CHIQUIBUL CAVE SYSTEM

CEBADA CAVE EXPEDITION

Biological Diversity Technical Report

August 28 - 30, 2012

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September 11, 2012

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INTRODUCTION

The Chiquibul Cave System (CCS) is the longest and largest presently known cave system in Central America. To date a total of 65 km of cave passages have been mapped (Czaplewski *et al.* 2003). It is situated in the jungles of the Vaca Plateau in west central Belize (most of the cave's network is found within the Chiquibul National Park (CNP). It consists of four hydrological linked caves, namely Actun Kabal, Actun Tunkul, Cebada and Xibalba [found in Guatemalan territory], plus numerous sinkholes, which based on uranium isotopes decay measurements the CCS began to form at least 800,000 years ago (Miller 2000).

Based on previous expeditions within Cebada there have been many reports of vertebrate remains. The skeleton of a juvenile extinct bear species (*Tremarctos floridanus*) was recorded by Miller (1989), while Krejca *et al*. 2000 reports skeletal remains of snakes, bats and even human remains. One of the most interesting discoveries is that of the skeletal remains of the extinct vampire bat *Desmodus draculae*, making this report the second occurrence of bat fossils in Central America (Czaplewski *et. al*. 2003). This bat species had been recorded at 6 different sites previously (5 in South America and 1 in Mexico, Yucatan Peninsula).

This report focuses on observations made during the expedition to Cebada Cave; paying greater attention to the biological integrity of the cave system and its present threats. The objectives of the three day expedition to Cebada Cave were to:

- ✓ Conduct a rapid biological assessment of the area.
- ✓ Identify present threats to the ecological and cultural integrity of the cave system.
- ✓ Identify species of conservation concern.

METHODOLOGY

The three day expedition to Cebada Cave (Figure 1) was conducted from the 28 to 30 of August 2012, making it the last of a series of expeditions funded by the Rufford Foundation to the Chiquibul Cave System in an effort to explore the system's native biodiversity and to identify present and potential threats to biodiversity within and around the cave; and also to the geological and archaeological features due mainly to human activities. The 11 member team consisted of 7 Belize Defense Force personnel, 1 Special Police Unit and 3 FCD representatives being: Lenny Gentle (cave guide specialist), Jose Sierra

(lead navigator) and Boris Arevalo (biologist). Data collection occurred during one day of the expedition as two days were consumed from hiking to and from Caracol to the cave system

Site Description

The CCS is found within the Chiquibul Forest (CF) (Figure 1 and Figure 2). The CF, located within the Cayo District, covers an area of 176,999 ha (437,376 acres) comprised of three protected areas being the Chiquibul National Park (106,838 ha), Chiquibul Forest Reserve (59,822 ha) and the Caracol Archeological Reserve (10,339 ha), with central UTM coordinates 1,878,200 – 1,871,800 North and 265,600 – 322,600 East. Meerman and Sabido (2001) identified 17 different ecosystems within the area, all being variants of Tropical Broadleaf Forests, except for a pine forest category. This dense rainforest was lightly logged in the late 1960's and 70's (Miller 1996). The climate is tropical-humid with mean annual temperatures of 22^{o}C and with a precipitation of 2000 mm/ yr; with a marked dry season between February to June and a rainy season coinciding with the hurricane season which starts from July to November (Salas & Meerman 2008). The soils are generally derived from limestone and are regarded fertile in comparison to other tropical areas but on the steeper limestone slopes. Wright *et al.*(1959) classifies the soils as skeletal where the bedrock tends to protrude out as a consequence of the soil layer being a few centimeters thick. Parent rock is a highly brecciated limestone of Cretaceous age upon which a mature karst landscape developed. According to Czaplewski *et al.* (2003), the constant 100% humidity and 22oC temperatures inside the CCS allow high biological activity, such as the alluvial-silt banks are perpetually covered in worm castings.

Data Collection

Time was the most critical limiting factor for using standardized protocols in biological data collection nonetheless data on species presence/absences and abundance was collected throughout the day. Biodiversity data was collected on an opportunistic basis while exploring the cave surroundings and during ours stays at campsites. Species identification occurred by direct and indirect sightings (use of tracks and vocalizations). Birds were identified using direct sightings and vocalizations while mammals were identified by direct sightings, vocalizations and tracks. Amphibian diversity was assessed by conducting a nocturnal active search survey on the banks of a stream located 3 km north east of the cave. Reptile diversity was assessed by recording all visual encounters along a 2 km trail leading to the entrance of the cave.

