

Doyle's Delight



The August 2004 Expedition.

Draf Report June 2007

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Picture cover: Colpothrinax coockii. Samuel Bridgewater

The August 2004, Expedition to Doyle's Delight: Introduction

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Doyle's Delight, the highest land area in Belize at 1,124 meters is located at UTM coordinates 1824,500 North and 281,600 East (North American Datum 1927, Zone 16N) on the boundary of the Cayo and Toledo districts (Directorate of Overseas Survey 1980). Field investigations to this area have always resulted in important and exciting findings. The Doyle's Delight August 2004 expedition proved no exception, as it provided additional insight into the unique role this area plays, both in the biological and physical profile of Belize.

In terms of geology the Doyle's Delight region of the Maya Mountains was part of an volcanic island during the Permian. After uplift of the Maya Mountain fault block in the Triassic and Jurassic, the Maya Mountains subsided in the late Jurassic during the rifting of South America and North America from Africa. From the early Cretaceous to the Cretaceous-Tertiary boundary all of Belize, including the Maya Mountains, formed part of the Yucatan carbonate platform where substantial thicknesses of shallow marine carbonate and evaporitic rocks were deposited.

What is recognized today as Doyle's Delight and the Maya Mountains has only been in existence for approximately 60 million years. During this time, the thick sequence of Cretaceous limestone which once covered the Maya Mountains has been largely eroded, though isolated limestone inliers remain. The erosion of the limestone has led to the exposure of the present day [pre-Cretaceous] Carboniferous and Permian bedrock and development of soils peculiar to the rocks, and the subsequent evolution of plant species which, in turn, support an array of other species. All of these factors combining to reinforce Doyle's Delight's reputation as Belize's "Lost World". The phrase "Lost World" was coined from Arthur Conan Doyle book "The Lost World" (1912), which contains the quote "there must be something wild and wonderful in a country such as this, and we're the men to find it out!". Recently there has been an attempt to rename the peak to "Kaan Witz" which is Maya for "Sky Mountain". But until now, this name has not found common acceptance.

However remote, Doyle's delight is not untouched by human hands. An interview in 2004 with Augustin Howe from San Antonio Village (Cayo District) revealed that this gentleman made several trips to "the highest point" during 1970. Objective of these trips was land measurement for the Department of Ordnance Survey (UK) by a team led by

Dunlop and McCartney. To reach the highest point in 1970, the team walked in from “Palmar camp” along the Smokey Branch in the Cayo District, carrying cement and equipment. At the highest point the team cleared a big patch of forest on the top to get a

clean line of sight to other points of reference. Additionally make-shift towers were erected in order to get above the surrounding canopy. Mr. Howe clearly remembers the prevalence of *Colpothrinax* and *Euterpe* palms on the top. The camp was made near a small stream a little ways down hill. Measurements were made using the equipment available in those days and often meaningful measurements were made impossible by the prevalence of a low cloud cover. The measurements apparently were very tricky and the teams had to return several times to the same point before satisfactory results

were obtained.

The marker which Mr. Howe helped put up, was rediscovered on top of the hill at the center of the helipad. The marker had overgrown with trees and was covered with a thick layer of soil. It was an amazing coincidence that we managed to unearth this small piece of history!

The name Doyle’s Delight was first coined in 1989 (Matola, 1989). This name has meanwhile achieved widespread acceptance. A quick web search revealed a large number of web sites that name Doyle’s Delight as the highest point of Belize, including the official Belize Government Website and Belmopan, the capital of Belize has a “Doyle’s Delight Street”.

The Doyle’s Delight August 10-23, 2004 expedition focused upon mycology, the study of fungi. With an enthusiastic letter of support from Dr. Neil Gow, the President of the British Mycological Society, the expedition quickly developed to not only allow a thorough look into the mycological features of this high plateau, but also, the vegetation, ornithology, herpetology and ecology. All of these form a basis of an area which remains unique in Belize and the region of Central America.

The results of this expedition serve to further establish that Doyle’s Delight requires additional investigations. The area remains undisturbed and can provide additional important data that will shed light on the significant role that this ancient landscape plays in the profile of neotropical biodiversity.

This expedition to Doyle's Delight would not have been possible without the major help and support of certain individuals or organizations. Thanks to Greg Sho for his assistance during the field work at Doyle's Delight. Most notably, the British Forces must be commended for their valuable support in providing helicopter-flight transportation to and from Doyle's Delight, especially CO Allan White who fully supported the 2004 Doyle's Delight Expedition.



Figure 2. Participants in the August 2004 Doyle's Delight expedition: (Back) Sam Bridgewater, botanist, British Museum of Natural History; Jan Meerman, ecologist, Belize Tropical Forest Studies and owner of the Green Hills Butterfly Ranch and Botanical Collections in Belize; D. Jean Lodge, mycologist, Center for Forest Mycology Research, Forest Products Lab, USDA-FS; Bruce Barcott, journalist; Julian Lee, herpetologist, University of Miami; Steven Brewer, botanist, University of North Carolina at Wilmington; Sharon Matola, former mycologist and survival training instructor, Director of the Belize Zoo and Tropical Education Centre; Dan Czederpiltz, mycologist, Center for Forest Mycology Research, Forest Products Lab, USDA-FS; (Front) Tim Baroni, mycologist, SUNY Cortland; Greg Sho, Guide, Belize Zoo and Tropical Education Centre; Mario Teul, ornithologist, Director of Birds Without Borders; and Martin Meadows, botanist/naturalist, Belize Botanic Gardens.

History of the Ecological Investigations Carried out in the Region of Doyle's Delight.

A. Maya Topping Expedition: 14-17 August 1987.

A team of five British army personnel, two BDF Air Wing pilots, one archaeologist from the Government- of Belize, and two members of the Belize Audubon Society, climbed to the highest area in Belize, 1124 meters. This expedition was called, "The Maya Topping Expedition".

Forester Martin Meadows, representing the Belize Audubon Society, was a participant on this initial expedition. Meadows noted that a common species of palm occurring on calcareous soils was the botan palm, *Sabal mauritiiformis*, but as the group made the transition to non-calcareous soils, another tall, robust palm species appeared to be a dominant species on the ridges.

Meadows made a careful description of the palm and forwarded this to the National Museum of Natural History, Smithsonian Institution, Department of Botany, in Washington, DC. It was studied, and botanist Bruce Read replied back that this palm was *Colpothrinax cookii*.

Colpothrinax cookii was first collected and photographed from Alta Verapaz in eastern Guatemala by Dr. O.F. Cook of the United States National Herbarium, March of 1902. Dr. Cook considered the new palm as representing a distinct genus and was preparing to publish this new monotypic genus in the year 1913. For some unknown reason, it was withdrawn from publication. Dr. Cook then revised the manuscript, added an analytical key, and elaborated on what he considered related genera. This second manuscript was scheduled for publication in 1914, but again, did not appear and subsequently remained among the specimens of this un-described species for the past 55 years (Read, 1969) .

Botanist Robert Read again collected the species in Alta Verapaz and wrote a paper describing this new palm from Central America. However, it is not monotypic. There is a species of *Colpothrinax* from Cuba, *Colpothrinax wrightii*.

Besides what appeared to be vegetation that was quite different from that found in lower altitudes in Belize, bird species sighted were also uncommon. Given the unusual profile of this high region, noted from a short time there, expedition member Martin Meadows felt that this area possibly contained more unusual species of flora and fauna, and he encouraged a return expedition to investigate the natural history of this high plateau in greater detail.

B. Doyle's Delight Expedition: 20-31 August 1989.

Six British Forces personnel and eight civilians with various degrees of natural history expertise were dropped by Puma helicopter one km northeast of the highest point, 1124 meters.

Documenting bird species and soils collection were undertaken in greatest detail, due to the participation of experienced scientists from both disciplines,

Avifaunal observations included seven migratory bird species, two species previously having been recorded only once, and one new record for the country, the Scaly Throated Foliage Gleaner, *Anabacerthia variegaticeps*.

The soils of this area were hardly known prior to this expedition. The area was even more inaccessible during the early 1950's when Wright et al. (1959) did their land survey of the entire country (Baille, et al., 1993). Information provided by soils analyses filled some of this information gap.

C. Doyle's Delight Expedition; 3-13 December 1993.

The late Theodore Parker felt strongly that the Maya Mountains played an important role in the migratory routes of many North American migratory bird species (Parker et al. 1993). In communications to expedition coordinator, Sharon Matola, Parker indicated his interest to participate in a further follow-up expedition to Doyle's Delight,

Botanical collections had not been undertaken during the 1989 expedition, and botanist Bruce Allen from the Missouri Botanical Gardens, agreed to participate. Four months before this expedition began, Theodore Parker was killed in a plane crash in Ecuador. Doyle's Delight expedition plans continued to be developed subsequent to Parker's untimely death. A further objective of this expedition was to keep the ideas and assumptions of Theodore Parker going forward. Ornithologists Steve Baird from Dartmouth College and Courtney Conway from the University of Rhode Island were invited to participate, both having had extensive experience in netting and documenting birds in Belize.

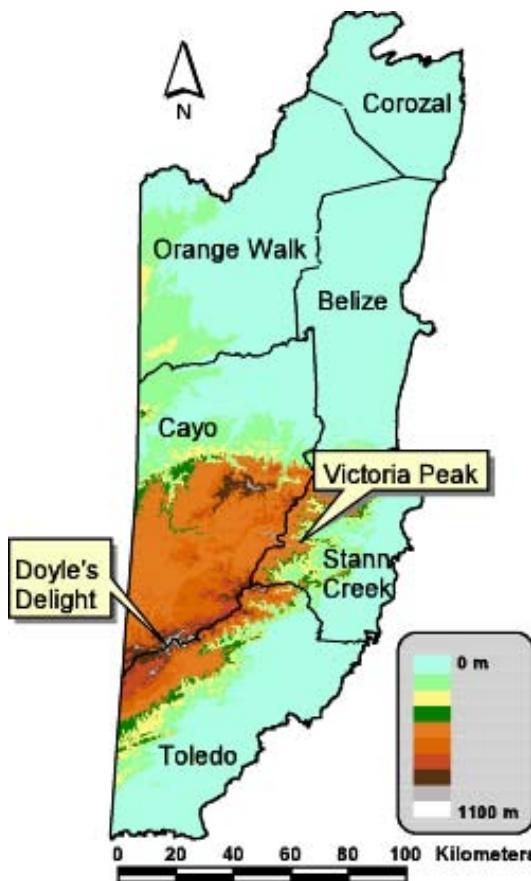
D. Doyle's Delight Expedition: 5-7 May 1994.

Due to a species of bamboo collected during the December expedition to Doyle's Delight being a new species previously unknown to science, British Forces agreed to return to this high plateau in order to collect samples of the bamboo for propagation at lower altitudes. Young plants were collected in Doyle's Delight soils, covered in plastic, and kept moist. One plant sample was transported to Kew Gardens, the remaining plants were kept under the care of Charles Wright where it was hoped that more data about this new species of bamboo could be documented should propagation be successful. Unfortunately, although the plant the plants survived for a number of years, they failed to thrive and eventually died.

Participating in this short expedition to Doyle's Delight was geologist Brian Holland, FGS.

Physical Description of Doyle's Delight.

Doyle's Delight, with UTM coordinates 1,824,500 North and 281,600 East (North American Datum 1927. Zone 16N), lies on the Maya Mountain Divide, approximately 6.5 kilometers north of the eastern margin of Little Quartz Ridge, and 32 kilometers west-southwest of Richardson Peak. With its elevation of 1124 meters, Doyle's Delight is the highest point in Belize.



It is generally assumed that the highest peak in Belize is Victoria Peak but this peak is apparently slightly lower with only 1120 m. Victoria peak which is located east of the Maya Mountain Divide in the Stann Creek District, is with clear weather quite visible from the coast and shows a dramatic peak (figure 3) while Doyle's Delight is located on a less visible location and is part of a more gently sloping range, not showing such a dramatic peak (figure 4).

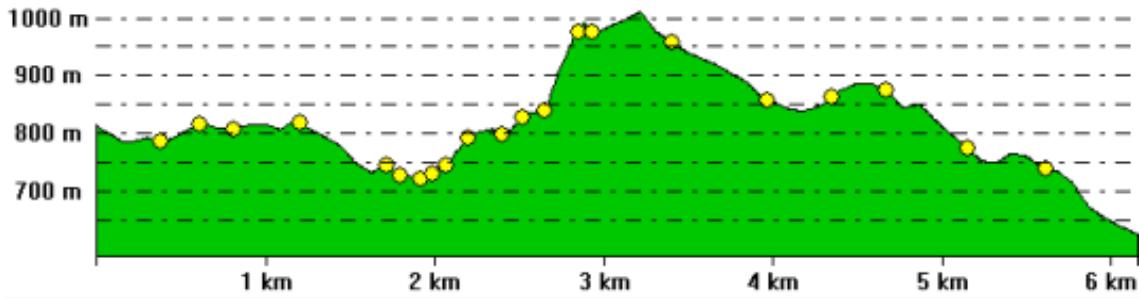


Figure 3. Elevational change along a 6.2 km W-E transect on the Cockscomb Range in the Stann Creek District (Based on Global Mapper analysis).

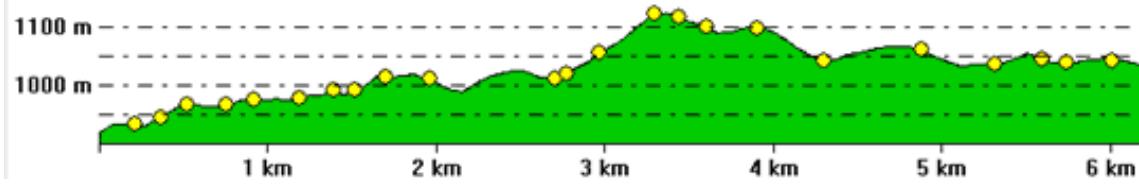
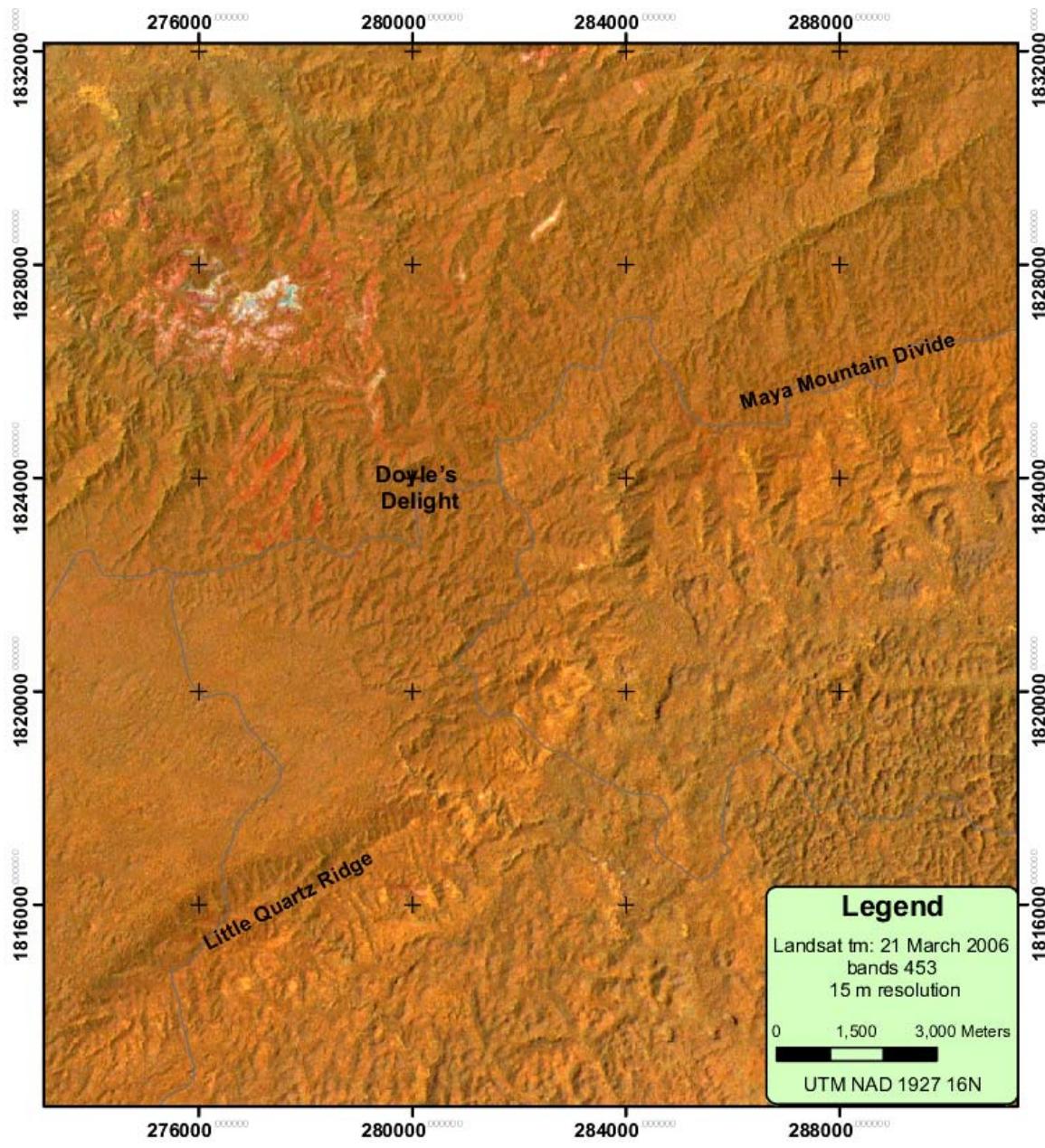


Figure 4. Elevational change along the Maya Mountain Divide from 3.1 km SW of Doyles Delight to 3.1 km NE of Doyles Delight (based on Global Mapper analysis).



