Biodiversity Baseline Survey Of Amphibians, Reptiles, And The Arborean Species Haptanthus Hazlettii In The Location Of The Jilamito Hydroelectric Project

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Jilamito Hydroelectric Project

Baseline study of amphibians, reptiles and the arboreal species *Haptanthus hazlettii* in the site of the Jilamito Hydroelectric Project

FINAL REPORT

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Photos on the cover: The arboreal species, *Haptanthus hazlettii,* found in bloom. In the pictures we observe: *Plectrohyla chrysopleura* (Climbing frog), *Atlantihyla spinipollex* (Ceiba stream frog), *Duellmanohyla salvavida* (Honduran brook frog), *Pleistioson sumichrastri* (blue tail lizard), *Bothriechis guifarroi* (green Tamagas, palm viper).

1 Content

2. SUMMARY

This document summarizes the results of the activities carried out during twelve field days (ten effective days) from the 12th torugh the 23rd of October, 2018. The work was carried out for this Biodiversity Baseline survey in the site of the Jilamito Hydroelectric Project (Jilamito HP), which is located between the villages of Mezapita and Jilamito, in the municipality of Arizona, Atlántida Department, on the northern coast of Honduras. An ecological assessment was carried out on amphibians and reptiles present in the project area. According to previous studies, this is a highly endemic area. A joint study was carried out on the arboreal species *Haptanthus hazlettii,* which is a very rare kind of tree in the area and in the country in general. The project site is located in the buffer zone of the Texiguat Wildlife Reserve (abbreviated in this document as WLR), located in the northern portion of the Nombre de Dios Mountain Range.

Among the activities that were carried out to gather information about the amphibians and reptiles present in the Texiguat WLR, 10 transects with variable lengths of 50 to 150 m., in the different areas of the project (main water intake [2], secondary water intake [1], upstream from the secondary water intake [1], soil disposal areas [1], mountain camp/penstock [3], downstream from the powerhouse [2]) were carried out to access the sampling areas; in the sites considered as control, no transects were made, just sightings and opportunistic collection of species, which were also analyzed. An acoustic sampling was also carried out, as well as a sampling for the Chytridiomycosis analysis (detection of the *Batrachochytrium dendrobatidis* fungus). For the gathering of information on the tree species, *Haptanthus hazlettii,* random routes through the wooded areas between trails and surroundings were made throughout the project area; however, this species was not seen on this site. Only eight specimens were found on a site out of the project area close to the place where Los Olivitos Creek meets the Jilamito River.

Regarding the acoustic sampling, audio recorders (Audiomoth) were installed in areas of direct impact of the project, as well as in areas considered for control, such as: La Quebradona, Los Olivitos Creek, El Danto Cree (upstream from the secondary uptake) and in the Jilamito River (upstream from the main water intake) with the purpose of comparing the above mentioned areas with the areas of impact of the project, to gather all possible information, samples and/or document the presence and abundance of amphibians and reptiles that are classified in the categories of Endangered (EN), and Critically Endangered (CR) per UICN criteria as well as data on the project site area and zones out of the project area like control sites for the Jilamito Hydroelectric Project

3. INTRODUCTION

The municipality of Arizona is located on the Atlantic coast in the Nombre de Dios Mountain Range, in the Atlántida Department. The economic activities that take place in the area are related to forests, ecotourism, livestock, and agriculture, which are the main source of income, with production of basic grains, fruits, and vegetables in family gardens. For this reason, the Jilamito Hydroelectric Project would generate work opportunities and would create options for better economic conditions in the households of that area.

According to Environmental Resolution No. 1429-2013 issued by SERNA on December 4, 2013, the Project is within a minimal part of the buffer zone in the Texiguat Wildlife Reserve, declared as such by Decree No.87-87, and it belongs to the National System of Protected Areas of Honduras. According to the cartographic review carried out, the interconnection works (Lean Substation and transmission line), a portion of the access roads, 70% of the pressure pipe, and the powerhouse are outside of the buffer zone.

The ecosystem of the Texiguat WLR is an area with an ecosystemic component comprised by a pre-mountainous rainforest and a mountainous rainforest (Holdridge, 1967), and these represent one of the most important sites for biodiversity in terms of endemic species in Honduras and Central America. To be able to determine management strategies in these protected areas, it is necessary to know the species that inhabit these areas. In this case, references were obtained of the species that inhabit the site by studies that have been conducted previously; nonetheless, it must be taken into consideration that the different species of herpetofauna, mastofauna, and ichthyofauna, as well as other sets of organisms that are mobile, present a broad distribution pattern within the Texiguat WLR (however, it is of great importance to mention that such characteristics are not for all species, since some move about slowly) as well as within other sites or protected areas of the country.

There are few studies on the other taxa and their ecological characteristics in all the protected areas of Honduras. This work aims, first, to show results on the presence and distribution of herpetofauna species that inhabit the area; therefore, priority is placed on monitoring and studies during the rainy and dry seasons. At the same time, steps can be established for the development of future studies related to natural history, protection programs, and management of species of ecological importance. In the area, there are species of amphibians and reptiles considered in the Red List of the International Union for Conservation of Nature (IUCN), as well as a diversity of bird species, among others of importance for the conservation of biodiversity.

4. BACKGROUND

The existing information on the biodiversity of the Jilamito River sub-basin has been documented by AMBITEC S.A. de C.V. since 2009; however, it is always necessary to develop detailed studies on existing species and flora and fauna communities and their connectivity with the protected area (Texiguat WLR), and that is where the company INGELSA, owner of the Jilamito Hydroelectric Project, as part of its environmental commitment, carried out a bibliographic and field study (ichthyofauna and macro-invertebrate inventory of the Area of Influence of the Jilamito Hydroelectric Project, 2017) performed by AMBITEC to determine the presence and distribution of the ichthyological fauna in the waters of the Jilamito River, in the Nombre de Dios Mountain Range. This study reflects the freshwater species that inhabit the Jilamito River and Los Olivos creek. Such monitoring of the aquatic fauna was done in the areas that will be impacted by the hydroelectric project, for construction and operation activities, including the powerhouse. This study shall reflect species that live in the area of influence of the hydroelectric project, in order to disclose scientific and technical information of said aquatic species.

On the other hand, we can mention other studies such as the Forest Management Plan of the Jilamito River Basin, carried out by the INGELSA technicians, the Environmental Management Plan, and the Qualitative Environmental Diagnosis of the Jilamito Hydroelectric Project elaborated by AMBITEC in 2009, among other studies carried out in the area by foreign and Honduran scientists who have made known part of the biological diversity in the surroundings of the Texiguat Wildlife Reserve, emphasizing that the weather conditions of the site are characterized by a very rainy tropical climate, with abundant rains throughout the year, with March to May as the least rainy months. Knowing the above, the need to perform this kind of studies along different times of the year becomes clear.

5. OBJECTIVES

5.1. General

To develop the baseline study of amphibians and reptiles and to determine the distribution and abundance of the species *Haptanthus hazlettii,* in the site of the Jilamito Hydroelectric Project, specifically in the area between the powerhouse and water intakes sites, considering the potential impacts of the project and the definition of the corresponding mitigation measures.

5.2, Specific

- To compile and interpret information to establish the baseline of amphibians and reptiles, focused on endangered species, as well as for the plant species *Haptanthus hazlettii* in the project site, through bibliographic review and integration of existing studies and identification of current threats to these species.

- To carry out a field study of the populations of amphibians and reptiles in the footprint of the project in the area between the powerhouse and the water intakes and the stretch of the Jilamito River bypass, using different sampling methods, including sampling transects, acoustic monitoring, and disease monitoring.

- To determine the distribution and abundance of the species *Haptanthus hazlettii* in the footprint of the project between the powerhouse and the water intakes.

- To identify and map the critical habitat areas for each of the species in the area of influence and superimpose them with the footprint of the project.

- To identify the potential impacts on the biodiversity during the different stages of the project.

- To propose the necessary measures to avoid, minimize or control the risks and direct impacts of the project on the species of amphibians and reptiles found.

- To propose recommendations and actions to be considered in the Biodiversity Action Plan and its long-term monitoring program.

6. LOCATION OF THE PROJECT AND AREA OF STUDY

The municipality of Arizona is located in the central zone of the Department of Atlántida on the northern coast of Honduras between the coastal plains of the Caribbean Sea and the foothills of the Nombre de Dios mountain range. It is divided into three environments: a narrow strip of beach, low and flat lands including wetlands, and highlands including slopes, hills and mountainous areas. Its limits are the following:

To the North: with the Caribbean Sea of the Antilles

To the South: with the municipality of Yoro, Department of Yoro.

To the East: with the municipality of Esparta

To the West: with the municipality of Tela.

Geographically, the municipality is located in the coordinates 15°14' north and 87°17' west. The municipal capital is the urban area of Arizona, located at an elevation of 42 meters above sea level.

The Municipality of Arizona, as it is located in the coastal plain of the Atlantic, has a varied topography, ranging from landscapes with gentle slopes, hills with slopes of between 15° and 65°, mountain ranges with medium and high levels, reaching elevations of more than 2,000 meters above sea level.

In general, three types of landscapes can be distinguished:

Alluvial landscape: it occupies the lowest part of the flat or gently rolling terrains where most of the human settlements and towns that practice different agricultural and livestock activities are located.

Hill landscape: Typical in the middle part of the municipality, with slopes of 30 and 60% and a broad-leaved forest rich in diversity of native species in the forest.

Mountain landscape: Located in the upper part, very far south from the municipality on sloping and hilly slopes greater than 70%, suitable for absolute forest protection and conservation of biodiversity. (**See Annex 3. Map N0PHJ-LBB-0**)

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Taking as a point of reference the city of Tegucigalpa, the most viable route to access the study area would be taking the CA-5 road that leads from Tegucigalpa to the north until reaching the Municipality of Arizona in the Atlántida Department, and following the 15-kilometer detour in the village of Lean, through the Lean Nuevo Hilamo road, that goes to the community of Mezapita, 359 km away, which takes approximately 7 hours 20 minutes with flowing traffic. The Jilamito Hydroelectric Project will, for the most part, take advantage of and be located on the banks of the Jilamito River, with its main headwaters beginning in the Nombre de Dios Mountain Range, with the community of Mezapita, 7.20 km NW of the mountain camp in a straight line as the midpoint of the project, and the closest part to said community would be the powerhouse, at 5.20 km. (See Annex 3. Map No. PHJ-LBB-0).

7. SUMMARY DESCRIPTION OF THE PROJECT

The project consists of the construction and execution of the necessary works to put into operation a power plant with a total installed power of 14.81 MW and an average generation of 84.9 GWh/year.

It is comprised by two works of gravity-fed water supply systems at run-of-the-river on the riverbed; the second work will be connected to the main weir through a concrete pipe, 30 inches in diameter and 220 meters long. It will have a sand trap that will be located next to the main water intake, a 1,220-meter-long pipe (Glass Reinforced Plastic-GRP), divided into two sections separated by a tunnel for open-channel flow for 218-meter-long conduction, and a surge tank installed at the end of the pipeline with 108 meters of pipe length (GRP), to mitigate the overpressure in the pressure pipe (GRP and Steel), which has a total length of 2.381 meters. The powerhouse will hold the generation equipment consisting of two horizontal Pelton turbines of 7.405 KW of installed nominal power. It will also hold the generators, the electromechanical control equipment and other auxiliary components that together convert hydraulic energy into electrical energy; the outlet of the turbinated water discharge will be made on the Los Olivitos creek, which is a tributary of the Jilamito River.

The interconnection works are made up of two substations (booster and switching - Lean), one adjacent to the Jilamito powerhouse, to raise the power from 13.8 kV to 34.5 kV, and the Lean Substation 34.5KV/138KV, to incorporate the power to the national transmission network at a point of opening of the circuit with a voltage of 138 kV. Both substations will be connected by means of a new transmission line of 34.5 KV and 10.6 km in length.

As for the access roads, there will be four segments: A) 7.5 km off road from the Mabey Johnson Bridge over the Mezapita river in the community of Mezapita to the Jilamito Project Powerhouse; B) a 1.1 km mountain road from such powerhouse to the pressure pipe station 1+880; C) a 1.106 km conduction pipe road starting from the pressure pipe station 0.00 up to the desander; and D) a 4.3 km road improvement where the transmission line will be located (Nance - New Jilamito). The conduction pipe road and the tunnel are part of the access to the area of the water intakes.

The Project will have a cable car, a transportation system that will be installed between the power house and the start of the pressure pipeline. This work will be built to accelerate the construction of structures and pressure pipes in the upper part of the mountain and to reduce environmental impacts. The cable car will transport materials and equipment for the construction of the conduction line, surge tank, tunnel, desander, interconnection pipe, weirs, and upper part of the pressure pipe. It will have a maximum capacity of 10 tons of cargo and an approximate length of 1.9 km.

Following is the order of the project structures, from the upper mountain to the Lean substation:

- Secondary water intake.
- Interconnection line, Secondary - Primary water intake.
- Primary water intake
- Desander
- Pipeline Desander - Tunnel

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- Conveyor tunnel
- Load chamber
- Pipeline
- Surge tank
- Penstock
- Powerhouse
- Booster substation 13.8 kV / 34.5 kV
- Transmission Line 34.5 kV
- Lean Switching Substation 34.5KV / 138KV

As an associated work, a mountain camp will be built, with the purpose of housing and providing basic needs to administrative and operational staff, which will be approximately 70 people in the peak months of construction. During the rest of the months, the staff will vary between 25 to 35 people. This camp will have the following areas: bedrooms for Administrative staff, bedrooms for Operating staff, and kitchen/dining room.