Identification of threats to biodiversity was conducted through direct observations and analyzing the magnitude of human activities around the target area and their implications to biodiversity and cultural conservation.

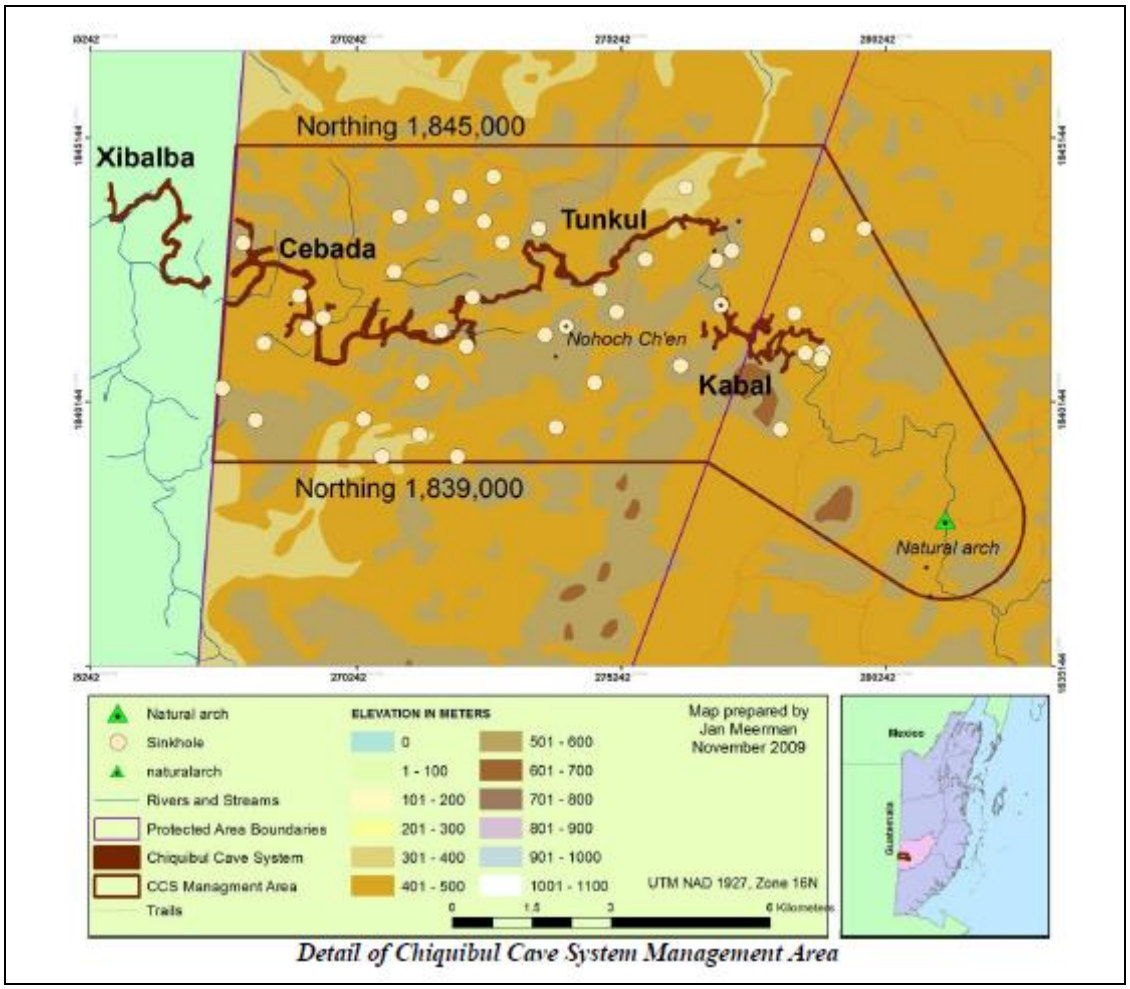


Figure 1: *Detailed map of the Chiquibul Cave System showing geographical location of the hierologically link caves.*