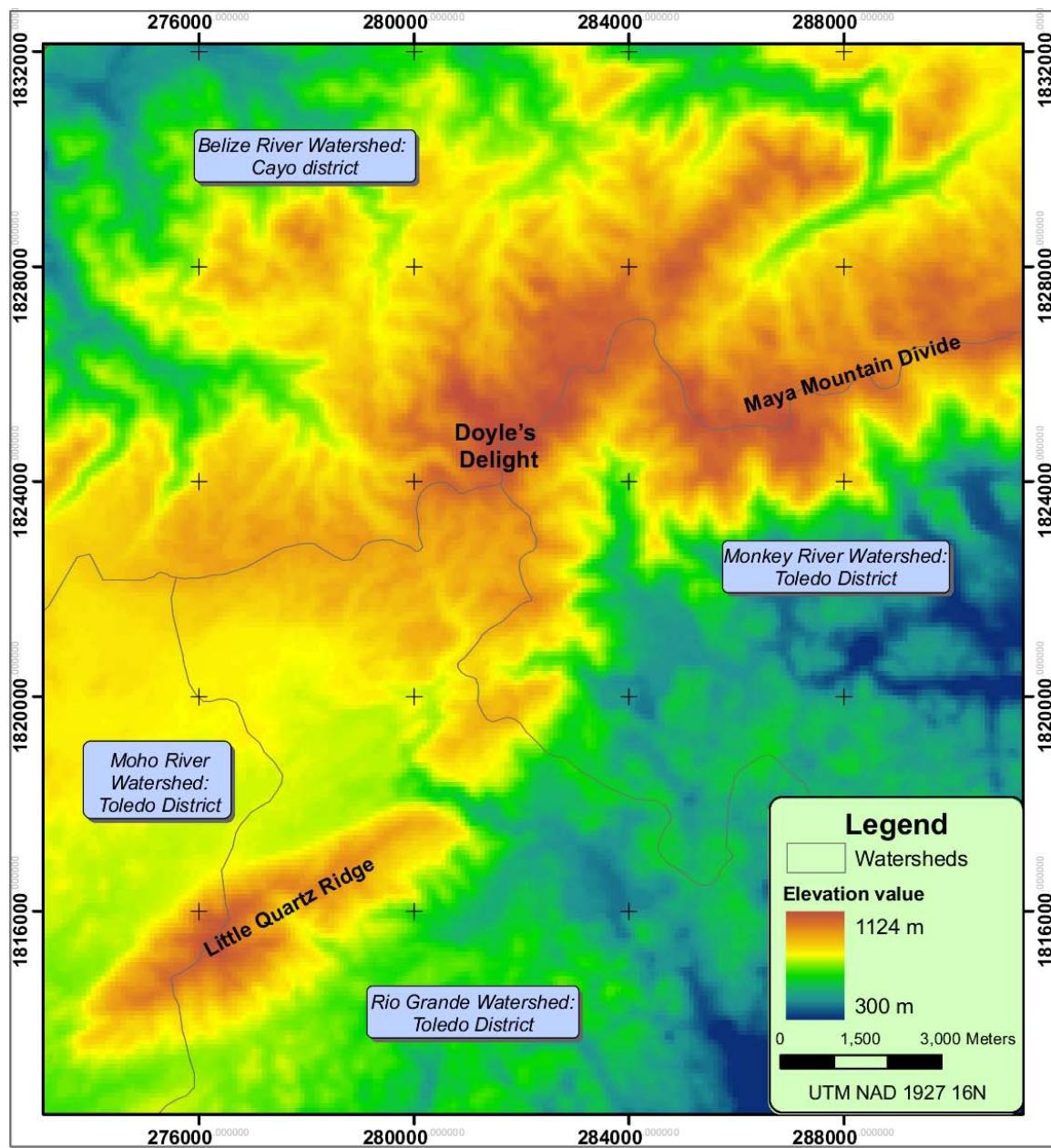


Figure 5. Digital elevation model of Doyle's Delight and general surroundings.





GEOLOGY AT DOYLE'S DELIGHT

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Details of the geology of the interior of the Maya Mountains are, to a great extent, still largely unknown. While geological mapping and sampling have been done along many of the rivers flowing out of the Maya Mountains (Ower, 1929; Dixon, 1956; Bateson & Hall, 1970, 1971, 1977, Hall & Bateson, 1972, Bateson, 1972), areas of higher elevation and the deep interior have largely remained “terra incognita”. There are several reasons for this, one is the extremely rugged nature of the area and, secondly, the dense tropical forest cover. The lack of commercial occurrences of metallic ore minerals elsewhere in the Maya Mountains has, perhaps, also contributed to a lack of interest in the geology of the interior.

Doyle's Delight, with UTM coordinates 1,824,500 North and 281,600 East, lies on the Maya Mountain Divide, approximately 6.5 kilometers north of the eastern margin of Little Quartz Ridge, and 32 kilometers west-southwest of Richardson Peak. With its elevation of 1124 meters, Doyle's Delight is the highest point in Belize.

According to Bateson & Hall (1972), Doyle's Delight lies outside the area they mapped as the Santa Rosa Group (SRG), which includes the Bladen Volcanic Member (BVM). The SRG comprises sedimentary and metasedimentary rocks of Permian and Carboniferous age, mostly shales, siltstones and shales and occasional limestones. According to Bateson & Hall (1972), the BVM consists mainly of alkali rhyolitic lavas, varying in texture from felsitic to coarsely porphyritic. These are sometimes interbedded with pyroclastic rocks and volcanic sediments. These sediments are interpreted as having been deposited contemporaneously with the lavas. Late Cretaceous limestones outcrop as white cliffs to the north of Doyle's Delight.

Approximately 100 meters northwest of the summit of Doyle's Delight is a small outcrop, approximately 2 meters high, of grayish yellow aphanitic rhyolite. 200 meters south of this outcrop, in the direction of the heli-pad, is an outcrop of a buff weathering, light gray mudstone. The rock has a blocky fracture, and occasionally shows rusty color staining on fracture surfaces. A greenish gray to yellowish gray porphyritic rhyolite was found at the base of a 40 meter deep ravine, located about 100 meters north of the heli-pad. The occurrence of rhyolitic rocks and the mudstone confirms the presence of the BVM at Doyle's Delight and extends the distribution of these Permian rocks further west than was previously known.

Preliminary Report on macrofungal collections obtained from Doyle's Delight, Maya Mountains in southern Belize

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Introduction

The Maya Mountains, and specifically Doyle's Delight, are considered geologically old for this part of Central America. The Maya Mt. formation, because it is geologically “old”, has the potential to be a biological refugium dating back at least 65 million years to the K/T boundary, when a bolide set off a massive tidal wave that may have extinguished all life in the region (Hedges, 1996). Since that time scientists believe that this landscape may have existed as islands (Bateson, 1972; Bateson & Hall, 1977/ Hartshorn et al., 1984 Kamstra, 1996; Means, 1997) and thus a haven for life. The refugium hypothesis seems to be borne out by studies on species of frogs, which shows high endemism (Means, 1997), and by our current discovery of certain macrofungal taxa not previously known outside of the Amazon Basin.



Our team has spent the last 4 years exploring the macrofungal biodiversity of numerous areas in Belize, including the Mountain Pine Ridge/Cayo District, Cockscomb Basin Wildlife Sanctuary/Jaguar Preserve/Stann Creek District, Blue Hole National Park/Caves Branch area, the pine/oak savanna areas around La Democracia/Belize District, Silk Grass/Stann Creek District, and the forests on the escarpment around the La Milpa/Rio Bravo Conservation

Areas/Orange Walk District. We have compiled nearly 4,000 macrofungal collections from these areas and have documented many new species to science and many more new first time reports for Belize. We had not however, had any opportunity to examine such a

pristine ecosystem as that of the cloud forest of Doyle's Delight. Our ability to examine this unique environment and compare the fungal organisms found in this ecosystem to those we have already documented for the rest of the country, provided a valuable scientific experience and a significant amount of new information on fungi of Belize.

Materials and Methods



Collections were made in as many different habitats as possible by hiking out from the base camp at Doyle's Delight. Sampling under particular tree types (*Quercus* spp.) received a greater amount of emphasis because of the known relationship between members of the Fagaceae and large macrofungi (ectomycorrhizae). After obtaining digital images of specimens and noting salient ecological features of the collection sites, samples were brought back to the base

camp so that descriptions on the fresh condition, including matching of colors, measurements of structures and some limited chemical spot tests could be obtained. The specimens were photographed again if necessary, and small tissue pieces were placed in DNA fixative (2X CTAB) for later extraction of genomic DNA. Those DNA samples will be used to answer questions about phylogenetic relatedness of species groups. The specimens were then split in ½, placed on metal screens of small mesh and dried in an aluminum box style dehydrator using butane as a source of heat. The drying temperature was kept low to insure slow even drying and preservation of microscopic features of the samples. Once dried the samples were placed with their notes in zip lock baggies for protection and transport.

Results

We made a total of 417 fungal collections at Doyle's Delight, primarily basidiomycetes such as agarics (mushrooms), boletes, puffballs, polypores (bracket fungi), jelly fungi, and tooth fungi. Some of the collections were of ascomycete fungi (dead man's fingers, and parasites on fungi and insects). One slime mold was also collected, and belongs to a separate subkingdom. Only half of the collections have been examined so far, but they are proving to be unusual with many undescribed species.



A list of specimens with identifications, where known so far, is appended in table 1.

Discussion

Doyle's Delight as a rare, cloud forest habitat island

The presence of large *Cyrilla racemiflora* trees along a west trending ridge that was connected to the south trail, and an abundance of *Clusia* trees along all the ridges, was reminiscent of the Palo Colorado zone in Puerto Rico (subtropical montane wet and subtropical montane rain forest, according to the Holdridge system). Not surprisingly, some of the basidiomycete fungi that are widespread in the Caribbean Basin, and which we also recorded at Doyle's Delight, are typical of Puerto Rican Palo Colorado forests and other high elevation forests in the Caribbean. These include *Hygroaster albellus*, *Hygrocybe cantharellus*, *H. papillata*, and *Humidicutis roseovinosa* (sp. nov., ined.) in the Hygrophoraceae. We also found an undescribed species of *Pouzarella* (Entolomataceae) that was previously found in a montane cloud forest in the Central Mountain Range of the Dominican Republic. In addition, an undescribed species of a previously monotypic genus in the Tricholomataceae, *Arthrosoporella*, was found at Doyle's Delight. While the new species of *Arthrosoporella* from Doyle's Delight is unique, this genus is typical of montane cloud forests in the Caribbean Basin. Two additional undescribed species of *Arthrosoporella* are known to us from cloud forests of Puerto Rico, the Dominican Republic, and Colombia.

Elements from lower elevation forests

While the species noted above are characteristic of very wet forests (cloud and rain forests) at high elevation in the Caribbean Basin, elements more typical of lower elevation moist or wet forests were also present. These included agarics such as *Alboleptonia cyathiformis* and *A. sulcata* in the Entolomataceae. Agarics in the Tricholomataceae recorded from Doyle's Delight that are typically found in lower elevation forests in the Caribbean included *Marasmiellus troyanus* (described from wet limestone forest the Cockpit Country of Jamaica), *Hydropus mycenoides*, and two undescribed species of *Mycena* known from wet forests dominated by *Dacryodes excelsa* in Puerto Rico (*M. roseovenosa*, and *M. pseudocuspitata pilosa* Lodge, spp. nov. ined.). Among the polypore fungi, a bright orange bracket fungus, *Pycnoporus sanguineus*, was found in a light gap, a dryer microhabitat. This species prefers extremely dry wood. In addition, three Ascomycete species were found that are more typical of moist or wet forests in the Caribbean Basin: *Xylaria areolata* and *X. meliaeарum* in the Xylariaceae (the latter specific to petioles of trees in the Meliaceae), and *Cookeina tricholoma*, a discomycete cup fungus (hairy Venus' winecup, in the Sarcoscyphaceae). The first two are new records for Belize, but the latter is very common throughout Belize.

Mexican elements

Two species of agarics we found were originally described from *Quercus-Liquidambar* forests in the state of Veracruz, Mexico. *Quercus* spp. were conspicuous at Doyle's Delight, and Martin Meadows located a stand of *Liquidambar*. These Mexican agaric elements were *Hygrocybe mexicana* (Hygrophoraceae) and *Favolaschia teapae*.

Ectomycorrhizal fungi

A number of basidiomycete species that are ectomycorrhizal were found at Doyle's Delight, primarily in association with *Quercus* species. A spectacular, gelatinous stalked puffball with a cinnabar red spore sac, *Calostoma cinnabarinus*, was found primarily with the narrow leaved oak species. It is found in North America as well as in Costa Rica. In Costa Rica, this species is also associated with *Quercus* spp. in wet montane areas.

Several species of tooth fungi were collected (*Hydnellum* & *Sarcodon* in the Thelephoraceae/ Hydnaceae), but these have not been identified. One possible collection of *Tomentella*, a resupinate species in the same family, was also recorded. Another resupinate species of *Lindtnaria* was also found, and both of these genera are presumably ectomycorrhizal. This is a difficult group requiring assistance from experts.

Lactarius cf. *fragilis* and three species of *Russula* were collected (Russulaceae), but one of the species decomposed before it could be recorded and dried. Three undescribed species of *Boletus* were found associated with *Quercus*. Two of these were remarkably small, and one does not appear to be closely related to other known taxa. Among the agaric fungi, one species of *Laccaria* (Tricholomataceae) was collected three times.



Plant, insect and fungal parasites

One basidiomycete tree pathogen was identified growing from the bases of oak trees on ridges – *Armillaria tabescens* (Tricholomataceae). This species is known to cause root rots. In addition, two ascomycete tree pathogens were recorded: *Kretzschmaria micropus* was collected and *K. coenopus* was photographed in or near the base camp. Trees on ridges may have suffered damage from previous hurricanes or droughts, allowing the fungi to gain entry.

Several species of insect parasites in the Clavicipitaceae were collected. We made three collections of *Ascopolyporus* (Clavicipitaceae), and these may have been parasitizing scale insects. A bright orange, resupinate *Cordyceps* species that parasitizes scale insects on vines was also recorded. We have collected the same *Cordyceps* species throughout Belize, and are awaiting an expert's determination. Two flies parasitized by another species of *Cordyceps* were also collected. One beetle grub that was parasitized by yet another species of *Cordyceps* was collected by Jan Meerman.

Three fungal parasites in the Hypocreaceae were recorded. One was a bright orange *Hypomyces* species that was found parasitizing fruit bodies of a polypore fungus, *Tyromyces*. A member of a related genus, *Sporophagomyces lanceolatus*, was found trapping and consuming the spores of another polypore species in the genus *Ganoderma*.

This is a known species that was recently moved into its own genus. Lastly, the asexual stage of a *Hypomyces*, *Sepedonium* sp., was found parasitizing fruit bodies of two *Boletus* species.

Amazonian elements and possible relicts

Quite a few species of agaric fungi represented disjunct populations of taxa known previously only from the Amazon Basin. These may represent relictual, ancient populations. This was particularly striking in the Tricholomataceae and Hygrophoraceae.

The Tricholomataceae had Amazonian elements in several genera. In the section Saccharifereae of the genus *Mycena*, we found *Mycena amazonensis* as well as two undescribed species related to it, *M. para-amazonensis* sp. nov., ined. and *M. stellulophora* sp. nov., ined. In *Mycena* Sect. Adonideae (should be in a separate genus based on morphology and DNA phylogenies), T.J. Baroni found a relatively large, undescribed pale pink species related to a recently described Amazonian species, *M. chrysites*. A surprising find was an undescribed scarlet species on leaf litter that is related to *Mycena ixoxantha*. This species complex has not been found previously outside of the Amazon Basin, and this species has previously been found in Amazonian Ecuador (Lodge, 1996). We made eleven collections of an undescribed species of *Arthrosiorella*, a previously monotypic genus described from Amazonian Brazil. The genus is characterized by production of asexual spores on the surfaces of the cap and stalk, dull colors, and crowded lamellae.

Amazonian elements were also prominent in the Hygrophoraceae, or wax caps. One collection (DJL-BZ-96) represents belongs to a species being described from Amazonian Ecuador, and not known elsewhere. Another collection matches an undescribed taxon from Amazonian Ecuador in the *Hygrocybe occidentalis* complex. This taxon is characterized by a pale yellow cap, and bright orange-red lamellae and upper stalk.

A stalked polypore with bright orange pores was found growing from the ground on a ridge. It is *Amauroderma dubiopansum* (Ganodermataceae), a species not previously reported outside of Mato Grosso Brazil and Venezuela. We have, however, collected it once before in Belize, in the Mountain Pine Ridge along the Five-Sisters Lodge Nature Trail.

Undescribed species and varieties

To date, we have found 33 undescribed species and one undescribed variety among the 184 collections we have examined so far. The work is slow, especially when new taxa are encountered; it often takes a half-day to several days to work up each undescribed taxon. The agarics in the Hygrophoraceae, Tricholomataceae, and Entolomataceae have received the greatest attention, as Lodge and Baroni are experts in these groups.

Two undescribed species of *Lepiota* (Lepiotaceae) were found, provisionally named *L. carneobrunnescens* and *L. rostratocystidiosa* by Baroni. Baroni has also identified an undescribed species of *Pyrrhoglossum* and provided the provisional name of

Pyrrhoglossum flaviceps because of the striking yellow pileus colors contrasting with a purple stalk.

