meámbar (1,950+ m), Cerro Celaque (various exposed ridges above 2,700 m), and Cerro Jilinco (2,240 m) and Cerro Cusuco (2,010 m) in the Sierra de Omoa (Hazlett, 1980; Mejía-Valdivieso, 2001; Townsend and Wilson, 2006). Heather Wind Scrub likely is found in at least small patches on the tops of most exposed peaks above around 1,900 m in elevation.

***Elfin Forest*****.** Herein, I use this term to describe the unique forest association found on Cerro La Picucha, in the highest portions of the Sierra de Agalta. Delineated as *Bosque enano* by Mejía-Valdivieso (2001), this habitat superficially resembles the Heather Wind Scrub in having a "canopy" not exceeding 3 m in height; however, in place of Ericaceae, this true dwarf forest is made up of twisted, epiphyte covered, bonsai-like versions of the trees *Billia hippocastanum*, *Podocarpus oleifolius*, and *Pinus hartwegii*, with exposed ground covered in clubmosses (*Huperzia* and *Lycopodium*) and dense patches of ground-dwelling tank bromeliads.

## HERPETOFAUNAL DIVERSITY OF THE CHORTÍS BLOCK

Given the wide variation in physiographic and ecological attributes that are evident in the Chortís Block, it comes as little surprise that the region also supports a rich and diverse biota. While the biotas of the Caribbean and Pacific lowlands typically are characterized as composed of relatively widespread species from both the west and south, the Chortís Highlands and associated piedmont is an area of considerable endemic biodiversity.

While investigation of the endemic fauna of the Chortís Block has been limited compared with other areas of the Neotropics, particularly southern Central America, the dedicated work of a small group of specialists has led to the documentation of endemism across a variety of taxonomic groups. Botanical data may support this better than other groups, with over 263 described endemic species found in Honduras alone (Nelson-S., 2001, 2008). Areas of elevated plant endemism include mesic highland forests and xeric intermontane valleys of the Chortís Block, and, in particular, the piedmont of the Cordillera Nombre de Dios (Nelson-S., 2008). Despite the high degree of localized plant endemism seen across the Chortís Block, to date there has been no published analysis of biogeographic patterns among these taxa. Over 166 native freshwater fishes have been documented from Honduras, including three described and at least six undescribed endemic species (Martin, 1972; Matamoros et al., 2009; Matamoros and Schaefer, 2010). Among terrestrial vertebrates, birds (one species; Monroe, 1968) and mammals (three species; Goodwin, 1942; Reid 2009) stand out in having very few described endemic species; however, at least for mammals, this low level of endemism almost certainly is an artifact of a lack of focused sampling in the molecular age, particularly for small mammals, by systematic mammalogists in the Chortís Block.

The herpetofauna, the amphibians and reptiles, provides the best opportunity for elucidating patterns of evolutionary diversification in the Chortís Block. My goal in the section below is to synthesize the available data for the Chortís Block herpetofauna, drawing first from a considerable regional literature base. These available data are augmented by the results of sampling efforts from 2006 to 2014 in Honduras and Nicaragua, and presented to provide the basis from which to further investigate herpetofaunal diversity and assess research and conservation priorities moving forward.

## Composition of the Herpetofauna

The native, non-marine herpetofauna of the Chortís Block is comprised of 397 species in 47 families, including 146 species of amphibians and 251 of reptiles (Tables 2, 3). The Chortís Block herpetofauna comprises approximately 2.3% of the global herpetofaunal species diversity (17,385 species as of 17 November 2014; 7,347 amphibians [AmphibiaWeb, 2014], 10,038 reptiles [Uetz and Hošek, 2014]). This includes 2.0% of the global amphibians, with 1% of the caecilians, 6.4% of the salamanders, and 1.6% of the anurans, along with 2.5% of the global reptiles, with 3.5% of the turtles, 8.0% of the crocodilians, and 2.5% of the squamates (1.6% of the lizards and 4.1% of the snakes).

Within Mesoamerica (considered in this discussion to include Mexico and Central America), the Chortís Block herpetofauna contains approximately 19.7% of the regional herpetofauna (Wilson and Johnson, 2010; Mesoamerican Herpetology, 2014). This includes 18.5% of the Mesoamerican amphibian species, with 12.5% of the caecilians, 15.3% of the salamanders, and 20.5% of the anurans, and 20.6% of the reptiles, including 26.1% of the turtles, two of three crocodilian species, and 20.3% of the squamates.

## Patterns of Distribution and Endemism within the Chortís Block

Within the Chortís Block, species were considered to occur within one of eight physiographic regions: the Caribbean Lowlands, Caribbean Versant Intermontane Valleys, Northern Cordillera of the Chortís Highlands, Central Cordillera of the Chortís Highlands, Southern Cordillera of the Chortís Highlands, Pacific Lowlands, Pacific Versant Intermontane Valleys, and Islas de la Bahía (Fig. 5; Tables 3, 4). The Caribbean Lowlands contain the highest diversity, with 191 species, with the Northern Cordillera being the most diverse portion of the Chortís Highlands, with 164 species (Tables 3, 4).

The majority of amphibians (52%) that occur in the Chortís Block are endemic, i.e., restricted in distribution to within the Chortís Block, with a lesser share of reptiles (29%) being endemic (Table 2). The salamanders exhibit a particularly high degree of endemism, with 37 of 43 species (86%) being Chortís Block endemics (Tables 2, 3). A large share of the named anuran species (38%) are also endemic (Tables 2, 3). Endemism in reptiles also is high (29%), particularly among the lizards, with 43% of species endemic to the Chortís Block.

## Conservation Status

A startling portion of the Chortís Block herpetofauna is threatened at the local, regional, and global levels (Tables 2, 3). At least 42% of the entire herpetofauna is endangered at a globally significant level (listed in one of the top three threat categories on the IUCN Red List: Critically Endangered, Endangered, or Vulnerable), including an alarming 74% of the salamanders (Table 2). Although not surprising given their typically narrow geographic distributions, 94% of all the species endemic to the Chortís Block also are listed in the top three IUCN Red List categories, with 41.6% of the endemic species listed in the highest risk category: Critically Endangered (Table 2). Regionally, the Conservation Status Score (CSS) was used to gauge the relative degree of threat facing members of the Chortís Block herpetofauna. Two hundred twenty-five species (56.7% of Chortís Block herpetofauna) were assessed a CSS between 3 and 11, placing them in the category of "Very High conservation significance," the highest risk category employed at the Mesoamerican scale by Wilson and Townsend (2010). Within the Chortís Block, the Environmental Vulnerability Score (EVS) was used to provide a local-scale measure of the relative degree of threat facing herpetofaunal species. Results of the EVS indicated an elevated degree of susceptibility to degradation for the Chortís Block herpetofauna, with 153 species (38.5%) assessed an EVS from 14 to 19, placing them in the "high vulnerability" category (Townsend and Wilson, 2010a).

**Table 2.** Summary of endemic and conservation priority herpetofaunal diversity in the Chortís Block.

| | Families | Genera | Species | Endemic Species (% of endemic species) | Critically Endangered/ Extinct Species | Endangered Species | Vulnerable Species | Total % of EX/CR/EN/ VU Species | Total % of EX/CR/EN/ VU Endemic Species |
|---|---|---|---|---|---|---|---|---|---|
| Gymnophiona | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 50% | – |
| Caudata | 1 | 5 | 43 | 37 (86%) | 17 | 13 | 2 | 74% | 86% |
| Anura | 10 | 34 | 101 | 38 (38%) | 27 | 14 | 3 | 44% | 95% |
| AMPHIBIA | 12 | 41 | 146 | 75 (52%) | 44 | 27 | 6 | 53% | 91% |
| Crocodylia | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 50% | – |
| Testudines | 5 | 5 | 12 | 0 | 0 | 0 | 1 | 10% | – |
| Squamata: Sauria | 17 | 27 | 95 | 41 (43%) | 9 | 29 | 7 | 47% | 100% |
| Squamata: Serpentes | 11 | 65 | 142 | 33 (23%) | 9 | 20 | 13 | 30% | 94% |
| REPTILIA | 35 | 99 | 251 | 74 (29%) | 18 | 49 | 22 | 35% | 97% |
| **Totals** | **47** | **140** | **397** | **149 (38%)** | **62** | **76** | **28** | **42%** | **94%** |

**Table 3.** Conservation status and physiographic distribution of the native non-marine herpetofauna of the Chortís Block. Data were sourced from Acevedo et al. (2010), Sunyer and Köhler (2010), Townsend and Wilson (2010a, b), Wilson and Johnson (2010), McCranie (2011), Solís et al. (2014), and my own observations. IUCN Red List status follows the IUCN (2014; www.iucnredlist.org) when available; other sources indicated in footnotes. Elevational Distributions are range-wide and not confined to the Chortís Highlands, except where upper elevation ranges exceed the highest elevation. General Distribution categories are delimited as follows: CB-SS = endemic to the vicinity of a single site in the Chortís Block, CB = endemic to the Chortís Block, WS = widespread, with distribution extending outside the Chortís Block. Physiographic distribution includes: CL = Caribbean Lowlands physiographic province, CV = Caribbean versant intermontane valleys, NC = Northern Cordillera of the *Serranía*, CC = Central Cordillera of the *Serranía*, SC = Southern Cordillera of the *Serranía*, PL = Pacific Lowlands physiographic province, PV = Pacific versant intermontane valleys, IB = Islas de la Bahía; a plus (+) indicates the taxon is found within the province.