RESULTS

Ecosystems

Three major ecosystems were observed being Tropical broadleaf Forest, guamil (regenerating forest) and milpas (non-mechanized agriculture), the former two as a consequence of human interventions. The tropical broadleaf Forest (Figure 2), found around Cebada can be subdivided into 6 different variants based on elevation and steepness (Meerman & Sabido 2004). This type of vegetation was observed to reach a canopy height of 15 to 20 m with occasional emergent trees. The understory is composed of a relatively dense tangle of vines, ferns, saplings and palms which greatly reduce visibility. Flora species that merit noting is the occurrence of Bullet Tree and *Pterocarpus reckoii, (*commonly known as palo de sangre). These species tends to occur mostly in water laden soils, a condition that was observed mainly in the valleys but at a very small scale. This ecosystem is the most mature and conserved of all but is

presently undergoing degradation due to illegal logging, hunting and other illegal non-timber forest product extraction activities, which are compromising the ecological integrity of the area.

A B

Figure 2: *Tropical broadleaf Forest dominant ecosystem around Cebada (A) aerial view and (B) understory.*

Guamils (Figure 3) (induce by human activities) were observed to be occurring around milpa farms as a consequence of deforested areas given a fallow period to allow soil fertility recovery. In total 4 guamiles were observed ranging from 2 to 10 ha. Vegetation height ranged from 1 to 3 m; composed mostly of pioneer herds and shrubs interspersed with pioneer trees such as balsa (*Ochroma pyramidale*) and Trumpet Tree (*Cecropia peltata*) and mature tropical forest tree species left standing when original vegetation was clear cut. Low vegetation height and species composition indicates that these areas have around 1 to 3 years of age, a contributing factor to the dense vegetation allowing understory visibility for a few meters only.

Figure 3*: Guamil recording around Cebada Cave, such ecosystem results from deforestation as a consequence of milpa farming*

A total of 3 active milpas and two deforested areas were recorded along the way to Cebada Cave. The first milpa was recorded 5 km north of the Cave and 1.3 km inside Belizean territory, east of the Belize-Guatemala border. All of the recorded milpas are relatively new based on the observation of fallen trees still containing solid twigs, with an estimated age not more than 3 years. Each milpa had an estimated area of 15 to 20 ha. One of the milpas was located only 50 m north from the main entrance to Cebada Cave and it is believed that the entire cave entrance area was not converted into a milpa due to the fact that it is located within a sink hole. It was observed that the milpa farms had the following crops growing: corn of various developmental stages, pumpkins and black beans.

Figure *4*: *Milpas recorded around Cebada Cave. These had corn, pumpkins and beans growing.*

In addition to the active milpas, 3 areas were observed to have been cleared from their underbrush giving an indication that these will in the immediate future be converted into a corn plantation. Each of these areas had an estimated area of about 10 ha.

Figure 5: *Area of mature forest cleared from it underbrush, an indication that area will be deforested and converted into a milpa in the near future.*

Biodiversity

The rapid biodiversity assessment of the area reveals a recorded faunal assemblage of 92 species. Reported diversity may be low but is as a consequence of low sampling intensity and not of poor natural habitat conditions. Birds were the most diverse taxon while reptiles had the least recorded richness (Table 1).

Even though recorded biodiversity richness was low a total of 5 fauna species (Table 2) are of conservation concern ranging from being vulnerable to endangered following the IUCN classifications system. Two bird and 3 mammal species were identified as being of importance at the national, regional and international level. Even though none of the recorded amphibian species are of conservation concern it is important to note that, amphibians as a whole are becoming of interest due to global warming and are said to be good indicators of habitat health.

