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VIEWPOINT

The Changing Trinidad and Tobago Herpetofauna

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ABSTRACT
The Trinidad and Tobago herpetofauna is rich in species and the numbers of recognised species on the islands are expected to grow despite the extensive efforts previously made to study the fauna. Recent advances in molecular technology and cladistics form the basis for these changes. Cryptic species have been found to be quite common and many of these remain to be described from the islands. Here we note name changes and additions to the herpetofauna since 1997, comment on the likelihood that the island still contains species that have gone unrecognized by science; discuss the implications of cryptic species for conservation efforts; and suggest that education is the long-term solution to retaining the biodiversity of Trinidad and Tobago.

Key words: cryptic species, cladistics, DNA, systematics, biodiversity.

INTRODUCTION

Human knowledge is expanding at an incredible rate. Current estimates based on the growth of academic publications and an increased number of filed patents claim our knowledge base will double every 2.31 to 2.44 years, respectively (Fuller 2007). What we know today makes much of what we knew a decade ago obsolete. This is perhaps most true in scientific fields and biology is no exception. The following addresses the herpetofauna of Trinidad and Tobago as seen in the light of recent molecular studies. We discuss why the species of Trinidad and Tobago continue to be renamed, and why the number of species is likely to increase.

Trinidad and Tobago fauna continues to have names changed, species added, and species subtracted. We make predictions here on which species may be species complexes and are candidates for future name changes based on the distance of the type locality from the islands. We also discuss the importance of educating the public on the unique nature of the Trinidad and Tobago herpetofauna and the need that exists to encourage local people to take the steps necessary to conserve and restore the fauna where it is appropriate.

Carl Linnaeus' *Systema Naturae* was an attempt to organize all life forms into categories. He succeeded in recognizing a startling 5222 taxa in his 10th edition published in 1758. Some life forms were recognized and diagnosed in the text of the book, while others were in tables that illustrated Linnaeus' concept of hierarchical relationships. Classes, orders, genera, and species accounted for 4735 of Linnaeus' taxa. The remaining 487 taxa were distributed among 12 categories, such as subgenera or infrasubgenera. Some of these categories were later invalidated by the International Commission on Zoological Nomenclature, but a dozen or so subgeneric names were revalidated and are still in use (Dubois 2007).

Following Linnaeus' work, late 18th and early 19th naturalists Josephus Laurenti, Johann Schneider, Bernard Lacépède, François-Marie Daudin and Johann Spix, scrambled to apply binomial names to Western Hemisphere amphibians and reptiles in the late 18th and early 19th centuries. By the end of the 19th century, it became popular to consolidate organisms that had a similar appearance and they were often lumped together sometimes under the oldest available name, other times not. About the time that R. R. Mole and F. W. Urich started making lists of the Trinidad and Tobago herpetofauna, Albert Günther and George Boulenger were lumping species named in the early and mid-19th century together. Günther and Boulenger knew much about the world's herpetofauna, but without today's understanding of the significant role geography plays in speciation, often ignored type specimens and their localities (Adler 1989). This, paired with the late 19th and early 20th century trend to lump species, led early 20th century biologists to greatly underestimate world biodiversity. Endersby (2009) noted the terms "lumper" and "splitter" are still in use and often applied when the user disagrees with the limits of a species used by someone else. Darwin recognized that classification would eventually evolve into genealogies when naturalists learned "...to discover and trace the many diverging lines of descent..." That time has now arrived. As it turns out, splitting species is more useful in understanding modern evolutionary concepts than having broadly defined species, because it provides more detailed evidence of the evolutionary process.

Types and Type Localities

The specimen used to describe a new species is referred to as the "holotype," or "syntypes," if there is more than one specimen. Type specimens are deposited in a museum so that they can serve as a reference for the species, and researchers describing related species can examine them for comparison. When H. W. Parker of the British Museum described the dwarf marsupial frog *Gastrotheca fitzgeraldi* in 1934, the description was based upon the type specimen in the British Museum and was given a number (it is now BMNH 1947.2.22.41). The geographic location where that type specimen originated from is the type locality, and Parker clearly stated that the type of *Gastrotheca* [now *Flectonotus*] *fitzgeraldi* came from "…3000 ft. on Mt. Tucuche….Trinidad." Thus, Mt. Tucuche becomes the type locality for this species. Type specimens are important because they fix the identity of a species and type localities are important because they provide a location for the origin of the type specimen. The type locality can be re-sampled for specimens and DNA to compare to more distant populations if the type specimen is lost or, as is often the case, DNA cannot be recovered from the type specimen due to exposure to formalin used in the specimen fixation process.