| Taxon | IUCN Red List Status | CSS | EVS | Elevational Distribution (m) | General Distribution | CL | CV | NC | CC | SC | PL | PV | IB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GYMNOPHIONA | | | | | | | | | | | | | |
| **Dermophiidae (2)** | | | | | | | | | | | | | |
| *Dermophis mexicanus* | Vulnerable A2ac[1] | 20 | 12 | 0–1,500 | WS | + | + | | | | + | | |
| *Gymnopis multiplicata* | Least Concern[1] | 14 | 12 | 0–1,400 | WS | + | + | | | | | | |
| CAUDATA | | | | | | | | | | | | | |
| **Plethodontidae (43)** | | | | | | | | | | | | | |
| *Bolitoglossa carri* | Critically Endangered B1ab(iii)+2ab(iii)[1] | 3 | 17 | 1,840–2,070 | CH-SS | | | | | + | | | |
| *Bolitoglossa cataguana* | Critically Endangered B1ab(iii)+2ab(iii)[2] | 3 | 16 | 1,800–2,080 | CH-SS | | | | + | | | | |
| *Bolitoglossa celaque* | Endangered B1ab(iii)[1] | 3 | 16 | 1,900–2,820 | CH | | | | | + | | | |
| *Bolitoglossa conanti* | Endangered B1ab(iii)[1] | 5 | 14 | 950–2,010 | CH | | | + | | + | | | |
| *Bolitoglossa decora* | Critically Endangered B1ab(iii)+2ab(iii)[1] | 3 | 17 | 1,430–1,550 | CH-SS | | | | + | | | | |
| *Bolitoglossa diaphora* | Critically Endangered B2ab(iii)[1] | 3 | 16 | 1,470–2,200 | CH-SS | | | + | | | | | |

| Taxon | IUCN Red List Status | CSS | EVS | Elevational Distribution (m) | General Distribution | CL | CV | NC | CC | SC | PL | PV | IB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Bolitoglossa dofleini* | Near Threatened[1] | 10 | 14 | 100–1,550 | WS | + |  | + | + |  |  |  |  |
| *Bolitoglossa dunni* | Endangered B1ab(iii)[1] | 5 | 14 | 1,020–1,600 | CH |  |  | + |  |  |  |  |  |
| *Bolitoglossa heiroreias* | Endangered B1ab(iii)[1] | 5 | 15 | 1,840–2,300 | CH-SS |  |  |  |  | + |  |  |  |
| *Bolitoglossa longissima* | Critically Endangered B1ab(iii)[1] | 3 | 17 | 1,840–2,240 | CH-SS | + |  |  | + |  |  |  |  |
| *Bolitoglossa mexicana* | Least Concern[1] | 14 | 9 | 0–1,900 | WS | + | + | + | + |  |  |  |  |
| *Bolitoglossa nympha* | Near Threatened[3] | 6[3] | 12[3] | 30–1,400 | CH | + |  | + | + |  |  |  |  |
| *Bolitoglossa oresbia* | Critically Endangered B1ab(iii)+2ab(iii)[1] | 3 | 17 | 1,560–1,880 | CH |  |  |  | + |  |  |  |  |
| *Bolitoglossa porrasorum* | Endangered B1ab(iii)[1] | 4 | 15 | 980–1,920 | CH |  |  | + | + |  |  |  |  |
| *Bolitoglossa striatula* | Least Concern[1] | 10 | 14 | 2–1,055 | WS | + |  |  |  |  |  |  |  |
| *Bolitoglossa synoria* | Critically Endangered B1ab(iii)[1] | 4 | 15 | 2,150–2,715 | CH-SS |  |  |  |  | + |  |  |  |
| *Cryptotriton monzoni* | Critically Endangered B1ab(iii)[1] | 3 | 17[4] | 1,570 | CH-SS |  |  | + |  |  |  |  |  |
| *Cryptotriton nasalis* | Endangered B1ab(iii)[1] | 5 | 15 | 1,220–2,200 | CH |  |  | + |  |  |  |  |  |
| *Cryptotriton necopinus* | Critically Endangered B1ab(iii)+2ab(iii)[3] | 3 | 16 | 1,880 | CH-SS |  |  |  | + |  |  |  |  |
| *Dendrotriton sanctibarbarus* | Endangered B1ab(iii)[2] [Vulnerable D2[1]] | 3 | 16 | 1,830–2,744 | CH-SS |  |  |  | + |  |  |  |  |
| *Nototriton barbouri* | Endangered B1ab(iii)[1] | 3 | 15 | 1,530–1,920 | CH |  |  |  | + |  |  |  |  |
| *Nototriton brodiei* | Critically Endangered B1ab(iii)[1] | 3 | 17 | 875–1,140 | CH |  |  | + |  |  |  |  |  |
| *Nototriton lignicola* | Critically Endangered B1ab(iii)[1] | 3 | 17 | 1,760–2,020 | CH |  |  |  | + |  |  |  |  |
| *Nototriton limnospectator* | Endangered B1ab(iii)[1] | 3 | 16 | 1,640–1,980 | CH |  |  |  | + |  |  |  |  |
| *Nototriton mime* | Critically Endangered B1ab(iii)[3] | 3[3] | 17[3] | 1,700–1,735 | CH-SS |  |  |  | + |  |  |  |  |
| *Nototriton picucha* | Critically Endangered B1ab(iii)[3] | 3[3] | 17[3] | 1,890–1,920 | CH-SS |  |  |  | + |  |  |  |  |
| *Nototriton saslaya* | Vulnerable D2[1] | 3 | 17[5] | 1,280–1,500 | CH-SS |  |  |  |  | + |  |  |  |
| *Nototriton stuarti* | Data Deficient[1] | 3 | 17[4] | 744 | CH-SS |  |  | + |  |  |  |  |  |
| *Nototriton tomamorum* | Critically Endangered B1ab(iii)+2ab(iii)[2] | 3[3] | 17[3] | 1,550 | CH-SS |  |  | + |  |  |  |  |  |
| *Oedipina chortiorum* | Data Deficient[3] | 5[3] | 14[3] | 1,460–1,550 | CH |  |  |  |  | + |  |  |  |
| *Oedipina elongata* | Least Concern[1] | 9 | 15 | 10–770 | WS | + |  | + |  |  |  |  |  |
| *Oedipina gephyra* | Critically Endangered B1ab(iii)+2ab(iii)[3] [Endangered B1ab(iii)[1]] | 3 | 16 | 1,580–1,810 | CH-SS |  |  | + |  |  |  |  |  |
| *Oedipina ignea* | Data Deficient[1] | 7 | 14 | 1,000–2,000 | WS |  |  |  |  | + |  |  |  |
| *Oedipina kasios* | Endangered B1ab(iii)[2] | 4 | 15 | 950–1,920 | CH |  |  |  | + |  |  |  |  |

| Taxon | IUCN Red List Status | CSS | EVS | Elevational Distribution (m) | General Distribution | CL | CV | NC | CC | SC | PL | PV | IB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Oedipina koehleri* | Endangered B1ab(iii)[3] | 3[3] | 15[3] | 628–945 | CH | | | | | + | | | |
| *Oedipina leptopoda* | Endangered B1ab(iii)[2] | 3 | 15 | 700–1,300 | CH | | | | + | | | | |
| *Oedipina motaguae* | Data Deficient[3] | 3[3] | 17[3] | 100–240 | CH-SS | | + | | | | | | |
| *Oedipina nica* | Endangered B1ab(iii)[3] | 3[3] | 15[3] | 1,360–1,660 | CH | | | | | + | | | |
| *Oedipina petiola* | Critically Endangered B1ab(iii)[3] | 3[3] | 17[3] | 1,580 | CH-SS | | | + | | | | | |
| *Oedipina quadra* | Vulnerable B1ab(iii)[2] | 3 | 15 | 70–540 | CH | + | | + | + | | | | |
| *Oedipina stuarti* | Data Deficient[1] | 6 | 15 | 0–1,000 | CH | | | | | | + | + | |
| *Oedipina taylori* | Least Concern[1] | 8 | 15 | 140–1,140 | WS | | | | | | | + | |
| *Oedipina tomasi* | Critically Endangered B2ab(iii)[1] | 3 | 16 | 1,800 | CH-SS | | | + | | | | | |
| **ANURA** | | | | | | | | | | | | | |
| **Bufonidae (10)** | | | | | | | | | | | | | |
| *Atelophryniscus chrysophorus* | Endangered A2ac & B1ab(iii,v)[1] | 4 | 12 | 750–1,760 | CH | | | + | | | | | |
| *Incilius campbelli* | Near Threatened[1] | 11 | 10 | 70–1,200 | WS | + | | + | | | | | |
| *Incilius coccifer* | Least Concern[1] | 15 | 6 | 0–1,350 | WS | | + | | + | + | + | + | |
| *Incilius ibarrai* | Endangered B1ab(iii)[1] | 7 | 11 | 1,500–1,730 | WS | | | + | | | + | + | |
| *Incilius leucomyos* | Endangered B1ab(iii)[1] | 6 | 11 | 0–1,600 | CH | + | | + | + | | | | |
| *Incilius luetkenii* | Least Concern[1] | 16 | 7 | 0–1,300 | WS | | + | | + | + | + | + | |
| *Incilius porteri* | Endangered B1ab(iii)[3] [Data Deficient[1]] | 3 | 13 | 1,524–1,890 | CH | | | | | + | + | | |
| *Incilius valliceps* | Least Concern[1] | 26 | 5 | 0–2,000 | WS | + | + | + | + | + | | + | |
| *Rhaebo haematiticus* | Least Concern[1] | 12 | 11 | 0–1,300 | WS | + | | | | | | | |
| *Rhinella marina* | Least Concern[1] | 35 | 5 | 0–2,000 | WS | + | + | + | + | + | + | + | + |
| **Centrolenidae (8)** | | | | | | | | | | | | | |
| *Cochranella granulosa* | Least Concern[1] | 11 | 12 | 0–1,500 | WS | + | | | | | | | |
| *Espadarana prosoblepon* | Least Concern[1] | 14 | 12 | 0–1,900 | WS | + | | | | | | | |
| *Hyalinobatrachium chirripoi* | Near Threatened[1] | 9 | 12 | 0–700 | WS | | | | + | | | | |
| *Hyalinobatrachium colymbiphyllum* | Least Concern[1] | 10 | 12 | 0–1,710 | WS | + | | | | | | | |
| *Hyalinobatrachium fleischmanni* | Least Concern[1] | 27 | 9 | 0–1,730 | WS | + | + | + | + | + | | | |
| *Sachatamia albomaculata* | Least Concern[1] | 12 | 12 | 0–1,500 | WS | + | | + | + | | | | |
| *Teratohyla pulverata* | Least Concern[1] | 11 | 12 | 0–950 | WS | + | | + | + | | | | |
| *Teratohyla spinosa* | Least Concern[1] | 9 | 13 | 0–560 | WS | + | | | | | | | |
| **Craugastoridae (32)** | | | | | | | | | | | | | |
| *Craugastor anciano* | Critically Endangered B1ab(iii,v)+2ab(iii,v)[1] | 4 | 15 | 1,400–1,840 | CH | | | | | + | | | |