8. MATERIALS AND METHODOLOGY

8.1. Equipment and Materials

Registration for flora	□ Pruning shears
	□ Botanical Press
	□ Newspapers
	□ Binoculars 10X45
Capture of species (Herpetofauna)	□ Herpetological hooks
	□ Rakes
	□ Fabric bags and/or blanket
	□ Plastic bags
For Registration of species	□ Plastic swabs
	□ 70% Alcohol
	□ Maps
	□ GPS Garmin Etrex 20
	□ BirdsEye Satellite Image
	□ Photo cameras
	□ Led lenser headlamps (head and handheld)
	□ Field notebook
	□ Plastic containers
	□ Plastic vials
	□ Dissection equipment
	□ Field Guides/Taxonomic Keys
For Registration of species	□ Labels
	□ Graphite pencils
	□ Vernier caliper
	□ Rubber boots
	□ Latex gloves
	□ Pocket knife
	□ AA and AAA batteries

8.2. Methodology

Methodology for Flora

In the bibliographic part, we went to the literature in search of all the information that would allow us to evaluate the diversity, wealth, and distribution of *Hapthantus hazlettii:* C. Nelson (1992; 2008), that refer to the location of the holotype; on the other hand, A. Oskolki *et al.* (2015) describe the

morphology and influorescence of *H. hazlettii*, and A. Shipunov & A. Oskolski (2011), who describe a small population in the surroundings of the Matarras River, close to the Juan Jose farm in the department of Atlantida, among other visited sites, as is the collection www.tropicos.org, as well as the samples of the herbarium UNAH-TEFH (Tegucigalpa Flora from Honduras) which were reviewed.

In the field phase, random trips were made to the forest areas between trails and around the delimited area of the hydroelectric project, with two samplers at each site. A comprehensive search was performed along the project area, as well as in the placement of the AudioMoth and in the riverine areas where it is intended to build structures over the river (primary and secondary water intakes). The area in which this species is searched is approximately 11.3 km, covering all the places where the project will be located.

In the place where the population of the arboreal species of *H. hazlettii* was registered, species of trees, shrubs, grasses, and epiphytes were recorded to observe the fidelity, development, and interaction of the tree with other species within its range of action. During the information gathering process, an inventory was prepared on flowers found by means of collecting non-sterile botanical samples (with flower or fruit parts), including photographic material. Nevertheless, most plants were identified on the field and tree and shrub species were identified by their common name with the help of local guides, and the tree species were identified to the lowest possible taxon, to later obtain the scientific name and family, through existing listings of the flora of Honduras. With all the information collected, processed, and analyzed, the floristic composition of the whole area was calculated according to habits and species, and those that could not be identified in the field were photographed, in the form of flowers or fruits, and in some cases collected for later identification in the reference collection of the Herbarium of UNAH - TEFH (Tegucigalpa Flora of Honduras) or in the Herbarium of El Zamorano.

In each fortuitous search, all existing species were recorded. It shall be noted that on the site were the only population registered was found close to the project with 9 individuals, a 100-meter long transept was done, with an average width of 20 m (observing 10 m on each side of the same transect) obtaining negative results in the search for more individuals of the tree *H. hazlettii.*

Methodology for Herpetofauna

For the diagnosis of amphibians and reptiles, the methodology was divided into two stages: a) Bibliographic review (before and after fieldwork) and b) field work.

In the revision of secondary sources: Prior to the fieldwork and as part of the clerical work, an exhaustive review was made to different bibliographical sources on the distribution of amphibians and reptiles in the Atlántida Department, Honduras. For this purpose, the following sources were used: Köhler (2009/[Reptiles from Central America]), (2011/[Amphibians from Central America]); McCranie, (2011/[Snakes of Honduras]),; 2018 /[Lizards, Crocodiles, and Turtles of Honduras]); McCranie & Smith, (2017)/[A revision to the group of species *Tantilla taeniata* in Honduras, with the description of three new species/); McCranie and Castañeda, (2007)/[Guide of Honduran Amphibians]; McCranie and Köhler, (2015/The Anolis of Honduras, Systematic Distribution and

Conservation]); Solís and O'Reilly (Distribution of the Amphibians in Honduras [Under preparation]); Townsend and Wilson, (2010/Conservation of the Herpetofauna of Honduras, Problems and Imperatives); Townsend *et al.* (2012/[A pre-mountainous forest of endemic herpetofauna upstream of the Texiguat Wildlife Refuge, Honduras]). This allowed elaborating a theoretical list of the potential species present in the study area. The list of species of likely occurrence served as an observation guide for fieldwork.

In the fieldwork: Sampling was done in the rainy season (winter), applying a comprehensive effort that was divided into the following actions: installation of @Audiomoths, during the trips in which this equipment was installed, random and/or opportunistic searches were performed. However, such methodology was also applied during the trips to the transects, applicable when the observed individuals were out of the established parameters. The transects (10) were approximately 50 to 150 meters long, with a width of two meters towards each riverbed and a height of two meters, based on the methodology proposed by Crump and Scott (1994). It must be noted that within the transects, different species of amphibians were randomly collected to take skin samples to determine the presence of absence by means of a swabbing or non-lethal technique to detect the chytrid fundus in the different species of anurans.

The transects were estimated during the afternoon (between 14:00 and 16:00, determining the area and marking the beginning and ending of the transect with a marking tape. Later, the trips were made at night (between 20:00 and 23:00) to cover the different activity patterns of amphibians and reptiles. The effort consisted of (4 persons x 3 hours of effort) 12 man/hours, for a total of 120 man/hours among the 10 transects performed, and for random sampling the effort (8 persons x 4 hours, [four persons per group], is estimated in 32 man/hours, for a total of 320 man/hours, in every area.

In the trips made, microhabitats were reviewed in which potentially these organisms could be found, and these were classified according to use, with the following categories: T – Terrestrial, F – Forest inhabitants, P – border of ponds, A – Arboreal, and S – inhabitant of rivers and creeks, pursuant to the works done by Wilson and McCranie (2004) and Wilson and Townsend (2207).

Acoustic Study

To increase the detection of anurans (toads and frogs), we used the methodology proposed by Hilje and Aide (2012), which is specific for species that are hard to observe (Ex. Arboreal or Cryptic). 34 automated recorders were used, developed by the research group **Automated Remote Biodiversity Monitoring Network (ARBIMON, https://arbimon.sieve-analytics.com),** which were placed in 34 sampling points covering the area of the project and in control sites. These were programmed to record 1 minute of sound at 10-minute intervals, during 24:00 hours, with a total of 12 (placed outside the area of the project area) at 13 days (upstream control sites) of permanence in the field (total time variation in the field was influenced by logistics and characteristics of the study area for 14 days. The recordings are analyzed using the **ARBIMON II,** which allows users to view and listen to recordings.

Study of the ***Batracochytrium dendrobatitis*** (Bd)

For this study, mainly non-lethal cleaning techniques were used for all amphibians (individuals) found on the different sampling sites, including those found in transects and opportunistic catches.

Each individual was cleaned by means of a swab for obtaining **Bd**, using the protocols recommended, established, and designed by experts at the Smithsonian Institution, by which the swab was rubbed 70 times on the amphibian, except that the swabs were placed and maintained in vials without 70% ethanol solution (dry medium). The extraction of DNA from the fungus in the laboratory will be done by means of the methodology used by Coutinho et al. (2015). The samples were transported and stored in the Center for Genetic Research of the Microbiology Research Institute of the National Autonomous University of Honduras (UNAH), where the analysis will be carried out.

Taxonomic Determination, Phylogenetic Ordering, and Conservation Status

The taxonomic determination of the species was carried out by using the keys and descriptions proposed by: McCranie. (2011; 2018); McCranie and Castañeda (2007); McCranie and Köhler, (2015); Köhler (2009 and 2011). In general terms, the taxonomic classification suggested by McCranie (2015) was followed; however, all taxonomic changes proposed after this list were taken into account (ex: Faivovich et al., 2018, for the Hylidae family; Luque-Montes et al., 2018, for Ranids; McCranie, 2017; 2018, for the *Tantilla taeniata* species; 2018 a,b for the group of *Craugastor laticeps* species and the different lizards that were found; Townsend, 2016, for salamander species, *Nototriton* genus). To determine the conservation status of the species, the following data bases were consulted: the IUCN Red List, CITES, and the works proposed by: Johnson et al., (2015); Mejía and House (2008).

9. VEGETATION COVERAGE AND LIFE AREA PRESENT IN THE VISITED SITES

In Honduras, there are different life zones, but this area where the Jilamito Hydroelectric Project is located corresponds to the Premountainous Rainforest (bh-S), (LR Holdridge, 1967). This area is characterized as it is found from sea level up to small elevations (600 meters), with remnants of undisturbed broadleaf forests. The vegetation it contains is classified as evergreen or sub-perennial, with large individuals and a high floristic and faunal diversity. The vegetation covering observed and conserved has well developed trees representing primary forests, consisting of tall trees easily exceeding 30 - 40 meters tall. One of the characteristics of these forests is the presence of epiphytic plants, with trees almost entirely covered by bromeliads, orchids, araceae, ferns, and mosses, where the lianas and vines reach a remarkable development, sometimes interlacing the dominant treetops and other times descending to the floor.

9.1. Broadleaf Forest

In this case, several types of broadleaf forests can be present, such as deciduous forests, which are characterized by the fact that most of their trees lose their leaves simultaneously in the dry season of each year, while others are broadleaf evergreen forests where the cover or canopy reaches up to 40 and 50 m. These are observed as dense and closed forests. Their differences are mainly in the drainage system and the type of soil; and the other type of forest would be the evergreen mountainous broadleaf forest, which is a dense forest, with rainfall between 2000 and 4000 mm in average annually.

Generally in these forests there are trees of the ficus genus, and in the low areas, frequently appear species such as Ceiba (*Ceiba pentandra*), Cedar (*Cedrela odorata*), Ice Cream Bean (*Inga sp.*), Mahogany (*Swietenia macrophylla*), Glassywood (*Astronium graveolens*), West Indian Locust (*Hymenae courbaril*), White Frangipani (*Plumeria alba*), Bitter Angelim (*Vatairea lundellii*), Yellow Ipê (*Tabebuia chrysantha*), Mountain Copal (*Tetragastris panamensis*), *Dendropanax arboreus*, etc…

9.2. Gallery Forest or Riparian Forest

It refers to the coverage comprised by arboreal vegetation located in the margins of permanent or temporary watercourses. Its amplitude limits this type of coverage, since it borders only the watercourses and natural drainages. When the presence of these strips of forests occurs in savanna regions, it is known as gallery forest or ravines.

The plant species that are normally found in this type of forest are: *Annona sp*., *Aspidosperma sp*., *Brosimum sp*., *Spondias mombin*, *Bursera simaouba*, *Cecropia peltata*, *Ceiba pentandra*, *Enterolobium cyclocarpum*, *Hymenaea courbaril*, *Jacaranda copaia*, *Lecythis sp*., *Pachira quinata*, *Schefflera sp., Terminalia amazonia*, *Inga vera*, *Mangifera indica*, among others.

9.3. Bushes and Pastures

In these areas, the most representative species are shrubby. The vegetation is not more than 5 meters high, considered as a type of forest in natural regeneration or recovery. Generally, this vegetation community is characterized by a secondary vegetation type, which develops after stripping a forest of its vegetation cover, which may be broadleaf, mixed or coniferous. Usually, original forest species that were not cut are observed, appearing in small stands or isolated individuals. This type of cover is also observed in plots that have had crops, later were grazing areas, and which were finally abandoned, growing a high thicket over time.

10. DESCRIPTION OF THE STUDY AREA

The project is travelled lengthwise, following the direction through which the pipeline that channeled the water and along the banks of the rivers will pass. The vegetation in the area of the water intakes have been intervened for different land uses such as dwellings, roads, pastures, and crops, among others; but on such sites, small remnants of broadleaf and seasonal gallery forests are seen, from which data were obtained on the vegetation that is still scattered in the area. It should be noted that in the area where the mountain camp and the cable car will be built, there are areas with primary forest with little deterioration due to mudslides or anthropogenic use.

10.1. Sites of Main And Secondary Water Intake Works

The water intake sites were characterized, and transects were made for flora and fauna on both sides of the Jilamito River, where the main water intake will be built at the geographic coordinates of 15°31'52.3" N; 87°17'49.7"W, at 990 m. of elevation, and in the El Danto stream where the secondary water intake will be located with coordinates 15°31'53.8" N; 87°17'35.5"W, at 1026 m. of elevation.

It was observed that the vegetation in this area is well degraded in the right margin of the main water intake, until it reaches the secondary water intake, since they communicate with each other by means of 250 m. of linear pasture where there is vegetation cover that has previously been degraded to pasture. Once the secondary water intake was reached in the other margin, it was found without any vegetation, as they used the land for crops and cattle grazing, leaving only a small strip of approximately 15 and 25 m. of riparian forests in some places.

Picture 1. Site of main water intake.

Picture 2. Beginning of transect in the upper part of the main water intake.

Picture 3. Overview of the vegetation present in the site of the main water intake.

Picture 4. Beginning of the works for the minor and/or secondary water intake.