In the Hygrophoraceae, we found six undescribed species and one undescribed variety of *Hygrocybe* in Section Firmae, a group that is characterized by having dimorphic spores and basidia. This is an almost exclusively topical group, and it has radiated in the neotropics. One of the new species has a small, pale orange-buff cap and a long, deep red, almost woody stalk (*Hygrocybe rubrodolichopoda* Lodge & Baroni, sp. nov., ined.). Another striking species in this section has a pale yellow, perforated cap with purple-brown scales, and a long white stalk. It is being named *Hygrocybe fosteri* in honor of Richard and Linda Foster.

In the Tricholomataceae, we have found one new species of *Arthrosiorella*, one new species of *Hydropus*, six new species of *Mycena*, one new species of *Marasmiellus* that was growing with rhizomorphs on a climbing Cyclanthaceae, one new species of *Marasmius*, and one new species of *Pleurocollybia*.

Among the agarics in the Entolomataceae, Baroni has found seven undescribed taxa. These include a new species of *Alboleptonia*, a new species of *Calliderma* (a large blue mushroom), a large species of *Entoloma* near *E. significum*, two new species of *Inocephalus*, one new species of *Leptonia*, and a new species of *Rhodocybe*.

Among the resupinate, corticioid fungi, Cederpiltz reports that we appear to have an undescribed species of *Dichostereum* (DLC04-57, -76, 77, -115, and -160). *Phanerochaete* (DLC04-133 and -145), a new species of *Phlebia* (DLC04-178), and a new species of *Protohydnnum* (DLC04-178), a toothed jelly fungus. Other species in this group are probably undescribed, but have not been investigated fully. There was a striking undescribed shelf fungus with purple staining when bruised, *Daedalea rosea*, being described by L. Ryvarden and J.L Mata from Costa Rica, and apparently associated with *Quercus*.



Table 1.

Family	Genus	species	Section	Variety	Number of records	New
Clavicipitaceae	<i>Ascopolyporus</i>	<i>sp.</i>			DLC-04-63, DLC-04-64, DLC-04-65	
Clavicipitaceae	<i>Cordyceps</i>	<i>sp. 1, on Diptera</i>			DLC-04-60, DLC-04-61	
Clavicipitaceae	<i>Cordyceps</i>	<i>sp.2, imperfect stage on Arachnid</i>			DLC-04-66	
Clavicipitaceae	<i>Hyperdermium</i>	<i>bertonii (Spreg.) J.F. White</i>			DLC-04-62	
Hypoocreaceae	<i>Hypomyces</i>	<i>sp., on Tyromyces</i>			DJL-113	
Hypoocreaceae	<i>Sepedonium</i>	<i>sp., on Boletus/Xerocomus</i>			DJL-119	
Hypoocreaceae	<i>Sporophagomyces</i>	<i>lanceolatus Samuels et al.</i>			DLC-04-167	
Pezizaceae	<i>Tremellidiscus</i>				TJB-9983	sp. nov.?
Sarcoscyphaceae	<i>Cookeina</i>	<i>tricholoma (Mont.) Kuntz</i>			TJB-9901	
Xylariaceae	<i>Kretzschmaria</i>	<i>micropus (Fr.) Sacc.</i>			DJL-17	
Xylariaceae	<i>Kretzschmaria</i>	<i>coenopus</i>			photos only, DJL	photos only
Xylariaceae	<i>Xylaria</i>	<i>areolata (Berk. & M.A. Curtis) Dennis</i>			DJL-61	
Xylariaceae	<i>Xylaria</i>	<i>fockei</i>			DJL-38	
Xylariaceae	<i>Xylaria</i>	<i>globosa</i>			DJL-37	
Xylariaceae	<i>Xylaria</i>	<i>magnoliae</i>			DJL-24, DJL-60, DJL-107	
Xylariaceae	<i>Xylaria</i>	<i>meliacearum Laessøe</i>			DJL-46	
Xylariaceae	<i>Xylaria</i>	<i>sp.</i>			DJL-23, DJL-31	
Agaricaceae	<i>Lepiota</i>	<i>"carneobrunnescens", sp. nov., nom. prov., ined.</i>	<i>Sericellae</i>		TJB-9919, TJB-9862	

Agaricaceae	<i>Lepiota</i>	"rostratocystidiosa", sp. nov., nom. prov., ined.	TJB-9920
Agaricaceae	<i>Lepiota</i>	<i>sulphureocyanescens</i> Franco-Molano	TJB-9884, DJL-26
Agaricaceae	<i>Lepiota</i>	<i>sp.</i>	DJL-114
Amanitaceae	<i>Amanita</i>		TJB-9918
Auriculariaceae	<i>Auricularia</i>	<i>delicata</i> (Fr.) P. Henn.	TJB-9875, TJB-9903, DJL-57
Bolbitiaceae	<i>Conocybe</i>	<i>pilocella</i> , cf.	DJL-54
Bolbitiaceae	<i>Conocybe</i>	<i>sp.</i>	TJB-9985, TJB-9893
Clavariaceae	<i>Clavulinopsis</i> , cf.	<i>sp.</i>	TJB-9924
Clavariaceae	<i>Clavaria</i>	<i>sp.</i>	TJB-9842, TJB-9867, TJB-9922, TJB-9923, TJB-9925
Coprinaceae	<i>Coprinus</i>	<i>disseminatus</i> (Pers.) S.F. Gray	DJL-25
Cortinariaceae	<i>Cortinarius</i>	<i>sp.</i>	TJB-9910
Cortinariaceae	<i>Flammulaster</i> , cf.	<i>sp.</i>	DJL-52
Cortinariaceae	<i>Galerina</i> , cf.	<i>sp.</i>	TJB-9964
Cortinariaceae	<i>Gymnopilus</i>	<i>sp.</i>	TJB-9915, DJL-73
Cortinariaceae	<i>Phaeocollybia</i>	<i>sp.</i>	TJB-9856
Cortinariaceae	<i>Phaeomarasmius</i>	<i>sp.</i>	TJB-9894, DJL-47
Cortinariaceae	<i>Pyrrhoglossum</i>	<i>sp. nov.</i>	DJL-53
Crepidotaceae	<i>Crepidotus</i>	<i>cuneiformis</i> , cf., <i>martini</i> , cf.	TJB-9852
Entolomataceae	<i>Alboleptonia</i>	'griseopallida' T.J. Baroni & Lodge, sp. nov., nom. prov., ined.	TJB-9909
Entolomataceae	<i>Alboleptonia</i>	<i>cyathiformis</i> (Dennis) Pegler	TJB-9822
Entolomataceae	<i>Alboleptonia</i>	<i>sulcata</i> T.J. Baroni & Lodge	TJB-9892
Entolomataceae	<i>Alboleptonia</i>	<i>sp.</i>	TJB-9909

Entolomataceae	<i>Calliderma</i>	'mayaorum' T.J. Baroni, sp. nov., nom. prov., ined.	TJB-9895	sp. nov.
Entolomataceae	<i>Claudopus</i>	<i>arachnoideus</i> (Berk. & M.A. Curtis) Pegler	TJB-9829	
Entolomataceae	<i>Claudopus</i>	sp.	TJB-9836	
Entolomataceae	<i>Clitopilus</i>	<i>hobsonii</i> , cf. (Berk.) P.D. Orton	TJB-9908	
Entolomataceae	<i>Entoloma</i>	<i>significum</i> , aff., sp. nov.	TJB-9876	sp. nov.
Entolomataceae	<i>Entoloma</i>	sp.	TJB-9857, TJB-9876	
Entolomataceae	<i>Inocephalus</i>	'marginatus' T.J. Baroni, sp. nov., nom. prov., ined.	TJB-9850	sp. nov.
Entolomataceae	<i>Inocephalus</i>	'vinaceus' T.J. Baroni, sp. nov., nom. prov., ined.	TJB-9845, TJB-9896	sp. nov.
Entolomataceae	<i>Inocephalus</i>	sp.	TJB-9866	
Entolomataceae	<i>Leptonia</i>	'purpureostriatula' T.J. Baroni, sp. nov., nom. prov., ined.	TJB-9878, TJB-9900	sp. nov.
Entolomataceae	<i>Leptonia</i>	sp.	TJB-9855, TJB-9865, TJB-9907, DJL-127	
Entolomataceae	<i>Nolanea</i>	sp.	TJB-9843, TJB-9849, TJB-9897, TJB-9904, TJB-9906, DJL-125	
Entolomataceae	<i>Pouzarella</i>	sp. nov.	DJL-49	sp. nov.
Entolomataceae	<i>Pouzarella</i>	sp.	TJB-9881	
Entolomataceae	<i>Rhodocybe</i>	'lutea' T.J. Baroni, sp. nov., nom. prov., ined.	TJB-9834	sp. nov.
Entolomataceae	<i>Rhodocybe</i>	<i>densifolia</i> , cf. T.J. Baronini & Horak	TJB-9847	
Entolomataceae	<i>Rhodocybe</i>	<i>mellea</i> T.J. Baroni & Ovrebo	TJB-9823, TJB-9874	sp. nov.

Hygrophoraceae	<i>Humidicutis</i>	<i>roseovinosa</i> S.A. <i>Cantrell & Lodge, sp.</i> <i>nov., nom. prov., ined.</i>	DJL-117	sp. nov.	
Hygrophoraceae	<i>Hygroaster</i>	<i>albellus</i> Singer	TJB-9844, TJB-9846, TJB-9851, DJL-71, DJL-85		
Hygrophoraceae	<i>Hygrocybe</i>	' <i>rubrodolichopoda</i> ' <i>Lodge, sp. nov., ined.</i>	Firmeae	DJL-71, DJL-100 sp. nov.	
Hygrophoraceae	<i>Hygrocybe</i>	<i>cantharellus</i> (Schwein.) Coccineae Murrill		DJL-99	
Hygrophoraceae	<i>Hygrocybe</i>	<i>chloochlora</i> Pegler & Flard	Firmeae	DJL-33, DJL-66 var. nov.	
Hygrophoraceae	<i>Hygrocybe</i>	<i>fosteri</i> Lodge, sp. nov., ined.	Firmeae	DJL-27 sp. nov.	
Hygrophoraceae	<i>Hygrocybe</i>	<i>mexicana</i> Singer	Coccineae	DJL-	
Hygrophoraceae	<i>Hygrocybe</i>	<i>occidentalis</i> (Dennis) Pegler	Firmeae	DJL-11, DJL-11.1, DJL-12, DJL-65, DJL- 70, DJL-81, DJL-101	
Hygrophoraceae	<i>Hygrocybe</i>	<i>occidentalis</i> (Dennis) Pegler	Firmeae	scarletina	DJL-14, DJL-87, DJL- 118
Hygrophoraceae	<i>Hygrocybe</i>	<i>papillata</i> (Dennis) S.A. <i>Cantrell & Lodge</i>	Coccineae	DJL-6	
Hygrophoraceae	<i>Hygrocybe</i>	<i>sp.</i>		DJL-	
Hygrophoraceae	<i>Hygrocybe</i>	<i>sp. 1</i>	Firmeae	DJL-65 sp.nov. 1	
Hygrophoraceae	<i>Hygrocybe</i>	<i>sp. 2</i>	Firmeae	DJL-70, 86 sp. nov. 2	
Hygrophoraceae	<i>Hygrocybe</i>	<i>sp. 3</i>	Firmeae	DJL-, DJL- sp. nov. 3	
Lycoperdaceae	<i>Lycoperdon, cf.</i>			DJL-90	
Pluteaceae	<i>Pluteus</i>	<i>admirabilis</i> Pk.		DJL-50	
Pluteaceae	<i>Pluteus</i>	<i>spp.</i>		TJB-9870, TJB-9886, DJL-30, DJL-97	
Strophariaceae	<i>Psilocybe</i>	<i>sp.</i>		DJL-72	
Tricholomataceae	<i>Armillaria</i>	<i>tabescens</i> (Scop.) Emel		DLC-04-95, DJL-75	

Tricholomataceae	<i>Arthrosiorella</i>	<i>sp.</i>	TJB-9820, TJB-9835, sp. nov. TJB-9858, TJB-9873, TJB-9887, TJB-9912, DLC-170, DJL-10, DJL-51, DJL-77, DJL-129
Tricholomataceae	<i>Collybia</i>	<i>spp.</i>	TJB-9831, DJL-4, DJL-79, DJL-88, DJL-92
Tricholomataceae	<i>Crinipellis</i>	<i>spp.</i>	TJB-9869, TJB-9871, DJL-5, DJL5.1
Tricholomataceae	<i>Dictyopanus</i>	<i>pussilus (Lév.) Singer</i>	DJL-04-191
Tricholomataceae	<i>Favolaschia</i>	<i>teapae Singer</i>	DJL-44
Tricholomataceae	<i>Filiboletus</i>	<i>gracilimus</i>	DJL-58
Tricholomataceae	<i>Gerronema</i>	<i>strombodes, cf.</i>	DJL-43
Tricholomataceae	<i>Gerronema</i>	<i>sp.</i>	TJB-9899
Tricholomataceae	<i>Hohenbuehelia</i>	<i>sp.</i>	TJB-9848
Tricholomataceae	<i>Hydropus</i>	<i>mycenoides (Dennis) Pegler</i>	TJB-9826, TJB-9853, DJL-7
Tricholomataceae	<i>Hydropus</i>	<i>sp. 1</i>	DJL-90, DJL-90.1 sp. nov.
Tricholomataceae	<i>Hydropus</i>	<i>spp.</i>	TJB-9872, DJL-120
Tricholomataceae	<i>Laccaria</i>	<i>sp.</i>	TJB-9911, DJL-20, DJL-74
Tricholomataceae	<i>Lyophyllum, cf.</i>	<i>sp.</i>	TJB-9914
Tricholomataceae	<i>Marasmiellus</i>	<i>defibulatus Singer</i>	DJL-15
Tricholomataceae	<i>Marasmiellus</i>	<i>opus (Berk. & M.A. Curtis) Singer</i>	DJL-29, DJL-63
Tricholomataceae	<i>Marasmiellus</i>	<i>troyanus (Murrill) Dennis</i>	DJL-28
Tricholomataceae	<i>Marasmiellus</i>	<i>sp.</i>	TJB-9880, DJL-19
Tricholomataceae	<i>Marasmiellus</i>	<i>sp.</i>	DJL-19 sp. nov.
Tricholomataceae	<i>Marasmius</i>	<i>cohaerens (Albert. & Schwein.) Cke. & Quél.</i>	TJB-9889
Tricholomataceae	<i>Marasmius</i>	<i>pseudoniveus Singer</i>	amylocystis Singer TJB-9890, DJL-116

Tricholomataceae	<i>Marasmius</i>	<i>sp.</i>	Sicci, Subsect. Siccini	DJL-62	sp. nov.
Tricholomataceae	<i>Micromphale</i>			TJB-9860	
Tricholomataceae	<i>Mycena</i>	'pseudo- <i>cuspidotopilosa</i> ' Lodge, sp. nov., nom. prov. ined.		DJL-103	sp. nov.
Tricholomataceae	<i>Mycena</i>	'roseovenosa' Lodge, sp. nov., nom. prov. ined.		DJL-89, DJL-104, DJL-109	sp. nov.
Tricholomataceae	<i>Mycena</i>	<i>aosma</i> , cf. Singer		DJL-8, DJL-112	
Tricholomataceae	<i>Mycena</i>	<i>chlorinosma</i> , aff.		DJL-22, DJL-69	
Tricholomataceae	<i>Mycena</i>	<i>chrysites</i> , aff., sp. nov.		DJL-67	sp. nov.
Tricholomataceae	<i>Mycena</i>	<i>depilata</i> Singer	Sacchariferae	DJL-18	
Tricholomataceae	<i>Mycena</i>	<i>ixoxantha</i> , aff., sp. nov.		DJL-121	sp.nov.
Tricholomataceae	<i>Mycena</i>	<i>para-amazonica</i> Lodge,	Sacchariferae	DJL-95	sp. nov.
Tricholomataceae	<i>Mycena</i>	<i>stellulaphora</i> Lodge, sp.	Sacchariferae	DJL-16	sp. nov.
		nov., nom. prov. ined.			
Tricholomataceae	<i>Mycena</i>	<i>xanthopoda</i> Dennis	Carolinenses	DJL-36, DJL-102, DJL-115	
Tricholomataceae	<i>Mycena</i>	<i>spp.</i> 1-5		DJL-1, DJL-68, DJL- 94, DJL-128	
Tricholomataceae	<i>Mycena</i> , cf., <i>Hemimycena</i> , cf.	SPP. 1-3		DJL-9, DJL-21, DJL- 78	
Tricholomataceae	<i>Mycena/Prunulus</i>	<i>holoporphryra</i> (Berk. & M.A. Curtis) Singer		DJL-2	
Tricholomataceae	<i>Mycena/Prunulus</i>	<i>holoporphryra</i> , aff.		DJL-41	
Tricholomataceae	<i>Neonothopanus</i>	<i>nambi</i> (Speg.) Petersen & Mata		TJB-9891	
Tricholomataceae	<i>Pleurocollybia</i>	'doylesdelightiorum' T.J. Baroni & D. Czederpiltz, sp. Nov., nom. Prov., ined.		TJB-9838	