| Taxon | IUCN Red List Status | CSS | EVS | Elevational Distribution (m) | General Distribution | CL | CV | NC | CC | SC | PL | PV | IB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Craugastor aurilegulus* | Endangered B1ab(iii,v)+2ab(iii,v)[1] | 6 | 14 | 50–1,550 | CH | + |  | + |  |  |  |  |  |
| *Craugastor bransfordii* | Least Concern[1] | 10 | 11[5] | 20–1,535 | WS | + |  |  |  |  |  |  |  |
| *Craugastor chac* | Near Threatened[1] | 8 | 14 | 0–1,000 | WS | + |  |  |  |  |  |  |  |
| *Craugastor charadra* | Endangered B1ab (iii, v)[1] | 7 | 13 | 30–1,370 | CH | + |  | + |  |  |  |  |  |
| *Craugastor chrysozetetes* | EXTINCT[1] | 3 | 17 | 880–1,130 | CH |  |  | + |  |  |  |  |  |
| *Craugastor coffeus* | Critically Endangered B1ab(iii) + 2ab(iii)[1] | 3 | 17 | 1,000 | CH |  |  | + |  |  |  |  |  |
| *Craugastor cruzi* | Critically Endangered A2ace, B1ab(iii,v) +2ab(iii,v)[1] | 3 | 17 | 1,520 | CH-SS |  |  | + |  |  |  |  |  |
| *Craugastor cyanochthebius* | Critically Endangered B1ab(iii)+2ab(iii)[2] [Near Threatened[1]] | 3 | 17 | 900–1,200 | CH |  |  | + |  |  |  |  |  |
| *Craugastor emleni* | Critically Endangered A2ace, B2ab(v)[1] | 3 | 14 | 800–2,000 | CH |  |  |  |  |  |  | + |  |
| *Craugastor epochthidius* | Critically Endangered A3ce[1] | 5 | 15 | 150–1,450 | CH |  |  |  | + |  |  |  |  |
| *Craugastor fecundus* | Critically Endangered A2ace[1] | 5 | 15 | 200–1,260 | CH |  |  | + |  |  |  |  |  |
| *Craugastor fitzingeri* | Least Concern[1] | 14 | 13 | 1–1,520 | WS | + |  | + |  |  |  |  |  |
| *Craugastor laevissimus* | Endangered A2ace[1] | 11 | 8 | 0–2,000 | CH | + |  | + | + | + |  | + |  |
| *Craugastor laticeps* | Near Threatened[1] | 13 | 14 | 10–1,600 | WS |  |  | + | + |  |  |  |  |
| *Craugastor lauraster* | Endangered B1ab(iii) [1] | 6 | 14 | 40–1,200 | CH | + |  |  | + | + |  |  |  |
| *Craugastor loki* | Least Concern[1] | 16 | 14 | 0–1,370 | WS | + |  |  |  |  |  |  |  |
| *Craugastor megacephalus* | Least Concern[1] | 10 | 14 | 1–1,200 | WS | + |  |  |  |  |  |  |  |
| *Craugastor merendonensis* | Critically Endangered A2ace, B1ab(v)+ 2ab(v)[1] | 3 | 17 | 150–200 | CH-SS | + |  |  |  |  |  |  |  |
| *Craugastor milesi* | Critically Endangered A2ae[1] | 4 | 15 | 1,050–1,720 | CH |  |  | + |  |  |  |  |  |
| *Craugastor mimus* | Least Concern[1] | 9 | 13 | 15–700 | WS | + |  |  |  |  |  |  |  |
| *Craugastor nefrens* | Data Deficient[1] | 3 | 17[4] | 800–1,000 | CH |  |  | + |  |  |  |  |  |
| *Craugastor noblei* | Least Concern[1] | 11 | 13 | 4–1,200 | WS | + |  | + | + |  |  |  |  |
| *Craugastor olanchano* | Critically Endangered A2ace[1] | 3 | 16 | 1,180–1,350 | CH |  |  |  |  |  |  |  |  |
| *Craugastor omoaensis* | Critically Endangered A2ace, B1ab(iii)[1] | 3 | 16 | 760–1,150 | CH-SS |  |  | + |  |  |  |  |  |
| *Craugastor pechorum* | Endangered B1ab(iii)[1] | 5 | 15 | 150–680 | CH |  |  |  | + |  |  |  |  |
| *Craugastor rostralis* | Near Threatened[1] | 6 | 14 | 850–1,800 | WS |  |  | + | + |  |  |  |  |
| *Craugastor rupinius* | Least Concern[1] | 9 | 13 | 200–1,900 | CH |  |  |  |  | + |  |  |  |
| *Craugastor saltuarius* | Critically Endangered A2ace[1] | 3 | 16 | 1550–1,800 | CH-SS |  |  | + |  |  |  |  |  |