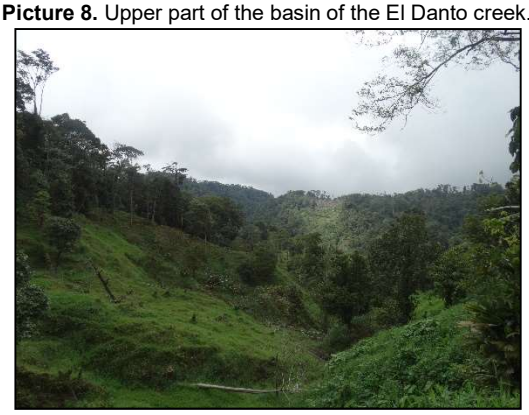
Picture 5. Minor and/or secondary water intake.

Picture 6. Panoramic view of the vegetation present in the site of minor and/or secondary water intake.

According to observations made in the field, in the sectors where the water intakes will be built, it can be observed that the pastures (paddocks) predominate on the upper part of the mountain and in the core area of the Texiguat Wildlife Refuge. These areas are used for grazing, with prevalence of pasture species such as: *Arundinella deppeana*, *Brachiaria decumbens*, *Eleusine sp.*, and *Panicum maximum*, among others. On the other hand, the new clearings in the upper part of the mountain are for various crops such as basic grains and other perennials such as coffee, and in the lower part of the mountain, there are pastures with other crops such as Lichas and/or Rambutan and Cocoa. It is worth noting that once these crops reach their peak, they will be abandoned and then converted into shrubs to continue the regeneration cycle of the native forest by means of natural successions corresponding to this type of neo-tropical forest.

Picture 7. Panoramic view of the camp at the La Liberación site.

Picture 8. Upper part of the basin of the El Danto creek.



Picture 9. Site above El Danto creek.

Picture 10. Panoramic where the degradation of the forest can be seen by leaps and bounds in La Liberación site.

10.2. Sites for soil disposal areas, mountain camp, cable car line, and pipeline

With respect to these sites, the vegetation pertains to broadleaf forest at all sites of what will be the hydroelectric project. The places characterized in this area were where the location of the bases of the cable car and the mountain camp are expected to be, beginning at coordinates 15°53'76.3"N; 87°30'50.7"W, at 978 m. of elevation. These coordinates correspond to the landfill passing through where the tower 5 of the cable car tower will be located, through the mountain camp with the geographic coordinates 15°54'06.8"N; 87°30'93.5"W, at 823 m. of elevation, following the line of the cable car that goes almost parallel to the pressure pipeline, with primary forest and in very few sides degraded by the anthropic use (crops) and an evidence of an old landslide in the left margin going down from the mountain camp .

11. RESULTS OF FLORA

11.1. *Haptanthus hazlettii* and abundance of species by habits

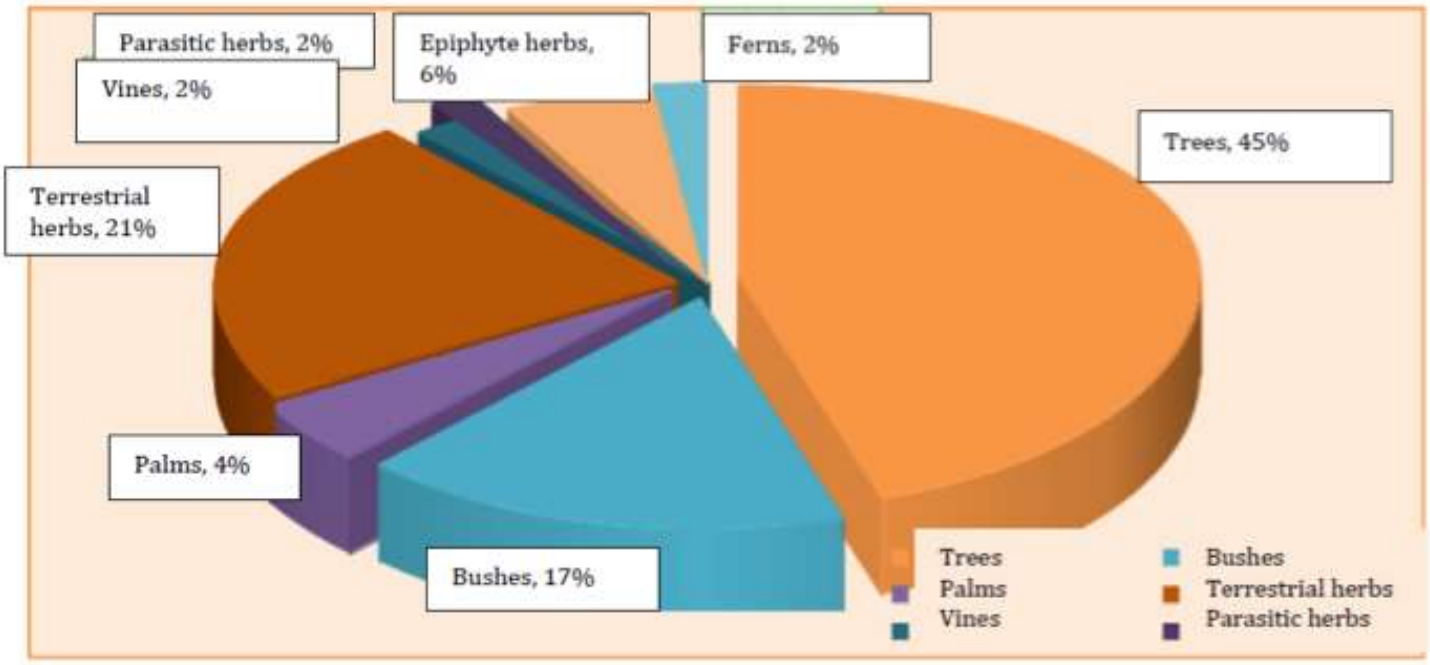
Regarding the comprehensive search of the arboreal species *Haptanthus hazlettii,* results were unsuccessful in the high lands of the project (cable car, mountain camp, soil disposal areas and water intakes, leading to the conclusion that, given the altitude above sea level where this species has been recorded, has not been found in such sites. Only a small population with 8 individuals was found in the lower part of the mountain at the same altitude as the power house at 330 meters above sea level. (See Annex 3, Map No. PHJ-LBB-11. The species *H. hazlettii* was recorded 30 meters upstream of the junction of the Los Olivitos Creek and the Jilamito river, NE from the power house and from the valves in a straight line with geographic coordinates 15º34'14.5" N; 87º18'46.1" W, since these works will be carried out at 348 meters high, close to Los Olivos creek, so it is stated that it is not close to the project area. However, constant monitoring will be required, and it must be mentioned that no other plant can be associated with *H. hazlettii* because it is not a significant population, and thus, it cannot be compared (for example the nearby population) since in the surroundings only plants of the Araceae family were observed on rocks (See Annex 3. Map No. PHJLBB-12).

For the flora of the Texiguat WLR, the first record of an orchid was documented (*Pleurothallis correllii*), which was observed in the vicinity of the main water intake on the way to the mountain camp, a species that has already been registered within the limits of the Cerro Azul Meambar National Park, (Wiese, 2015); however, this species is found in the area between El Salvador and Mexico, (Trópicos, 2018). The arboreal species (Haptanthus *hazlettii)* was found downstream of Jilamito, not near the project site at 840 m. NE of the powerhouse and the straightline outlet, with geographic coordinates 15°34'14.5"N; 87°18'46.1"W, at 348 m of elevation, since these works will be done in the vicinity of the Los Olivos creek. However, constant monitoring will be required. On the other hand, it can be mentioned that the most representative families were Fabaceae, with 19 species representing 10.5% of the flora found, followed by Araceae, with 9 species representing 5%, and the other most representative families are Orchidaceae and Arecaceae or Palmae, with 8 species each, representing 4.4% of all the flora found, respectively.

It is noted that the most abundant species in what will be the site of the Jilamito Hydroelectric Project are plants with arboreal habits, which are found mostly between the main water intake passing through the mountain camp, the cable car, and pipeline down to the powerhouse. According to the habits of the plants registered within the areas of the Jilamito Hydroelectric Project, it can be observed that in these areas they are mostly represented by tree species taller than 30 m. and with a deciduous crown, with 83 species, which represent 45% of this habit. The trees taller than 15 and 20 meters are; Hormigo *(Platymiscium dimorphandrum),* Areno *(Ilex tectonica),* Jobo *(Spondias mombin),* Naked Indian *(Bursera simaruba),* Guama *(Inga vera),* Varillo *(Symphonia globulifera),* Crotes *(Tabebuia chrysantha),* Zorra *(Schizolobium parahyba),* Querosén *(Tetragastris*

panamensi), (Dendropanax arboreus), Mountain plum *(Astronium graveolens), Santa Maria (Calophyllum brasiliense),* Ceiba *(Ceiba pentandra),* Malcota *(Quercus insignis),* and Guanacaste *(Enterolobium cyclocarpum),* among others.

For significant coverage, it is worth mentioning that if we combine the shrub and herbaceous habits (vines, epiphytes, ferns, parasites, and grasses), they represent a greater value of abundance of 55%, for a total of 99 species. (See general plant list in Annex 1, Table No. 1). This should be highlighted because it is very important that this type of plant coverage be preserved because it serves as a refuge for wildlife against predators, for feeding, and for protection from insolation, taking into account that temperature plays a very important role for most animal species (reptiles, amphibians, birds, insects, and rodents).



Graph 1 . Predominant habits in the flora found at the project site.

12. RESULTS OF FAUNA

12.1. Results of the Field Study

Currently in Honduras, a Herpetofauna of 416 species (including the 8 introduced species) is recognized, which has increased by recent descriptions of new species, additions, and/or records and different taxonomic changes (Solís, et al., 2014; Solís et al., 2016; Solís & O'Reilly [Under preparation]; McCranie, 2015; 2017a, b; 2018; Townsend et al., 2015).

According to the bibliography used, in the Atlántida Department 99 species can be found, (According to: Köhler, et al., 2016; McCranie and Wilson 2002; McCranie & Castañeda, 2007; McCranie, 2011, 2017, 2018; McCranie & Solis, 2014; Solis et al., 2017; Townsend et al., 2010; Townsend et al., 2012;), which represent 23.7% of all known species in the country. This list is a tool that helps the researcher as an observation guide for fieldwork (See Annex 2, Table 2).

There is a considerable amount of data regarding the component of species of amphibians and reptiles in the study area, but these are largely dispersed in different publications; McCranie and Wilson (2002) record *Bolitoglossa porrasorum* in Cerro San Francisco, south of La Liberación, in the core area of the Texiguat Wildlife Refuge. This data confirmed by McCranie and Castañeda (2007), in the same location *Duellmanohyla salvavida* was found. McCranie (2011) registers *Drymobius margaritiferus.* This information gap for the locality is contrasted with the studies that were carried out for the south zone of the refuge, where a considerable amount of species is documented, including descriptions of endemic species (ex. *Itsmohyla insolita*, *Geophis damian i*and *Omoadiphas texiguatensis*). It is until 2010 that an expedition was carried out by J. Townsend accompanied by a large team, which showed the richness of species in the area of influence of the project. In that study several endemic species were documented, resulting in a series of works that were published in the following years: Townsend et. Al. (2010) was the first of these publications, it describes some notes about *Geophis damiani,* found in La Liberacion. The second publication was about the discovery of a new population of the critically endangered frog: *Plectrohyla chrysopleura* (Townsend et al., 2011). In 2012, Townsend et. al. presented the complete list of species (47; in this study species are mentioned that are described in this research paper that include *Atlantihyla spinipollex*) of amphibians and reptiles that were found in the inventories of the 2010 expeditions. Due to the high level of endemism found in this study, it is concluded that this part of the Texiguat Wildlife Refuge can be called a "hotspot" of endemism. This conclusion continued to be reinforced, since, from 2013, the description of several new species comes to light. Based on samples collected in La Liberacion and its surroundings, a new species of snake is described (*Bothriechis guifarroi*) (Townsend et al., 2013b). Townsend et. Al. (2013a) describe another snake (*Tantilla olympia*) from the same location mentioned above. In 2016, a new species of salamander is described (*Nototriton nelsoni*), located in Cerro El Chino (Townsend, 2016). Recently McCranie (2018) describes a new species of anuro (*Craugastor gutschei*) for the locality of La Liberacion, thus completing one of the most

significant sequences of contributions in terms of description of endemic fauna for Honduras and the Nombre de Dios Mountain Range. Because of this, Townsend et. Al. in 2013 concluded that the area is part of the most important regions for endemism of the herpetofauna of Central America, and that substantial protection should be considered as a central piece in the efforts of conservation of the biodiversity of Honduras.

As part of the necessary diligences to fill the necessary requirements for the accreditation that derives from the construction, the Jilamito hydroelectric project has devoted effort to document the diversity present in the microbasin. In 2015, Matamoros presented a list of 42 species in the area of direct influence of the project, based on observations and collections made in the microbasin, in which he highlighted the importance of endemic species categorized by the IUCN. Subsequently, Enviromental Resources Management (ERM) lists 16 of the species of interest for the area in 2016, and finally Golder Associates in 2017, list 15 of the species of concern for the Jilamito micro-basin.

In comparative Table No. 1, theoretical results are mentioned, taken from previously mentioned studies with the findings of the present baseline biodiversity study for species of reptiles and amphibians, specifically.