Tricholomataceae	<i>Strobilurus</i>	<i>conigenoides</i> (Ellis) Singer	TJB-9827, TJB-9861, TJB-9902
Tricholomataceae	<i>Troglia</i> , cf.		DJL-13
Tricholomataceae	<i>Xeromphalina</i>	<i>tenuipes</i> , cf.	DJL-3
Boletaceae	<i>Boletellus</i> (<i>Xerocomus</i>)		TJB-9821, TJB-9916 sp. nov.
Boletaceae	<i>Boletus</i>	'ruguliceps' T.J. Baroni & Lodge, sp. nov., ined.	TJB-9833 sp. nov.
Boletaceae	<i>Boletus</i>	<i>campestris</i> , aff., sp. nov.	TJB-9854 sp. nov.
Cantharellaceae	<i>Catharellus</i>	sp.	TJB-9828
Hydnaceae	<i>Hydnnum</i>	sp.	TJB-9877, TJB-9921
Atheliaceae/Corticiaceae	<i>Athelia</i>		DLC-04-40, DLC-04- 58, DLC-04-194
'corticeaceae'	<i>Corticium</i>		DLC-04-42, -55, -56, -75, -85, -102, -122, -124, -129, -130, - 136, -156, -176, - 181, -195
Corticiaceae	<i>Dendrothele</i>	sp.	DLC-04-155, -180
Xenasmataceae/Corticiaceae	<i>Xenasma</i>		DLC-04-188, -201
Schizoporaceae	<i>Hyphodontia</i>	sp.	DLC-04-70
Sisotremataceae/Corticiaceae	<i>Sistotrema</i>	sp.	DLC-04-79, -101, - 123, -125, -132, - 171, -199
Sisotremataceae/Corticiaceae	<i>Trechispora</i>	<i>mollusca</i> , cf. (Pers.) <i>Liberta</i>	1
Sisotremataceae/Corticiaceae	<i>Trechispora</i>	sp.	3
Hymenochaetaceae	<i>Stipitochaetae</i> , cf.	<i>damaecornis</i>	2
Hymenochaetaceae/Polyporaceae	<i>Hymenochaete</i>		4
Hymenochaetaceae/Polyporaceae	<i>Phellinus</i>	<i>gilvus</i> (Schwein.) Pat.	1
Hymenochaetaceae/Polyporaceae	<i>Phellinus</i>	sp.	1

Hymenochaetaceae/Polyporaceae	<i>Phylloporia</i>	<i>chrysita</i> (Berk.) Ryv.	2
Gastraceae	<i>Geastrum</i>	<i>minimum</i> Schwien.	2
Protophallaceae	<i>Protubera</i>	<i>jamaicensis</i> Murrill	4
Sclerodermataceae	<i>Calostoma</i>	<i>cinnabrina</i> Desv.	4
Coriolaceae/Polyporaceae	<i>Ceriporia</i>	<i>sp.</i>	1
Coriolaceae/Polyporaceae	<i>Fomitopsis</i>	<i>sp.</i>	1
Coriolaceae/Polyporaceae	<i>Hapalopilus</i>	<i>sp.</i>	1
Coriolaceae/Polyporaceae	<i>Hexagonia</i>	<i>hydnoides</i> (Fr.) M. <i>Fidalgo</i>	1
Coriolaceae/Polyporaceae	<i>Hydnopolyporus</i>	<i>fimbriatus</i> (Fr.) Reid	1
Coriolaceae/Polyporaceae	<i>Poria</i>	<i>sp.</i>	4
Coriolaceae/Polyporaceae	<i>Pycnoporus</i>	<i>sanguineus</i> (L.) Murrill	1
Coriolaceae/Polyporaceae	<i>Rigidoporus</i>	<i>aurantiaca</i> Ryv. & <i>Ituriaga</i>	1
Coriolaceae/Polyporaceae	<i>Rigidoporus</i>	<i>sp.</i>	2
Coriolaceae/Polyporaceae	<i>Skeletocutis</i>	<i>sp.</i>	4
Coriolaceae/Polyporaceae	<i>Tinctoporellus</i>	<i>epimiltinus</i> (Berk. & M.A. Curtis) Ryv.	2
Coriolaceae/Polyporaceae	<i>Trametes</i>	<i>sp.</i>	7
Coriolaceae/Polyporaceae	<i>Tyromyces</i>	<i>sp.</i>	3
Cystostereaceae	<i>Cystostereum</i>	<i>sp.</i>	1
Fomitopsidaceae/Polyporaceae	<i>Daedalea</i>	<i>rosea</i>	2
Fomitopsidaceae/Polyporaceae	<i>Daedalea</i>	<i>sp.</i>	2
Ganodermataceae/Polyporaceae	<i>Amauroderma</i>	<i>dubioansum</i> (Lloyd) Dennis	1
Ganodermataceae/Polyporaceae	<i>Amauroderma</i>	<i>sp.</i>	5
Ganodermataceae/Polyporaceae	<i>Ganoderma</i>	<i>sp.</i>	5
Grammotheleaceae/Polyporaceae	<i>Porogramme</i>	<i>albocincta</i> (Cooke & Massee) Lowe	3
Hypodermataceae/Corticiaceae	<i>Hyphoderma</i>	<i>sp.</i>	7
Hypodermataceae/Corticiaceae	<i>Hyphodontia</i>	<i>sp.</i>	15
Lentinaceae/Polyporaceae	<i>Lentinus</i>	<i>berteroii</i> , cf.	1
Meruliaceae/Corticiaceae	<i>Merulipsis</i>	<i>corium</i>	1
Meruliaceae/Corticiaceae	<i>Mycoacia</i>		1
Meruliaceae/Corticiaceae	<i>Phanerochaete</i>	<i>sp.</i> 1	2
			sp. nov.

Meruliaceae/Corticiaceae	<i>Phanerochaete</i>	<i>sp.</i>	5	
Meruliaceae/Corticiaceae	<i>Phelbia</i>	<i>sp.</i>	3	sp.nov.
Meruliaceae/Corticiaceae			2	
Podoscyphaceae	<i>Stereopsis</i>	<i>radicans, cf.</i>	1	
Polyporaceae	<i>Nigrofomes, c.f.</i>	<i>sp.</i>	1	
Polyporaceae	<i>Polyporus</i>	<i>melanopus Fr.</i>	2	
Polyporaceae	<i>Polyporus</i>	<i>tenuiculus (Beauv.) Fr.</i>	2	
Polyporaceae	<i>Polyporus</i>	<i>sp.</i>	8	
Steccherinaceae	<i>Junghunia</i>	<i>sp.</i>	1	
Steccherinaceae/Corticiaceae	<i>Steccherinum</i>	<i>sp.</i>	1	
Stereaceae	<i>Gleoecystidiellum</i>	<i>sp.</i>	3	
Stereaceae	<i>Stereum</i>	<i>ostrea (Blum. & Nees)</i> <i>Fr.</i>	1	
Stereaceae	<i>Stereum</i>	<i>sp.</i>	5	
Hericiaceae	<i>Mucronella</i>	<i>sp.</i>	1	
Ramariaceae	<i>Ramaria</i>	<i>sp.</i>	1	
Russulaceae	<i>Lactarius</i>	<i>fragilis</i>	2	
Russulaceae	<i>Russula</i>	<i>sp. 1</i>	1	
Russulaceae	<i>Russula</i>	<i>sp. 2</i>		
Lachnocladiaceae	<i>Asterostroma</i>	<i>sp.</i>	2	
Lachnocladiaceae	<i>Lachnocladium</i>	<i>sp.</i>	2	
Lachnocladiaceae			1	
Thelephoraceae	<i>Hydnodon</i>	<i>thelephorus (Lév.)</i> <i>Banker</i>	5	
Thelephoraceae	<i>Sarcodon</i>	<i>sp. 1</i>	1	
Thelephoraceae	<i>Sarcodon</i>	<i>sp. 2</i>	2	
Thelephoraceae	<i>Tomentella</i>	<i>sp.</i>	1	
Tremellaceae	<i>Tremella</i>	<i>fuciformis Berk.</i>	1	

Botanical Survey: Composition and Ecology of the Vegetation of Doyle's Delight

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Goals and objectives

The goals of the botanical survey were to determine the vascular plant richness and diversity, and compositional and physical structure of plant taxa of Doyle's Delight and its surroundings. The objectives of the survey can be summarized as:

- ❖ Document and collect samples of the species of vascular plants of the area
- ❖ Quantify the abundance of tree taxa of the area
- ❖ Assess landscape patterns of diversity, composition, and physical structure

Methods

Belt Transect Censuses



One 2 m x 500 m transect was placed along the ridges centered on Doyle's Delight. Due to the discontinuous nature of the ridges, the transect was used in "pieces" on the surrounding ridges. The rationale for such a discontinuous design is that each ridge sample would be weight by its length, a proxy for its area. Due to time restrictions, only ridge forest composition was sampled systematically in this manner. Belt transects are less biased by the effect of clumping of individuals, which accounts for most of the spatial distribution of tree species in tropical forests of all kinds. Furthermore, square or circular plots confound the effects of spatial scale and physical structure of the forest and landscape. For example, smaller plots including recently colonized treefall gaps, or one very large tree, do not adequately

sample average diversity and density of tree species. Plots usually are biased by the “grain sizes” of the forest and/or landscape, therefore they must be sufficiently large and require careful placement with respect to topographical, substrate, and historical features. All trees \geq 5 cm dbh (1.3 m above the ground at its highest point adjacent to the stem base) were identified and measured for dbh, height class (for palms only), and position along the transect. Voucher specimens were collected for each species present in the transect, and general observations were made about the surrounding area. Vascular plant taxa not in, but within sight, of the transects were collected as well.

General Collecting

Vascular plant taxa were collected in the forests surrounding Doyle's Delight at different topographic positions, including streamside vegetation, ridges, and slopes, and degrees of disturbance (treefall gaps to mature-phase vegetation). Although a number of trees were climbed, collection of woody and herbaceous plants was conducted primarily from the ground. Epiphytic plants had been collected during the 1993(?) expedition; therefore collection of freestanding plants was emphasized, with opportunistic collections of epiphytes and hemi-epiphytes. Specimens were pressed between sheets of newspaper, given a collection number, and either dried immediately (Bridgewater) or soaked in 70% isopropyl and preserved in plastic bags until they could be dried at an herbarium. Most specimens are currently being identified by S. Bridgewater and S. Brewer, while some specimens have been sent to specialists. Duplicates of all taxa will be sent to the Belize Herbarium (BRH), the Missouri Botanical Garden (MO), the Natural History Museum in London (BM), the California Academy of Science (CAS), the Field Museum in Chicago (F), among others.

Data Analyses

Data analyses for the transect and collection data are in progress. Richness, diversity, composition and abundance will be compared with other forests in Belize and Central America

Results

Approximately 400 plant collections were made by Brewer and Bridgewater during the 10 days of the expedition. Recollected was a new species of *Merostachys* (Poaceae) that was in sterile condition and is unlikely to be collected in flower in the foreseeable future, given the remote nature of the species' locations and the fact that it belongs to a group of woody grasses – the bambusoid poaceae – that typically does not flower for 60-120 years after establishment. According to Gerrit Davidse at MO, the species has likely been collected in Guatemala as well as Belize. Dr. Davidse may describe the species (Davidse, pers. comm.).

At least 8 new species for Belize including one new genus were collected. *Alchorneopsis floribunda* (Benth.) Müll. Arg. (Euphorbiaceae) was collected in sterile condition (also



collected in fertile condition by Brewer in May 2004 elsewhere in the Maya Mountains). Other collections of species new to Belize included *Styrax glabrescens* Benth. (Styracaceae), *Sloanea longipes* Ducke (perhaps synonymous with *Sloanea floribunda* Spruce ex Benth., Elaeocarpaceae), and *Bernardia* sp. (Euphorbiaceae). One tree that we collected is a new species for Belize, *Schlegelia nicaraguensis* Standl. (Schlegeliaceae), but itself and the other members of the genus are very rarely collected as a free-standing tree. Another unusual collection was of *Roupala glaberrima* Pittier (Proteaceae). This species was unknown from Belize until 2002 when a single specimen of William Schipp (Schipp S-649) was identified. As far as we know, our collection of this species is only the second for Belize. *Elvasia bisepala* Sastre & Whitefoord (Ochnaceae) was also collected in the area; this species was only recently described, the type collection coming from the Bladen Nature Reserve. Another unusual collection was very rare species for Belize, *Persea schiedeana* Nees (Lauraceae). Finally, one collection of *Quercus* sp. appears to be new for Belize, although it may simply be a hybrid species. Determining the identity of this specimen and a number of others is ongoing. Until date, 151 species belonging to 68 families were collected.

Discussion

The very preliminary results of the expedition indicate that the high ridge top forests of the Maya Mountains are comprised of a mix of northern Central American and neotropically widespread vascular plant taxa. Given the presence of several new species for Belize that were collected in a short time, the Doyle's Delight area and similar forests are quite likely to harbor new vascular plant taxa for the country. The forests of the area appear to be somewhat similar in composition but vary greatly – across a small scale of only hundreds of meters – in the structure of that composition. Factors most likely to influence the forests of Doyle's Delight appear to be topographic position and exposure (proxy variables primarily for moisture and drainage, but to some extent light availability), and history (particularly disturbance history).

These high-elevation forests are sufficiently rare and unique in Belize as to warrant protection from resource extraction. The status of similar forests in Central America is one of rapid decline and/or isolation from neighboring forests, due to timber extraction and clearing for agriculture.



Table # Plant species collected at Doyles Delight by Brewer and Bridgewater in August 2004

Family	Species	Notes
Annonaceae	<i>Guatteria amplifolia</i> Triana & Planch.	
Apocynaceae	<i>Cynanchum</i> sp.	
Apocynaceae	<i>Lacistema standleyi</i> (Woodson) Monach.	
Aquifoliaceae	<i>Ilex guianensis</i> (Aubl.) Kuntze	
Araceae	<i>Anthurium lucens</i> Standl. Ex Yuncker	
Araceae	<i>Anthurium microspadix</i> Schott	
Araceae	<i>Philodendron jodavisionum</i> G. S. Bunting	
Araceae	<i>Philodendron sagittifolium</i> Liebm.	
Araceae	<i>Rhodospathe wendlandii</i> Schott	
Araliaceae	<i>Dendropanax arboreus</i> (L.) Decne & Planch.	
Arecaceae	<i>Chamaedorea pinnatifrons</i> (Jacq.) Oerst.	
Arecaceae	<i>Geonoma interrupta</i> (Ruiz & Pav.) Mart. var. <i>interrupta</i>	
Aspleniaceae	<i>Arachniodes</i> sp.	
Aspleniaceae	<i>Arachnioides denticulata</i> (Sw.) Ching	
Aspleniaceae	<i>Asplenium cirrhatum</i> Rich. ex Willd.	
Aspleniaceae	<i>Asplenium rutaceum</i> (Willd.) Mett.	New Record
Aspleniaceae	<i>Polybotrya polybotryoides</i> (Baker) H. Christ	
Asteraceae	<i>Sinclairia discolor</i> Hook. & Arn.	
Asteraceae	<i>Telanthophora cobanensis</i> (J. M. Coul.) H. Rob. & Brettell	
Bromeliaceae	<i>Pitcairnea</i> sp.	
Cecropiaceae	<i>Cecropia peltata</i> L. (seedling)	
Celastraceae	cf. <i>Crossopetalum</i> sp.	
Celastraceae	<i>Zinowiewia pallida</i> Lundell	
Chloranthaceae	<i>Hedyosmum mexicanum</i> C. Cordem.	
Clusiaceae	<i>Clusia massoniana</i> Lundell	
Clusiaceae	<i>Clusia quadrangula</i> Bartlett	
Clusiaceae	<i>Sympodia globulifera</i> L.	
Commelinaceae	<i>Tradescantia</i> sp.	
Convolvulaceae	Convolvulaceae	
Costaceae	<i>Costus pulverulentus</i> C. Presl	
Cyclanthaceae	<i>Asplundia</i> sp.	
Cyperaceae	<i>Scleria latifolia</i> Sw.	
Cyperaceae	<i>Scleria</i> sp.	
Cyrillaceae	<i>Cyrilla racemiflora</i> L.	
Dennstaedtiaceae	<i>Lindsaea quadrangularis</i> Radii subsp. <i>subalata</i> K. U. Kramer	
Dichapetalaceae	<i>Dichapetalum donnell-smithii</i> Engl.	
Elaeocarpaceae	<i>Sloanea floribunda</i> Spruce ex Benth.	New Record
Elaeocarpaceae	<i>Sloanea meianthera</i> Donn. Sm.	
Ericaceae	Indet species 1	
Ericaceae	Indet species 2	
Ericaceae	<i>Sphyrospermum cordifolium</i> Benth.	
Euphorbiaceae	<i>Alchornea latifolia</i> Sw.	
Euphorbiaceae	<i>Alchorneopsis floribunda</i> (Benth.) Müll. Arg.	New Record
Euphorbiaceae	<i>Bernardia</i> sp.	New Record
Euphorbiaceae	<i>Hieronyma oblonga</i> (Tul.) Müll. Arg.	
Fabaceae	<i>Abarema idiopoda</i> (S. F. Blake) Barneby & J. W. Grimes	