Table 1: *Faunal richness recorded around Cebada Cave.*

Taxon	Richness
Birds	67
Mammals	10
Amphibians	7
Reptiles	8

***Table 2**: Species of conservation concern recorded around Cebada Cave.*

Group	Colloquial Name	Family	Species	IUCN Class	Status in Belize
Bird	Crested Guan	Cracidae	*Penelope purpurascens*		VU
Bird	Mealy Parrot	Psittacidae	*Amazona farinosa*	NT	VU
Bird	Keel-billed Motmot	Momotodae	*Electron carinatum*	VU	
Mammal	Black Howler Monkey	Cebidae	*Alouatta pigra pigra*	EN	VU
Mammal	Jaguar	Felidae	*Panthera onca goldmani*	NT	NT
Mammal	Ocelot	Felidae	*Leopardus pardalis pardalis*	VU	VU

Threats to biodiversity

Most of the present threats to the ecological, geological and cultural integrity of the Chiquibul Forest are as a consequence of Guatemalans from buffering communities. People in these communities are mostly poor and are highly dependent on the natural resources found within the Chiquibul for their daily survival. The most evident threats to the ecological and cultural integrity of Cebada cave are: i) agricultural encroachments (Figure 6), that take the form of milpa farms, whose expansion leads to deforestation of natural areas; ii) illegal logging (Figure 7) which is having a direct impact of mahogany and cedar populations (target species) and leads to forest degradation and deforestation; iii) hunting/ poaching (Figure 8); iv) illegal extraction of non-timber forest products such as Xaté and v) looting of cultural artifacts (Figure 9) within and around the cave system.

***Figure 6:** Deforestation as a consequence of agricultural encroachments around Cebada Cave*

Figure 7: *Illegally logged under sized mahogany tree around Cebada Cave*

A **B**

Figure 8: *Evidence of illegal hunting recorded from Cebada Cave area (A) bones of large mammal found at an illegal logger makeshift camp, (B) 'Tapesco' makeshift structure use by hunters to ambush game animals.*

DISCUSSION

Due to the proximity of Cebada Cave to the Belize-Guatemala international border (1.4 km) it is experiencing various threats that compromise the ecological and cultural integrity of the site. Even though limited biological data was collected during the expedition, as time was a limiting factor, a relatively rich faunal assemblage was recorded. Many of the species were indicative of mature Tropical

Broadleaf forest such as the bird species: *Amazona farimosa, Xiphorhnchus flavigaster, Buteogallus urubitinga, Electron carinatum* among others and large predatory mammals as were the wildcats *Panthera onca* and *Leopardus pardalis pardalis*. The occurrence of species of conservation concern indicates that the ecosystems still provides much of the ecological function to remain viable in time but adequate management and conservation strategies are needed.

It is evident that the close proximity of the cave to the border makes it more vulnerable to human induced threats. The impacts that the identified threat have on the area's ecology depends greatly on the magnitude of the threat. The most severe threat is agricultural encroachment (milpa farms) which inevitably causes deforestation. It is extremely difficult to quantify the true ecological impact of deforestation on the local biodiversity without having rigorous research that aim to provide insight on specific questions. Being faced with lack of information only general conclusions can be made, based on the results of other case studies. An evident impact of deforestation is habitat loss and destruction but its true impact on population dynamics is not known. This alters population structure by limiting habitat and food availability. The disturbances create habitat and niches for more generalist species that will tend to displace specialized ones. Another evident effect of deforestation is the phenomenon known as "edge effect." This concept tends to explain that not only the deforested patch is affected but that the effect migrates into forested areas as there are changes in light availability, humidity and temperature that affects floral composition and structure up to a kilometer from the edge depending the severity of deforestation ultimately having a direct impact on fauna diversity. Base on the observations made during the expedition Guatemalans are deforesting large tracks of land (estimated area of each plot to be between 15 – 20 ha) to plant corn, beans and pumpkins. It is evident that there are no signs of a decrease in the impacted area but the opposite is observed as plots of mature forest were observed to have been cleared from their underbrush.

Another impact associated with agriculture encroachments is the contamination of the environment with agrochemicals (mainly herbicides and pesticides) that are being used to tend crops. Many used agrochemical containers (Figure 9) were observed to be inappropriately disposed off within these milpas. The close proximity (50 m away) of milpas from the cave entrance has great implications to the conservation of the system's cultural and ecological integrity. The conversion of natural areas into agricultural lands completely change the ecology of the area by changing species composition and structure but most importantly by altering the environmental conditions as the

***Figure 9** : Used agrochemical containers*

large gaps created allow greater light and sunlight radiation to penetrate the ground causing a change in the microclimate.

Illegal logging is not new to the area as stumps of old cut trees were observed but there is fresh illegal logging. All target tree species are either mahogany or cedar and based on the observations all fresh logged trees were undersize (ranging from 30 to 40 cm in diameter) a clear indication that the targeted populations are being overharvested.