Evolving Ideas and the Herpetofauna

Today, the intimate relationship between geography and biodiversity is well understood. Topography may impose barriers to gene flow or create corridors that permit it. Barriers keep individuals of a species from moving around, preventing them from reproducing with other members of that species from other populations. Barriers differ for individual species and could be as large as a river or a mountain range, or as small and seemingly simple as a small waterfall, a road, or an agricultural field. Restricting gene flow isolates populations and the results of that isolation may range from the formation of a new species to the extinction of an existing one. As topography changes over time, gene flow changes with it. Closely related species may become isolated and then reconnect, only to be isolated again. Some may hybridize and form new species or become extinct because they cannot reproduce. The goal of modern systematics is to produce a system of classification that reflects ancestry, and how a group of related species and their most recently shared ancestor link together. Any group of species and their immediate ancestor is known as a clade and most changes in scientific nomenclature today are the result of additions or subtractions of species to or from a given clade.

In the second half of the 20^{th} century, the roots of two scientific disciplines evolved, providing powerful new tools for understanding evolution: molecular biology and cladistics. Cladistics is a way of evaluating and comparing hypotheses as to how species and groups of species are related to each other based upon shared evolutionary novelties. It allows for an examination of diverse sets of characters (morphological, behavioral, and molecular) by considering all the evidence simultaneously to produce phylogenetic trees – diagrams that show the relationships between species and groups of species. Molecular biology examines organisms at the level of genes (and their products) and makes it possible to collect much more data useful to discerning relationships between species and groups of species. Molecular sequence data – the genetic code – is the closest science has come to an unbiased assessment of evolutionary relationships. Thus, cladistics and molecular biology are at the center of reconstructing the tree of life. Computer technology has made a huge contribution to this effort, handling the large amounts of data generated by both cladistic analysis and molecular sequencing.

Linnaeus was responsible for about 23% of the names earlier applied to Trinidad and Tobago amphibians and reptiles (Murphy 1997). That proportion has now decreased slightly to 21% due to additions to the fauna and the splitting of previously named species. Thus Linnaeus' contributions to the herpetofauna can be expected to continue to decline as once-thought widespread species are divided into species with more restricted distributions and new species are found.

The Trinidad and Tobago fauna has been described as a depauperate Venezuelan fauna (Kenny 2000). There is some truth in this view. Both islands are continental and they contain a flora and fauna that had their ancestry on mainland South America. However it is a mistake to believe that the flora and fauna of the islands are just remnants of South America. By definition, terrestrial species on islands are genetically isolated, in this case by the sea that creates a barrier between Trinidad and Tobago and mainland Venezuela.

But gene isolation occurs even more specifically than at the island level. Trinidad and Tobago are full of unique and isolated tracts of land whose organisms are unable to interact with other populations of the same species. The first that comes to mind are man-made patches of now-fragmented habitat, cut off from the surrounding region by urban sprawl or agricultural lands. However, some are naturally occurring "terrestrial islands" like Trinidad's three hill ranges and Tobago's Main Ridge, all elevated terrain composed of unique habitat when compared to the lower lands surrounding them. Likewise, the species in the savanna habitats at Aripo and Erin are, or were, restricted to those grasslands by the encompassing forest.

Today we see the marine barriers to terrestrial vertebrates that isolate the islands from the mainland. But tectonic forces, historic fluctuations in sea level, altered drainage basins, climate change, and dispersal of species to the island both by natural means and human mediated transport have been at work on the flora and fauna to produce the species we see today. The flora and fauna of Trinidad and Tobago have not ceased to evolve since the islands were isolated from South America.

Widespread and Endemic Species

Nine frogs, seven lizards and eleven snakes, or approximately 19% of Trinidad and Tobago's total herpetofauna (including introduced species and questionable records) are currently considered endemic. That is, these endemics occur only on the islands and are found nowhere else in the world. Until recently, the data suggested that the other 81% was composed of more widespread species: those of Amazonian or Guyanan ancestry with distributions extending into Central and South America. However, this perspective is changing.