Fabaceae	<i>Dialium guianense</i> (Aubl.) Steud.	
Fabaceae	<i>Inga cocleensis</i> Pittier subsp. <i>cocleensis</i>	
Fabaceae	<i>Machaerium floribundum</i> Benth.	
Fabaceae	<i>Machaerium</i> sp.	
Fabaceae	<i>Ormosia isthmensis</i> Sw.	
Fabaceae	<i>Swartzia phaneroptera</i> Standl.	
Fagaceae	<i>Quercus cortesii</i> Liebm.	
Fagaceae	<i>Quercus insignis</i> M. Martens & Galeotti	
Fagaceae	<i>Quercus</i> sp. 3	
Flacourtiaceae	<i>Casearia arborea</i> (Rich.) Urb.	
Flacourtiaceae	<i>Casearia coronata</i> Standl. & L.O. Williams	
Flacourtiaceae	<i>Macrohasseltia macroterantha</i> (Standl. & L. O. Williams) L. O. Williams	
Gesneriaceae	<i>Besleria laxiflora</i> Benth.	
Gesneriaceae	<i>Voyria flavescens</i> Griseb	
Gleicheniaceae	<i>Sticherus palmatus</i> (W. Schaffn. ex E. Fourn.) Copel.	
Grammitidaceae	<i>Terpsichore asplenifolia</i> (L.) A. R. Sm.	
Hymenophyllaceae	<i>Trichomanes rigidum</i> Sw.	
Icacinaceae	<i>Calatola costaricensis</i> Standl.	
Indet	Indet species 1	
Lamiaceae	<i>Scutellaria longifolia</i> Benth.	
Lauraceae	<i>Cinnamomum areolatum</i> (Lundell) Kosterm.	
Lauraceae	<i>Licaria peckii</i> (L. M. Johnst.) Kosterm.	
Lauraceae	<i>Nectandra cuspidata</i> Nees	
Lauraceae	<i>Ocotea effusa</i> (Meisn.) Hemsl.	
Lauraceae	<i>Ocotea helicterifolia</i> (Meisn.) Hemsl.	
Lauraceae	<i>Ocotea leucoxylon</i> (Sw.) Laness.	
Lauraceae	<i>Ocotea veraguensis</i> (Meisn.) Mez	
Lauraceae	<i>Persea schiedeana</i> Nees	
Loganiaceae	<i>Strychnos</i> aff. <i>peckii</i> B. L. Rob.	
Lycopodiaceae	<i>Huperzia dichaeoides</i> (Maxon) Holub	
Magnoliaceae	<i>Magnolia yoroconte</i> Dandy	
Marantaceae	<i>Stromanthe hjalmarssonii</i> (Körn) Petersen	
Marantaceae	<i>Stromanthe tonckat</i> (Aubl.) Eichler	
Marcgraviaceae	<i>Marcgravia schippii</i> Standl.	New Record
Marcgraviaceae	<i>Marcgravia</i> sp. (juvenile shoots)	
Marcgraviaceae	<i>Souroubea loczyi</i> (V. A. Richt.) de Roon	
Melastomataceae	<i>Blakea cuneata</i> Standl.	
Melastomataceae	<i>Clidemia involucrata</i> DC.	
Melastomataceae	<i>Conostegia montana</i> (Sw.) D. Don. ex DC.	New Record
Melastomataceae	<i>Conostegia</i> sp. 2	
Melastomataceae	<i>Conostegia</i> sp. 3	
Melastomataceae	<i>Melastomataceae</i> sp. 8	
Melastomataceae	<i>Miconia centrodesma</i> Naudin	
Melastomataceae	<i>Miconia</i> cf. <i>prasina</i> (Sw.) DC.	
Melastomataceae	<i>Miconia glaberrima</i> (Schltdl.) Naudin	New Record
Melastomataceae	<i>Miconia punctata</i> (Desr.) D. Don ex DC.	
Meliaceae	<i>Guarea grandifolia</i> DC.	
Menispermaceae	<i>Abuta panamensis</i> (Standl.) Krukoff & Barneby	
Monimiaceae	<i>Mollinedia guatemalensis</i> Perkins	
Monimiaceae	<i>Siparuna thecaphora</i> (Poepp. & Endl.) A. DC.	

Moraceae	<i>Brosimum lactescens</i> (S. Moore) C. C. Berg
Moraceae	<i>Ficus</i> aff. <i>insipida</i> Willd.
Moraceae	<i>Ficus popenoei</i> Standl.
Moraceae	<i>Ficus</i> sp. 3
Moraceae	<i>Pseudolmedia spuria</i> (Sw.) Griseb.
Myristicaceae	<i>Compsoneura sprerei</i> (A. DC.) Warb.
Myrsinaceae	<i>Ardisia compressa</i> Kunth
Myrsinaceae	<i>Ardisia compressa</i> Kunth
Myrsinaceae	Myrsinaceae 1
Myrsinaceae	Myrsinaceae 2
Myrtaceae	<i>Myrcia</i> sp.
Myrtaceae	Myrtaceae sp. 2
Myrtaceae	Myrtaceae sp. 3
Myrtaceae	Myrtaceae sp. 4
Nyctaginaceae	<i>Neea</i> sp.
Ochnaceae	<i>Elvasia bisepala</i> Sastre & C. Whitefoord
Piperaceae	<i>Piper</i> sp.
Podocarpaceae	<i>Podocarpus guatemalensis</i> Standl.
Polypodiaceae	<i>Polypodium dissimile</i> L.
Polypodiaceae	<i>Polypodium fraxinifolium</i> Jacq.
Polypodiaceae	<i>Polypodium fraxinifolium</i> Jacq.
Proteaceae	<i>Roupala glaberrima</i> Pittier
Pteridophyta	10 species not yet identified
Pteridophyta	<i>Cyathea multiflora</i> Sm.
Pteridophyta	<i>Cyathea schiedeana</i> (C. Presl) Domin
Pteridophyta	<i>Sphaeropteris horrida</i> (Liebm.) R. M. Tryon
Rhizophoraceae	<i>Cassipourea guianensis</i> Aubl.
Rosaceae	<i>Prunus</i> aff. <i>tikalana</i> Lundell
Rosaceae	<i>Rubus</i> sp.
Rubiaceae	<i>Coccocypselum herbaceum</i> P. Browne
Rubiaceae	<i>Faramea brachysiphon</i> Standl.
Rubiaceae	<i>Hillia panamensis</i> Standl.
Rubiaceae	<i>Notopleura uliginosa</i> (Sw.) Bremek.
Rubiaceae	<i>Palicourea guianensis</i> Aubl.
Rubiaceae	<i>Psychotria buchtienii</i> (H.J.P. Winkl.) Standl.
Rubiaceae	<i>Psychotria elata</i> (Sw.) Hammel
Rubiaceae	<i>Psychotria guadalupensis</i> (DC.) R. A. Howard
Rubiaceae	<i>Psychotria panamensis</i> Standl. var. <i>panamensis</i>
Rubiaceae	<i>Psychotria poeppigiana</i> Müll Arg.
Rubiaceae	<i>Randia matudae</i> Lorence & Dwyer
Rubiaceae	<i>Ronabea latifolia</i> Aubl.
Rutaceae	<i>Zanthoxylum acuminatum</i> ssp. <i>juniperinum</i> (Poepp.) Reynel
Salicaceae	<i>Casearia</i> sp.
Sapotaceae	<i>Pouteria izabalensis</i> (Standl.) Baehni
Sapotaceae	<i>Sideroxylon salicifolium</i> (L.) Lam.
Schlegeliaceae	<i>Schlegelia nicaraguensis</i> Standl.
Selaginellaceae	<i>Selaginella</i> sp.
Solanaceae	Indet. sp.
Solanaceae	<i>Solanum erythrotrichum</i> Fernald
Solanaceae	<i>Solanum</i> sp.

New Record

Solanaceae	<i>Witheringia solanacea</i> L' Hér.
Styracaceae	<i>Styrax glabrescens</i> Benth.
Ternstroemiaceae	<i>Ternstroemia tepezapote</i> Schltdl. & Cham.
Ulmaceae	<i>Trema micrantha</i> (L.) Blume
Viscaceae	<i>Phoradendron</i> sp.
Zingiberaceae	<i>Renealmia</i> sp.

Table #. Characteristics of the Doyle's Delight ridge forest as trees sampled by a transect 2 m x 500 m. Columns represent the sample divided into categories by minimum diameter at breast height.

	<u>≥ 2.5 cm</u>	<u>≥ 5 cm</u>	<u>≥ 10 cm</u>
Species	44	40	31
Individuals	512	230	167
Basal Area	24.36	19.11	21.74
Shannon H	2.512	2.741	2.347
Simpson 1-D	0.8258	0.8831	0.8253
Fisher's α	11.53	13.99	11.21

Table 2. Tree species of the Doyle's Delight ridge forest as sampled by a transect 2 m x 500 m. Species are ranked by number of individuals (N), with basal area (BA, in cm²) as supplementary data.

Rank	SPECIES	N	BA(cm²)
1	<i>Synechanthus fibrosus</i> (H. Wendl.) H. Wendl.	193	7825
2	<i>Colpothrinax cookii</i> Read	58	82583
3	<i>Euterpe precatoria</i> Mart. var. <i>longivaginata</i> (Mart.) Henderson	43	20837
4	<i>Merostachys</i> sp. nov.	33	992
5	<i>Cyathea</i> sp. 1	23	11410
6	<i>Psychotria elata</i> (Sw.) Hammel	22	804
7	<i>Clusia massoniana</i> Lundell	21	32816
8	<i>Psychotria panamensis</i> Standl. var. <i>panamensis</i>	13	5438
9	<i>Randia matudae</i> Lorence & Dwyer	10	10370
10	<i>Cinnamomum areolatum</i> (Lundell) Kosterm.	7	8439
11	<i>Conostegia</i> 2	7	963
12	<i>Dendropanax arboreus</i> (L.) Decne. & Planch.	6	753
13	Myrtaceae sp. 1	6	3947
14	<i>Inga davidsei</i> M. Sousa	6	1803
15	Myrsinaceae 1	6	3739
16	Myrtaceae sp. 2	5	639
17	<i>Nectandra cuspidata</i> Nees	5	3395
18	Myrsinaceae 2	4	577
19	<i>Alchornea latifolia</i> Sw.	3	549
20	<i>Macrohasseltia macroterantha</i> (Standl. & L. O. Williams) L. O. Williams	3	7166
21	<i>Sphaeropteris horrida</i> (Liebm.) R. M. Tryon	3	675
22	<i>Sloanea floribunda</i> Spruce ex Benth.	3	2693
23	<i>Calatola costaricensis</i> Standl.	2	114
24	<i>Conostegia montana</i> (Sw.) D. Don. ex DC.	2	196
25	<i>Mollinedia guatemalensis</i> Perkins	2	201
26	<i>Ocotea effusa</i> (Meisn.) Hemsl.	2	492
27	<i>Ocotea veraguensis</i> (Meisn.) Mez	2	375
28	<i>Prunus tikalana</i> Lundell	2	2174
29	<i>Quercus cortesii</i> Liebm.	2	2733
30	<i>Roupala glaberrima</i> Pittier	2	1321
31	<i>Sloanea meianthera</i> Donn. Sm.	2	181
32	<i>Zanthoxylum acuminatum</i> subsp. <i>juniperinum</i> (Poepp.) Reynel	2	739
33	<i>Brunellia mexicana</i> Standl.	1	564
34	<i>Conostegia</i> sp. 1	1	243
35	<i>Hedyosmum mexicanum</i> C. Cordem.	1	1359
36	<i>Inga cocleensis</i> Pittier subsp. <i>cocleensis</i>	1	1207
37	<i>Magnolia yoroconte</i> Dandy	1	18530
38	<i>Miconia punctata</i> (Desr.) D. Don ex DC.	1	163
39	Myrtaceae sp. 3	1	962
40	<i>Ocotea leucoxylon</i> (Sw.) Laness.	1	232
41	<i>Psychotria hispida</i> Standl. ex Steyermark	1	28
42	<i>Quercus insignis</i> M. Martens & Galeotti	1	272
43	<i>Swartzia phaneroptera</i> Standl.	1	1810
44	<i>Zinowiewia pallida</i> Lundell	1	1295

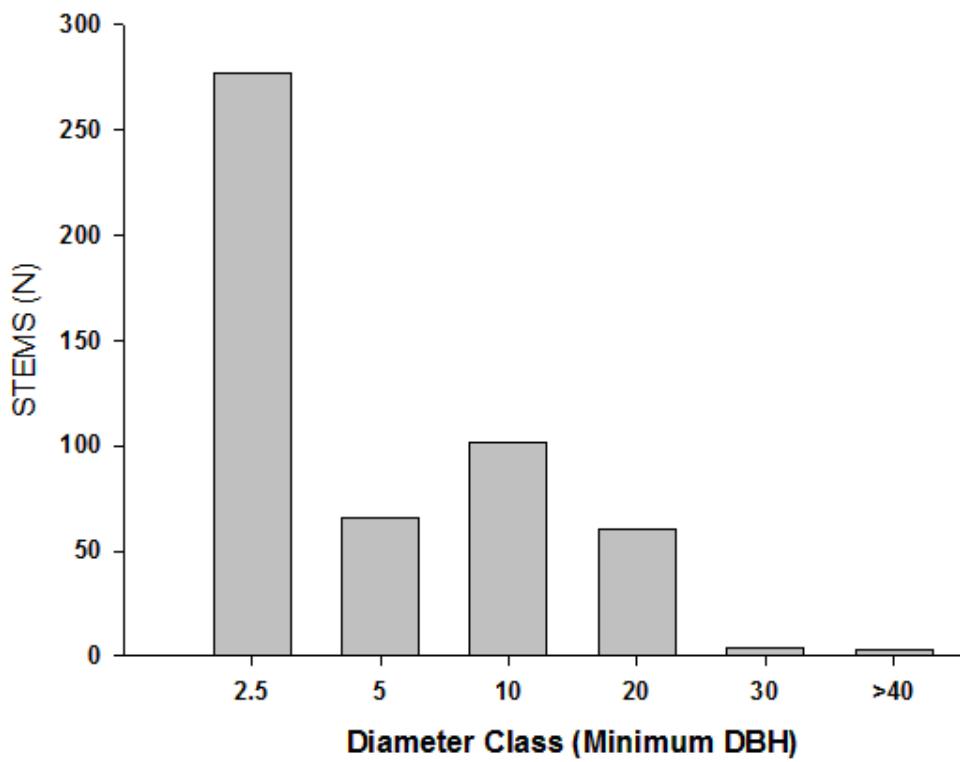


Figure #. Number of stems by diameter class within a 2 m x 500 m transect along Doyle's Delight ridge.

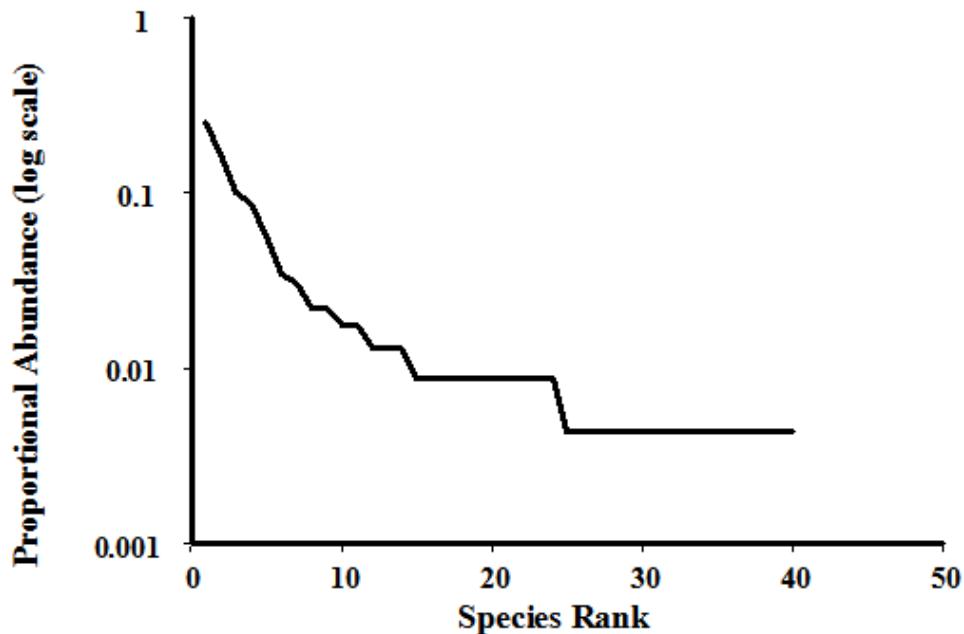


Figure #. Proportional abundance of tree species >5 cm DBH, by rank according to abundance.

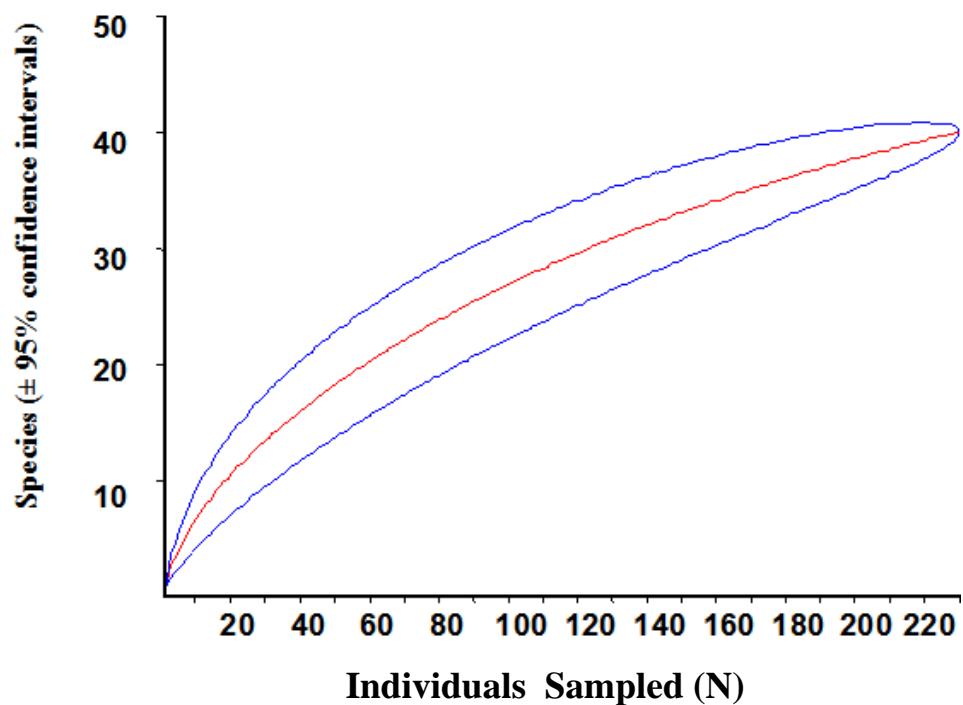


Figure 2. Rarefaction curve (red) for trees ≥ 5 cm DBH generated by the software PAST (see methods for explanation). Confidence intervals are shown in blue.