| Taxon | IUCN Red List Status | CSS | EVS | Elevational Distribution (m) | General Distribution | CL | CV | NC | CC | SC | PL | PV | IB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Craugastor stadelmani* | Critically Endangered A2ace[1] | 4 | 15 | 1125–1,900 | CH | | | + | + | | | | |
| *Pristimantis cerasinus* | Least Concern[1] | 9 | 14 | 19–680 | WS | + | | | + | | | | |
| *Pristimantis ridens* | Least Concern[1] | 12 | 12 | 0–1,600 | WS | + | | + | + | | | | |
| **Eleutherodactylidae (1)** | | | | | | | | | | | | | |
| *Diasporus diastema* | Least Concern[1] | 11 | 14 | 0–1,620 | WS | + | | | | | | | |
| **Hylidae (35)** | | | | | | | | | | | | | |
| *Agalychnis callidryas* | Least Concern[1] | 17 | 10 | 0–1,200 | WS | + | + | + | + | + | | | |
| *Agalychnis moreletii* | Critically Endangered A3e[1] | 19 | 13 | 200–2,130 | WS | | | + | + | + | | | |
| *Agalychnis saltator* | Least Concern[1] | 9 | 13 | 0–819 | WS | + | | | | | | | |
| *Anotheca spinosa* | Least Concern[1] | 11 | 15 | 95–2,068 | WS | + | | | | | | | |
| *Bromeliohyla bromeliacia* | Endangered A2ace[1] | 8 | 15 | 900–1,790 | WS | | | + | | | | | |
| *Cruziohyla calcarifer* | Least Concern[1] | 9 | 12 | 30–820 | WS | + | | | | | | | |
| *Dendropsophus ebraccatus* | Least Concern[1] | 16 | 11 | 0–1,320 | WS | + | | | | | | | |
| *Dendropsophus microcephalus* | Least Concern[1] | 19 | 5 | 0–1,200 | WS | + | + | + | + | + | | + | + |
| *Duellmanohyla salvavida* | Critically Endangered B2ab(iii,v)[1] | 5 | 12 | 90–1,400 | CH | | | + | | | | | |
| *Duellmanohyla soralia* | Critically Endangered B2ab(iii,v)[1] | 7 | 10 | 40–1,570 | CH | | | + | | | | | |
| *Ecnomiohyla miliaria* | Vulnerable; B1ab(iii)[1] | 9 | 15 | 0–1,330 | WS | + | | | | | | | |
| *Ecnomiohyla salvaje* | Critically Endangered B1ab(iii)[1] | 5 | 16 | 1,370–1,520 | CH | | | + | | | | | |
| *Exerodonta catracha* | Endangered B1ab(iii)+2ab(iii)[1] | 3 | 13 | 1,800–2,160 | CH | | | | + | + | | | |
| *Isthmohyla insolita* | Critically Endangered B1ab(iii)+2ab(iii)[1] | 3 | 16 | 1,550 | CH-SS | | | + | | | | | |
| *Isthmohyla melacaena* | Critically Endangered B2ab(iv)[2]<br>[Near Threatened[1]] | 3 | 16 | 1,550 | CH | | | + | | | | | |
| *Plectrohyla chrysopleura* | Critically Endangered A2ace, B1ab(iii,v)+ 2ab(iii,v)[1] | 4 | 13 | 930–1,550 | CH | | | + | | | | | |
| *Plectrohyla dasypus* | Critically Endangered A2ace, B1ab(iii,v) +2ab(iii,v)[1] | 3 | 13 | 1,410–1,990 | CH-SS | | | + | | | | | |
| *Plectrohyla exquisita* | Critically Endangered A3e[1] | 3 | 13 | 1,490–1,680 | CH-SS | | | + | | | | | |
| *Plectrohyla guatemalensis* | Critically Endangered A3e[1] | 11 | 9 | 900–2,800 | WS | | | + | + | + | | | |
| *Plectrohyla hartwegi* | Critically Endangered A3e[1] | 9 | 12 | 925–2,700 | WS | | | | | + | | | |
| *Plectrohyla matudai* | Vulnerable B1ab(iii)[1] | 8 | 10 | 700–2,300 | WS | | | + | | + | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Plectrohyla psiloderma* | Endangered B1ab(iii)[1] | 4 | 12 | 2,400–2,530 |  |  |  |  |  | + |  |  |  |
| *Ptychohyla euthysanota* | Near Threatened[1] | 10 | 11[4] | 200–2,200 | WS |  |  |  |  | + |  |  |  |
| *Ptychohyla hypomykter* | Critically Endangered A3e[1] | 11 | 9 | 340–2,070 | CH |  |  | + | + | + |  |  |  |
| *Ptychohyla salvadorensis* | Endangered B1ab(iii)[1] | 8 | 11 | 700–2,050 | CH |  |  |  |  | + |  |  |  |
| *Ptychohyla spinipollex* | Endangered B1ab(iii)+2ab(iii)[1] | 6 | 11 | 160–1,580 | CH |  |  | + |  |  |  |  |  |
| *Scinax boulengeri* | Least Concern[1] | 11 | 11 | 0–700 | WS | + |  |  |  |  |  |  |  |
| *Scinax staufferi* | Least Concern[1] | 25 | 5 | 0–1,530 | WS | + | + | + | + | + | + | + | + |
| *Smilisca baudinii* | Least Concern[1] | 30 | 4 | 0–1,925 | WS | + | + | + | + | + | + | + | + |
| *Smilisca phaeota* | Least Concern[1] | 11 | 10 | 0–1,116 | WS | + |  |  | + |  |  |  |  |
| *Smilisca sordida* | Least Concern[1] | 13 | 11 | 0–1,525 | WS | + |  |  |  |  |  |  |  |
| *Tlalocohyla loquax* | Least Concern[1] | 18 | 6 | 0–1,585 | WS | + | + |  | + | + |  | + |  |
| *Tlalocohyla picta* | Least Concern[1] | 15 | 9 | 0–1,300 | WS | + | + |  |  |  |  |  |  |
| *Trachycephalus typhonius* | Least Concern[1] | 25 | 5 | 0–1,610 | WS | + | + |  |  |  | + |  |  |
| *Triprion petasatus* | Least Concern[1] | 12 | 12 | 0–740 | WS |  |  |  | + |  |  |  |  |
| **Leiuperidae (1)** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *Engytomops pustulosus* | Least Concern[1] | 24 | 6 | 0–1,540 | WS |  | + |  | + | + | + | + |  |
| **Leptodactylidae (4)** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *Leptodactylus fragilis* | Least Concern[1] | 25 | 6 | 0–1,700 | WS | + | + | + | + | + | + | + |  |
| *Leptodactylus melanonotus* | Least Concern[1] | 25 | 6 | 0–1,440 | WS | + | + |  | + |  | + | + | + |
| *Leptodactylus savagei* | Least Concern[1] | 15 | 11 | 0–1,200 | WS | + |  |  |  |  |  |  |  |
| *Leptodactylus silvanimbus* | Critically Endangered B2ab(iii,v)[1] | 4 | 13 | 1,470–2,000 | CH |  |  |  |  | + |  |  |  |
| **Microhylidae (3)** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *Gastrophryne elegans* | Least Concern[1] | 13 | 11 | 0–1,500 | WS | + |  |  |  |  |  |  |  |
| *Hypopachus barberi* | Vulnerable B1ab(iii)[1] | 10 | 11 | 1,300–2,500 | WS |  |  |  |  | + |  |  |  |
| *Hypopachus variolosus* | Least Concern[1] | 31 | 6 | 0–2,200 | WS |  | + | + | + | + |  | + |  |
| **Ranidae (6)** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *Lithobates brownorum* | Least Concern[1] | 18 | 3 | 0–1,200 | WS | + | + | + | + |  |  |  |  |
| *Lithobates forreri* | Least Concern[1] | 20 | 8 | 0–1,960 | WS |  |  |  |  |  | + | + |  |
| *Lithobates maculatus* | Least Concern[1] | 16 | 6 | 40–2,849 | WS | + |  | + | + | + |  |  |  |
| *Lithobates taylori* | Least Concern[1] | 7[3] | 12 | 10–1,200 | WS |  |  |  | + | + |  |  |  |
| *Lithobates vaillanti* | Least Concern[1] | 21 | 7 | 0–990 | WS | + |  | + | + |  |  |  | + |
| *Lithobates warszewitschii* | Near Threatened[1] | 13 | 11 | 0–2,500 | WS | + |  |  |  |  |  |  |  |
| **Rhinophrynidae (1)** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *Rhinophrynus dorsalis* | Least Concern[1] | 18 | 9 | 0–700 | WS | + | + |  |  |  |  |  |  |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **REPTILIA** | | | | | | | | | | | | | |
| TESTUDINES | | | | | | | | | | | | | |
| **Chelydridae (2)** | | | | | | | | | | | | | |
| *Chelydra acutirostris* | Data Deficient[3] | 12 | 13 | 0–1,164 | WS | + | + | | | | | | |
| *Chelydra rossignonii* | Vulnerable A2d[1] | 11 | 14 | 0–660 | WS | + | + | | | | | | |
| **Emydidae (3)** | | | | | | | | | | | | | |
| *Trachemys emolli* | Least Concern[3] | 5 | 12 | 0–75 | WS | | | | | | + | | |
| *Trachemys grayi* | Least Concern[3] | 6 | 11 | 0–200 | WS | | | | | | + | | |
| *Trachemys venusta* | Near Threatened[2] | 26 | 14 | 0–650 | WS | + | + | | | | | | |
| **Geoemydidae (4)** | | | | | | | | | | | | | |
| *Rhinoclemmys annulata* | Lower Risk/Near Threatened[1] | 11 | 13 | 2–920 | WS | | | | | | | | |
| *Rhinoclemmys areolata* | Near Threatened[1] | 12 | 12 | 0–600 | WS | | + | | | | | | |
| *Rhinoclemmys funerea* | Lower Risk/Near Threatened[1] | 7 | 16 | 2–600 | WS | | | | | | | | |
| *Rhinoclemmys pulcherrima* | Near Threatened[2] | 19 | 9 | 0–1,480 | WS | | + | | | | + | + | |
| **Kinosternidae (2)** | | | | | | | | | | | | | |
| *Kinosternon leucostomum* | Least Concern[2] | 21 | 9 | 0–1,500 | WS | + | + | | | | | | |
| *Kinosternon scorpioides* | Least Concern[2] | 24 | 9 | 0–1,500 | WS | + | | | | | + | | |
| **Staurotypidae (1)** | | | | | | | | | | | | | |
| *Staurotypus triporcatus* | Lower Risk/Near Threatened[1] | 10 | 15 | 0–300 | WS | + | | | | | | | |
| CROCODILIA | | | | | | | | | | | | | |
| **Alligatoridae (1)** | | | | | | | | | | | | | |
| *Caiman crocodilus* | Least Concern[2] [Lower risk/least concern[1]] | 15 | 16 | 0–300 | WS | + | | | | | + | | |
| **Crocodylidae (1)** | | | | | | | | | | | | | |
| *Crocodylus acutus* | Vulnerable A1ac[1] | 22 | 13 | 0–650 | WS | + | + | | | | + | | + |
| **SQUAMATA: LIZARDS** | | | | | | | | | | | | | |
| **Anguidae (3)** | | | | | | | | | | | | | |
| *Abronia montecristoi* | Endangered B1ab(iii)[1] | 4 | 15 | 1,370 | CH | | | + | | + | | | |
| *Abronia salvadorensis* | Endangered B1ab(iii)[1] | 3 | 16 | 2,020–2,125 | CH | | | | | + | | | |
| *Mesaspis moreletii* | Least Concern[2] | 13 | 13 | 1,450–2,849 | WS | | | + | + | + | | | |
| **Corytophanidae (7)** | | | | | | | | | | | | | |
| *Basiliscus plumifrons* | Least Concern[1] | 11 | 13 | 0–780 | WS | + | | | | | | | |
| *Basiliscus vittatus* | Least Concern[2] | 25 | 7 | 0–1,500 | WS | + | + | + | + | + | + | + | + |
| *Corytophanes cristatus* | Least Concern[2] | 20 | 11 | 0–1,640 | WS | + | | + | | | | | |

| **Taxon** | **IUCN Red List Status** | **CSS** | **EVS** | **Elevational Distribution (m)** | **General Distribution** | **CL** | **CV** | **NC** | **CC** | **SC** | **PL** | **PV** | **IB** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Corytophanes hernandesii* | Least Concern$^2$ | 14 | 12 | 0–1,400 | WS |  | + |  |  |  |  |  |  |
| *Corytophanes percarinatus* | Vulnerable B1ab(iii)$^2$ | 11 | 14 | 200–2,200 | CH |  |  |  |  | + |  |  |  |
| *Laemanctus longipes* | Least Concern$^1$ | 17 | 9 | 0–1,200 | WS | + | + |  |  |  |  |  |  |
| *Laemanctus serratus* | Least Concern$^1$ | 17 | 12 | 0–1,600 | WS |  |  |  |  |  |  | + |  |
| **Dactyloidae: (38)** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *Anolis allisoni* | Least Concern$^2$ | 7 | 13 | 0–30 | WS |  |  |  |  |  |  |  | + |
| *Norops amplisquamosus* | Endangered B1ab(iii, v)$^1$ | 3 | 16 | 1,530–2,200 | CH-SS |  |  | + |  |  |  |  |  |
| *Norops beckeri* | Least Concern$^2$ | 22 | 11 | 0–1,780 | WS | + | + |  |  |  |  |  |  |
| *Norops bicaorum* | Endangered B2ab(iii)$^2$ | 3 | 16 | 0–20 | CH |  |  |  |  |  |  |  | + |
| *Norops biporcatus* | Least Concern$^2$ | 23 | 10 | 0–2,000 | WS | + |  | + | + | + |  |  |  |
| *Norops capito* | Least Concern$^2$ | 19 | 11 | 0–1,250 | WS | + |  | + | + | + |  |  |  |
| *Norops carpenteri* | Least Concern$^1$ | 6 | 13$^5$ | 4–682 | WS |  |  |  |  | + |  |  |  |
| *Norops crassulus* | Least Concern$^2$ | 11 | 13 | 1,200–2,849 | WS |  |  |  |  | + |  |  |  |
| *Norops cupreus* | Least Concern$^2$ | 13 | 9 | 0–1,435 | WS |  |  |  |  |  | + |  |  |
| *Norops cusuco* | Endangered B1ab(iii)$^1$ | 3 | 16 | 1,550–1,935 | CH-SS |  |  | + |  |  |  |  |  |
| *Norops heteropholidotus* | Endangered B2ab(iii)$^2$ | 4 | 14 | 1,860–2,200 | CH |  |  |  |  | + |  |  |  |
| *Norops johnmeyeri* | Endangered B1ab(iii)$^2$ | 3 | 15 | 1,340–1,825 | CH |  |  | + |  |  |  |  |  |
| *Norops kreutzi* | Critically Endangered B1ab(iii)+2ab(iii)$^2$ | 3 | 16 | 1,670–1,690 | CH-SS |  |  | + |  |  |  |  |  |
| *Norops laeviventris* | Least Concern$^2$ | 17 | 9 | 500–2,000 | WS |  |  | + | + | + |  |  |  |
| *Norops lemurinus* | Least Concern$^2$ | 26 | 9 | 0–2,000 | WS | + | + | + | + |  |  |  |  |
| *Norops limifrons* | Least Concern$^2$ | 13 | 12 | 0–1,340 | WS | + |  |  |  |  |  |  |  |
| *Norops lionotus* | Least Concern$^1$ | 5 | 13 | 20–1,200 | WS | + |  |  |  |  |  |  |  |
| *Norops loveridgei* | Endangered B1ab(iii) $^1$ | 6 | 14 | 550–1,600 | CH |  |  | + |  |  |  |  |  |
| *Norops morazani** | Critically Endangered B1ab(iii)$^2$ | 3 | 16 | 1,780–2,150 | CH-SS |  |  |  | + |  |  |  |  |
| *Norops muralla* | Vulnerable D2$^1$ | 3 | 15 | 1,440–1,740 | CH-SS |  |  |  | + |  |  |  |  |
| *Norops ocelloscapularis* | Endangered B1ab(iii)$^2$ | 4 | 15 | 1,150–1,450 | CH |  |  | + |  |  |  |  |  |
| *Norops petersii* | Vulnerable B1ab(iii)$^2$ | 14 | 13 | 200–2,130 | WS |  |  | + |  |  |  |  |  |
| *Norops pijolensis* | Critically Endangered B1ab(iii)$^2$ | 4 | 14 | 1,180–2,050 | CH |  |  |  | + |  |  |  |  |
| *Norops purpurgularis* | Endangered B1ab(iii)+2ab(iii)$^2$ | 3 | 15 | 1,550–2,040 | CH |  |  | + |  |  |  |  |  |
| *Norops quaggulus* | Least Concern$^2$ | 8 | 12 | 0–1,350 | WS | + |  |  |  |  |  |  |  |
| *Norops roatanensis* | Endangered B1ab(iii)+2ab(iii)$^2$ | 3 | 15 | 0–30 | CH |  |  |  |  |  |  |  | + |
| *Norops rodriguezii* | Least Concern$^2$ | 16 | 10 | 0–2,000 | WS | + | + |  |  |  |  |  |  |