Hunting and looting is believe to be an opportunistic activity where individuals engaged in farming and/ or illegal logging subsidize their diet with game meat in most cases their only source of animal protein. Based on observations, most Mayan mounds found within the Chiquibul Forest and with no exception around Cebada have been looted. Once looted it is impossible to recover stolen artifacts leading to the loss of priceless archaeological data that could have contributed to the understanding of the role that caves played in the ancient Mayan society. At the entrance of the cave evidence (Figure 10) was found that people have been entering it and since being one of the least studies cave systems the impact that intruders have on the ecological and cultural integrity of the systems is unknown.

Figure 10: *Boot prints observed at entrance of Cebada indicating that unauthorized individuals have been entered the cave*

To better understand the biological importance of Cebada it is important to conduct further biological studies both outside and inside the cave, especially in the cave's aquatic environment. Until there is no biological baseline of the system it is impossible to quantify the true ecological impact that human activities are having on the system.

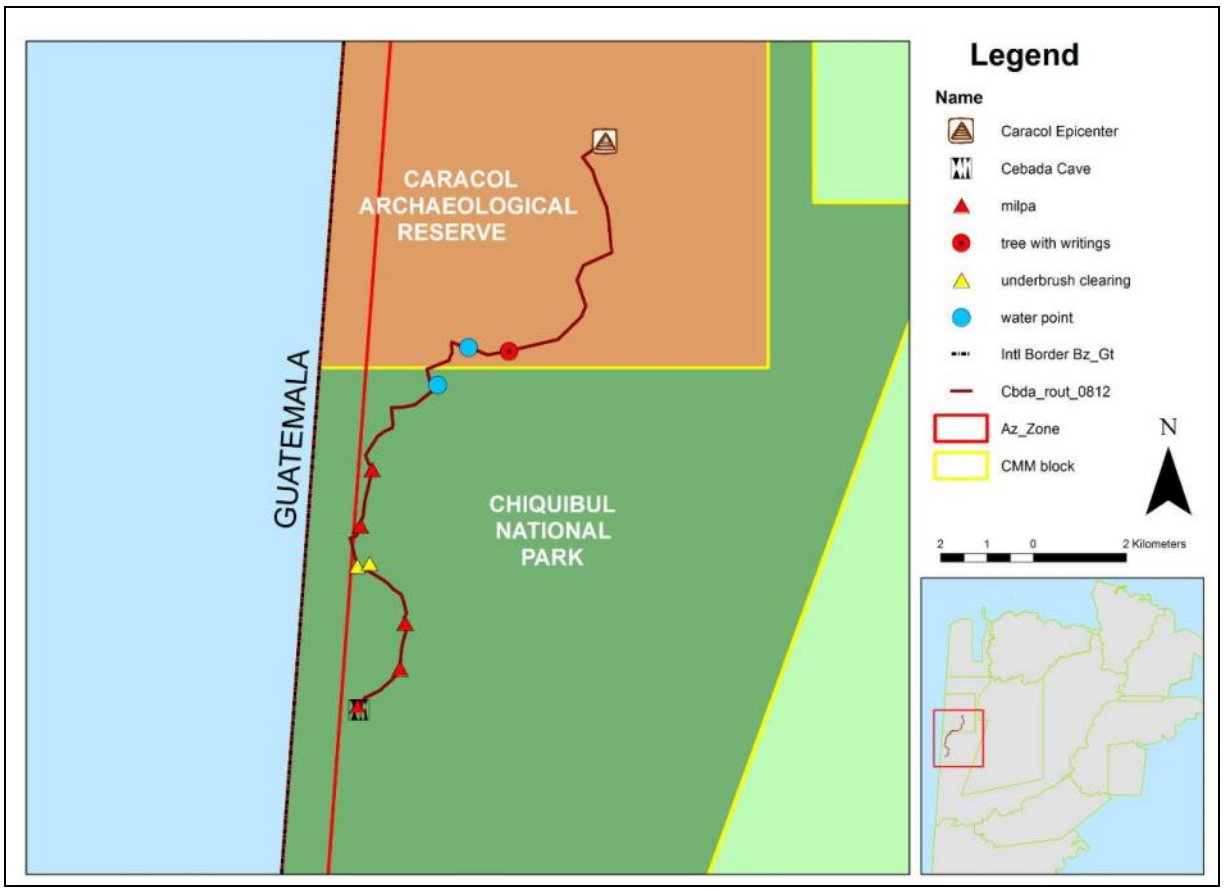
To conserve the ecological, cultural and geological uniqueness of Cebada it is important that adequate and efficient management strategies are set in place. There is an urgent need to stop the advancement of agricultural encroachments into the Chiquibul Forest and allow the natural regenerations of area that have been deforested. It is important to address the issue of illegal logging, hunting and looting. In order to set in place effective conservation strategies it is important for the active participation of various Governmental Ministries and Departments such as the Forest Department, the Institute of Archaeology, Ministry of Forestry, Fisheries and Sustainable Development, the Ministry of National Security and the Ministry of Foreign Affairs due to the territorial dispute of Guatemala over Belize. Most important the