Recently, several studies suggest that South American frogs are much more diverse than previously thought. In fact, researchers now believe this may be the case worldwide. New frog species are being described at an exceptionally rapid rate. For the last five years, approximately one new frog has been described every three days (AmphibiaWeb 2011).

Fouquet *et al.* (2007) addressed 60 French Guyanan frog species, most considered widespread with distributions ranging throughout Guyana and Amazonia. They attempted to estimate the number of undescribed species of amphibians in this region by examining the variation in the mitochondrial 16S gene. They found that 21 of the 60 species (35%) of the geographically distant populations belong to very distinct genetic lineages that could be new species. From this they estimated that as many as 115% additional Neotropical amphibians may be expected to be discovered. Of the 400 frog species recognized from Amazonia and Guyana, 150 (37%) of them have distributions covering more than 1 million km^2 – a sizable geographic area easily capable of containing potentially cryptic, undetected species. Fouquet *et al*. (2007) suggest that the total number of species in these regions will easily approach 600, and there may be 860 total frog species for Amazonia, with the implication of South America potentially holding 4400 species of frogs (at this writing in November, 2011 AmphibiaWeb lists 6089 species of frogs on the planet).

Given Trinidad and Tobago's proximity to this diverse region, it seems probable to us that, like the nearby mainland ecosystems, these islands hold more endemic and near endemic species masquerading as widespread or Amazonian species. Furthermore, it is unlikely that these additional species are limited to frogs.

Widespread lizards and snakes are also likely candidates for being endemics or near endemics. However, widespread species do exist. Fouquet *et al*. (2007) found some widespread species that were so similar genetically, that they may have spread over South America quite recently, but the authors note that these widespread species compose the minority of cases. For example, of the recorded frog species inhabiting Trinidad, only 10 (*Rhinella marina*, *Leptodactylus fuscus*, *Leptodactylus hylaedactylus*, *Engystomops pustulosus, Scinax ruber, Sphaenorhynchus lacteus*, *Lithobates palmipes*, *Pipa pipa*, and *Hypsiboas boans*) are thought to be true widespread species also found over large areas of South America. It is important to note that these species are affiliated with either savanna, riverine, or swamp habitats. In all cases, habitats suspected allow organisms to move rapidly through large expanses of similar habitat or along corridors that connect patches of similar habitat. In the long run even this view may change; rivers change course, wetlands fill through sedimentation, and new ones form by erosion.

Endemic species in Venezuela and Trinidad and Tobago often share a common ancestor; the stream frogs of the genus *Mannophryne* are an excellent example. *Mannophryne olmonae* is found on Tobago, *M. trinitatis* is found on Trinidad, and *Mannophryne leonardi* and *M. venezuelensis* are found in Venezuela. However, as late as the 1960's all four species were lumped into the single species *Mannophryne trinitatis*. Jowers *et al*. (2011) used molecular data to show that *M. trinitatis* and *M. venezuelensis* are sister species with their most recent common ancestor at 7.28 MYA. Additionally, they described *M. leonardi*, a Venezuelan species that had been confused with *M. trinitatis.* Jowers *et al*. also showed *M*. *trinitatis* to be the result of vicariance, not dispersal by rafting. Thus, *Mannophryne trinitatis* and *M. venezuelensis* likely split from their shared ancestor when Trinidad separated from Venezuela in the Miocene. Undoubtedly, this is true for many of the Trinidad and Tobago species – their presence as island endemics is the result of vicariance. However, some species may well have reached the islands by dispersal from the mainland or colonization from the Lesser Antilles.

There are widespread lizard and snake species, also. Kronauer *et al*. (2005) examined the widespread turnip-tailed gecko, *Thecadactylus rapicauda*, and found the Trinidad and Tobago populations were more closely related to mainland populations than the Lesser Antilles populations. Gamble *et al*. (2008) found little genetic divergence in the widespread *Gonatodes humeralis*, and the divergence they did find originated relatively recently, about 1.9 MYA. They also suggest the most recent common ancestor for the two sister species of geckos, *Gonatodes ocellatus* (a Tobago endemic) and *Gonatodes ceciliae* (a near Trinidad endemic), split roughly 3.8 MYA.