| Taxon | IUCN Red List Status | CSS | EVS | Elevational Distribution (m) | General Distribution | CL | CV | NC | CC | SC | PL | PV | IB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Norops rubribarbaris* | Critically Endangered B1ab(iii)[2] | 3 | 16 | 1,700 | CH-SS | | | | + | | | | |
| *Norops sminthus* | Endangered B1ab(iii)+2ab(iii)[2] [Data Deficient[1]] | 4 | 15 | 1,450–2,200 | CH | | | | | + | | | |
| *Norops tropidonotus* | Least Concern[2] | 20 | 5 | 0–1,900 | WS | + | + | + | + | + | | + | |
| *Norops uniformis* | Least Concern[2] | 13 | 11 | 0–1,370 | WS | + | | | | | | | |
| *Norops unilobatus* | Least Concern[3] | 26 | 7 | 0–1,200 | WS | + | + | | | | | | |
| *Norops utilensis* | Critically Endangered B1ab(iii)[2] | 3 | 16 | 0–5 | CH-SS | + | | | | | | | |
| *Norops wampuensis* | Endangered B2ab(iii)[2] | 3 | 16 | 95–110 | CH-SS | + | | | | | | | |
| *Norops wellbornae* | Least Concern[3] | 8 | 9 | 0–1,050 | WS | | | | | | + | + | |
| *Norops wermuthi* | Vulnerable B1ab(iii)[5] | 3 | 15[5] | 1,230–1,660 | CH | | | | | + | | | |
| *Norops yoroensis* | Endangered B1ab(iii)+2ab(iii)[2] | 4 | 14 | 1,180–1,600 | CH | | | | + | | | | |
| *Norops zeus* | Endangered B1ab(iii)[2] | 5 | 14 | 90–900 | CH | + | | + | | | | | |
| **Diploglossidae (3)** | | | | | | | | | | | | | |
| *Celestus bivittatus* | Endangered B1ab(iii)[1] | 7 | 13 | 1,510–1,980 | CH | | | | | + | | | |
| *Celestus montanus* | Endangered B1ab(iii)[1] | 5 | 14 | 915–1,372 | CH | | | + | | | | | |
| *Celestus scansorius* | Endangered B2ab(iii)[2] [Near Threatened[1]] | 3 | 14 | 1,550–1,590 | CH | | | + | + | | | | |
| **Eublepharidae (1)** | | | | | | | | | | | | | |
| *Coleonyx mitratus* | Least Concern[1] | 16 | 10 | 0–1,435 | WS | + | + | | | | + | + | + |
| **Gymnophthalmidae (1)** | | | | | | | | | | | | | |
| *Gymnophthalmus speciosus* | Least Concern[2] | 24 | 8 | 0–1,320 | WS | + | + | | | | + | + | |
| **Helodermatidae (1)** | | | | | | | | | | | | | |
| *Heloderma horridum* | Near Threatened[4] [Least Concern[1]] | 11 | 14[4] | 100–1,530 | WS | | + | | | | | | |
| **Iguanidae (9)** | | | | | | | | | | | | | |
| *Ctenosaura bakeri* | Critically Endangered B1ab(i,ii,iii,v)+ 2ab(i,ii,iii,v)[1] | 3 | 19 | 0–5 | CH-SS | | | | | | | | + |
| *Ctenosaura flavidorsalis* | Endangered B1ab(iii,v)+2ab(iii,v)[1] | 8 | 13 | 370–750 | CH | | + | | | | + | | |
| *Ctenosaura melanosterna* | Critically Endangered B1ab(iii,v)[1] | 5 | 17 | 0–300 | CH | | + | | | | | | + |
| *Ctenosaura oedirhina* | Endangered B1ab(iii)[1] | 3 | 18 | 0–20 | CH | | | | | | | | + |
| *Ctenosaura palearis* | Endangered B1ab(i,ii,iii,iv,v)+ 2ab(i,ii,iii,iv,v)[1] | 3 | 17[4] | 150–700 | CH | | + | | | | | | |
| *Ctenosaura praeocularis* | Endangered B1ab(iii,v)[3] [Data Deficient[1]] | 3[3] | 17[3] | 800–1,000 | CH | | | | | | | + | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ctenosaura quinquecarinata* | Endangered B1ab(iii,v)+2ab(iii,v)[1] | 5 | 16[5] | 0–250 | WS | | | | | | + | + | |
| *Ctenosaura similis* | Least Concern[1] | 22 | 11 | 0–1,320 | WS | + | + | + | + | + | + | + | + |
| *Iguana iguana* | Least Concern[2] | 26 | 12 | 0–1,000 | WS | + | + | + | + | + | + | + | + |
| **Mabuyidae (2)** | | | | | | | | | | | | | |
| *Marisora brachypoda* | Least Concern[1] | 27 | 7 | 0–1,800 | WS | + | + | + | + | + | + | + | |
| *Marisora roatanae* | Critically Endangered B1ab(v)[1] | 3 | 15 | 0–30 | CH | | | | | | | | + |
| **Phrynosomatidae (3)** | | | | | | | | | | | | | |
| *Sceloporus malachiticus* | Least Concern[1] | 16 | 8 | 540–2,849 | WS | | | + | + | + | | | |
| *Sceloporus variabilis* | Least Concern[1] | 25 | 7 | 0–1,500 | WS | + | + | | | | + | + | |
| *Sceloporus squamosus* | Least Concern[1] | 14 | 10 | 0–2,500 | WS | | + | | | | + | + | |
| **Phyllodactylidae (4)** | | | | | | | | | | | | | |
| *Phyllodactylus palmeus* | Endangered B2ab(iii)[2] | 3 | 15 | 0–30 | CH | | | | | | | | + |
| *Phyllodactylus paralepis* | Endangered B2ab(iii)[3] | 3 | 15 | 0–30 | CH | | | | | | | | + |
| *Phyllodactylus tuberculosus* | Least Concern[1] | 23 | 10 | 0–1,230 | WS | | + | | | | + | + | |
| *Thecadactylus rapicauda* | Least Concern[2] | 21 | 10 | 0–1,052 | WS | + | + | + | + | | | | |
| **Polychrotidae** (1) | | | | | | | | | | | | | |
| *Polychrus gutturosus* | Least Concern[2] | 12 | 12 | 6–700 | WS | + | | | | | | | |
| **Scincidae (2)** | | | | | | | | | | | | | |
| *Mesoscincus managuae* | Least Concern[1] | 10 | 12 | 0–920 | WS | | | | | | + | | |
| *Plestiodon sumichrasti* | Least Concern[1] | 16 | 11 | 0–1,000 | WS | + | | + | | | | | |
| **Sphaerodactylidae (10)** | | | | | | | | | | | | | |
| *Gonatodes albogularis* | Least Concern[2] | 20 | 10 | 0–1,000 | WS | + | + | | | | + | + | |
| *Sphaerodactylus alphus* | Endangered B2ab(iii)[3] | 3 | 15 | 0–30 | CH | | | | | | | | + |
| *Sphaerodactylus continentalis* | Least Concern[3] | 19 | 7 | 0–1,000 | WS | + | + | + | + | | | + | + |
| *Sphaerodactylus dunni* | Vulnerable B1ab(iii)[2] [Least Concern[1]] | 4 | 14 | 60–230 | CH | + | + | | | | | | |
| *Sphaerodactylus glaucus* | Least Concern[1] | 14 | 13 | 0–1,000 | WS | | + | | | | | | |
| *Sphaerodactylus guanajae* | Endangered B2ab(iii)[3] | 3 | 15 | 0–30 | CH | | | | | | | | + |
| *Sphaerodactylus leonardovaldesi* | Endangered B2ab(iii)[3] | 3 | 15 | 0–30 | CH | | | | | | | | + |
| *Sphaerodactylus millepunctatus* | Least Concern[1] | 19 | 7 | 0–1,000 | WS | + | + | + | + | | | + | + |
| *Sphaerodactylus poindexteri* | Critically Endangered B1ab(iii)[3] | 3 | 16 | 3–10 | CH | | | | | | | | + |
| *Sphaerodactylus rosaurae* | Endangered B2ab(iii)[2] [Least Concern[1]] | 3 | 15 | 0–20 | CH | | | | | | | | + |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sphenomorphidae (3)** | | | | | | | | | | | | | |
| *Scincella assatus* | Least Concern[1] | 16 | 13 | 0–2,500 | WS | | | | | | + | | |
| *Scincella cherriei* | Least Concern[1] | 23 | 7 | 0–1,860 | WS | + | + | + | + | + | | + | |
| *Scincella incerta* | Vulnerable B1ab(iii)[2]<br>[Least Concern[1]] | 6 | 12 | 1,350–1,670 | WS | | | + | | | | | |
| **Teiidae (5)** | | | | | | | | | | | | | |
| *Aspidoscelis deppii* | Least Concern[1] | 22 | 8 | 0–1,200 | WS | + | + | | | | + | + | |
| *Aspidoscelis motaguae* | Least Concern[1] | 12 | 9 | 175–1,200 | WS | | + | | | | | + | |
| *Cnemidophorus ruatanus* | Least Concern[3] | 8 | 12 | 0–400 | WS | + | + | | | | | | |
| *Holcosus festivus* | Least Concern[2] | 20 | 10 | 0–1,400 | WS | + | + | + | + | | | | + |
| *Holcosus undulatus* | Least Concern[1] | 27 | 7 | 0–1,800 | WS | + | + | | | | | + | |
| **Xantusiidae (2)** | | | | | | | | | | | | | |
| *Lepidophyma flavimaculatum* | Least Concern[2] | 19 | 11 | 0–1,400 | WS | + | + | + | | | | | |
| *Lepidophyma mayae* | Vulnerable B1ab(iii)[2] | 7 | 13 | 100–800 | | | | + | | | | | |
| **SQUAMATA: SNAKES** | | | | | | | | | | | | | |
| **Anomalepididae (1)** | | | | | | | | | | | | | |
| *Anomalepis mexicanus* | Data Deficient[1] | 8 | 11 | 5–500 | WS | + | | | | | | | |
| **Boidae (2)** | | | | | | | | | | | | | |
| *Boa imperator* | Least Concern[2] | 32 | 8 | 0–1,500 | WS | + | + | + | + | + | + | + | + |
| *Corallus annulatus* | Least Concern[2] | 9 | 11 | 0–400 | WS | + | | | | | | | |
| **Charinidae (1)** | | | | | | | | | | | | | |
| *Ungaliophis continentalis* | Vulnerable B1ab(iii)[2] | 11 | 12 | 990–2,300 | WS | | | + | | + | | | |
| **Colubridae (45)** | | | | | | | | | | | | | |
| *Chironius grandisquamis* | Least Concern[2] | 12 | 12 | 0–1,600 | WS | + | | + | + | | | | |
| *Dendrophidion apharocybe* | Least Concern[3] | 17 | 12 | 30–1,500 | WS | + | | + | + | | | | |
| *Dendrophidion percarinatum* | Least Concern[2] | 13 | 12 | 4–1,200 | WS | + | | + | + | | | | |
| *Dendrophidion rufiterminorum* | Least Concern[1] | 18 | 13 | 15–1,500 | WS | + | + | | | | | | |
| *Drymarchon melanurus* | Least Concern[1] | 35 | 9 | 0–2,500 | WS | + | + | + | + | + | + | + | + |
| *Drymobius chloroticus* | Vulnerable; B1ab(iii)[2]<br>[Least Concern[1]] | 18 | 11 | 500–2,500 | WS | | | + | + | + | | | |
| *Drymobius margaritiferus* | Least Concern[2] | 33 | 7 | 0–2,000 | WS | + | + | + | + | + | + | + | |
| *Drymobius melanotropis* | Least Concern[1] | 8 | 14 | 0–1,400 | WS | + | | | + | | | | |
| *Ficimia publia* | Least Concern[1] | 18 | 11 | 0–1,000 | WS | | + | | | | | | |
| *Lampropeltis abnorma* | Least Concern[2] | 36 | 9 | 0–2,500 | WS | + | + | + | + | + | + | + | |
| *Leptodrymus pulcherrimus* | Least Concern[1] | 14 | 10 | 10–1,300 | WS | + | + | | | + | + | + | |
| *Leptophis ahaetulla* | Least Concern[2] | 24 | 8 | 0–1,680 | WS | + | + | + | | | | + | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Leptophis depressirostris* | Least Concern[5] | 9 | 13[5] | 4–1,120 | WS | + | | | | | | | |
| *Leptophis mexicanus* | Least Concern[1] | 28 | 8 | 0–1,700 | WS | + | + | + | + | + | | + | + |
| *Leptophis modestus* | Vulnerable; B1ab(iii)[1] | 8 | 15 | 1,500–2,500 | WS | | | + | + | + | | | |
| *Leptophis nebulosus* | Least Concern[1] | 12 | 14 | 0–1,600 | WS | + | | | | | | | |
| *Masticophis mentovarius* | Least Concern[2] | 32 | 11 | 0–2,500 | WS | + | + | | + | + | + | + | |
| *Mastigodryas alternatus* | Least Concern[1] | 24[3] | 9[3] | 20–800 | WS | + | | | | | | | |
| *Mastigodryas dorsalis* | Vulnerable B1ab(iii)[2] [Least Concern[1]] | 10 | 12 | 635–1,900 | WS | | | + | + | + | | | |
| *Mastigodryas melanolomus* | Least Concern[1] | 27 | 9[6] | 0–1,040[6] | WS | + | + | + | | | | + | |
| *Oxybelis aeneus* | Least Concern[2] | 35 | 9 | 0–2,500 | WS | + | + | + | + | + | + | + | |
| *Oxybelis brevirostris* | Least Concern[2] | 12 | 13 | 4–800 | WS | + | | | | | | | |
| *Oxybelis fulgidus* | Least Concern[2] | 27 | 10 | 0–1,600 | WS | + | + | | + | | | + | + |
| *Oxybelis wilsoni* | Endangered B1ab(iii)[1] | 3 | 15 | 0–95 | CH | | | | | | | | + |
| *Phrynonax poecilonotus* | Least Concern[1] | 22 | 12 | 0–1,330 | WS | + | + | + | + | | | | |
| *Pseudelaphe flavirufa* | Least Concern[1] | 21 | 12 | 0–1,200 | WS | + | + | | | | | | + |
| *Rhinobothryum bovallii* | Least Concern[1] | 9 | 15 | 4–550 | WS | + | | | | | | | |
| *Scaphiodontophis annulatus* | Least Concern[1] | 19 | 12 | 0–1,400 | WS | + | + | + | + | | | | |
| *Scaphiodontophis venustissimus* | Least Concern[2] | 11 | 11 | 2–830 | WS | + | | | | | | | |
| *Scolecophis atrocinctus* | Least Concern[1] | 14 | 14 | 100–1,530 | WS | | + | | | | | + | |
| *Senticolis triaspis* | Least Concern[1] | 30 | 10 | 10–2,500 | WS | + | + | | | | | + | |
| *Spilotes pullatus* | Least Concern[2] | 30 | 9 | 0–1,500 | WS | + | + | + | + | | + | + | |
| *Stenorrhina degenhardtii* | Least Concern[2] | 23 | 10 | 0–1,900 | WS | + | + | + | + | + | | + | |
| *Stenorrhina freminvillei* | Least Concern[1] | 22 | 11 | 0–2,000 | WS | + | + | | | | + | + | |
| *Tantilla armillata* | Least Concern[1] | 14 | 9 | 0–1,435 | WS | + | + | | | | + | + | |
| *Tantilla impensa* | Least Concern[1] | 10 | 12 | 300–1,600 | CH | | | + | | | | | |
| *Tantilla lempira* | Endangered B1ab(i,ii,iii,iv,v)[1] | 4 | 13 | 1,450–1,730 | CH | | | | | + | | | |
| *Tantilla olympia* | Critically Endangered B1ab(iii)+2ab(iii)[3] | 3[3] | 16[3] | 1,150 | CH-SS | | | + | | | | | |
| *Tantilla psittaca* | Vulnerable B1ab(iii)[1] | 5[3] | 13 | 60–420 | CH | + | | + | | | | | |
| *Tantilla schistosa* | Least Concern[1] | 24 | 10 | 40–1,680 | WS | + | | + | + | | | | |
| *Tantilla taeniata* | Least Concern[1] | 13 | 10 | 0–1,280 | WS | + | + | | + | | | + | |
| *Tantilla tritaeniata* | Critically Endangered B1ac(iv)[1] | 3 | 15 | 0 | CH-SS | | | | | | | | + |
| *Tantilla vermiformis* | Least Concern[1] | 7[3] | 11 | 0–520 | WS | | | | | | + | | |
| *Tantillita lintoni* | Least Concern[1] | 15 | 13 | 0–550 | WS | + | | | | | | | |
| *Trimorphodon quadruplex* | Least Concern[1] | 14 | 10 | 0–2,000 | WS | | + | | | | + | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dipsadidae (63)** | | | | | | | | | | | | | |
| *Adelphicos quadrivirgatum* | Least Concern$^{1}$ | 19 | 8 | 0–1,740 | WS | + | + | + | + | + | | + | |
| *Amastridium sapperi* | Least Concern$^{1}$ | 18 | 12 | 100–1,600 | WS | | | + | | | | | |
| *Clelia clelia* | Least Concern$^{2}$ | 18 | 11 | 0–1,000 | WS | + | + | + | + | | | | |
| *Coniophanes bipunctatus* | Least Concern$^{1}$ | 18 | 11 | 0–1,000 | WS | + | | | | | | | + |
| *Coniophanes fissidens* | Least Concern$^{2}$ | 28 | 9 | 0–2,200 | WS | + | + | + | + | + | | | |
| *Coniophanes imperialis* | Least Concern$^{1}$ | 19 | 11 | 0–2,000 | WS | + | + | + | | | | + | + |
| *Coniophanes piceivittis* | Least Concern$^{1}$ | 23 | 11 | 0–1,305 | WS | | + | | | | + | + | |
| *Conophis lineatus* | Least Concern$^{1}$ | 22 | 9 | 0–1,500 | WS | + | + | | | | + | + | |
| *Crisantophis nevermanni* | Least Concern$^{1}$ | 11 | 14 | 0–1,385 | WS | | | | | | + | | |
| *Dipsas bicolor* | Least Concern$^{2}$ | 8 | 11 | 4–1,100 | WS | + | | | + | | | | |
| *Enuliophis sclateri* | Least Concern$^{2}$ | 10 | 11 | 0–1,235 | WS | + | | | | | | | |
| *Enulius bifoveatus* | Critically Endangered B1ac(iv)$^{1}$ | 3 | 15 | 0–10 | CH-SS | | | | | | | | + |
| *Enulius flavitorques* | Least Concern$^{2}$ | 26 | 6 | 0–2,849 | WS | + | + | | | | + | + | + |
| *Enulius roatanensis* | Endangered B1ab(iii)$^{1}$ | 3 | 15 | 0–10 | CH | | | | | | | | + |
| *Erythrolamprus mimus* | Least Concern$^{1}$ | 12 | 12 | 70–1,400 | WS | + | | | + | | | | |
| *Geophis damiani* | Critically Endangered B1ab(iii)$^{1}$ | 3 | 15 | 1,075–1,750 | CH-SS | | | + | | | | | |
| *Geophis dunni* | Data Deficient$^{1}$ | 3 | 16$^{5}$ | 900 | CH | | | | | + | | | |
| *Geophis fulvoguttatus* | Endangered B1ab(iii)$^{1}$ | 6 | 12 | 1,680–2,200 | CH | | | + | | + | | | |
| *Geophis hoffmanni* | Least Concern$^{2}$ | 14 | 12 | 18–670 | WS | + | | + | + | + | | | |
| *Geophis nephodrymus* | Endangered B2ab(iii)$^{2}$ [Vulnerable D2$^{1}$] | 3 | 14 | 1,560–1,580 | CH-SS | | | + | | | | | |
| *Geophis rhodogaster* | Endangered B1ab(iii)$^{2}$ [Least Concern$^{1}$] | 8 | 12 | 1,480–2,600 | WS | | | | | + | | | |
| *Hydromorphus concolor* | Least Concern$^{1}$ | 16 | 9 | 1–1,500 | WS | + | + | + | | | | | |
| *Imantodes cenchoa* | Least Concern$^{2}$ | 30 | 6 | 0–2,063 | WS | + | + | + | + | | | | |
| *Imantodes gemmistratus* | Least Concern$^{2}$ | 26 | 10 | 2–1,435 | WS | | + | | | | + | + | |
| *Imantodes inornatus* | Least Concern$^{1}$ | 12 | 10 | 5–1,450 | WS | + | | | + | + | | | |
| *Leptodeira nigrofasciata* | Least Concern$^{1}$ | 18 | 10 | 0–1,300 | WS | | + | | | | + | + | |
| *Leptodeira rhombifera* | Least Concern$^{1}$ | 28 | 8 | 0–2,000 | WS | + | + | | + | + | + | + | |
| *Leptodeira septentrionalis* | Least Concern$^{2}$ | 33 | 9 | 0–2,000 | WS | + | + | + | + | + | | | |
| *Ninia diademata* | Least Concern$^{1}$ | 19 | 8 | 0–2,200 | WS | + | + | + | + | | | | |
| *Ninia espinali* | Endangered B1ab(iii)$^{2}$ [Near Threatened$^{1}$] | 5 | 12 | 1,590–2,242 | CH | | | + | + | + | | | |
| *Ninia maculata* | Least Concern$^{2}$ | 13 | 12 | 36–1,800 | WS | | | | + | | | | |
| *Ninia pavimentata* | Endangered B1ab(iii)$^{2}$ | 5 | 12 | 1,300–1,500 | WS | | | + | | | | | |