Jilamito Hydroelectric Project

Comparative Table Nº1 – Comparison between ERM studies; Golder and LBB - PHLJ

Item	Comparison between ERM studies; Golder and LBB – PHLJ						
	Species	UICN Category	Geographical distribution	Year			
				2016	2017	2018	2018
				ERM Report	ESDD Golder Report	Baseline study	Preliminary Audio study
	Plants						
1	*Haptantus hazletii*	NE		**X**	**X**	**X**	
	Amphibians						
	Caudata						
2	*Bolitoglossa cf porrasorum*	CR	Endemic (Broad/Honduras)	**X**	**X**		
3	*Nototriton sp.*	CR	Texiguat WLR	**X**	**X**		
	Anura						
4	*Incilius leucomyos*	EN	Endemic (Broad/Honduras)	**X**	**X**	**X**	**X**
5	*Hyalinobatrachium fleischmanni*	LC	Centro América			**X**	**X**
6	*Teratohyla pulverata*	LC	Centro América			**X**	**X**
7	*Duellmanohyla salvavida*	CR	Nombre de Dios Moun. Range	**X**	**X**	**X**	**X**
8	*Atlantihyla aff spinipollex*	EN	Nombre de Dios Moun. Range	**X**	**X**	**X**	**X**
9	*Craugastor aurilegulus*	EN	Endemic (Broad/Honduras)	**X**	**X**	**X**	
10	*Plectrohyla chrysopleura*	CR	Nombre de Dios Moun. Range	**X**	**X**	**X**	
	Reptilia						
	Sauria						
11	*Norops kreutzi*	CR	Endemic (Broad/Honduras)	**X**	**X**		
12	*Norops loveridgei*	EN	Nombre de Dios Moun. Range	**X**	**X**	**X**	
13	*Norops yoroensis*	EN	Endemic (Broad/Honduras)	**X**	**X**	**X**	
14	*Norops zeus*	LC	Endemic (Broad/Honduras)	**X**	**X**	**X**	

	Ophidia						
15	*Geophis damiani*	CR	Texiguat WLR	**X**	**X**		
16	*Ninia pavimentata*	LC		**X**	**X**		
17	*Tantilla excelsa*	EN	Endemic (Broad/Honduras)			**X**	
18	*Tantilla olympia*	CR	Texiguat WLR	**X**	**X**		
19	*Bothriechis guifarroi*	CR	Nombre de Dios Moun. Range	**X**	**X**	**X**	

12.2. Results of the field phase

A total effort of 440 man-hours was performed for all the sampling, distributed among six areas of importance of the project and four control areas. The transects were carried out only in the sites of direct influence between the following areas: Main (2) and secondary (2) water intakes; soil disposal areas (1); mountain camp and pipeline (3), and powerhouse (2 [downstream]). Within the control sites: Los Olivitos creek, La Quebradona, La Quebrada, El Danto, and upstream of the intakes of the Jilamito River, random and/or opportunistic searches were carried out, due to the time and distance of these areas for sampling.

The effort invested was of (4 people x 3 hours of effort) 12 man/hours, for a total of 120 man/hours between the 10 transects carried out and for the random sampling, an effort of (8 people x 4 hours., [four persons per group]) 32 man/hours, for a total of 320 man/hours, per control site.

With an effort of 78 man-hours (day), for a total of 780 man-hours for all the samplers distributed among six areas of importance of the project and four areas of indirect influence. The fieldwork was developed during the rainy season (winter), where a specific richness (S) of 42 species (14 amphibians and 27 reptiles), belonging to 2 orders, 19 families, and 32 genera (Annex 2, Table 3), was documented. These represent 42.2% of the known species for the Atlántida Department and 9.7% of the known species for the whole country.

The 14 species of anurans belong to five families: Bufonidae (2 genera, 2 species), Centrolenidae (2 genera, 2 species), Craugastoridae (1 genus, 4 species), Hylidae (4 genera and 4 species), and Leptodactylidae (1 genus, 1 species). Among the caudates, we find only one genus and one species belonging to the Plethodontidae family. Among the lizards, 13 species of nine families were recorded: Corytophanidae (2 genera, 2 species), Dactyloidae (1 genus and 5 species), Mabuyidae (1 genus, 1 species), Phyllodactylidae (1 genus, 1 species), Scincidae (1 genus, 1 species), Sphaenomorphidae (1 genus and 1 species), Sphaerodactylidae (1 genus and 1 species), Teiidae (1 genus and 1 species), and Xanthusidae (1 genus, 1 species). As for the snakes, four families were registered, represented by: Colubridae (5 genera and 5 species), Dipsadidae (5 genera and 5 species), Elapidae (1 genus and 1 species), and Viperidae (3 genera and 3 species).

The best-represented families among the anurans were Craugastoridae and Hylidae, both with five species respectively. In the case of reptiles, the most represented were Colubridae and Dipsadidae with five species for both families. The majority of the species live in the forest (78.5%), arboreal (54.7%) and terrestrial (45.2%), and less species were seen of those that inhabit the riverbanks (28.5%) and ponds (11.9%) (See Annex 2, Table 3). Regarding the distribution of the species at a general level, it was observed that 64.2% are distributed outside the core of Central America (WS), 11.9% is distributed in the Central American core (between the countries of Guatemala, Belize, El Salvador, and the north of

Nicaragua [NCA]), but the fact that 23.8% of endemic species was recorded in the project site, it must be highlighted that these species that were registered in that area are also distributed in other sites or areas outside the project; therefore, it is confirmed that they have a considerably wide distribution and/or a restricted distribution in the Atlantic part of the country. **(See Annex 2. Table No. 3).**

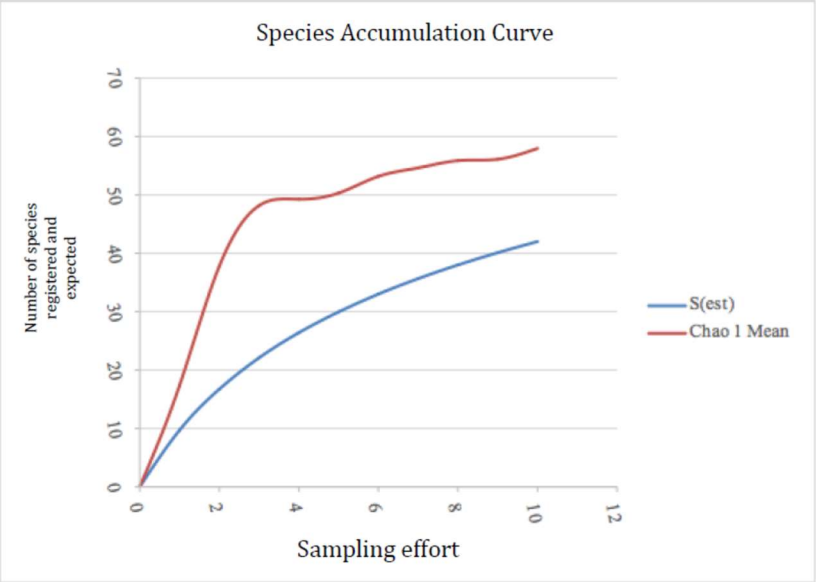
According to Annex 2, Table 3, we observed that the majority (45.2%) of the species are not frequent. This is due to their habits or behavior. Likewise, a high percentage (40.0%) of common species was observed. There are rare species (14.2%), though in less quantity.

12.3. Species registered by sampling area

Among the sites or intervention areas of the project, we observed that the main water intake (58 species were observed) and **the secondary water intake** (60 species were observed), present the highest numbers of observation of individuals. Then, we observed that the area where the powerhouse will be located presented a high number of observed species (45 observations among all the species). Then in a smaller range of observation, we have sites like **the mountain camp** (29 observations), **penstock and cable car** (9 observations), and finally, the soil disposal area (8 observations). In terms of areas of indirect influence, **El Danto Creek** (52 observations among all the species) [above the secondary water intake]) and **Los Olivitos Creek** (40 observations among all the species), and in smaller quantity, sites **such as La Quebradona** (20 observations among all species) and **the control point** above the main water intake, (28 observations among all species). **See Annex 3, Map No. PHJ – LBB – 12 Map No. PHJ – LBB 13.**

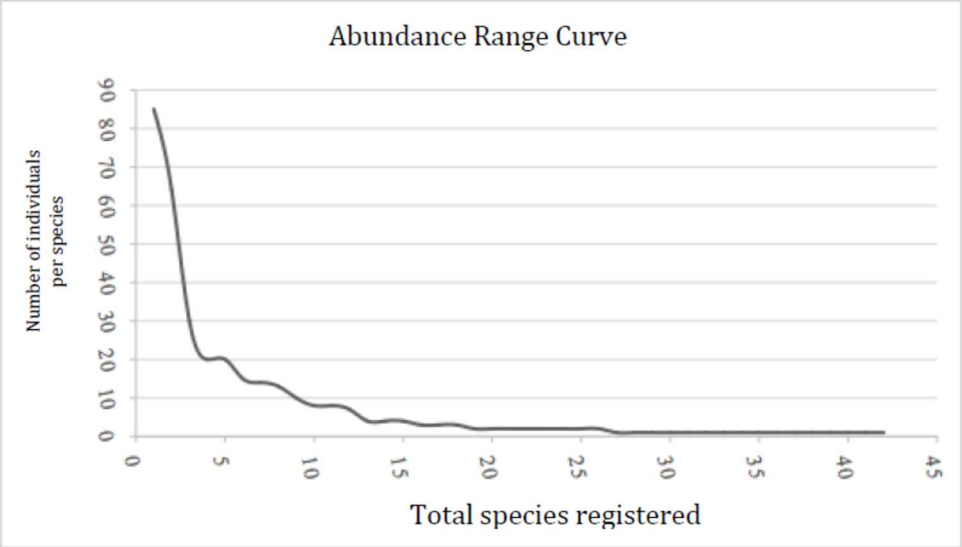
12.4. Ecological parameters

Based on the curve of accumulation of species, it is estimated that the inventory of amphibians and reptiles for the study area is not complete, given that the curve (real data [S(est)]) does not reach its asymptote and it continues to rise. The use of this method tells us when an inventory is complete, taking into account the time spent during the field phase (Figure 1). In addition, analyses carried out through the Estimate 9.1 program (Colwell 2013) tell us that the maximum number of species that we could register for the area can reach around 59 species (Chao 1), investing the same time effort. To obtain this parameter, the number of individuals per area of intervention was taken into account, to highlight the effort among the different applied methodologies, transects, and opportunists. Data expressed here are only for a season of the year (winter), for which said asymptote can stabilize, making the same effort in the dry season (summer).



Graph 2 . Curve of accumulation of species in the site of the Jilamito Hydroelectric Project. In blue, please find the curve generated for real data, and in orange, the logarithmic trend line (Chao 1).

Regarding the abundance of species, we find that ***Duellmanohyla salvavida*** had the highest values (85 individuals: 38 individuals in transects, 17 opportunists over transects, and 30 random observations), followed by ***Atlantihyla aff. spinipollex*** (64 individuals: 20 individuals in transects, 3 opportunists over transects, and 41 random observations). Notably, ***D. salvavida*** is a species that is restricted to the Nombre de Dios Mountain Range (NDMR). In the case of ***A. aff. spinipollex,*** according to McCranie & Wilson, 2002, and McCranie & Castañeda, 2007, this species is distributed throughout the NDMR region; nevertheless, Townsend et al., (2012), and Townsend & Wilson, (2016), mention that the population found in the Texiguat WLR presents morphological characteristics and genetic differences compared to the rest of the known populations for said region.



Graph 3 . Abundance range curve for amphibians and reptiles registered in the proposed area for the Jilamito Hydroelectric Project site. October 2018.

Likewise, we use the Simpson Index (***Ecological Importance Value Index [EIVI]***), which provides the parameters that allow measuring the richness of the species and/or organisms of a specific area. In this case, this index helped us to quantify the diversity of amphibians and reptiles in the total area of the project site.

$$D = \frac{\sum_{i=1}^{S} n_i(n_i - 1)}{N(N-1)}$$

Equation 1 . Simpson index or Ecological Importance Value Index (EIVI)

Where:

- **S** is the number of species
- **N** is the total number of organisms present (or square units)
- **n** is the number of individuals per species.

A specific richness (S) of 42 different species was registered between both taxa, documented by the observation of 346 individuals. The Simpson index is a representation that gives us a range that goes from 0 to 1, where, if it approaches 1, the study area presents a low diversity and if it approaches 0, it presents high dominance. The calculation of this index was made by taking all the data of observed species in combination with techniques for its detection. **See Annex 6, Table No. 20.** Given our calculations, it shows us that the biological diversity of the site is low (0.11) and that there is high dominance (0.88).

In addition, data is entered into the abundance range curve, where species with a large number of observations occur. This shows that there is a possible stability between these

species, showing communities with fairly good-sized stocks. However, this is not quite right, as this can be attributed to the strong anthropic pressure within the site, among other factors, which reduces diversity to favor a few species. Diversity is, therefore, an important factor in the management for the conservation of species and their development habitat. **See Annex 2, Table No. 7 and Table No. 8.**

13. THREATENED SPECIES AND NOTES OF IMPORTANCE FOR CONSERVATION

The Texiguat Wildlife Refuge was declared as such, like many other areas, in November 1987 pursuant to decree 87-87. With the objective of protecting and regulating the activities within a mountainous region with an extension that includes a land surface of 16,000 ha of low mountainous rainforest and pre-mountainous rainforest. In this protected area co-management of the non-governmental organization known as PROLANSATE has been low. It was expected to find secondary forests or successions (since, for the declaration of the area, there was already considerable intervention reflected in land use, deforestation, and extraction of species), as well as considerable extensions of mature and well-structured and stratified forest.