Without collecting, sequencing, and comparing DNA from a variety of locations, it is difficult to know if a species is a widespread form or a complex of cryptic species. Using existing data, ruling out the known widespread species, and examining the remaining species, clues to which species may be cryptic can be had. The greater the distance between the islands and the type locality of a specific species, the more likely it is that a currently recognized species is actually a complex of cryptic species. This is based upon the simple assumption that a greater distance between two sites results in a reduced chance of genetic exchange.

This, however, is not the whole story; even species with relatively restricted distributions can be composed of unrecognized taxa. The variegated gecko, *Gonatodes ceciliae,* is a likely candidate for representing two or more species on Trinidad that are cryptic, sympatric, and syntopic. McBee *et al*. (1987) found two different karyotypes (individuals with different sets of chromosomes) living together. No one has followed up on this report, but cryptic vertebrate species living side by side is a phenomenon that has only recently been recognized (Stuart *et al*. 2006) and emphasizes the fact that biodiversity has been severely underestimated. McLeod (2010) recently reported three distinct, cryptic lineages of the Southeast Asian frog *Limnoectes khulii* living side by side at a single locality – something that researchers would have thought highly improbable, if not impossible, only a few years ago.

Predicting Cryptic Species

As explained above, it is possible to predict which allegedly widespread species are likely candidates for cryptic species complexes by investigating the distance between a type locality and a more distant collection site. Using this principle and distance measurements from Google Earth, we can apply the type localities reported in Murphy (1997) and updated by the Amphibian Species of the World website (Frost 2011) and the Reptile Database website (Utez 2011), to predict which of Trinidad and Tobago's populations are likely to contain cryptic species and require taxonomic updates.

We found 36 species with type localities greater than 800 km from Trinidad. An 800 km radius will produce a terrestrial area that is about one million km^2 the area Fouquet *et al*. (2007) predicted likely to contain undiscovered cryptic species. In reality, it may be much less. Consider the genus *Chironius*, commonly called the machete. Trinidad has three species, two are very difficult to separate from each other – these are cryptic species. Dixon *et al*. (1983) reviewed the genus; they state that *Chironius carinatus* has 12-12-8 scale rows (meaning 12 scale rows on the forebody, 12 at mid body and 8 near the vent) and that this will distinguish this snake from all other *Chironius*. However, *C. septentrionalis* (also found on Trinidad) has 12-12-8 in males and 12-12-10 in females. The ventral scale counts for *C. carinatus* are given as 108-145 and for *C. septentrionalis* as 161-196, but superficially these snakes are quite similar.

Due to cladistics, molecular biology and computer technology, the investigation of amphibian and reptile evolution is now advancing at a faster pace than at any time in history. New species will continue to be described at a rapid pace and the number of species composing the Trinidad and Tobago herpetofauna will also increase. The recently discovered hylid frog *Scarthyla vigilans* (Smith *et al*. 2011) is an excellent example. The current nomenclature of the herpetofauna of Trinidad and Tobago is provided in Table 1. Despite the work done by Boos, Downie, Kenny, and Murphy, much remains to be learned, not only about the Trinidad and Tobago herpetofauna, but about the rest of the islands' organisms as well.

SOME OVERLOOKED RECORDS FROM MUSEUMS AND FIELD NOTES

Plica plica on Tobago

This lizard has not been previously reported from Tobago. However, on 12 June, 1994 one of us (JCM) observed a large (~20 individuals) colony of these lizards in central Tobago at an abandoned sawmill. None were collected.

Two New Species of Skinks in Trinidad and Tobago

Copeoglossum aurae Hedges and Conn 2012. This species has been called: *Mabuia agilis, Mabuia aenea, Mabuya mabouia, Mabuya mabouya mabouya, Mabuya bistriata, Mabuya sloanii, Mabuya nigropunctata* by various authors over the years. It is the most frequently seen skink on Trinidad and Tobago. In 2012, Hedges and Conn demonstrated this lizard was not conspecific with any of the Amazonian skinks and named it *Copeoglossum aurae*. This species is now known from Grenada, St. Vincent, the Grenadines, Trinidad (including Huevos Island), and Tobago as well as Sucre, Venezuela.

Marisora aurulae Hedges and Conn 2012. This species has also been called *Mabuya falconensis.* In 2010, a Trinidad specimen of this skink (Fig. 1) was collected in the southern peninsula near Icacos. However, Hedges and Conn demonstrated this lizard was not conspecific with *falconensis* and named it *Marisora aurulae*. A species distributed in the southern Lesser Antilles and on Trinidad and Tobago; and known to occur on Young's Island (a satellite of St. Vincent), the Grenadines (Mayero Island, Carriacou, and Petit Bateau in the Tobago Cays), Grenada, Trinidad, and Tobago.