Guatemalan government needs to implement poverty alleviation programs within buffering communities of the Chiquibul as the populations solely depend on the forest resources for their survival, resources that have been depleted in their communities due to the high rate of deforestation in the neighboring country (Figure 11).

Figure 11: *Aerial photo along Belize- Guatemala border showing high rate of deforestation in Guatemala (December 2011).*

ANNEXES

<u>Annex 1</u>: Detailed map of the trail taken from Caracol Archaeological Reserve to Cebada



Annex 2: List of wildlife sightings during the Cebada Cave Expedition, 2012

English Name	*Scientific Name*	Taxon	Abundance
Barred Antshrike	*Thamnophilus doliatus*	Birds	1
Barred Woodcreeper	*Thamnophilus doliatus*	Birds	1
Black-cheek Woodpecker	*Melanerpes pucherani*	Birds	1
Yellow-tailed Oriole	*Icterus mesomelas*	Birds	2
Bat Falcon	*Falco rufigularis*	Birds	1
Black-faced Antthrush	*Formicarius analis*	Birds	1
Black-headed Saltator	*Saltator atriceps*	Birds	2
Black-headed Trogon	*Trogon melanocephalus*	Birds	2
Blue-crown Motmot	*Momotus momota*	Birds	2
Bright-rumped Attila	*Attila spadiceus*	Birds	1
Brown Jay	*Cyanocorax morio*	Birds	4
Pauraque	*Nyctidromus albicollis*	Birds	1
Common Yellowthroat	*Geothlypis trichas*	Birds	1
Crested Guan	*Penelope purpurascens*	Birds	3
Dot-winged Antwren	*Microrhopias quixensis*	Birds	2
Great Black Hawk	*Buteogallus urubitinga*	Birds	1
Great Tinamou	*Tinamus major*	Birds	1
Green-backed Sparrow	*Arremonops chloronotus*	Birds	2
Ivory-billed Woodcreeper	*Xiphorhynchus flavigaster*	Birds	1
Keel-bill motmot	*Electron carinatum*	Birds	1
Keel-billed Toucan	*Ramphastos sulfuratus*	Birds	2
Lineated Woodpecker	*Dryocopus lineatus*	Birds	1
Little Hermit	*Phaethornis striigularis*	Birds	1
Long tail Hermit	*Phaethornis longirostris*	Birds	1
Mealy Parrot	*Amazona farinosa*	Birds	10
Melodius Blackbird	*Dives dives*	Birds	4
Montezuma Oropendola	*Psarocolius montezuma*	Birds	2
Mottled Owl	*Ciccaba virgata*	Birds	1
Northern Bentbill	*Oncostoma cinereigulare*	Birds	1
Ochre-bellied Flycatcher	*Mionectes oleagineus*	Birds	1