Collection of Unique Plant Associations and Plants Of The Belize Botanic Gardens (Bbg)

Martin Ivo Meadows,
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San Ignacio, Belize

Introduction

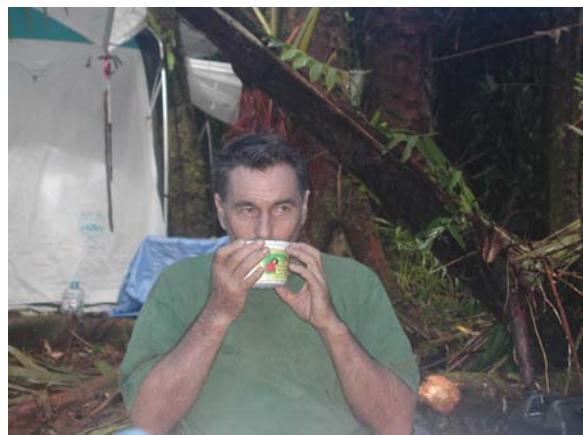
Belize has only two areas reaching 1,100 m. They are Victoria Peak and Doyles Delight. Victoria Peak as its name suggests is a peak and such has a small area of over 1,000m elevation, is rocky with only small patches of thin soil. Doyles Delight area is rounded and has overall deep soils and has nearly 1.5km X 3km of over 1000m with in many places tall forest and massive trees and as shows itself as an area large enough overtime to keep a stable population of many species.

In Holdridge's life zones classification system Doyle's Delight falls under lower montane sub tropical wet forest. Isolated mountains often have telescoped zones and the highest area has some wind blown gnarled trees covered with epiphytes and approaches 'Elfin' forest on exposed windward ridges and is also in places almost cloud forest as it is epiphyte rich having nightly condensation and is often in lower cloud during some daylight hours.

The collection concentrated on these epiphytes, especially orchids for the BBG's national orchid collection and some special terrestrial plants of the area. Several species have closely related species in Louisiana, USA 500 miles latitude being roughly equivalent to 1,000feet in altitude; only here in Belize can you see this together with species found in Alta VeraPaz, Guatemala 200 miles to the south

Method of collecting

The emphasis was on collecting plants in the Cayo District as our gardens are in this district and it will give visitors an insight to the biodiversity of this district. It was also concentrated on tree falls/branch drop for epiphytes which were long term doomed by their descent to a lower level; only towards the end were other plants taken when the species could not be located on the falls/drops. Seedlings were taken when their prospects did not look good and other seedlings of the species were around.



Dropped limbs were often peeled of their coat of epiphytes to be dressed on limbs in the botanical garden to show who they grow and the species associations. There collections

often collected species several times over for the effect of this habitat to be appreciated by garden visitors.

A few palms, a *Heliconia*, a bamboo, begonias were taken to complete our collection of species or to increase our provenance base. We now have all of Belize's known heliconias and varieties, almost all our palms and more provenances of several palms and Begonias.

Clusia sp, *Quercus* sp, *Inga* sp seedlings were taken and seed of *Ilex* sp and *Magnolia* sp were collected which with a tree fern, palms and bamboo should in time make the Doyle's Delight habitat exhibit have the right habitat feel for visitors to experience.

Points of interest on some of the plants

In the humidity of Doyle's Delight several epiphytes are of members of families which at lower levels we do not think of as having epiphytic members but even these have modifications.

A Solanaceae, an Asteraceae and to a lesser extent an Urticulaceae all had swollen lower stem upper root area to store water/nutrients/food in case of a period of no fog/rain situation.

An Ericaceae has very thick shiny leaves to reduce water loss as did a rubiaceae.

A hanging Lycopodiaceae epiphyte was also present (*Huperzia* sp).

It was interesting to note that while all but one of our 10 listed cactus members are epiphytes, only one seems able to stand the wet humid conditions or stand up to the competition of so many epiphytes on Doyles Delights; *Epiphyllum crenatum*.

Filmy ferns (Hymenophyllaceae) exist in abundance and except for their veins have leaves one cell thick and are intolerant to dying out.

Plants collected

This included

1 filmy Fern

Clusiaceae *clusia* spp.

Araceae

Anthurium spp. 2 species

Spathiphyllum sp 1 sp.

Philodendron sp. 4 spp.

Areceace

Chamaedorea Pinnatifrons

Calyptrogyne ghiesbreghtiana

Colpothrinas cookii

Euterpe precatoria

Synechanthus fibrosus

Astereaceae

an Epiphyte



<i>Bromeliaceae</i>
<i>Gusmania spp.</i> 2 spp.
<i>Tillandsia spp.</i>
<i>Catopsis spp.</i>
<i>Pitcairnia imbricata</i>
<i>Chloranthaceae</i>
<i>Hedyosmum mexicanum</i>
<i>Erucaceae</i>
1 epiphyte
<i>Fagaceae</i>
<i>Quercus sp.</i> 2 seedlings
<i>Lauraceae</i>
1 species. Sprouting seed <i>Persea sp.?</i>
<i>Magnoliaceae</i>
<i>magnolia guatemalensis</i> (seeds)
<i>Heliconiaceae</i>
<i>Heliconia (red form)</i>
<i>Marantaceae</i>
1 species
<i>Marcgraviaceae</i>
1 species
<i>Zingiberaceae</i>
<i>Renealmia arumatica</i>
<i>Costaceae</i>
<i>Costus pulverulentus</i>
<i>Marantaceae</i>
1 species
<i>Commelinaceae</i>
1 species
<i>Cyclanthaceae</i>
<i>Asplundia spp.</i> 2 species
<i>Cyclanthus bipartitus</i>
<i>Piperaceae</i>
<i>Peperomia spp.</i>
<i>Rubiaceae</i>
<i>Hillia sp.</i>
<i>Soanaceae</i>
1 species epiphyte
<i>Cactaceae</i>
<i>Epiphyllum crenatum</i>
<i>Fabaceae</i>
<i>Inga sp.</i> 2 seedlings
<i>Aquifoliaceae</i>
<i>Ilex sp.</i> Seeds
<i>Begoniaceae</i>



Begonia Glabra
Begonia heracleifolia

Melastomaceae

1 sp.

Orchidaceae

In all 85 entries

Many of these were on fallen branches and in poor condition and even healthy one may have to wait until flowering for identification.

The following species are listed as rare in “Native Orchids of Belize’s” but this may well be of a lack of knowledge or visits by the authors of this highest extensive area, further visits may find some of them common in this area. Interestingly Godyera erosa is listed as occurring in the “Elfin Forests” and the “locality for Belize as not known”

“Rare”? Species

Comparertia falcata
Dichaea Glauca
Dichaea Hystricina
Elleanthus Caricoides
Elleanthus cynarocephalus
Epidanthus paranthicus
Goodyera erosa
Gongora cassidea
Scaphyglottis lindeniana
Sobralia mucronata



The collection at the Belize botanic gardens

Many species at Doyle's Delight seem to have roots in the thick humus and do not penetrate into the high in Aluminum soils. The humus is damp and feels cold.

At BBG the plants in the exhibit are on soil with a thin covering of sand and then a thick layer of old rotten pine shavings to try to give an equivalent to the poor humus almost peaty soils above the mineral soil. The epiphytes are on trees and on poles leaning onto the trees.

Misters from overhead lines and a sprinkler keep the exhibit moist and the shavings moist, this is both for water and for the evaporation from the branches/shaving layer which cools the area. Doyle's Delight probably never reaches 90 degree F.

Plants recovering (specimens often doomed where they were languishing at ground level) are in chopped coconut husks in pots in the shaded (70-80%) nursery on moist shavings.

The Doyle's Delight collection adjoins a Columbia Forest Reserve/ nearby village area grouping in the hardwood wet exhibit, which in turn is adjacent to the subtropical moist forest area.

Discussion

This unique area, which is highly vulnerable to disturbance and soil erosion, should have the status of a "nature reserve" under the Belize law which allows for scientific and educational use only. It stands as an isolated island of over 1000m altitude which due to its species richness (for a high altitude) shows it is with adjacent ridges just large enough to maintain a good species diversity. This could easily be lost by land clearing, milpas and paths leading to it from lower altitudes.

To reduce disturbance it would be best for the existing helipad be kept for data gathering but no others be made and the surrounding areas be kept as forest reserves/ national parks. A village or road at the base of the "mountain" with paths up and inevitable visits, milpas and fires would be the end of this irreplaceable heritage.



Invertebrates of Doyle's Delight

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Invertebrates are rarely sampled during Rapid Ecological Assessments. If any it is the Lepidoptera (Butterflies and Moths) that are most commonly - and easiest – incorporated in a study such as this. Although certain Lepidoptera families in Belize are rather well sampled (Meerman, 1999), the wet, higher altitude regions of southern Belize are among the poorest researched habitats of Belize.



Certain Lepidoptera families have to be considered important ecological and biodiversity indicators. The diurnal families studied here are relatively large, ecologically and taxonomically diverse, individually habitat-faithful, well studied, non-furtive, diurnal and easily identified. Their herbivorous immature stages create a clear link with the flora of the study area and generally, diverse Lepidoptera fauna's are indicative of a diverse and complex flora.

Data on diurnal Lepidoptera during the August 2004 expedition to Doyle's Delight were collected in various ways. Some collecting was done with the aid of a standard butterfly net, but in addition, 3 butterfly traps baited with overripe fruit were operated near the camp. Canopy species were observed and identified with the use of binoculars. Nocturnal Lepidoptera were collected by means of one 15 W. UV fluorescent tube powered by a car battery (which was maintained in a charged condition by means of a small 1 amp solar panel). In general no collections were made. Instead, specimens were documented by means of digital pictures.

Lepidoptera in general proved to be relatively scarce. The most common species being the White Morpho (*Morpho polyphemus*) which was seen abundantly throughout the duration of the expedition. This relative scarcity may have been an artifact of the unseasonably dry conditions in the months preceding the expedition. In the case of nocturnal Lepidoptera, the experience is that these have their peak in the period from May through July (Meerman, 1999) and thus species diversity for this group would have past its peak during the expedition in August.

In total 47 species of Lepidoptera were recorded (table #), of these 47 species, no less than 5 (10%) were new records for Belize! Two butterflies; *Adelpha leuceria* and *Opoptera staudingeri*, Two Hawkmoths; *Adhemarius donysa* and *Xylophanes germen*, and one Emperor Moth; *Automeris postalbida*. Interesting too, was that several of the

new records were among the most common species around. These observations demonstrate how little is still known about the higher elevation habitats in Belize and how many new records are potentially still waiting to be discovered.



Table # Lepidoptera recorded from Doyle's Delight, August 2004.

Family	Subfamily	Species name	Number
Nymphalidae	Brassolinae	<i>Opoptera staudingeri</i> *	8
Nymphalidae	Charaxinae	<i>Memphis proserpina</i>	1
Nymphalidae	Heliconinae	<i>Dryas iulia</i>	2
Nymphalidae	Heliconinae	<i>Heliconius cydno</i>	4
Nymphalidae	Heliconinae	<i>Philaethria dido</i>	3
Nymphalidae	Ithominae	<i>Greta nero</i>	2
Nymphalidae	Ithominae	<i>Ithomia patilla</i>	2
Nymphalidae	Morphinae	<i>Morpho peleides</i>	6
Nymphalidae	Morphinae	<i>Morpho polyphemus</i>	very common > 60
Nymphalidae	Nymphalinae	<i>Adelpha leuceria</i> *	10
Nymphalidae	Nymphalinae	<i>Catenophele mexicana</i>	3
Nymphalidae	Nymphalinae	<i>Catenophele numilia</i>	8
Nymphalidae	Nymphalinae	<i>Siproeta epaphus</i>	1
Nymphalidae	Nymphalinae	<i>Smyrna blomfieldia</i>	12
Nymphalidae	Satyrinae	<i>Chloreuptychia cericella</i>	4
Nymphalidae	Satyrinae	<i>Pareuptychia metaleuca</i>	6
Nymphalidae	Satyrinae	<i>Pierella luna</i>	8
Papilionidae	Papilioninae	<i>Battus sp.</i>	1
Pieridae	Dismorphinae	<i>Dismorphia amphiona</i>	4
Pieridae	Dismorphinae	<i>Dismorphia theucharila</i>	2
Riodinidae	Riodininae	<i>Calephelis sp.</i>	1
Riodinidae	Riodininae	<i>Mesosemia gaudiolum</i>	2
Saturniidae	Ceratocampinae	<i>Adeloneivaia irrorata</i>	1
Saturniidae	Ceratocampinae	<i>Adeloneivaia jason</i>	8
Saturniidae	Ceratocampinae	<i>Othorene purpurascens</i>	4
Saturniidae	Hemileucinae	<i>Automeris banus</i>	2
Saturniidae	Hemileucinae	<i>Automeris postalbida</i> *	2
Saturniidae	Hemileucinae	<i>Hylesia acuta</i>	6
Saturniidae	Saturniinae	<i>Copaxa rufinans</i>	3
Saturniidae	Saturniinae	<i>Copaxa multifenestrata</i>	1
Saturniidae	Saturniinae	<i>Rothschildia lebeau</i>	4
Saturniidae	Saturniinae	<i>Rothschildia roxana</i>	1
Sphingidae	Macroglossinae	<i>Eumorpha phorbas</i>	1
Sphingidae	Macroglossinae	<i>Xylophanes amadis</i>	4
Sphingidae	Macroglossinae	<i>Xylophanes belti</i>	2
Sphingidae	Macroglossinae	<i>Xylophanes ceratomoides</i>	12
Sphingidae	Macroglossinae	<i>Xylophanes chiron</i>	4
Sphingidae	Macroglossinae	<i>Xylophanes germen</i> *	Common, up to 70 per night.
Sphingidae	Macroglossinae	<i>Xylophanes thyelia</i>	3
Sphingidae	Macroglossinae	<i>Xylophanes titana</i>	6
Sphingidae	Macroglossinae	<i>Xylophanes undata</i>	6
Sphingidae	Macroglossinae	<i>Xylophanes zurcheri</i>	1
Sphingidae	Sphinginae	<i>Adhemarius donysa</i> *	1
Sphingidae	Sphinginae	<i>Adhemarius gannascus</i>	3
Sphingidae	Sphinginae	<i>Adhemarius ypsilon</i>	6
Sphingidae	Sphinginae	<i>Cocytius duponchel</i>	6
Sphingidae	Sphinginae	<i>Cocytius lucifer</i>	4

AMPHIBIANS AND REPTILES OF THE DOYLE'S DELIGHT EXPEDITION

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Introduction

Our herpetological fieldwork at Doyle's Delight, conducted from 10 through 18 August 2004, produced a small collection of nineteen specimens representing two species of salamanders and four species of frogs. We secured photographic documentation of one additional species of frog, three species of lizards, one species of snake, and a sight record for one additional species of snake. Thus, our fieldwork has documented the occurrence of 12 species of amphibians and reptiles at Doyle's Delight. Together with previous fieldwork conducted in the vicinity of Doyle's Delight in December 1993 (Meyer, 1995), the known herpetofauna of the area consists of nine species of amphibians and five of reptiles.

Methods

Our methods follow closely those of Meerman and Lee (2003) at Little Quartz Ridge, Belize; readers are referred to that paper for details. Briefly, we carefully searched all major habitats of amphibians and reptiles, with the exception of the forest canopy. We searched forest trails and the forest floor, both day and night, raking through leaf litter, turning over surface debris, opening fallen logs, and examining the buttresses and the lower portions of tree trunks. We removed loose bark from standing trees and searched within bromeliads. We waded streams by day and night, searching for frogs and their tadpoles, and we raked through muddy stream banks in search of caecilians. We were alert to the species-specific advertisement calls of male frogs and toads. Other members of our party in the course of their research collected a few specimens opportunistically.



All specimens are deposited at the University of Miami, Coral Gables, Florida. In the following, species accounts, specimens are identified by their JCL field tag number.

Results

The herpetofauna of Doyle's Delight is listed in Table 1, based upon our fieldwork and the previous fieldwork of others (Matola, 1995).

Salamanders



Two diminutive salamanders were collected on the night of 15 August, both on vegetation approximately 1-1.5 meters above the forest floor following heavy rain. These specimens (JCL 7434, 7436) are tentatively referred to *Bolitoglossa rufescens* on the basis of their distribution, small size, and short tails. However, this species is very similar morphologically to *B. occidentalis*, a species that occurs primarily on the Pacific slope from Oaxaca, Mexico to Honduras (Lee, 1996).

Curiously, both of our specimens lack maxillary teeth, a condition typical of *B. occidentalis*. The taxonomic status of these two species is uncertain; several cryptic species may be involved (D. Wake, personnel communication).

A larger *Bolitoglossa* (JCL 7433) was found on the same night on vegetation approximately one meter above the forest floor. That specimen is tentatively referred to *Bolitoglossa odonneli* (D. Wake, personal communication). *B. odonneli* is known with certainty from the departments of Alta Verapaz, and Izabal, Guatemala, and possibly from Honduras (McCranie and Wilson, 2002). This would constitute the first record of this species from Belize, and would represent a northeasterly range extension of approximately 75 km. *B. odonneli* is listed as endangered by the IUCN.

Frogs – Specimens of the Broad-headed Rain Frog, *Eleutherodactylus laticeps* (JCL 7420-22, 7427-30, 7432) were encountered commonly on the forest floor during the day and night. This species occurs at low, moderate, and intermediate elevations on the Atlantic slope from southern Veracruz, Mexico to northern Honduras. It is known from several localities in Cayo and Toledo Districts, Belize.