Eco-physiographically, the sampling sites are found in the forest system of the mountainous areas of the central Caribbean and the highlands of the north-central region (Wilson et al., 2000) in climatic zones known as humid intermediate lands and humid highlands. This region corresponds to and covers most of the Nombre de Dios Mountain Range. This is the reason why the forests of the area of influence of the project share much similarity in terms of plant structure and species composition with other sites such as Pico Bonito National Park or the Nombre de Dios National Park. And like all these areas, the site faces the same problem given the richness of its resources and the relatively little historical exploitation they have had given their rugged topography.

Due to the nature and scope of the study carried out, it was possible to notice the intensity with which the inhabitants cause direct impacts on the forest coverage that is still present in a good portion of the high part of the mountains, as well as on the shore of the majority of water bodies such as rivers and streams. It is difficult to determine how long ago began the intensive intervention of the lands in the area. Presently, what can be assured is that grazing lands on which the base camp was installed, in La Liberación, are possibly one of the first clearing and access point to other sites, since it is conveniently located among the rugged mountains. This intervention must be more than ten years old (at least), since Townsend (2010) found the same conditions (same access roads, which were climbed by means of "mules" or "horses"*, and the same grazing area in La Liberación) (Townsend et al., 2012). McCranie and Castañeda (2007) also present information that serves as background. The mentioned (p. 268) that, on the southern side, there has been a drastic reduction of the stocks of endemic species due to considerable alterations in the vegetation that forms part of the gallery forests present on the banks of the streams.

New clearings were found near El Danto creek and in tributaries of the Jilamito River, within the core zone of the protected area. It was found that there are coffee plantations and other fruits such as lemons, bananas, and chayote. These clearings bear the construction of rustic cabins where the workers of these lands sleep. Some of these clearings were very recent (approximately one week before our arrival). In one of the tributaries where one of the control sites for the bio-acoustics study a porcupine was found

(***Sphiggurus mexicanus***) that was killed by a tree that unfortunately fell on top of it. The tree was cut down during the clearing process.

When advancing through the same tributary mentioned above, a good portion of the forest was found and ready to be cleared. The underwood was totally destroyed, and trees were ready to be cut. Much of the tributary is covered by the trees and residual branches of the clearing, making the advance through the rush of water very complicated. The same situation occurs in the strip of land that would correspond to the gallery forest, in which only a few trees that have not yet been cut remain. In the parts already cleared, plastic waste was found, such as bags, plastic bottles and clothes. Rusty tools such as hoes and shovels were also found.

The advance of the settlers to occupy the lands within the area is another problem. We refer to the introduction of exotic species and imbalance in the dynamics of reptile and amphibian populations in the area. Plant species such as crops, fruit, and ornamental plants are already beginning to occupy significant portions of land, and animal species such as dogs and livestock, in general, can be seen. All this causes an impact that cannot yet be determined. Regarding the changes in the population dynamics of amphibians and reptiles, it can be seen how this seems to be evident; there are places where the tree frog ***Smilisca baudinii*** and the puddle frog ***Leptodactylus fragilis*** are found in abundance that is not normal, thus showing an atypical dominance (according to the place where the study is carried out), because of the intervention.

It is important to carry out long-term studies (bi-annually and in the dry and rainy seasons), during the construction phase and operation of the project, to determine the population dynamics of the species and in turn find out what are the direct and indirect effects on them. These studies are necessary due to lack of information, and also if the high degree of endemism in the area is taken into account. It would be a mistake not to consider the impact of altering the population dynamics of species that have been found in the area. That is why, although it is true that it seems positive that there is a very evident relative dominance of ***A. aff spinipollex*** along the riverbeds, it is important to be discreet when affirming how healthy these are, since such abundance may be a consequence of the disappearance of another species which was not favored by the alteration of gallery forests.

This becomes more evident if one compares the portion of El Danto creek, where a considerable abundance of ***A. aff. spinipollex*** was found. On the other hand, in another tributary of the Jilamito River, that has a less intervened gallery vegetation, the same species was found in smaller quantities and ***Duellmanohyla salvavida*** and ***Plectrohyla chrysopleura*** were also found in relatively considerable amounts. The nature of the coexistence of these species is unknown to date, but this ecological factor should not be ignored as a diagnostic to determine (even if comparatively) the spatio-temporal conservation status of the forests in which they live.

The access trails to the study area allowed to determine, to a certain extent, the intensity of hunting activities. During several of the days and nights shots were heard, and remains of

ammunition were also found among the leaves in the forest floor. Several simple hunting platforms were found in several places, and in some places, there were hunting platforms with only a few meters of separation from each other. These were a common denominator in all the areas covered. The condition of the access to La Liberación and to hidden paths allows determining that the transit of people through the forests and rivers in the area occurs regularly enough so as to cause a significant impact on the flora and fauna.

Of special concern is the fact that the clearings occur on hillsides with proximity to water that is parallel to these, because the effects of these could be seen immediately. During the days in which the study was conducted there were storms, and therefore, in a matter of a few minutes said tributaries showed a sudden flood, and the water changed color due to the excess of sediments carried by the water, as a result of the accelerated erosion produced by the lack of vegetation coverage in those areas. It is clear that these floods occur naturally at the site, because the topography facilitates rapid drainage; however, the effect of low water retention on lands where vegetation coverage no longer exists is evident, producing the aforementioned effect.

Picture. 11 A) Clearing found in the periphery of the core area, on the shore of one of the tributaries of the Jilamito River. **B)** One of the hunting platforms observed in the study area.

Picture. 12 A) Dead porcupine because of the fall of a tree, in the vicinity of one of the observed debris. **B)** Remains of ammunition used by the hunters, observed in the vicinity of the mountain camp.

Following the above-mentioned, and based on the composition and conservation status for the herpetofauna registered in the study area according to Wilson and Townsend, (2007); Townsend and Wilson (2010), and Johnson et al., (2015), Mejía and House, 2008, the Red List of IUCN and CITES, (see Annex 2, table 4), reveals the following: 42.5% are species in the least concern (LC) category, which coincides with species that have a low environmental vulnerability value (3-9), and this only varies by 9.5% with species that have stable stocks (35.7% *[*Es*]*).

On the other hand, and very importantly, 10 endemic species were registered at an equivalent to 23.8% of all registered species, which are in categories such as Critically Endangered (CR) and Endangered (EN), highlighting among them species not evaluated (NE) by the IUCN. The same data overlap with the conservation status according to the value of environmental vulnerability, where the species in EN and CR, have populations in decline (D) and those not assessed for their conservation status without data (ND).

Mentioning the conservation status (**See Annex 2. Table 5**) of the species registered in the study area, it is important to mention that if the degradation of the forest upstream of the wildlife refuge in an anthropic manner, continues at this rate, many of the tributaries are part of the river network that sustains Jilamito River may be considerably reduced in the long term, producing a "domino effect" in which the net volume of water that flows by the main riverbed may be affected. The negative effect of these consequences will not only affect the endemic diversity of the wildlife refuge (as is evident), but it will also affect the inhabitants that use these water resources in villages that are near the foot of these mountains.

As it should be noted, the entire forest system is under constant pressure, given the expansive activities of livestock, agriculture, and illegal felling, for the use of land, and that is why many of the species present are threatened by several of the causes mentioned above. These lead to the species or stock to be vulnerable of disappearing. This problem is

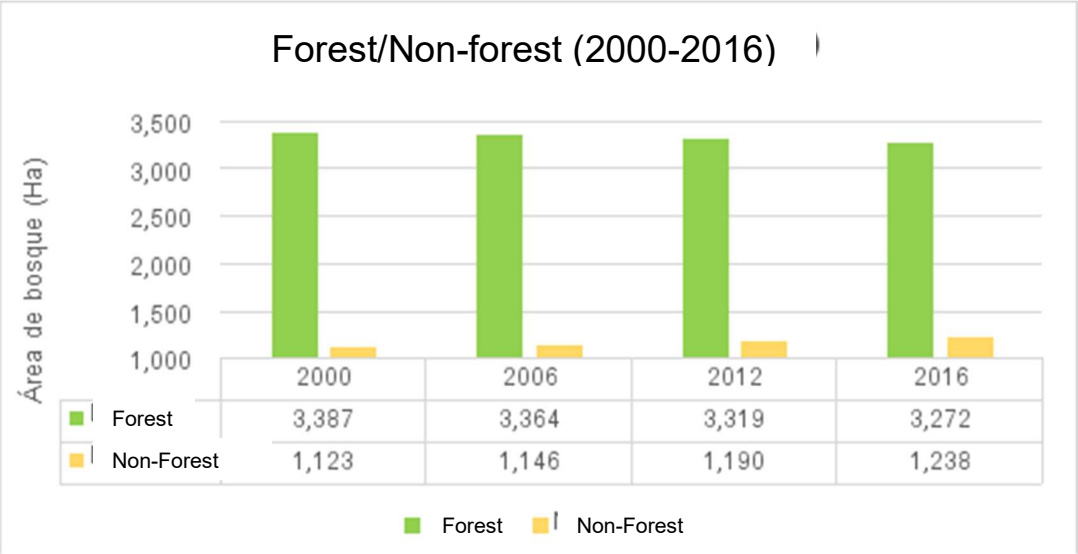
part of the causes of the dramatic disappearance of amphibian populations worldwide. That is why INGELSA is committed to forest conservation, and therefore supports the resource to be used by following the recommendations in this assessment.

According to data from the Forest and Wildlife Conservation Institute (ICF), for the Jilamito sub-basin for the period 2000-2016, it can be noted that forest loss is increasing for each period from 3.82 hectares per year (2000-2006) to 11.86 hectares per year for 2012-2016. This is a real threat to the species (loss of the ecosystem). The map shows the polygons where forest losses have occurred (**See Annex # 3 Map PHJ-LBB-14 Source web portal of the Institute of Forest Conservation of Honduras of 2016**)

Regarding losses (without the project), according to our biological perspective, in a year more is lost than what the project would cause. The project proposes to recover more than 60 hectares in 3 years. That means recovering the losses of the last 5 years in this zone.

This is based on the activity data of forest emission levels for Honduras (source Institute of Forest Conservation of Honduras), which were generated from a satellite image analysis (medium resolution) between 2000 and 2016, where the dynamics of the coverage was determined for the aforementioned periods in the entire national territory.

For the sectorization of the dynamics of coverage, the figure of the limit of the Jimalito basin was transposed, presenting the following results for the Forest/Non-Forest categories:



Where we observe a tiny decrease in forest coverage between 2000 and 2016, going 3,387 hectares, at the beginning of the analysis, to 3,272 hectares of forest in 2016, registering a total loss for the 16 years, approximately 115 hectares of forest, which represent 3.40% (approximately) of total forest area for the year 2000, as well as a gain of 10% in non-forest

areas. With a gross deforestation per year of 7.18 Ha/year, which translated to a deforestation rate of -0.22%.

Likewise, it was determined that, in the last analysis period, there was an increase in the loss of coverage for a fraction of time, as shown in the following table, where the aforementioned is evident, increasing by more than 300% between the averages of the first and last period of analysis

	Changes	
Analysis period	**Area (Ha)**	**Area (Ha / year)**
2000-2006	22.92	3.82
2006-2012	44.37	7.39
2012-2016	47.43	11.86

The map of the location of the micro-basin is also attached (see map annex #3 map, #13), where the losses of coverage according to the periods of analysis and the areas that are mostly affected by changes in coverage in the forest are seen.

Picture. 13 A) Cattle present in the paddocks of La Liberación, which is a great extension of territory destined for feeding these species, permanently maintaining the area without trees. **B)** Part of the area used for many years for livestock in La Liberación, near the boundary of the core area of the wildlife refuge, has influence on the Jilamito River and its tributaries such as El Danto creek.