Olivaceous Woodcreeper	*Sittasomus griseicapillus*	Birds	1
Olive-backed Euphonia	*Euphonia gouldi*	Birds	2
Olive-throated Parakeet	*Aratinga nana*	Birds	6
Orange-billed Sparrow	*Arremon aurantiirostris*	Birds	2
Short-billed Pigeon	*Patagioenas nigrirostris*	Birds	1
Pale-billed Woodpecker	*Campephilus guatemalensis*	Birds	1
Plain Chachalaca	*Ortalis vetula*	Birds	3
Plain Xenops	*Xenops minutus*	Birds	1
Red-lored Parrot	*Amazona autumnalis*	Birds	5
Red-throated Ant-Tanager	*Habia fuscicauda*	Birds	4
Ruddy Woodcreeper	*Dendrocincla homochroa*	Birds	1
Ruddy Quail-Dove	*Geotrygon montana*	Birds	1
Rufous-tailed Hummingbird	*Amazilia tzacatl*	Birds	2
Scaly-throated Leaftosser	*Sclerurus guatemalensis*	Birds	2
Short-billed Pigeon	*Patagioenas nigrirostris*	Birds	1
slated color solitaire	*Myadestes unicolor*	Birds	4
Slaty Tail Trogon	*Trogon massena*	Birds	1
Slaty-breasted Tinamou	*Crypturellus boucardi*	Birds	1
Smoky-brown Woodpecker	*Veniliornis fumigatus*	Birds	1
Social Fly Catcher	*Myiozetetes similis*	Birds	2
Spot-breasted Wren	*Thryothorus maculipectus*	Birds	1
Squirrel Cukoo	*Piaya cayana*	Birds	1
Striped-tail Hummingbird	*Eupherusa eximia*	Birds	2
Sulpher-rumped Flycatcher	*Myiobius sulphureipygius*	Birds	1
Tawny-crowned Greenlet	*Hylophilus ochraceiceps*	Birds	1
Tawny-winged Woodcreeper	*Dendrocincla anabatina*	Birds	1
Thrushlike Schiffornis	*Schiffornis turdina*	Birds	1
Turkey Vulture	*Cathartes aura*	Birds	1
Violaceous Trogon	*Trogon violaceus*	Birds	2
Wedge-bill Woodcreeper	*Glyphorynchus spirurus*	Birds	1
White-bellied Emerald	*Amazilia candida*	Birds	1
White-bellied Wren	*Uropsila leucogastra*	Birds	2

White-breasted Woodwren	*Henicorhina leucosticta*	Birds	1
White-collared Seedeater	*Sporophila torqueola*	Birds	2
White-crowned Parrot	*Pionus senilis*	Birds	4
White-tipped Dove	*Leptotila verreauxi*	Birds	2
Blue-black Grassquit	*Volatinia jacarina*	Birds	2
Black howler Monkey	*Alouatta pigra pigra*	mammals	3
Deppe's Squirrel	*Sciurus deppei vivax*	mammals	2
Yucatan Squirrel	*Sciurus yucatanensis*	mammals	1
White-tail Deer	*Odocoileus virginianus truei*	mammals	1
Jaguar	*Panthera onca goldmani*	mammals	1
Ocelote	*Leopardus pardalis pardalis*	mammals	1
Coati	*Nasua narica*	mammals	4
Paca	*Agouti paca nelsoni*	mammals	1
Kinkajuo	*Potos flavus chiriquensis*	mammals	2
nine-band armadillo	*Dasypus novemcinctus mexicanus*	mammals	1
Viened Frog	*Phrynohyas venulosa*	amphibian	1
Red-eye treefrog	*Agalychnis callidryas*	amphibian	2
Sheep Frog	*Hypopachus variolosus*	amphibian	4
Leopard Frog	*Rana berlandieri*	amphibian	1
Vallient's Frog	*Rana vaillanti*	amphibian	1
Marine Toad	*Bufo marinus*	amphibian	2
Gulf Coast Toad	*Bufo valliceps*	amphibian	3
Blunt-headed Tree Snake	*Imantodes cenchoa*	Reptile	1
Mexican Vine Snake	*Oxybelis aeneus*	Reptile	1
Hog-nose Pit Viper	*Porthidium nasutum*	Reptile	3
Indigo Tail	*Drymarchon corais*	Reptile	1
Redback coffee-snake	*Ninia sebae*	Reptile	1
Norops	*Norops Capito*	Reptile	1
Smoothheaded Helmet basilisk	*Corytophanes cristatus*	Reptile	1
Wiptail	*Ameiva undulata*	Reptile	2

Annex 3: Cebada Cave Expedition 2012, Team members (FCD personnel)

Left to right: Lenny Gentle (cave specialist, Guide), Boris Arevalo (biologist) and Jose Sierra (Lead navigator)

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