Epictia goudotii in Trinidad and Tobago

Peters and Orejas-Miranda (1970) reported Trinidad in the range of *Epictia* (=*Leptotyphlops*) *goudotii*; Emsley (1977) included *Epictia* (=*Leptotyphlops*) *goudotii* in his list of invalid records of snakes from Trinidad. He wrote, "…known only from Patos Island, which was politically part of Trinidad until 1942." We located two specimens of this snake with the locality data of "Trinidad" in the USNM (Fig. 2). This is the first confirmation of this snake on Trinidad.

Table 1. Changes in the names and the addition of species to the Trinidad and Tobago herpetofauna since Murphy (1997).

Name Used in Murphy 1997	Current Name and Additions	References
	Frogs	
	Family Bufonidae - True Toads	
Bufo beebei	*Rhinella humboldti* (Gallardo 1965)	Narvaes and Rodrigues 2009
Bufo marinus	*Rhinella marina* (Linnaeus)	Chaparro *et al.* 2007
	Family Centrolenidae - Glass Frogs	
Hyalinobatrachium orientale tobagoensis	*Hyalinobatrachium orientale* (Rivero)	Castroviejo-Fisher *et al.* 2008
	Family Hylidae - Tree Frogs	
Hyla microcephala misera	*Dendropsophus microcephalus misera* (Cope)	Faivovich *et al.* 2005
Hyla minuscula	*Dendropsophus minusculus* (Rivero)	Faivovich *et al.* 2005
Hyla minutus	*Dendropsophus minutus* (Peters)	Faivovich *et al.* 2005
Hyla boans	*Hypsiboas boans* (Linnaeus)	Faivovich *et al.* 2005
Hyla crepitans	*Hypsiboas crepitans* Weid-Neuwied	Faivovich *et al.* 2005
Hyla geographica	*Hypsiboas geographicus* (Spix)	Faivovich *et al.* 2005
Hyla punctata	*Hypsiboas punctatus* (Schneider)	Faivovich *et al.* 2005
Phyllodytes auratus	*Phytotriades auratus* (Boulenger)	Jowers *et al.* 2009
Added to fauna	*Scarthyla vigilans* (Solano)	Smith *et al.* 2011
Phryanohyas venulosa	*Trachycephalus typhonius* (Linnaeus 1758)	Lavilla *et al.* 2010
	Family Leiuperidae	
Physalaemus pustulosus	*Engystomops pustulosus* (Cope 1864)	Nascimento *et al.* 2005
	Family Leptodactylidae	
Adenomera hylaedactylus	*Leptodactylus hylaedactylus* (Cope)	Frost *et al.* 2006
	Family Ranidae	
Rana palmipes	*Lithobates palmipes* (Spix)	Frost *et al.* 2006
	Family Strabomantidae	
Eleutherodactylus charlottevillensis	*Pristimantis charlottevillensis* (Kaiser *et al.*)	Heinicke *et al.* 2007

Table 1 cont. Changes in the names and the addition of species to the Trinidad and Tobago herpetofauna since Murphy (1997).