| Taxon | IUCN Red List Status | CSS | EVS | Elevational Distribution (m) | General Distribution | CL | CV | NC | CC | SC | PL | PV | IB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ninia sebae* | Least Concern[1] | 28 | 4 | 0–2,200 | WS | + | + | + | + | + | + | + | |
| *Nothopsis rugosus* | Least Concern[1] | 11 | 12 | 2–830 | WS | + | | | | | | | |
| *Omoadiphas aurula* | Endangered B2ab(iii)[2]<br>[Vulnerable D2[1]] | 3 | 15 | 1,250–1,900 | CH-SS | | | + | | | | | |
| *Omoadiphas cannula* | Critically Endangered B1ab(iii) [1] | 3[3] | 14[3] | 1,250 | CH-SS | | | | + | | | | |
| *Omoadiphas texiguatensis* | Critically Endangered B1ab(iii)[1] | 3 | 14 | 1,690 | CH-SS | | | + | | | | | |
| *Oxyrhopus petolarius* | Least Concern[2] | 18 | 13 | 0–800 | WS | + | | + | + | | | | |
| *Pliocercus elapoides* | Least Concern[1] | 25 | 10 | 0–2,000 | WS | + | + | + | + | + | | | |
| *Pliocercus euryzonus* | Least Concern[1] | 13 | 14 | 0–1,250 | WS | + | | | | | | | |
| *Rhadinaea decorata* | Least Concern[2] | 20 | 11 | 0–1,400 | WS | + | | | + | | | | |
| *Rhadinella anachoreta* | Endangered B1ab(iii)[2]<br>[Least Concern[1]] | 9 | 12 | 500–1,180 | CH | + | | + | | | | | |
| *Rhadinella godmani* | Vulnerable B1ab(iii)[2]<br>[Least Concern[1]] | 13 | 9 | 1,200–2,200 | WS | | | + | + | + | | | |
| *Rhadinella kinkelini* | Vulnerable B1ab(iii)[2]<br>[Least Concern[1]] | 10 | 12 | 1,370–2,085 | CH | | | + | + | + | | | |
| *Rhadinella lachrymans* | Vulnerable B1ab(iii)[2]<br>[Least Concern[1]] | 12 | 13 | 500–2,849 | WS | | | | + | | | | |
| *Rhadinella montecristi* | Endangered B1ab(iii)[2]<br>[Vulnerable B1ab(iii)[1]] | 7 | 12 | 1,370–2,620 | CH | | | + | | + | | | |
| *Rhadinella pegosalyta* | Endangered B2ab(iii)[3]<br>[Vulnerable B2[1]] | 3 | 14 | | CH-SS | | | + | | | | | |
| *Rhadinella rogerromani* | Vulnerable B1ab(iii)[5] | 3 | 16[5] | 1,450 | CH-SS | | | | | + | | | |
| *Rhadinella tolpanorum* | Endangered B1ab(iii)[1] | 3 | 15 | 1,690–1,900 | CH-SS | | | + | | | | | |
| *Sibon annulatus* | Least Concern[1] | 10 | 12 | 2–1,300 | WS | + | | | | | | | |
| *Sibon anthracops* | Least Concern[1] | 12 | 14 | 4–915 | WS | | + | | | | | + | |
| *Sibon carri* | Endangered B1ab(iii)[2] | 8 | 12 | 30–800 | CH | | | | | | + | + | |
| *Sibon dimidiatus* | Least Concern[1] | 18 | 11 | 0–1600 | WS | + | | + | + | + | | | |
| *Sibon longifrenis* | Least Concern[1] | 9 | 11 | 60–750 | WS | + | | | | | | | |
| *Sibon manzanaresi* | Critically Endangered B1ab(iii)+2ab(iii)[2]<br>[Near Threatened[1]] | 3 | 15 | 250–300 | CH-SS | + | | | | | | | |
| *Sibon miskitus* | Critically Endangered B1ab(iii)+2ab(iii)[2]<br>[Near Threatened[1]] | 3 | 15 | 150 | CH-SS | + | | | | | | | |
| *Sibon nebulatus* | Least Concern[2] | 27 | 8 | 0–1,690 | WS | + | + | + | + | | | | |
| *Tretanorhinus nigroluteus* | Least Concern[2] | 18 | 8 | 0–1,200 | WS | + | + | | | | | + | |
| *Tropidodipsas fischeri* | Least Concern[1] | 12 | 12 | 1,000–2,849 | WS | | | | | + | | | |
| *Tropidodipsas sartorii* | Least Concern[1] | 26 | 12 | 0–2,000 | WS | + | + | + | + | | | | |
| *Urotheca decipiens* | Least Concern[2] | 10 | 11 | 15–1,500 | WS | + | | | | | | | |