The much smaller Chac's Rain Frog, *Eleutherodactylus chac* (JCL 7418-19, 7431), was also found commonly on the forest floor during the day and night, and the distinctive advertisement call of males was often heard. *E. chac* occurs at low and moderate elevations in the Guatemalan departments of Alta Verapaz and Izabal, and in Cayo, Stann Creek, and Toledo Districts, Belize.

A single specimen of the glass frog, *Hyalinobatrachium fleischmanni*, was found calling while sitting on top of a leaf approximately 3 meters over a small stream, just after rain. This widespread species ranges from Guerrero and Veracruz, Mexico to northern South America. In Belize it has been recorded in Cayo and Toledo Districts.

A single specimen of *Smilisca cyanosticta* was found calling in a shallow pool just after heavy rain towards the end of the expedition. This is a species occurring in disjunct locations throughout Southern Mexico and Northern Central America. In Belize it is known only from the higher elevations of the Maya Mountains and Vaca Plateau.



A subadult specimen (JCL 7435) of a fringe-limbed treefrog was found at the base of a fern, approximately 15 cm above the forest floor on 15 August. This is only the second known specimen of a fringe-limbed treefrog from Belize. The other specimen is from Gloria Camp, Toledo District, Belize. Confusion exists concerning the taxonomic status of the rare fringe-limbed treefrogs of Belize, Honduras, and northern Guatemala. Specimens previously assigned to *H. valencifer* from Baja Verapaz were

described as *H. minera* by Wilson et al. (1985), a species said to differ from *H. valencifer* in having cranial co-ossification. Our specimen lacks cranial co-ossification, as does the other Belizean specimen, and on that basis we assign them to *H. valencifer*, a species that otherwise is known only from southern Veracruz, Mexico.

The Maya Mountain Frog, *Rana juliani* (JCL 7423 [tadpole], 7424-26) was frequently encountered on the banks of small streams at night. This is the only species of amphibian endemic to Belize. It is known from several localities in the Maya Mountains, where it is closely associated with stream habitats.

Lizards

One specimen of the Big-head anole *Norops capito* was encountered not far away from the camp. This is an uncommonly encountered species of high forests from southern Mexico to Panama.

Several specimens of the small, forest-floor inhabiting *Norops uniformis* were observed by day. This species is widely distributed on the Atlantic slope from Chiapas, Mexico, to Honduras. In Belize it is known from numerous localities in the central and southern portions of the country. Stuart (1948) considered this species one of the most reliable indicators of undisturbed forest in Guatemala.

A single specimen of the Ground Skink, *Scincella cherriei* was captured at the edge of a trail, during the day of 15 August. This species is common at low and moderate elevations from southern Mexico to Panama. In Belize it occurs countrywide, where it is known from numerous localities.

Snakes

A specimen of the putative coral snake mimic, *Pliocercus elapoides*, was discovered on the forest floor in camp on the morning of 13 August. This uncommon species is widely distributed from Tamaulipas and Oaxaca, Mexico to northern Central America. In Belize, it is known from several localities in the southern half of the country.

A specimen of the fer-de-lance, *Bothrops asper*, was encountered on the forest floor by day. This common and widespread species ranges from Tamaulipas, Mexico to northern South America. In Belize it occurs countrywide.

Discussion and conclusions



We assume that the community of amphibians and reptiles at Doyle's Delight consists of a few abundant species and many rare ones, as is the case for many tropical ecological communities. Accordingly, our brief herpetological inventory cannot hope to sample more than a small but unknown fraction of the species present at Doyle's Delight. Consistent with this view is the fact that most of our records are for species that are common and widespread at low and moderate elevations in southern Mexico

and northern Central America. Nonetheless, the herpetofauna of Doyle's Delight seems depauperate, for several common and conspicuous species (e.g., *Eleutherodactylus sabrinus*, *Bufo campbelli*, *Rana vaillanti*) went undetected, and other species that are usually abundant elsewhere were only occasionally encountered (e.g., *Norops uniformis*, *Scincella cherriei*).

Rainfall during the first four days of our fieldwork was unusually scant, and the leaf litter seemed remarkably dry. This may have depressed surface activity of leaf litter amphibians and reptiles.

Yet, several noteworthy records were obtained as a result of our fieldwork. The second Belizean specimen of the rare fringe-limbed tree frog, *Hyla valancifer* was obtained, and a salamander tentatively identified as the uncommon *Bolitoglossa odonnelli* will, if it proves to be that species, constitute the first record for Belize. The Broad-headed Rain Frog, *Eleutherodactylus laticeps* was common at Doyle's Delight, whereas it is apparently absent from Little Quartz Ridge, a mere 35 km to the southwest (Meerman and Lee, 2003). Given its elevation and isolation, the Maya Mountains in general and the Doyle's Delight area in particular, can be expected to harbor more herpetological novelties. Unquestionably, greater sampling effort, conducted during different seasons, will reveal the presence of additional species of amphibians and reptiles, some of which will likely be new to Belize and, possibly, new to science.

Table 1. Taxonomic composition of the herpetofauna of Doyle's Delight. Names in bold are from Meyer (1995).

AMPHIBIA

CAUDATA

PLETHODONTIDAE

Bolitoglossa sp. (*cf. odonnelli*)

B. sp. (*cf. rufescens*)

ANURA

CENTROLENIDAE

Hyalinobatrachium fleishmanni

LEPTODACTYLIDAE

Eleutherodactylus chac

E. laticeps

E. "rugulosus" (= *sabrinus*? Based on Meyer, 1995)

BUFONIDAE

Bufo campbelli (Listed as *B. valliceps* by Meyer, 1995)

HYLIDAE

Hyla valancifer

Smilisca cyanosticta

RANIDAE

Rana juliani

REPTILIA

SAURIA

POLYCHROTIDAE

Norops capito

Norops uniformis

SCINCIDAE

Scincella cherriei

SERPENTES

COLUBRIDAE

Pliocercus elapoides

VIPERIDAE

Bothrops asper

Ornithological Report of Doyle's Delight Expedition.

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Introduction

The area known (unofficially) as Doyle's Delight is the highest land area in Belize at 1,124 meters (Matola 1995). It lies on the Maya Mountain Divide approximately 6.5 kilometers north of the eastern margin of Little Quartz Ridge and 32 kilometers west south-west of Richardson Peak (Matola 1995) and is classified within the subtropical lower montane wet forest zone (Hartshorn et al. 1984). Because of its remoteness and high inaccessibility, the floral and faunal communities of this area require further extensive surveys to document the species present. To date, three intensive scientific expeditions have been undertaken to begin documenting the natural resources of this unique area.



The late Theodore A. Parker felt strongly that the Maya Mountains played an important role in the migratory routes of many North American migratory bird species (Parker et al. 1993, Jones and Gardner 1997). As a preliminary assessment of his hypothesis, Parker was the leader of an expedition into the Columbia River Forest Reserve in April 1992 to conduct an avian survey. Another survey of the Forest Reserve in February 1997 by Jones and Gardner continued to document the avian community of this area. The results from both surveys corresponded closely, although the surveys were conducted at different times of the year and in different areas of the reserve except for one area of overlap (Parker et al. 1993, Jones and Gardner 1997). The extensive tract of tropical wet forests of the Chiquibul National Park, Bladen Nature Reserve, Cockscomb Basin Wildlife Sanctuary, Mountain Pine Ridge Forest Reserve, and Columbia River Forest Reserve represent one of the largest continuous expanses of tropical forest remaining in Middle America (Parker et al. 1993). These extensive areas of lower montane forests will undoubtedly become increasingly important to migratory bird populations as lowland

¹ Birds Without Borders – *Aves Sin Fronteras* (BWB-ASF) is a research, conservation, and education project sponsored by the Zoological Society of Milwaukee and the Foundation for Wildlife Conservation, Inc. in cooperation with private landowners and local schools. BWB-ASF has been studying birds in Belize and Wisconsin, USA since 1997.

forest is reduced (Parker et al. 1993). Therefore, conservation of these areas is critical to conservation of Neotropical migratory birds and biodiversity in Central America (Conway & Baird 1993), especially since the montane forests along the Maya Divide have not been surveyed effectively and species diversity in this forest ecosystem is unknown (Parker et al. 1993).

Parker (Parker et al. 1993) had predicted that additional cloud forest species may eventually be found in unexplored, higher parts of the Maya Mountains in Belize. His greatest ambition was to participate in a Doyle's Delight expedition to continue documenting the avian community of the area (Matola, pers. comm.). However, his dream never materialized but his predictions were confirmed on two separate Doyle's Delight expeditions. The first expedition in 1989 documented a scaly-throated foliage gleaner (*Anabacerthia variegaticeps*) while a second expedition in 1993 also documented another new species, a tawny-throated leaffotser (*Sclerurus mexicanus*). Both species were the first records for Belize. Although the 2004 expedition did not yield any new bird species records for the country, it was important to continue the documentation of rare or recently recorded species for Belize.

The 2004 expedition took place on August 10th – 21st, just at the beginning of the migration period for Neotropical migrants. The 1989 expedition took place from August 20th to 31st, while the 1993 expedition took place from December 3rd to 13th. Both of these expeditions occurred when migrants are more common in Belize.

Methods and Results.

Two methods were utilized to document the bird communities of Doyle's Delight during the 2004 expedition. Mist nets operated at ground level sampled the area within two to three meters of the ground (Remsen & Good 1996) in three different locations. A census of all birds seen or heard throughout the day was also conducted. Other expedition participants (Jan Meerman, Martin Meadows, Julian Lee, and Sharon Matola) supplemented each day's bird species list with their casual observations. The three mist netting locations were approximately five to six hundred meters apart and were called DD – A, DD – B, and Helicopter Landing. DD – A was in the valley at the bottom of a hill, DD – B was located on a narrow ridge on the top of a hill and Helicopter Landing was located almost at the top of another hill just below the clearing used for the helicopter landing.

Two half-days of mist netting and bird banding (between 3 to 6 hours/day) were conducted at each of the three sites using six mist nets set up randomly approximately 50 meters apart throughout each area. The total net hours for all sites combined were 130.5 hours. (One net hour = one 12 m net open for one hour). At DD – A, a shallow, narrow stream trickling southwards was located in the center of the mist netting area. The vegetation varied from very dense undergrowth to partial openings among the trees. A huge Magnolia (*Magnolia yoroconte*) tree measuring approximately 70 to 80 cm dbh (diameter at breast height) and about 25 meters in height towered above the canopy at this site. The overall vegetation height ranged from approximately 15 meters to 20 meters. DD – B was situated on the top of a high ridge where the vegetation was lower. Vegetation height in the DD – B study area ranged from 8 to 12 meters except for a

moderate number of emergent palms (*Colpothrinax cookii*) which ranged in height from 15 to 20 meters. A steep mud bank was located along the edge of the ridge in this area. At the Helicopter Landing study area, the vegetation height was similar to DD – B and ranged from 8 to 12 meters. A few emergent trees and *Colpothrinax cookii* were also present in this area.

Forty - four birds of fourteen species were captured in the mist nets (Table 1). All of these birds, except for the hummingbirds, were banded with numbered aluminum bands, examined, and released. The bands used on the resident species were purchased from a band manufacturer in the U.S. The bands used on the migrant species were issued by the US Bird Banding Laboratory (US Geological Survey). The numbers on each band, the age and sex and notes on the bird's physical condition (such as fat, brood patch, cloacal protuberance, wing chord, body or flight feather molt and molt limits) were recorded. Twelve species (86%) of birds captured in mist nets were permanent resident species while two species (14%) were Neotropical migrants. The four species of birds that were captured most frequently were the Violet sabrewing, Stripe-tailed hummingbird, White-breasted wood-wren, and Common bush-tanager and all were resident species (Table 1). Because the four species of hummingbirds (all resident species) that were captured were not banded, the number of hummingbirds listed in Table 1 may have been overestimated.



Species that were recorded most frequently via the daily census included the bat falcon, spotted wood-quail, vermiculated screech-owl, all the hummingbird species, golden-olive woodpecker, plain xenops, olivaceous woodcreeper, spotted woodcreeper, black-faced antthrush, tawny-crowned greenlet, white-breasted wood-wren, spot-breasted wren, white-bellied wren, slate-colored solitaire, golden-crowned warbler, red-crowned ant-tanager, olive-backed

euphonia, and orange-billed sparrow. Combining the results of the daily census and mist netting allowed us to document a total of 79 species of 32 families at Doyle's Delight during this expedition (Table 1). Of these, 75 species (95%) were permanent residents, one (1%) dry season resident, and three (4%) were Neotropical migrants. The Neotropical migrants documented were the northern and Louisiana waterthrushes, and the black-and-white-warbler. The number of species recorded during this expedition is higher than the previous two expeditions (Table 1). For example, during the 1989 expedition, 70 bird species (63 resident and 6 migrant, and 1 dry season resident) were recorded while 72 species (54 resident, 17 migrant, and 1 unidentified Empidonax sp.) were recorded during the 1993 expedition (Table 1).

Discussion.

In order to continue documentation of the flora and fauna species present at Doyle's Delight, additional intensive surveys need to be conducted. The three expeditions undertaken thus far have yielded exciting results. As the late Ted Parker envisioned

(1993), the highlands of the Maya Mountains have provided new records of bird species for the country. To ensure that the documentation continues in a comprehensive manner, the surveys/expeditions should be conducted at different times throughout the year.

The first scientific expedition documenting the avian community of Doyle's Delight took place from August 20th to 31st 1989. Since this was the first expedition to the highlands of Belize, several highlands species, although common at Doyle's Delight, were otherwise rare in other parts of Belize or recorded for the first or second time in Belize (Jones, pers. comm.). For example, the stripe-tailed hummingbird, spotted woodcreeper, and common bush-tanager, have since proven to be common at high elevations while the scaly-throated foliage gleaner and elegant euphonia remain rare anywhere else in Belize (Jones, pers. comm.). The second Doyle's Delight expedition from December 3rd to 13th 1993, documented the first tawny-throated leaffosser record for Belize, the scaly throated foliage-gleaner for the second time, and the slaty antwren for the third time (Conway & Baird 1993). The spotted woodcreeper, tawny-throated leaffosser, and slaty antwren have been found elsewhere, but the scaly-throated foliage-gleaner has been found only at this site so may be confined strictly to Doyle's Delight in Belize (Jones, pers. comm.). The 2004 expedition did not document the scaly-throated foliage-gleaner but it could have been overlooked or may have been extirpated from the area, especially if there was a small population to begin with (Jones, pers. comm.). However, most of the other highland species found in the two prior expeditions were also found in 2004. Significant findings during the 2004 expedition were the singing quail, white-bellied wren, and keel-billed motmot. This is the first record for the singing quail and white-bellied wren to extend beyond their known range and altitudinal limit (Jones, pers. comm.). The rare keel-billed motmot, a species of humid evergreen forest (Howell & Webb 1995) and primary moist forest interior with an abundance of lianas (Jones 2003), could have been overlooked during the previous two visits or could be expanding its range. The 1989 expedition occurred during migration while the 1993 expedition occurred during the time when Neotropical migrants are on their non-breeding (overwintering) areas. The 2004 expedition took place when migration has just commenced, possibly explaining why only three Neotropical migrant species were recorded. It is interesting to note that the number of species recorded increased with each expedition (Table 1). This could possibly be due to a collective increase in experience with submontane species and general expertise over the past decade and a half which resulted in more species being detected on the latest expedition. Also, the recent Hurricane Iris in southern Belize could have had an effect on birds moving into an area. Although there were no immediate signs of vegetation damage at Doyle's Delight, gusts of high winds could have prevailed over the area since the strength of the hurricane passed by very closely to the south.

Expeditions have yet to be conducted at the height of either spring or fall migration (April-May; September-October), or during the breeding season (February-July). An expedition to Doyle's Delight during these time periods could provide further information on migrant species present during migration and also on breeding resident birds. Migrant species enroute to North America for the breeding season or to areas to the south for the non-breeding season may utilize the highlands of the Maya Mountains as stopover sites. For breeding resident birds, it is known that birds in the tropics have longer breeding seasons than birds in temperate zones (Murray 1985, Gill 1994).

However, highland species of neighboring Guatemala have shorter and more defined breeding seasons from April to May (Murray 1985). Because of its altitude, the resident bird species breeding at Doyle's Delight may also have shorter and more defined breeding seasons. Also, during the breeding season, birds tend to vocalize more (Gill 1994) and this would greatly increase detection of species which normally forage quietly in dense undergrowth or in the canopy. Therefore, conducting an expedition during these time periods could provide more information on both migrant and resident species.

The critical need for the protection of the montane tropical forests of the Maya Mountains cannot be over-emphasized. As more and more lowland forests are converted into farmlands and are modified by other human activities, the need to preserve montane forests becomes increasingly important to migrant birds (Conway and Baird, 1993). Therefore, it is with only proper and continued documentation of the flora and fauna of Doyle's Delight that we can begin to give a true value to this unique area and thereby, promote its importance especially to migrant and resident bird species.

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Species Accounts

The species in the accounts below are from the 2004 Doyle's Delight expedition. The bird species listed were either captured in mist-nets or documented by visual or aural methods. The method of detection is indicated after the abundance. The abundance designations in the list below are based on methods utilized by Jones and Gardner (1997).

Very common: 10 or more recorded daily

Common: 1-10 recorded daily

Fairly common: Not recorded every day.

Uncommon: Recorded at least twice, but generally not more than 4-5 times.

Rare: Recorded only once; or 1 individual recorded on 2 or more dates.

Plain chachalaca *Ortalis vetula*. Rare. Approximately four birds heard vocalizing one morning.

Crested guan *Penelope purpurascens*. Rare to uncommon. Two birds seen daily but believed to be same pair since sighted more or less in same area throughout the expedition.

Spotted wood-quail *Odontophorus guttatus*. Fairly common. Approximately one to four birds heard vocalizing most days.