Name Used in Murphy 1997	Current Name and Additions	References
Eleutherodactylus cf. *rozei*	*Pristimantis turpinorum* (Hardy)	Heinicke *et al.* 2007
Eleutherodactylus urichi	*Pristimantis urichi* (Boettger)	Heinicke *et al.* 2007
	Turtles	
	Family Chelidae	
Phrynops gibba	*Mesoclemmys gibba* (Schweigger)	McCord *et al.* 2001
	Family Testudinidae	
Geochelone carbonaris	*Chelonoidis carbonaria* (Spix)	Cei 1993
Geochelone denticulata	*Chelonoidis denticulata* (Linnaeus)	Obst 1985
	Lizards	
	Family Gymnopthalmidae	
Proctoporus shrevei	*Riama shrevei* (Parker)	Doan and Castoe 2005
	Family Dactyolidae	
Added to fauna	*Anolis wattsi* Boulenger 1894	White and Hailey 2006
	Family Scincidae	
Added to fauna	*Marisora aurulae* Hedges and Conn 2012	Hedges and Conn 2012
Mabuya bistriata	*Copeoglossum aurae* Hedges and Conn 2012	Hedges and Conn 2012
	Family Tropiduridae	
Tropidurus plica	*Plica plica* (Linnaeus)	Frost *et al.* 2001
	Snakes	
	Family Aniliidae	
Added to fauna	*Anilius scytale scytale* (Linnaeus 1758)	Boos 2001
	Family Leptotyphlopidae	
Added to fauna	*Epictia goudotti* (Dumeril and Bibron 1844)	Confirmed here
Leptotyphlops albifrons	*Epictia tenella* (Klauber 1939)	Adalsteinsson *et al.* 2009
	Family Boidae	
Corallus hortulanus cookii	*Corallus ruschenbergerii* (Cope 1867)	Henderson 1997
Epicrates cenchria maurus	*Epicrates maurus* Gray	Passos and Fernandes 2008
	Family Colubridae	
Added to fauna	*Chironius septentrionalis* Dixon, Wiest and Cei	Boos 2001
Added to fauna	*Chironius scurrulus* (Wagler)	Boos 2001
Leptophis riveti	*Leptophis stimsoni* Harding	Harding 1995
Mastigodryas boddaerti dunni	*Mastigodryas dunni* (Stuart)	Montingelli 2009
Dipsas variegate trinitatis	*Dipsas trinitatis* Parker	Harvey 2008
Added to fauna	*Erythrolamprus bizona* Jan	Boos 2001
Thamnodynases sp.	*Thamnodynastes ramonriveroi* Manzanilla and Sánchez	Manzanilla and Sánchez 2005

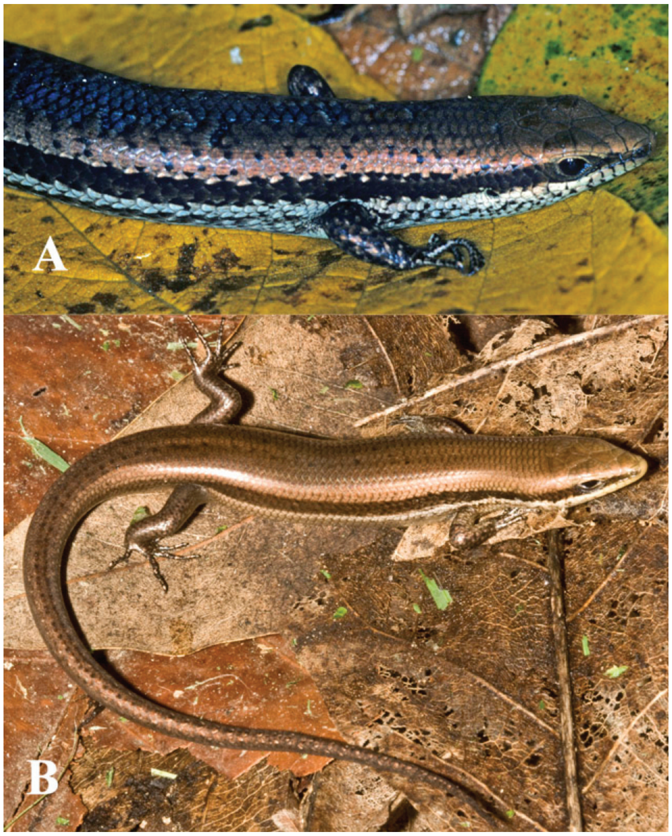

Fig. 1. Two species of Trinidad and Tobago skinks, both species are present on both islands. **A.** *Copeoglossum aurae* (previously called *Mabuya bistriata* or *M. nigropunctatus*). **B.** *Marisora aurulae* (previously called *Mabuya falconensis).*