| Taxon | IUCN Red List Status | CSS | EVS | Elevational Distribution (m) | General Distribution | CL | CV | NC | CC | SC | PL | PV | IB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Urotheca guentheri* | Least Concern[1] | 13 | 12 | 25–1,600 | WS | + | | | | | | | |
| *Xenodon angustirostris* | Least Concern[2] | 24 | 12 | 0–1,300 | WS | + | + | + | + | + | | | |
| **Elapidae (6)** | | | | | | | | | | | | | |
| *Micrurus alleni* | Least Concern[1] | 11 | 15 | 1–1,620 | WS | + | | | | | | | |
| *Micrurus browni* | Least Concern[1] | 15 | 13 | 0–2,200 | WS | | | | | + | | | |
| *Micrurus diastema* | Least Concern[1] | 19 | 12 | 50–600 | WS | + | | + | + | | | | |
| *Micrurus mipartitus* | Least Concern[5] | 6 | 15[5] | 2–1,160 | WS | + | | | | | | | |
| *Micrurus nigrocinctus* | Least Concern[2] | 21 | 9 | 0–1,600 | WS | + | + | | | | + | + | |
| *Micrurus ruatanus* | Critically Endangered B1ab(iii)[1] | 3 | 17 | 0–20 | CH | | | | | | | | + |
| **Leptotyphlopidae (2)** | | | | | | | | | | | | | |
| *Epictia ater* | Least Concern[1] | 9[3] | 6[6] | 0–1,350 | WS | + | + | | | | + | + | |
| *Epictia magnamaculata* | Endangered B1ab(iii)+2ab(iii)[3] | 3[3] | 15[3] | 0–25 | CH | | | | | | | | + |
| **Loxocemidae (1)** | | | | | | | | | | | | | |
| *Loxocemus bicolor* | Least Concern[2] | 16 | 11 | 0–750 | WS | | + | | | | + | + | |
| **Natricidae (4)** | | | | | | | | | | | | | |
| *Storeria dekayi* | Least Concern[1] | 13 | 9 | 0–1,900 | WS | + | | | + | + | | | |
| *Thamnophis fulvus* | Least Concern[1] | 10 | 14 | 1,680–2,849 | WS | | | | | + | | | |
| *Thamnophis marcianus* | Least Concern[1] | 22 | 13 | 0–1,400 | WS | | | | + | | | | |
| *Thamnophis proximus* | Least Concern[1] | 27 | 9 | 0–2,500 | WS | + | + | | + | | + | + | |
| **Typhlopidae (3)** | | | | | | | | | | | | | |
| *Amerotyphlops costaricensis* | Least Concern[2] | 11 | 11 | 540–1,500 | WS | + | | | | + | | | |
| *Amerotyphlops stadelmani* | Endangered B1ab(iii) [2] [Vulnerable D2[1]] | 6 | 12 | 320–1,370 | CH | + | | + | + | | | | |
| *Amerotyphlops tycherus* | Vulnerable D2[1] | 3 | 14 | 1,550 | CH-SS | | | + | | | | | |
| **Viperidae (14)** | | | | | | | | | | | | | |
| *Agkistrodon bilineatus* | Near Threatened[7] | 8[7] | 13[7] | 0–1,500 | WS | | | | | | + | + | |
| *Agkistrodon howardgloydi* | Endangered B1ab(iii)[7] | 5[7] | 17[7] | 0–600 | WS | | | | | | + | | |
| *Atropoides indomitus* | Endangered B1ab(iii)[1] | 3[3] | 17 | 670–1,200 | CH | | | | + | | | | |
| *Atropoides mexicanus* | Least Concern[2] | 17 | 12 | 0–1,600 | WS | + | + | + | + | | | | |
| *Atropoides occiduus* | Vulnerable[4] | 7 | 15[4] | 100–1,600 | WS | | | | | + | | | |
| *Bothriechis guifarroi* | Endangered B1ab(iii)[3] | 6 | 14 | 1,015–1,450 | CH | | | + | + | | | | |
| *Bothriechis marchi* | Endangered B1ab(iii, v)[1] | 5 | 16 | 500–1,840 | CH | | | + | | | | | |
| *Bothriechis schlegelii* | Least Concern[2] | 21 | 12 | 0–1,530 | WS | + | + | + | + | | | | |
| *Bothriechis thalassinus* | Vulnerable B1ab(iii)+2ab(iii)[2] | 5 | 15 | 1,370–1,750 | CH | | | + | + | | | | |