13.1. Outstanding Species

It is considered that outstanding species during sampling, each presented the following characteristics: these are endemic with restricted distribution in the northern zone of the country between the Departments of Yoro, Cortes, Atlántida, and Colon or with distribution in the Nombre de Dios (NDMR) only. These species are also characterized by their conservation status: endangered (EN) or in critical danger (CR), however, and in the same way species that have not been evaluated (NE) or with no data (ND). Among the anurans, the presence of: ***Incilius leucomyos***, ***Craugastor aurilegulus***, ***Atlantihyla aff. Spinipollex***, ***Duellmanohyla salvavida***, and ***Plectrohyla chrysopleura***. Among the lizards:

Norops loveridgei, ***Norops yoroensis*** and ***Norops Zeus***, and among the snakes: ***Tantilla excelsa*** and ***Botriechis guifarroi***. **(See Annex 2, Table No. 6)**

Note: Impacts by species, See Annex 4, and Mitigation Measures by species, See Annex 5

Incilius leucomyos (McCranie & Wilson, 2000); common name: Toad of the Central Forest. This large-sized toad is characterized by well-developed cranial crests, with a rough surface (typical in toads), yellowish-brown to brown to pale brown, with or without conspicuous brown spots on the back. This endemic species is known as stocks cut-off from each other in low, moderate, and intermediate elevations between the Departments of Colon, Olancho (northeast end), Yoro, Atlántida, and Cortes (near the Yojoa lake). At the altitudinal level, these can be seen from sea level to up to 1600 m in elevation in lowland rainforest, in the very humid Pre-Mountainous rainforest and in the very humid Mountainous low rainforest, (McCranie & Wilson, 2002, McCranie, 2007; McCranie & Castañeda, 2007; Solis & O'Reilly/Unpublished data/). **See Annex 3. Map PHJ – LBB – 01.**

Picture 14. Adult male of *Incilius Leucomyos.* Photo: Mario Solis

Craugastor aurilegulus (Savage, McCranie & Wilson, 1988); common name: Rain frog, which belongs to the group of *C. rogulosus.* It is recognized as having a prominent eardrum, a wrinkled belly, and usually is pale yellow. This species is found in low, moderate, and intermediate elevations on the slope of the Atlantic. It is known that it is distributed between the Departments of Atlántida, Yoro, and Olancho, from 50 to 1550 m elevation in humid lowland forest formations, very humid pre-mountainous rainforest and in the periphery of the very humid low mountainous rainforest, (McCranie & Wilson, 2002; McCranie & Castañeda, 2007). According to Wilson & McCranie, (1998) and Pushendorf et al., (2006), this species showed declines in the 80s, and since then, its abundance has

Picture. 15. Adult male *of Craugastor aurilegulus* (in situ). **Photo**. Mario Solís.

been decreasing, the same phenomenon is attributed to the disease known as Chytridiomycosis. **See Annex 3 Map PHJ – LBB – 02.**

Atlantihyla aff. spinipollex (Schmidt, 1936); common name: Climbing frog, according to McCranie & Wilson, 2002; McCranie & Castañeda, 2007; Köhler, 2011. This species is recognized as having keratinized pointed thorns in the penis (structure in the form of thorns used for mating). It is known that this species is distributed between the Departments of Colon, Atlántida, and Yoro in an elevation range of 160 to 1580 m above sea level in lowland rainforest formations, pre-mountainous Very Humid rainforest, and in the periphery of the low mountainous rainforest. However, it should be noted that Townsend et al., 2012, and Townsend & Wilson, 2016, mention that the population found in the Texiguat WLR has different morphological and genetic characteristics among the rest of the populations known for the aforementioned species throughout its range of distribution. Before the genus of this species was included within the genus *Ptychohyla,* according to Faivovich, (2018). **See Annex 3. Map PHJ – LBB – 03.**

Picture 16. Adult male *Atlantihyla aff. spinipollex*. **Photo**. Mario Solís.

Duellmanohyla salvavida (McCranie & Wilson, 1986); common name: Red-eyed stream frog. This endemic frog of moderate size is characterized by having a uniform green dorsal surface (pale brown to dark brown), with a white line on the lips, with a bright red iris. It is known only from the Departments of Atlántida and Yoro, at low and moderate elevations in the Nombre de Dios Mountain Range and in Macuzal Mountain. It has been found from 90 to 1400 m elevation in lowland rainforest and in the very humid pre-mountainous rainforest formations, (McCranie & Wilson, 2002, McCranie & Castañeda, 2007). **See Annex 3. Map PHJ – LBB – 04.**

Picture 17. Adult male *Duellmanohyla salvavida*, (In situ). **Photo.** Mario Solís.

Picture18. Adult male *Plectrohyla chrysopleura*. **Photo**. Carlos O´Reilly.

Plectrohyla chrysopleura (Wilson, McCranie & Cruz, 1994); common name: Climbing frog This large-sized endemic frog is characterized by having a coloration that goes from gray to brown in the dorsal part, with golden yellow marks in the groin, armpits, and under the arm, and with a golden iris. It is known only in the Atlántida Department, in moderate and intermediate elevations that range between 930 and 1550 m of elevation in formations of very humid pre-mountainous forest and very humid low mountainous rainforest. It can be observed in primary forests and in slightly altered sites. The site where this species was described in Quebrada de Oro, Pico Bonito National Park, has not had records of this species since 1996. Until now, the only area with a known stable population has been the Texiguat Wildlife Reserve, at the site known as La Liberación, (McCranie & Wilson, 2002, McCranie & Castañeda, 2007, Townsend et al., 2011, Townsend, et al., 2012, Townsend & Wilson, 2016). **See Annex 3. Map PHJ – LBB – 05.**

Picture 19. Adult male *Norops loveredgei.* **Photo** . Josue Ramos.

Norops loveridgei (Schmidt, 1936): Common name: Giant lizard. This is a large lizard that is characterized by having a very developed gular fold of orange color, with black longitudinal stripes. This species is found in moderate and intermediate elevations of the Nombre de Dios Mountain Range between the Departments of Atlántida (Nombre de Dios National Park and Pico Bonito National Park), and northwest of Yoro. It can be observed in elevations from 550 to 1600 m in pre-mountainous rainforest formations and in pre-mountainous low rainforest. This species is very little known, given its arboreal habits. Usually this species is observed during the night in its perch sites between 2 to 3 m. of soil elevation in branches, (MCranie & Solís, 2014; McCranie & Köhler, 2015; Luque-Montes & Townsend, 2016). According to the IUCN, this species is in the category of Endangered (EN), (Meyer, 2011); however, McCranie & Köhler, (2015) place this species in the category of Near Threatened, given

that the species is found in different protected areas (mentioned above). **See Annex 3. Map PHJ – LBB – 06.**

Norops yoroensis (McCranie, Nicholson & Köhler, 2002); common name: Anole lizard or Pichete Bandera. This endemic lizard is characterized by having a dark yellow gular fold, with small black spots in the center and with the edge thereof with a light yellow. This species is known in the Departments of Ocotepeque, Santa Bárbara, Cortes, Yoro, Olancho, and Atlántida, at moderate and intermediate elevations between 650 and 1600 m. It is usually observed in the pre-mountainous rainforest, low pre-mountainous rainforest, and on the periphery of the tropical rainforest, (Köhler, 2009, McCranie & Köhler, 2015). This lizard does not have IUCN evaluation records; however, McCranie & Köhler (2015), mention that this species is Near Threatened (NT), due to the problems of anthropic origin (deforestation in general) in places where the species has been observed and collected. **See Annex 3. Map PHJ – LBB – 07.**

Picture 20. Adult male *of Norops yoroensis*. **Photo**. Mario Solís.

Norops zeus (Köhler & McCranie, 2001); common name: Anole lizard or Pichete Bandera. This small-sized lizard is known to have a white gular fold. This endemic species is known in the Departments of Cortes (Cerro Azul Meambar), Yoro, and Atlántida (lower part of the Nombre de Dios Mountain Range) in low and moderate elevations, between 5 and 900 m. in rainforest formations, low, pre-mountainous rainforest, and in the periphery of the formation of lowland dry forest. This lizard is usually found active during the day foraging in the dry leaves (McCranie & Köhler, 2016). Like ***N. yoroensis*** , this species does not have an evaluation by the IUCN; however, McCranie & Köhler, (2015) places this species, using the IUCN criteria, in the category of Less Concern (LC). **See Annex 3. Map PHJ – LBB – 08.**

Tantilla excelsa (McCranie & Smith, 2017): Common name: Snake. This endemic and recently described snake is little known. It is known that the holotype (first revised specimen) and its paratypes (type specimens) come from places such as the Lancetilla Botanical Garden (LBG) *[* Atlántida *]*), near the community of Peña Blanca

Picture 21. Adult female of *Tantilla excelsa* **Photo**: Mario Solís.

(Cortes) and the City of Progreso (Yoro), between elevations of 30 to 700 m. Since very little is known about the species, the specimen collected in the LBG comes from a coffee farm and the other two known locations have a lowland dry forest, (McCranie & Smith, 2017). The record on the vicinity of the Texiguat WLR gives us more information about the habitat and distribution of the species. Currently, this species does not have an assessment (NE) on the IUCN Red List. **See Annex 3. Map PHJ – LBB – 09.**

Botriechis guifarroi (Townsend, Medina-Flores, Wilson, Jadin & Austin, 2013); common name: Green Tamagás, Colgado. This endemic and recently described snake is distributed among the Departments of Yoro (Portion of the Texiguat WLR and Atlántida (between the protected areas of the Pico Bonito National Park in the town of Quebrada de Oro and the Texiguat WLR). This species is observed between the 1,015 to 1,450 m of elevation in the eastern portion of the Nombre de Dios Mountain Range between the pre-mountainous rainforest formations and the periphery of the low mountainous rainforest, (Townsend, et al., 2013). According to Townsend et al, (2010) and Townsend et al., (2012), this species is critically threatened by illegal felling and/or deforestation, including extensive cattle ranching in the area. This species does not have an evaluation in IUCN; however, Townsend et al., (2013) classified this species as Critically Endangered (CR), given the region and the pressure that this species presents. **See Annex 3. Map PHJ – LBB – 10.**

Picture. 22 Subadult of *Bothriechis guifarroi* . **Photo** . Carlos O'Reilly.

The maps generated for all species show the general distribution inside and outside the study area to understand the dynamics that these organisms have within the Texiguat WLR. The map generated that shows all the DMUs in the study area is focused to perform the necessary samplings for each of the species that were recorded during the field phase. **See Annex 3 Map No. PHJ- LBB-15**.

13.2. Classification Of The Type Of Habitat, Based On Guidance Note (GN) Of Performance Standard 6 (PS6).

Pursuant to performance standard (IFC) 2012 and Guidance Notes (GN54 and GN55), a "Critical Habitat" area is defined according to its high biological diversity due to the following considerations:

- habitats of significant importance for the survival of threatened or critically endangered species.
- Habitats of significant importance for the survival of endemic species or species restricted to certain areas.

- Unique or highly threatened ecosystems.
- Areas associated with key evolutionary processes.

Just as in Performance Standard (PS6, paragraphs 14-15), it mentions the importance and establishes specific requirements for carrying out actions in critical habitats such as:

[14]Natural habitats will not be modified or significantly deteriorated.

- There are no other viable alternatives within the region for the development of the project within modified habitats.

[15]In areas of natural habitats, when feasible, mitigation measures will be designed to ensure there is no loss of biodiversity.

- Prevention of impacts on biodiversity through the identification and protection of reserve areas.
- Application of measures to minimize habitat fragmentation, such as biological corridors.
- Habitat restoration during operations and/or restoration of habitats after the operation.
- Execution of compensation measures equivalent to biodiversity.

According to the above, the area of the hydroelectric project is located in a minimum part of the buffer zone of the Texiguat Wildlife Reserve. The Texiguat Wildlife Reserve is located in the north of the Nombre de Dios Mountain Range between the municipalities of Esparta in the department of Atlántida, and in the municipality of Yoro, in the department of the same name. Its territorial extension is approximately 29,763.00 ha (According to Technical Document No. DAPVS-0113-2006 of 2006 issued by COHDEFOR) and it is characterized by having a steep topography and several types of soil that result in a dominant vegetation that constitutes a Premontane Rainforest (rainforest/buffer zone), and a Low Mountainous Rainforest (cloud forest/core zone), (McCranie and Castañeda, 2007; Townsend, et al., 2012).

In this case, the Texiguat WLR is considered a critical habitat because of high diversity in terms of amphibians and endemic reptiles, which are in the categories of Vulnerable (VU), Endangered (EN) and Critically Endangered (CR), according to the IUCN criteria. According to the literature reviewed and the survey carried out this Biodiversity Baseline, the Texiguat Wildlife Refugee has 12 endemic amphibians (4 salamanders, 1 toad, and 7 frogs), and it has 13 reptiles (7 lizards and 6 snakes), according to McCranie, (2011; 2018); Townsend and Luque-Montes, (2010); Townsend et al., (2012); Townsend et al., (2013a, 2013b); Townsend and Wilson (2016), and the Biodiversity Baseline Survey conducted during the field investigation.

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Pursuant to the findings obtained during the field phase of the Biodiversity Baseline Survey, 10 endemic species of the 25 identified for the entire reserve were recorded, (Incilius leucomyos, Craugastor aurilegulus, Atlantihyla aff. spinipollex, Duellmanohyla salvavida, Plectrohyla chrysopleura, Norops yoroensis, Norops loveridgei, Norops zeus, Tantilla excelsa, and Bothriechis guifarroi).

Given the data obtained and according to the Performance Standard (PS6) and its Guidance Notes (GN6) of 2012 , the Texiguat WLR is considered a Criterion 1 Tier 1 habitat for the following species that are Endangered (EN) and Critically Endangered (CR) and because the Texiguat Wildlife Refugee sustains ≥ 10 percent of the global population of these two species:

- Atlantihyla aff. spinipollex (EN)
- Plectrohyla chrysopleura (CR)

We also consider criterion 1 level 1, for the following species, since their habitat is one of 10 or fewer discrete management sites globally for those species, according to GN71-GN74:

- Incilius leucomyos (EN)
- Craugastor aurilegulus (EN)
- Atlantihyla aff. spinipollex (EN)
- Duellmanohyla salvavida (CR)
- Plectrohyla chrysopleura (CR)
- Norops loveridgei (EN)
- Bothriechis guifarroi (CR)

However, we consider Criterion 2 Tier 2 for the following endemic species since the Texiguat Wildlife Refugee supports a population greater than or equal to 1%, but less than 95% of the global population of these registered species per GN83:

- Incilius leucomyos (EN)
- Craugastor aurilegulus (EN)
- Atlantihyla aff. spinipollex (EN)
- Duellmanohyla salvavida (CR)
- Plectrohyla chrysopleura (CR)

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- Norops loveridgei (EN)
- Norops yoroensis
- Norops Zeus
- Tantilla excelsa
- Bothriechis guifarroi (CR)

Due to the Jilamito Hydroelectric Project, as mentioned above, this will be located in a minimum part of the RVS Texiguat buffer area, covering a total of 3.36462 ha., (= 0.0113% of the total area of the reserve according to Technical Document No. DAPVS-0113-2006 of 2006 issued by COHDEFOR), between the works of the main water uptake (0.1249 ha.), the secondary water uptake (0.0663 ha.), the connection pipeline between dams (0.0872 ha.), the connection pipeline before the tunnel (0.18 ha.), the loading chamber (0.0320 ha.), the conduction pipeline after tunnel (1.69 ha.), the surge chamber (0.0387 ha.), the mountain camp (0.5516 ha.), the penstock (0.4438 ha.), and the cable car route (0.15 ha). All these areas are located along 1.53 km from the limit of the buffer area to the site of the water uptakes. The rest of the works are located outside the reserve area (Buffer Zone), such as: most of the penstock, machine house, Jilamito and Lean substations, transmission line, office facilities, and access roads.