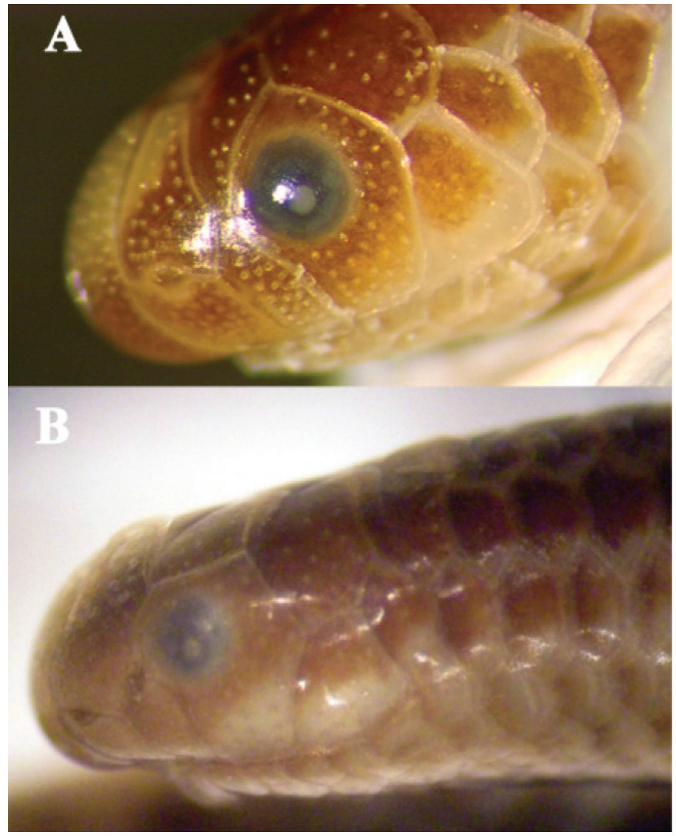

Fig. 2. A comparison of the two species of Trinidad thread snakes. **A.** The relatively well-known *Epictia tenella* (formerly called *Leptotyphlops tenella*). **B.** A specimen of *Epictia goudotti* not previously reported from Trinidad.

IMPLICATIONS FOR CONSERVATION AND NATURAL HISTORY EDUCATION

Amphibians and reptiles are among the most endangered of all vertebrate species (Gibbons *et al*. 2000; Stuart *et al*. 2004). Of the species monitored by the IUCN, more than 30% of the amphibians and reptiles are considered threatened, and these are just the ones we know about. The Center for Biological Diversity recently started a campaign titled, 'The Amphibian and Reptile Extinction Crisis.'

In addition to contributing to climate change, over the last few hundred years humans have dramatically fragmented the 'original' habitat of Trinidad and Tobago. Gone are most of the lowland forests – making much of both islands uninhabitable for the forested species that once inhabited the region. Patches of forests in the Northern, Central and Southern Ranges on Trinidad and the Main Ridge of Tobago are now isolated and in the process of being divided into even smaller parcels by human actions including road building, agriculture, and urban sprawl. Habitat fragmentation makes it difficult for many species to maintain viable populations and therefore increases the extinction rate.

Recently, Hailey and Cazabon-Mannette (2011) assessed the conservation of the islands' herpetofauna and noted that Trinidad and Tobago are unique amongst other Caribbean islands because they were developed relatively late in the European colonial period and the delayed population and agricultural growth left relatively large areas of original habitat. Further, they found industrial development is a major feature of current economic growth on Trinidad, while Tobago is more like the typical Caribbean island, without major industrial development. They see future development exacerbating the habitat loss that has already occurred: pollution from industrialization, urbanization, transport links, and quarrying (siltation of rivers as well as habitat loss); agriculture pesticides; and the salinization of water from the oil and gas industry. All of these pose major threats to the well-being of the islands' herpetofauna. They also discuss forestry practices, climate change and the frog fungus disease, chytridiomycosis, which is present on the islands, but not yet known to have caused deaths.

Protecting the valuable biodiversity resources of Trinidad and Tobago should be considered an immediate problem and given the highest priority. While legislation that regulates development may help in the short-term, the long-term solution to this problem is education. If the next generation values the environment and its diversity more than the current generation, things can improve. Protecting the existing gene pools until this can be accomplished is important and a goal worthy of national attention.

Natural history can be considered a means of exploring the stories of nature by attending to and focusing on the natural world. Sadly, public education of the subject matter and the perspective it brings is absent from most modern educational systems in all countries and is one of the reasons why the environment, the world's biodiversity, and humanity at large are threatened by impending ecological disasters. While the study of natural history focuses human attention on nature, most current educational systems center on programs that decouple humans from nature. Changing the worldwide perspective to help humans understand how they, the non-human organisms, and the landscape share in a single, interactive system could literally save the planet. This does not mean changing the subjects taught in schools: language, math, social studies, and science can all be taught with a natural history focus. Integrating natural history education into school curricula should be the mission and passion of groups like the Trinidad and Tobago Field Naturalists' Club.

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