Singing quail *Dactylortyx thoracicus*. Rare. Two birds heard vocalizing one morning.

King vulture *Sarcoramphus papa*. Rare to uncommon. Three birds observed soaring in one day.

Gray-headed kite *Leptodon cayanensis*. Rare. One bird seen.

Swallow-tailed kite *Elanoides forficatus*. Uncommon. Two sightings; a pair seen flying overhead on day 2 and nine observed soaring on day 8.

Great black-hawk *Buteogallus urubitinga*. Rare. One bird seen.

Black-and-white hawk-eagle *Spizastur melanoleucus*. Rare. One bird seen.

Black hawk-eagle *Spizaetus tyrannus*. Uncommon. Two records-both heard vocalizing at different times.

Bat falcon *Falco rufigularis*. Common. One to two birds seen daily.

Short-billed pigeon *Patagioenas nigrirostris*. Uncommon. Two birds heard vocalizing one morning.

Olive-throated parakeet *Aratinga nana*. Rare. A flock of four birds flew overhead one afternoon.

White-crowned parrot *Pionus senilis*. Rare. A pair seen one evening.

Mealy parrot *Amazona farinosa*. Uncommon. A pair flew over one evening and a flock of four several days later.

Vermiculated screech-owl *Megascops guatemalae*. Fairly common. One to two individuals heard vocalizing most nights.

Mottled owl *Ciccaba virgata*. Uncommon. One individual heard vocalizing a couple nights.

White-collared swift *Streptoprocne zonaris*. Rare to uncommon. A flock of six birds observed flying overhead.

* **Long-billed hermit** *Phaethornis longirostris*. Common. Three caught in mist net and one to three individuals seen daily.

Stripe-throated hermit *Phaethornis striigularis*. Common. One to two individuals seen daily.

* **Violet sabrewing** *Campylopterus hemileucurus*. Common. Five caught in mist net and one to six individuals seen daily.

White-bellied emerald *Amazilia candida*. Common. One to two individuals seen daily.

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- * **Azure-crowned hummingbird** *Amazilia cyanocephala*. Common. One caught in mist net and one to two individuals seen daily.
 - * **Stripe-tailed hummingbird** *Eupherusa eximia*. Common. Nine caught in mist net and one to seven individuals seen daily.
- Collared trogon** *Trogon collaris* Rare to uncommon. One individual seen on three different days.
- Tody motmot** *Hylomanes momotula*. Rare. One bird vocalizing one morning.
- Blue-crowned motmot** *Momotus momota*. Fairly common. One individual vocalizing on five different days.
- Keel-billed motmot** *Electron carinatum*. Uncommon. One individual vocalizing on two separate days.
- Rufous-tailed jacamar** *Galbulia ruficauda*. Rare. Two birds vocalizing one morning.
- Emerald toucanet** *Aulacorhynchus prasinus*. Rare. A flock of four seen one morning.
- Keel-billed toucan** *Ramphastos sulfuratus*. Rare. One bird vocalizing one morning.
- Smoky-brown woodpecker** *Veniliornis fumigatus*. Uncommon. Two birds vocalizing on separate days.
- Golden-olive woodpecker** *Piculus rubiginosus*. Common. One to three birds heard vocalizing daily.
- Pale-billed woodpecker** *Campephilus guatemalensis*. Rare. Two birds seen one morning.
- * * **Buff-throated foliage-gleaner** *Automolus ochrolaemus*. Uncommon. Two caught in mist net and banded.
- Plain xenops** *Xenops minutus*. Fairly common. One to two individuals seen most days.
- Tawny-throated leaffosser** *Sclerurus mexicanus*. Uncommon. One individual seen four different times.
- Scaly-throated leaffosser** *Sclerurus guatemalensis*. Rare to uncommon. One individual seen three different times.
- Tawny-winged woodcreeper** *Dendrocincla anabatina*. Rare. One bird seen.
- Ruddy woodcreeper** *Dendrocincla homochroa*. Rare. One bird seen.
- * * **Olivaceous woodcreeper** *Sittasomus griseicapillus*. Common. Two caught in mist net/banded and one to two birds seen/heard daily.
- Wedge-billed woodcreeper** *Glyphonyxus spirurus*. Rare. One individual seen.
- Strong-billed woodcreeper** *Xiphocolaptes promeropirhynchus*. Rare to uncommon. Three individuals seen.
- Spotted woodcreeper** *Xiphocolaptes erythropygus*. Fairly common. One to two birds seen on most days.
- Slaty antwren** *Myrmotherula schistocolor*. Rare. Two individuals seen one morning.
- * * **Black-faced antthrush** [*Formicarius analis (moniliger)*]. Common. Two birds caught in mist net/banded and one to three birds vocalizing daily.
- Ochre-bellied flycatcher** *Mionectes oleaginous*. Uncommon. Two birds seen.
- Northern bentbill** *Oncostoma cinereigulare*. Uncommon. Two birds seen.

Stub-tailed spadebill *Platyrinchus cancrominus*. Rare. One bird heard vocalizing.

* * **Sulphur-rumped flycatcher** *Myiobius sulphureipygius*. Uncommon. Two birds caught in mist net/banded and one bird seen.

Tropical pewee *Contopus cinereus*. Rare. One bird seen.

Rufous piha *Lipaugus unirufus*. Rare. One bird heard vocalizing

White-collared manakin *Manacus candei*. Uncommon. Two individuals seen.

Red-capped manakin *Pipra mentalis*. Uncommon. Two individuals seen.

Tawny-crowned greenlet *Hylophilus ochraceiceps*. Common. One to four birds seen/heard daily.

Green jay *Cyanocorax yncas*. Rare to uncommon. A flock of five birds seen one day.

Northern rough-winged swallow *Stelgidopteryx serripennis*. Rare to uncommon. A flock of four birds seen one day.

Barn swallow *Hirundo rustica*. Rare to uncommon. A flock of five birds seen one day.

Spot-breasted wren *Thryothorus maculipectus*. Common. One to four birds vocalizing daily.

White-bellied wren *Uropsila leucogastra*. Rare to uncommon. One to three birds seen/heard for a couple days.

* * **White-breasted wood-wren** *Henicorhina leucosticta*. Common. Seven caught in mist net/banded and one to six birds seen/heard daily.

Nightingale wren *Microcerculus philomela*. Rare to uncommon. Three individuals heard vocalizing on separate days.

* * **Slate-colored solitaire** (*Myadestes unicolor*). Common. Two caught in mist net/banded and one to six birds seen/heard daily.

White-throated robin *Turdus assimilis*. Rare. One individual seen.

Black-and-white warbler *Mniotilla varia*. Uncommon. Three individuals seen separately in different locations.

* * **Northern waterthrush** *Seiurus noveboracensis*. Rare. One bird caught in mist net/banded and one bird seen.

* * **Louisiana waterthrush** *Seiurus motacilla*. Rare. One bird banded.

Golden-crowned warbler *Basileuterus culicivorus*. Common. One to two birds heard daily.

Bananaquit *Coereba flaveola*. Rare. One bird seen.

* * **Common bush tanager** *Chlorospingus ophthalmicus*. Very common. Five birds caught in mist net/banded and flocks of five to fifteen birds seen daily.

Red-crowned ant-tanager *Habia rubica*. Common. One to six birds seen/heard daily.

Yellow-winged tanager *Thraupis abbas*. Rare. One individual seen.

Green honeycreeper *Chlorophanes spiza*. Uncommon. One to two birds seen on a couple occasions.

Shining honeycreeper *Cyanerpes lucidus*. Rare. Three birds seen one afternoon.

Red-legged honeycreeper *Cyanerpes cyaneus*. Fairly common. Two to four birds seen most days.

* * **Orange-billed sparrow** *Arremon aurantiirostris*. Fairly common. Two birds caught in mist net/banded and one to two birds seen most days.

Black-faced grosbeak *Caryothraustes poliogaster*. Uncommon. One individual and a flock of six birds seen on two occasions.

Yellow-throated euphonia *Euphonia hirundinacea*. Rare. Two birds seen.

Olive-backed euphonia *Euphonia gouldi*. Common. Flocks of three to ten birds seen daily.

* = hummingbirds which were caught in mist-nets but not banded.

* * = birds caught in mist-nets and banded.

Table 2. Bird species recorded at Doyle's Delight during the 1989, 1993, and 2004 expeditions.

1989	1993	2004	Status*
CURASSOWS & GUANS – CRACIDAE			
		Plain chachalaca	R
Crested guan	Crested guan	Crested guan	R
	Great curassow		R
NEW WORLD QUAIL – ODONTOPHORIDAE			
Spotted wood-quail	Spotted wood-quail	Spotted wood-quail	R
		Singing quail	R
PELICANS – PELECANIDAE			
Brown pelican			R
STORKS – CICONIIDAE			
Wood stork (no record for southern Belize)			R
AMERICAN VULTURES – CATHARTIDAE			
King vulture		King vulture	R

KITES, EAGLES, HAWKS & ALLIES – ACCIPITRIDAE			
		Gray-headed kite	R
Swallow-tailed kite		Swallow-tailed kite	S
Bi-colored hawk			R
Great black hawk	Great black-hawk	Great black-hawk	R
Solitary eagle	Solitary eagle		R
Black-and-white hawk-eagle		Black-and-white hawk-eagle	R
		Black-hawk eagle	R
	Ornate hawk-eagle		R
Short-tailed hawk			R
CARACARAS & FALCONS – FALCONIDAE			
Barred forest falcon			R
Collared forest falcon	Collared forest falcon		R
Bat falcon	Bat falcon	Bat falcon	R
RAILS, GALLINULES & COOTS – RALLIDAE			
	Ruddy crake		R
	Gray-necked wood-rail		R
PIGEONS & DOVES – COLUMBIDAE			
Short-billed pigeon		Short-billed pigeon	R
Ruddy quail dove			R
Blue ground dove			R
PARROTS – PSITTACIDAE			
		Olive-throated parakeet	R
White crowned parrot		White-crowned parrot	R

Mealy parrot	Mealy parrot	Mealy parrot	R
	Red-lored parrot		R
TYPICAL OWLS – STRIGIDAE			
Vermiculated screech owl		Vermiculated screech-owl	R
Mottled owl		Mottled owl	R
GOATSUCKERS – CAPRIMULGIDAE			
	Common paraque		R
SWIFTS			
	Vaux's swift		R
White collared swift		White-collared swift	R
HUMMINGBIRDS – TROCHILIDAE			
Long-billed hermit	Long-billed hermit	Long-billed hermit	R
	Stripe-throated hermit	Stripe-throated hermit	R
Violet sabrewing		Violet sabrewing	R
White-necked Jacobin			R
		White-bellied emerald	R
	Azure-crowned hummingbird	Azure-crowned hummingbird	R
Striped-tailed hummingbird (Noted as very rare)	Striped-tailed hummingbird	Striped-tailed hummingbird	R
Black-crested coquette			R
TROGONS – TROGONIDAE			
Collared trogon	Collared trogon	Collared trogon	R
MOTMOTS – MOMOTIDAE			

	Tody motmot	Tody motmot	R
Blue-crowned motmot	Blue-crowned motmot	Blue-crowned motmot	R
		Keel-billed motmot	R
JACAMARS – GALBULIDAE			
		Rufous-tailed jacamar	R
TOUCANS – RAMPHASTIDAE			
Emerald toucanet	Emerald toucanet	Emerald toucanet	R
Keel-billed toucan	Keel-billed toucan	Keel-billed toucan	R
WOODPECKERS – PICIDAE			
	Yellow-bellied sapsucker		M
		Smoky-brown woodpecker	R
Golden-olive woodpecker	Golden-olive woodpecker	Golden-olive woodpecker	R
		Pale-billed woodpecker	R
OVENBIRDS – FURNARIIDAE			
Buff-throated foliage-gleaner	Buff-throated foliage-gleaner	Buff-throated foliage-gleaner	R
	Plain xenops	Plain xenops	R
	Tawny-throated leaffosser	Tawny-throated leaffosser	R
Scaly-throated leaffosser (leafscraper)		Scaly-throated leaffosser	R
Scaly-throated foliage gleaner (New record for Belize)	Scaly-throated foliage gleaner		R
WOODCREEPERS – DENDROCOLAPTIDAE			

Tawny-winged woodcreeper		Tawny-winged woodcreeper	R
	Ruddy woodcreeper	Ruddy woodcreeper	R
Olivaceous woodcreeper	Olivaceous woodcreeper	Olivaceous woodcreeper	R
		Wedge-billed woodcreeper	R
		Strong-billed woodcreeper	R
Spotted woodcreeper (Previously 1 record for Belize)	Spotted woodcreeper	Spotted woodcreeper	R
Streak-headed woodcreeper			R
ANTBIRDS – THAMNOPHILIDAE			
	Slaty antwren	Slaty antwren	R
Dusky antbird			R
ANTTHRUSHES – FORMICARIIDAE			
Black-faced antthrush	Black-faced antthrush	Black-faced antthrush	R
TYRANT FLYCATCHERS – TYRANNIDAE (Elaeniinae)			
	Ochre-bellied flycatcher	Ochre-bellied flycatcher	R
(Platyrinchinae)			
Northern bentbill	Northern bentbill	Northern bentbill	R
Stub-tailed spadebill	Stub-tailed spadebill	Stub-tailed spadebill	R
(Fluvicolinae)			
Sulphur-rumped flycatcher	Sulphur-rumped flycatcher	Sulphur-rumped flycatcher	R
		Tropical pewee	R

	Epidonax spp.		?
(Tyranninae)			
	Bright-rumped Attila		R
Boat-billed flycatcher			R
(Genera INCERTAE Sedis)			
	Thrushlike schiffornis		R
		Rufous piha	R
MANAKINS – PIPRIDAE			
		White-collared manakin	R
	Red-capped manakin	Red-capped manakin	R
VIREOS – VIREONIDAE			
Tawny-crowned greenlet	Tawny-crowned greenlet	Tawny-crowned greenlet	R
Green shrike vireo			R
JAYS – CORVIDAE			
Green jay	Green jay	Green jay	R
SWALLOWS – HIRUNDINIDAE			
Purple martin			T
		Northern rough-winged swallow	R/M
Barn swallow		Barn swallow	T
WRENS – TROGLODYTIDAE			
	Spot-breasted wren	Spot-breasted wren	R
		White-bellied wren	R
	Carolina wren		R

White-breasted wood-wren	White-breasted wood-wren	White-breasted wood-wren	R
Nightingale wren		Nightingale wren	R
SOLITAIRES, THRUSHES & ALLIES – TURDIDAE			
Slate-colored solitaire	Slate-colored solitaire	Slate-colored solitaire	R
	Swainson's thrush		M
	Wood thrush		M
White-throated robin		White-throated robin	R
MOCKINGBIRDS, THRASHERS & ALLIES – MIMIDAE			
	Gray catbird		M
WOOD WARBLERS – PARULIDAE			
	Golden-winged warbler		M
	Magnolia warbler		M
	Black-throated green warbler		M
Blackburnian warbler			T
	Yellow-throated warbler		M
	Grace's warbler		R
Black and white warbler	Black-and-white warbler	Black-and white warbler	M
	American redstart		M
	Worm-eating warbler		M
	Ovenbird		M
	Northern waterthrush	Northern waterthrush	M
Louisiana waterthrush	Louisiana waterthrush	Louisiana waterthrush	M
Hooded warbler	Hooded warbler		M

	Wilson's warbler		M
Golden-crowned warbler	Golden-crowned warbler	Golden-crowned warbler	R
BANANAQUITS – COEREBIDAE			
	Bananaquit	Bananaquit	R
TANAGERS – THRAUPIDAE			
Common bush tanager (Noted as rare)	Common bush-tanager	Common bush-tanager	R
Red-crowned ant-tanager	Red-crowned ant-tanager	Red-crowned ant-tanager	R
White-winged tanager			R
		Yellow-winged tanager	R
Green honeycreeper (Noted as rare)		Green honeycreeper	R
Shining honeycreeper (Noted as rare)	Shining honeycreeper	Shining honeycreeper	R
Red-legged honeycreeper		Red-legged honeycreeper	R
EMBERIZINES – EMBERIZIDAE			
Orange-billed sparrow	Orange-billed sparrow	Orange-billed sparrow	R
CARDINALS & ALLIES – CARDINALIDAE			
Black-faced grosbeak	Black-faced grosbeak	Black-faced grosbeak	R
Blue-black grosbeak			R
FINCHES & EUPHONIAS – FRINGILLIDAE			
		Yellow-throated euphonia	R
Olive-backed euphonia	Olive-backed euphonia	Olive-backed euphonia	R

Elegant euphonia (Previously 1 record for Belize)			R
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*S = Seasonal resident, R = Permanent resident, M = Migrant, T = Transient.

Mammals of Doyle's Delight

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During the August 2004 Rapid Ecological Assessment of Doyle's Delight, there were no scientist involved that were dedicating some time to recording mammals. The species list below is therefore a compilation of opportunistic observations and records made by the combined team present.

Baird's Tapir; Tracks found in Creek Bed south of camp

Cacomistle; August 12, 2004. Several animals heard calling near camp

Kinkajou; August 13, 2004. Animal
Scolding all night in camp Visual + heard +
skull of other individual found at camp.

Mexican Black Howler Monkey; Aug. 12,
2004. Heard approximately 1 ml to the east
of camp.

Murid Rodents; Small blue-grey terrestrial
murid rodents. Various observations.

Nine-banded Armadillo; August 14, 2004.
Visual near camp.

Ocelot; August 14, 2004. Visual of an animal crossing a bird transect line near camp
during daytime.

Red Brocket Deer; Aug 11, 2004, Visual of an animal crossing trail during daylight
hours

Yucatan Squirrel; August 14, 2004. Visual near camp.



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