If we analyze by works (species encountered according to the Biodiversity Baseline Survey sampling), it is reflected that not all endemic species and/or those registered as Endangered (EN) or Critically Endangered (CR) categories are found together in any one of these, as a result of the different conditions of these areas, from the fragmentation of the forest by anthropic activities (grazelands for livestock and cultivation areas) to ecosystemic conditions due to the difference of the general distribution, altitudinal area, water network, and the life zones (same criteria used for the realization of the DMU). It is worth mentioning and emphasizing that none of the works is close to the core zone and/or the cloud forest of the reserve, the nearest is the main water intake, which is at a distance (straight line) of 4.73 km from the core zone. The core zone is the area that houses most of the reserve's endemic species (see McCranie and Castañeda, 2007; Townsend and Luque-Montes, 2010; Townsend et al., 2012; Townsend et al, 2013; and Townsend and Wilson, 2016).

Since the project plans the improvement of the ecosystem for endemic species, Endangered (EN) and Critically Endangered (CR) species, actions for their protection are based on

GN31, which assure that there will not be a net loss, but that there will be net conservation increases following these three guidelines:

- Positive conservation management interventions, such as restoration, improvement, or stopping of the degradation of the biodiversity components of adequate compensation sites;
- Reconstruction of an ecologically equivalent ecosystem and the associated biodiversity values;
- Risk avoidance interventions that result in the in situ protection of biodiversity.

14. CURRENT IMPACTS IN THE AREA OF LOCATION OF THE PROJECT AND MITIGATION MEASURES

In the study area, several environmental liabilities were observed, which were identified during the field phase. The environmental liabilities displayed are those listed in the following table:

Environmental liability	Example	Corrective measure
1. Intervened habitat or habitat types		
a. a.1 Grasslands **b. a.2 fallow land,** **c. a.3 remaining forest, a.4 tropical rainforest**	for livestock and now for coffee growing	Limit the advance of the livestock and agricultural border with the issue of coffee growing (Use of pesticides or excess fertilizers)
d. Loss of habitat	For species of interest, mainly endemic	Restoration of sites and another compensation measure as protection of non-intervention areas
e. Presence of other species linked to anthropogenic intervention sites	*Smilisca baudinii* and *Leptodactylus fragilis*, indicator species	Awareness of neighbors about deforestation, illegal felling, inter-institutional intervention since these are the experts in this subject matter or have expertise: Institute of Forest Conservation (IFC) - PRLANSATE - INGELSA

Environmental liability	Example	Corrective measure
f. Hunting	 Hunting Platform, hunting pressure on species, mainly on mammals	Awareness of municipal governments and control by the Municipal Environmental Units (MEU) IFC (controls) Campaign for awareness and environmental education - INGELSA.
2. Transformation in land use		Regular Reforest and protect the forest - INGELSA
a. Cattle advances		
b. Crops		Land purchase or payment for environmental services
c. Timber harvesting		Selective harvest or payment for environmental services

MITIGATION MEASURES ACCORDING TO EACH STRUCTURE.

A) Roads. Access roads to the Powerhouse will be built in a 95% deforested area covered by pastures. On the way of the road to be built, INGELSA acquired 30 ha. that will be reforested, and an agreement has been established to reforest other areas privately owned with the sponsorship of INGELSA.

While the road will affect an area of 1.2 ha., an area of 30 ha. of pastures acquired by INGELSA, and 14 ha. of paddocks in possession of other neighbors will be reforested. In the future this can be expanded.

B) Powerhouse. A structure that includes the building where the two turbines, globe valves, hydraulic pumps, generators and their cooling system, governors, traveling crane or assembly crane, and panels and cubicles for the operation will be assembled. Next to the substation is 13.8/34.5 and proximity and circulation yards, all of which occupy an area of 2 ha. that are currently covered by 95% of partially established pastures and that use fire as their cleaning system.

For the construction of this structure and the connection with other works, INGELSA acquired 14 ha of which twelve (12) will be planted with native species of the area.

During construction, these will be the physical impacts on the 2 hectares:

- Excavation and filling: practically balanced, therefore very little or no transportation of materials because the excavation materials were used as filler. The excavated plant layers will be deposited in special areas or deposits that are currently covered with Gramineae. The excavated materials will preferably be stacked and protected from rain to minimize the impact of erosion and sediment transportation, until their final disposal in compacted landfills.
- Buildings with imported material (concrete, iron, metal roofs in a very concentrated area.)

The area of direct impact is the 2 mentioned hectares and indirectly 100 meters upstream and 500 meters downstream of the site of restitution of the turbinated water in Los Olivitos creek. 7 days before beginning the earth work, anurans, snakes, and other reptiles that are located and relocated in the areas previously established as appropriate will be captured. This activity will be carried out by INGELSA staff from the Biodiversity Department.

Once the excavation process has begun and during the construction, there will be an inspector to determine the presence of these individuals, and they will inform the Construction Supervisor of INGELSA and the Biology Department to follow the **relocation process.**
Final status:
Impact 2 hectares.
Recovery 12 ha., gain 12 ha. of forest

C) Pressure pipeline.

At a distance of 2,450 meters on the top of the mountain, an excavation will be made of a depth is 3.0 m in the bottom 2 m and 5.5 m in the crown. There are no permanent feasible landfills, only temporary ones.

- Average excavation 411.25 m^3/ m, temporary lateral and/or nearby storage.
- Tube placement and filling with site material
- Ditch filling with material previously deposited laterally and/or nearby. That is, there will be soil restitution
- Activity by longitudinal section of 9 to 12, level the bottom in the design slope, place the pipe with the design coordinates, and fill in a shift or maximum of 2. In

case of rain, the trench, the excavated materials, and filling materials will be covered.

- When restoring the areas with the filling, grasses will be planted temporarily, as the case may be:

1) **Vetiver or valerian**. Gramineae with root extension of 0.80 m depth and 0.60 m diameter with detrital roots of great relative resistance to tension. This grass manages to reinforce surfaces to prevent small landslides that if not controlled lead to greater landslides.
   This plant has the advantage in the medium term (3 months) of giving opportunity for native vegetation species to grow on the surfaces intervened by the construction. This grass will be planted in areas where the forest cover is already non-existent and before entering the buffer zone of the Texiguat Wildlife Refuge.

2) **Gramineae, Jasmine or Cornnel,** is a fast-growing grass. It is so useful that a mantle of this vegetation immediately prevents superficial erosion, and its growth allows that after two days, it is already growing. After 22 days, it is a closely woven green surface that protects intervened surfaces. Its root extension is 0.05 m, and it is easily invaded by native vegetation. Due to the above, it will be our initial colonization species within the wildlife refuge to try to quickly cover the area of the construction strip. These options give the opportunity to plant adequate trees to restore the forest; in this case, it would not be done with timber trees to prevent damage to the pressure pipe. The "Gualiqueme" is an arboreal species used in a micro basin project with great results as it grows up to 0.30 m in diameter in just 3 years, with broadleaf foliage and strong.

D) Driving road, Pipeline, and Tunnel. More environmentally friendly constructive aspects

Driving road. To place the pipeline, it will be necessary to build a road called the driving road, which will require an excavation of 40,000 to 50,000 m^3. This material must be taken to three nearby landfills. Previously cut trees will be required, and before this, animals must be tracked, rescued, and relocated in predetermined areas.

With a minimum of 15 days prior to the beginning of the felling of the trees within the area of the driving road, which will have a surface area of 10 ha. to 15 ha., for a road of 4.20 m wide of road and a slope with an average height of 10 m, fauna will be rescued and relocated.

Timber trees will be processed by the cooperative CALIJINUL with the logistics support of INGELSA as there is an agreement between both parties, considering that the Cooperative is the co-manager of the forest before the ICF (Institute of Forestry Conservation).

A constructive measure of mitigation on slopes with residual soil will not allow slopes without protection greater than 6 m. Slopes greater than 6 m should have a support at the foot of the slope with gabions after a short analysis of soil resistance. The 6 m of the free slope should be vegetated with vetiver and another grass that could be Jasmine grass, given our experience in the area. Within a year native species will protect the slope by natural regeneration.

The filling of the ditches of the pipeline will be made with materials from the excavation of the same ditch, if this were possible from the point of view of quality of the material or of the material coming from the excavation of the road, previously selected.

E) Soil disposal areas. are planned at the top of the troughs, and at the Mezapa hydroelectric power plant, it was done in a similar way. It worked and continues to work well. There will also be a tracking of reptile and anuran species, and they will be rescued and relocated. The encounters in this case and in others will be inventoried and will be recorded in logs. Maps stating the origin and the area where they will be relocated will be prepared, keeping a record of the behavior and the population with respect to time. In the dumps the sub-forest will be cut, although not the large trees, which will give stability to the area. The terrace equipment will be adapted as far as size to make the activity possible and effective.

F) Tunnel. The noise caused by the explosions causes fauna to migrate; however, birds and mammals then return, taking into account that hunting will be reduced completely when the Project starts operating. The material of the tunnel (2500 m^3) will be reused as a rolling layer in the driving road and the stone will be used in the cyclopean concrete of the two dams.

G) Weirs or water intakes. The water intakes are a small structure of 4.8 m high that, on the edge of water, will not create reservoirs. The area affected by circulation during construction between one weir and another is also small, and the current degradation without the project is so high that replanting forest in the area will be an immediate environmental gain. Once reestablished, this environmental gain (tree plantation), the relocation areas upstream of the dams are as immediate as favorable for the relocation of amphibians and reptiles. During construction, there is no practical reason to mobilize equipment and personnel 50 m upstream from the main and secondary water intakes, and it will be a measure of strict environmental compliance. In general, the project has as a goal the Tripartite agreement between ICF, PROLANSATE, and INGELSA to reforest 45 ha. We do not doubt that by gradually incorporating more of the pasture area that we observe now in the area of the water uptake into the reforestation area will produce an environmental gain that is very positive for conservation interests in the country.

H) Mountain Camp. Although there is a small kitchen in the camp, the food would be prepared in the town's specialized kitchen and sent by the cable car in special containers.

The sewage will be collected in mobile booths with sealed containers where they will be stabilized with microbial species, and these will be collected in special tanks that will be transported by means of the cable car towards the office building close to the El Nance site, as it will be transported for its treatment by a specialized company according to the environmental procedures and licenses granted by the corresponding national agencies. The garbage will also be transported, classified, to the garbage dump built for that purpose.

15. COMPLEMENTARY STUDIES

15.1. Acoustic study

As part of the complementary studies, an acoustic survey was carried out to detect toad or frog species that are hard to detect (ex. arboreal or cryptic species). An effort was made to place such equipment in 44 ha, which are reflected by placing it on the entire study area. The study consisted of placing 34 automated recorders, developed by the research group **Automated Remote Biodiversity Monitoring (ARBIMON, https://arbimon.sieve-analytics.com),** between the areas of direct and indirect influence to cover as much area as possible and thus know the potential distribution of the anurans. The audio team recorded 1-min sound in 10-min intervals, per 24 hours. However, only 31 of the 34 recorders worked optimally in the field.

The 31 recorders registered a total of 54,313 recordings to be able to analyze the distribution and dynamics of six key species:

Species: *Incilius leucomyos*
Hyalinobatrachium fleischmanni
Teratohyla pulveratum
Duellmanohyla salvavida
Atlantihyla aff. Spinipollex
Craugastor sp.

In the analysis of said data, there is support from the Smithsonian Institute, which has been present in all identification processes of the aforementioned species through their vocalization. ARBIMON II software is a program built by ARBIMON, to allow the user to view and listen to recordings at all times for later identification.

Currently, no data has been obtained on this intervention, and the Biodiversity Baseline of INGELSA resulted in over 54,313 recordings of 1-minute long each in 31 audiomoth, and at this time said data is being analyzed.

15.2. Study of *Batracochytrium dendrobatitis* (Bd)

For this study in the process of analysis, 132 samples were obtained, which were taken by means of non-lethal techniques. Each amphibian was cleaned by means of a swab to detect in the laboratory the presence of BD.

Analysis will be carried out in the Center for Genetic Research of the Microbiology Research Institute of the National Autonomous University of Honduras (UNAH), where the analysis will be carried out.

16. CONCLUSIONS

- In the realization of the botanical transects, new reports and/or more endemic plants of the zone and the country were observed as plants of the genera *Costus*, *Pleurothallis*, *Calathea*, *Adiantum*, *Cymbopetalum*, *Ticodemdrum*, *Molinadendrum*, *Pynguicola*, *Utricularia*, among others, that were not collected since in their phenology they do not present flowers or fruits, while emphasizing that until now the fruit of the species *H. hazlettii* is not known.

- According to the results based on opportunistic sightings and counting of fauna on transects developed in-situ, the species of amphibians and reptiles found were a total of 42 species (15 amphibians and 27 reptiles).

- The endemic tree identified as *H. hazletti*, was not found in the area of impact of the project. However, it was found in a location near the area where the Jilamito River and Los Olivitos Creek meet.