| Taxon | IUCN Red List Status | CSS | EVS | Elevational Distribution (m) | General Distribution | CL | CV | NC | CC | SC | PL | PV | IB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Bothrops asper* | Least Concern[2] | 25 | 12 | 0–1,300 | WS | + | + | + | + | + |  |  |  |
| *Cerrophidion wilsoni* | Vulnerable B1ab(iii)[2] | 15 | 12 | 1,300–2,849 | WS |  |  | + | + | + |  |  |  |
| *Crotalus simus* | Least Concern[1] | 21 | 12 | 500–2,600 | WS | + |  |  | + | + | + | + |  |
| *Porthidium nasutum* | Least Concern[1] | 18 | 12 | 0–1,100 | WS | + | + | + | + |  |  |  |  |
| *Porthidium ophryomegas* | Least Concern[1] | 15 | 9 | 0–1,400 | WS | + | + |  |  |  | + | + |  |

[1] IUCN Red List (2011)
[2] Townsend and Wilson (2010)
[3] Evaluated for this study
[4] Acevedo et al. (2010)
[5] Sunyer and Köhler (2010)
[6] McCranie (2011)
[7] Porras et al. (2013)

**Table 4**. Broad distributional patterns of herpetofaunal diversity in the Chortís Block. CB = Chortís Block restricted, WS = widespread, CL = Caribbean Lowlands, CV = Caribbean Intermontane Valleys, NC = Northern Cordillera, CC = Central Cordillera, SC = Southern Cordillera, PL = Pacific Lowlands, PV = Pacific Intermontane Valleys, IB = Islas de la Bahía.

|  | Distribution |  | Physiographic Regions |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  | **CB** | **WS** | **CL** | **CV** | **NC** | **CC** | **SC** | **PL** | **PV** | **IB** |
| Gymnophiona | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 0 | 0 |
| Caudata | 37 | 6 | 7 | 2 | 17 | 18 | 10 | 1 | 2 | 0 |
| Anura | 38 | 63 | 51 | 18 | 50 | 38 | 31 | 12 | 16 | 6 |
| AMPHIBIA | 75 | 71 | 60 | 22 | 67 | 56 | 41 | 14 | 18 | 6 |
| Crocodylia | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 0 | 1 |
| Testudines | 0 | 12 | 6 | 6 | 0 | 0 | 0 | 4 | 1 | 0 |
| Squamata: Sauria | 41 | 54 | 37 | 33 | 33 | 22 | 20 | 17 | 21 | 21 |
| Squamata: Serpentes | 33 | 109 | 86 | 54 | 64 | 60 | 41 | 29 | 37 | 14 |
| REPTILIA | 74 | 177 | 131 | 95 | 97 | 81 | 61 | 52 | 59 | 37 |
| **Totals** | **149** | **248** | **191** | **117** | **164** | **137** | **102** | **66** | **77** | **43** |

## Challenges to Regional Research

Systematic herpetologists have been active in the Chortís Block since at least the early 1900's, with the constituent countries of the Chortís Block (El Salvador, Guatemala, Honduras, and Nicaragua) each with their own rich histories of herpetological investigation (Mertens, 1952; Stuart, 1963; Meyer, 1969; Villa, 1972; Wilson et al., 2010). Most research has taken a geopolitically-delimited approach that often is arbitrary and seldom congruent with biogeographic boundaries. While this approach is practical and largely necessary due to a variety of considerations (e.g., visas, research and export permits, logistics), it also can come at the expense of a biogeographically-meaningful approach to research, or of a unified strategy for conservation in transboundary areas. The Chortís Block is an exemplar of this issue, where national boundaries effectively divide efforts to document and conserve isolated cloud forest areas in five mountain ranges that serve to physically delineate national borders.

In some cases, border regions are avoided due to security-related issues. Honduran frontier zones have become increasingly favored by transnational narcotics traffickers, particularly over the past decade as the influence of Mexican drug cartels has expanded into Central America (e.g., Archibold and Cave, 2011). In an even more extreme case, the highest mountain range in Nicaragua (Sierra de Dipilto, maximum elevation 2,107 m), which also forms the border with Honduras, was considered a strategic vantage point that was heavily contested, and subsequently landmined, during the Contra-Sandinista War of the 1980's (United Nations Mine Action Service, 1998). Despite the apparent biogeographic importance of this mountain range and its potential for supporting endemic species, little to no biological inventory work has been carried out in the Sierra de Dipilto. Beyond this mountain range, a large area of the Chortís Highlands in northern Nicaragua also has been heavily undersampled as a result of being the principal zone of conflict in the Contra-Sandinista War, and only recently has begun to be sampled in a concerted fashion (Sunyer et al., 2009; Travers et al. 2011).

Political boundaries have placed the majority of the endemic-rich Chortís Highlands within the borders of one country, Honduras, with significant extensions into three neighboring countries, most notably Nicaragua. A consequence of research constrained by political boundaries is that systematic cataloguing of regional diversity has been handicapped. As a result, a number of endemic species are known from localities in one country but unconfirmed as occurring across the border in ecophysiographically contiguous areas, as in the cases, for example, of *Cryptotriton monzoni* (endemic to the Sierra de Espíritu Santo in Guatemala) and *Anolis johnmeyeri* (endemic to the Sierra de Espíritu Santo and Sierra de Omoa in Honduras). In at least one case, it has been suggested that two species of *Cryptotriton* described from opposite sides of the Sierra de Omoa (called the Sierra de Caral in Guatemala), *C. nasalis* and *C. wakei*, actually represent the same species (McCranie and Rovito, 2014).

Moreover, the distributions of at least six endemic species are restricted to one or a few highland localities that straddle the borders between two or even three countries, creating additional challenges to the development of comprehensive conservation strategies for these taxa. Notable localities include the Sierra de Omoa, Honduras/Sierra de Caral, Guatemala (*Bolitoglossa conanti*, *B. dunni*, *Cryptotriton nasalis*, and *Duellmanohyla soralia*), Cerro El Pital, El Salvador/Honduras (*Bolitoglossa synoria*), and Cerro Montecristo, El Salvador/Guatemala/Honduras (*Bolitoglossa heiroreias*).

Minimizing the constraints of these largely political and logistical issues is necessary if regional patterns of biogeography and endemism are to be analyzed and interpreted accurately. More importantly, seeking creative and collaborative solutions to working across or breaking down these boundaries are critical if effective conservation strategies are to have any hope for formulation or eventual success.

***Acknowledgments.***— This paper largely was completed as part of my PhD dissertation at the University of Florida, and first and foremost I would like to thank my advisor, James Austin, and committee members Rob Fletcher, Mike Miyamoto, Rick Stepp, and Larry David Wilson, for their guidance, advice, and support. It was under the mentorship of Larry Wilson that I began my study of the herpetofauna of the Chortís Block, first as his student at Miami Dade Community College in 1999, and I cannot overstate my gratitude for his steadfast support and encouragement over the course of the past 15 years. Completion of this manuscript for publication was carried out with support from an AWE 3-credit release from the Indiana University of Pennsylvania (IUP) College of Natural Science and Mathematics (CNSM), and I thank the Dean of CNSM, Dr. Deanne Snavely, for offering me this opportunity. Fieldwork was funded to varying extents by the Critical Ecosystem Partnership Fund (CEPF), a Summer Research Grant from the Working Forests in the Tropics IGERT Program (National Science Foundation DGE–0221599) at the University of Florida, and a grant to Kirsten Nicholson (Central Michigan University; National Science Foundation DEB-0949359). In addition to the support of literally dozens of coworkers in the field (Table 1), I would like to thank the personnel at the Section of Protected Areas and Wildlife, Instituto Nacional de Conservación y Desarrollo Forestal, Áreas Protegidas y Vida Silvestre (ICF), and particularly Saíd Lainez O., Iris Acosta, and Carla Cárcamo, for their strong support for our ongoing research efforts and their assistance in acquiring research and export permits. Louis Porras was of great assistance in editing this manuscript for publication, and I am thankful for his time and efforts. Finally, I am deeply grateful to Ileana Luque-Montes for the countless ways she supported my professional endeavors, including the preparation of this manuscript and translation of the *Resumen*.

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