- The present fauna study states that out of the 42 species of amphibians and reptiles, 10 of these species are endemic for Honduras.

- Regarding amphibians and reptiles found in all the sampled areas, many of the observed species have a low environmental vulnerability index, which agrees with the species that have the least concern (LC) according to IUCN criteria. However, it is noted that most of these species are not evaluated (NE) by these criteria or are without data (ND).

- In terms of biological diversity, several species that are important for conservation of critical habitats were recorded or observed in the project area, which not only includes the endemic species, but also the species found for the Central American core (CAC). They require attention and importance in terms of conservation.

- According to the data known for the Honduras in terms of conservation, in the List of Special Concerns, only one species is mentioned under this criterion (*Incilius leucomyos*), and likewise, we only find one species under the CITES category (*Micrurus nigrocinctus*).

- Currently, without the project, there is a certain vulnerability or potential risk in the dynamics of the conservation of some species of fauna and flora in the study area, as a result of human activity, since anthropic intervention was observed in the field, in the area of project action (project footprint), and in the control sites (outside the project's footprint). The identified activities were: grazing land for livestock, debris for new human settlements and/or places for coffee growing, and for poaching (tapescos).

- It is expected that with the execution of the Jilamito Hydroelectric Project, anthropogenic activities that currently represent a high ecological risk will be diminished in such a way that with the development of a conscious and adequate environmental and social management system (example: ND 6, IFC), it will be possible to ensure the follow up, conservation, and monitoring of flora and fauna species in the area of impact of the project.

17. RECOMMENDATIONS

- It is recommended that constant monitoring and biological monitoring be carried out on the Jilamito River basin during the construction and operation phase, in order to obtain a better knowledge about the herpetofauna, endemic flora, and other present life forms, which will allow to systematically estimate as a function of time, the gain, dynamics, and variability of the ecosystem inside and outside (control points established in the Baseline of the biodiversity study) of the project's footprint.

- Establish management or cooperation agreements with groups (educational entities, state entities, local governments, NGOs, and others) interested in knowledge management, with the purpose of establishing actions and shared activities on topics related to biological studies and fauna and flora monitoring (bird sightings, tracking of mammals, and others). In this sense, these agreements will have the mission to establish, in a shared manner, the guidelines, strategies, and financial support required for the scope of said management and cooperation agreements.

- Within the Biodiversity Action Plan, the construction and operation phases should be considered for the conservation of the species to contemplate the construction of wildlife passages, which serve to maintain the biological connectivity and the perpetuation of the species and their ecological and biological cycles. These will be placed in the construction phase according to the works included and with maintenance of the same in the operation phase of the project.

- Socialize and disseminate the results of the information generated from the different studies or investigations developed in the project, in order to be able to contribute to the publication of data obtained from the actors. The generated documents will describe and report on the results of the evaluation and monitoring process of the construction and operation phases of the Jilamito Hydroelectric Project.

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ANNEXES

ANNEX 1. GENERAL LIST OF FLORA IN THE STUDY AREA OF THE JILAMITO HYDROELECTRIC PROJECT.

Table No. 1

No.	Family	Species	Common name	Habit
1	Annonaceae	*Annona reticulata* L.	Anona	Tree
2	Acanthaceae	*Aphelandra aurantiaca Lindl.*		Herb
3	Actinidiaceae	*Saurauia sp.*	Moquillo	Tree
4	Altingiaceae	*Liquidambar styraciflua* L.	Liquidambar	Tree
5	Anacardiaceae	*Astronium graveolens Jacq.*	Ciruelo de montaña	Tree
6	Anacardiaceae	*Mangifera indica* L.	Mango	Tree
7	Anacardiaceae	*Spondias mombin* L.	Jobo	Tree
8	Apocynaceae	*Aspidosperma spruceanum* Benth. ex Müll. Arg.	Cañamito	Tree
9	Apocynaceae	*Gonolobus barbatus* Kunth	Champel	Vine
10	Aquifoliaceae	*Ilex tectonica* W.J. Hahn	Areno de montaña	Tree
11	Araceae	*Anthurium schlechtendalii* Kunth	Mano de piedra	Grass
12	Araceae	*Anthurium sp.* (1)		Grass
13	Araceae	*Anthurium sp.* (2)		Grass
14	Araceae	*Colocasia esculenta* (L.) Schott	Corazón de Maria	Grass
15	Araceae	*Monstera acuminata* K. Koch		Vine
16	Araceae	*Syngonium podophyllum* Schott		Vine
17	Araceae	*Xanthosoma hoffmannii* (Schott) Schott	Quequesque	Grass
18	Araceae	*Xanthosoma robustum* Schott	Quiscamote	Grass
19	Araceae	*Xanthosoma violaceum* Schott	Malanga	Grass
20	Araliaceae	*Dendropanax arboreus* (L.) Decne. & Planch.		Tree
21	Araliaceae	*Oreopanax sp.*		Shrub
22	Araliaceae	*Schefflera sp.*	Guarumo de montaña	Tree
23	Arecaceae	*Acrocomia aculeata* (Jacq.) Lodd. ex Mart.	Palma coyol	Palma
24	Arecaceae	*Astrocaryum mexicanum* Liebm. ex Mart.	Palma Lancetilla	Palma
25	Arecaceae	*Bactris gasipaes* Kunth	Pijebaye	Palma
26	Arecaceae	*Cocos nucifera* L.	Palma de coco	Palma
27	Arecaceae	*Chamaedorea pinnatifrons* (Jacq.) Oerst.	Palma	Palma
28	Arecaceae	*Chamaedorea sp.*	Palma	Palma
29	Arecaceae	*Geonoma undata* Klotzsch	Capuca	Palma
30	Arecaceae	*Reinhardtia gracilis* (H. Wendl.) Drude ex Dammer	Palma	Palma
31	Asclepiadaceae	*Asclepias curassavica* L.		Grass
32	Asparagaceae	*Dracaena americana* Donn. Sm.	Izote de montaña	Shrub
33	Asteraceae	*Vernonia patens* Kunth	Sucunán	Tree
34	Begoniaceae	*Begonia sp.*		Grass
35	Bignoniaceae	*Jacaranda copaia* (Aubl.) D. Don	Tambor/Zorra	Tree

No.	Family	Species	Common name	Habit
36	Bignoniaceae	*Tabebuia chrysantha G. Nicholson*	Cortez	Tree
37	Bignoniaceae	*Tabebuia rosea (Bertol.) DC.*	Macuelizo	Tree
38	Bixaceae	*Bixa orellana* L.	Achiote	Tree
39	Boraginaceae	*Cordia alliodora* (Ruiz & Pav.) Oken	Laurel	Tree
40	Bromeliaceae	*Aechmea bracteata* (Sw.) Griseb.		Grass
41	Bromeliaceae	*Bromelia plumieri* (E. Morren) L.B. Sm.	Piñuela	Grass
42	Bromeliaceae	*Catopsis sp.*	Gallito	Grass
43	Bromeliaceae	*Tillandsia sp.*	Gallito	Grass
44	Brunelliaceae	*Brunellia mexicana* Standl.	Cedrillo	Tree
45	Burseraceae	*Bursera simaruba* (L.) Sarg.	Indio desnudo	Tree
46	Burseraceae	*Tetragastris panamensis* (Engl.) Kuntze	Kerosén	Tree
47	Buxaceae	*Haptanthus hazlettii Goldberg & C. Nelson*		Tree
48	Cactaceae	*Epiphyllum sp.*		Epiphyte
49	Cactaceae	*Hylocereus triangularis* (L.) Britton & Rose	Pitaya	Epiphyte
50	Calophyllaceae	*Calophyllum brasiliense Cambess.*	Santa Maria	Tree
51	Caricaceae	*Carica papaya* L.	Papaya	Shrub
52	Chrysobalanaceae	*Licania hypoleuca* Benth.	Cenizo	Tree
53	Clethraceae	*Clethra mexicana* DC.		Tree
54	Clusiaceae	*Clusia rosea* Jacq.		Shrub
55	Clusiaceae	*Symphonia globulifera* L. f.	Varillo	Tree
56	Costaceae	*Costus scaber* Ruiz & Pav.	Caña agria	Grass
57	Cyatheaceae	*Cyathea sp.*	Fern arborescente	Fern
58	Cyclanthaceae	*Carludovica palmata* Ruiz & Pav.	Palmito	Shrub
59	Cyperaceae	*Scleria melaleuca* Rchb. ex Schltdl. & Cham.	Navajuela	Grass
60	Davalliaceae	*Nephrolepis sp.*	Fern	Fern
61	Euphorbiaceae	*Acalypha sp.*		Shrub
62	Euphorbiaceae	*Sapium glandulosum* (L.) Morong	Lechoso	Shrub
63	Fabaceae	*Acacia sp.*	Cachito	Tree
64	Fabaceae	*Andira inermis* (W. Wright) Kunth ex DC.		Tree
65	Fabaceae	*Albizia sp.*		Tree
66	Fabaceae	*Cojoba arborea* (L.) Britton & Rose		Tree
67	Fabaceae	*Dalbergia calycina* Benth.	Granadillo	Tree
68	Fabaceae	*Dialium guianense* (Aubl.) Sandwith	Paleto	Tree
69	Fabaceae	*Enterolobium cyclocarpum* (Jacq.) Griseb.	Guanacaste	Tree
70	Fabaceae	*Erythrina berteroana* Urb.	Pito	Tree
71	Fabaceae	*Gliricidia sepium* (Jacq.) Kunth ex Walp.	Madreado	Shrub
72	Fabaceae	*Hymenaea courbaril* L.	Guapinol	Tree
73	Fabaceae	*Inga punctata* Willd.	Guaba roja	Tree
74	Fabaceae	*Inga sp.*	Guama negra	Tree
75	Fabaceae	*Inga vera* Willd.	Guamo	Tree
76	Fabaceae	*Lonchocarpus sp.*	Chaperno	Tree

No.	Family	Species	Common name	Habit
77	Fabaceae	*Platymiscium dimorphandrum* Donn. Sm.	Hormigo	Tree
78	Fabaceae	*Pterocarpus officinalis* Jacq.	Sangro	Tree
79	Fabaceae	*Schizolobium parahyba* (Vell.) S.F. Blake	Zorra	Tree
80	Fabaceae	*Swartzia panamensis* Benth.	Madreado de montaña	Tree
81	Fabaceae	*Vatairea lundellii* (Standl.) Killip ex Record	Amargoso	Tree
82	Fagaceae	*Quercus insignis* M. Martens & Galeotti	Malcota	Tree
83	Fagaceae	*Quercus oleoides* Schltdl. & Cham.	Encino	Tree
84	Heliconiaceae	*Heliconia bihai* L.		Grass
85	Heliconiaceae	*Heliconia hirsuta* L. f.		Grass
86	Hernandiaceae	*Hernandia stenura* Standl.	Tambor	Tree
87	Lamiaceae	*Tectona grandis* L.F.	Teca	Tree
88	Lauraceae	*Nectandra gentlei* Lundell	Aguacatillo	Tree
89	Lauraceae	*Persea americana* Mill.	Aguacate	Tree
90	Loranthaceae	*Phoradendron quadrangulare* (HBK) Krug & Urban	Mata palo	Parasite
91	Loranthaceae	*Psittacanthus schiedeanus* (Schltdl. & Cham.) Blume	Muerdago	Parasite
92	Loranthaceae	*Struthanthus orbicularis* (Kunth) Blume		Parasite
93	Lygodiaceae	*Lygodium venustum* Sw.	Enredadera	Fern
94	Lythraceae	*Pehria compacta* (Rusby) Sprague	Guacamaya	Shrub
95	Malpighiaceae	*Byrsonima crassifolia* (L.) Kunth	Nance	Shrub
96	Malvaceae	*Ceiba pentandra* (L.) Gaertn.	Ceiba	Tree
97	Malvaceae	*Hampea sp.*		Tree
98	Malvaceae	*Luehea candida* (Moc. y Sessé ex DC.) Mart.	Guacimo	Tree
99	Malvaceae	*Luehea speciosa Willd.*	Canastilla	Tree
100	Malvaceae	*Pachira quinata* (Jacq.) W.S. Alverson		Tree
101	Malvaceae	*Theobroma cacao* L.	Cacao	Tree
102	Malvaceae	*Sterculia apetala* (Jacq.) H. Karst.	Castaño	Tree
103	Marantaceae	*Calathea sp.*		Grass
104	Melastomataceae	*Bellucia axinanthera* Triana	Manzano	Tree
105	Melastomataceae	*Clidemia hirta* (L.) D. Don		Grass
106	Melastomataceae	*Conostegia xalapensis* (Bonpl.) D. Don ex DC.	Sirín	Shrub
107	Melastomataceae	*Miconia argentea* (Sw.) DC.	Sirín	Tree
108	Melastomataceae	*Miconia sp.*	Sirín	Shrub
109	Meliaceae	*Cedrela odorata* L.	Cedro	Tree
110	Meliaceae	*Guarea glabra* Vahl.	Carbón	Tree
111	Meliaceae	*Guarea grandifolia* DC.	Marapolan	Tree
112	Meliaceae	*Swietenia macrophylla* King	Caoba	Tree
113	Moraceae	*Castilla elastica* Sessé	Palo de hule	Tree
114	Moraceae	*Brosimum sp.*	Masica	Tree
115	Moraceae	*Dorstenia drakena* L.		Grass
116	Moraceae	*Ficus insipida* Willd.	Amate	Tree
117	Moraceae	*Ficus maxima* Mill.	Higuero	Tree

No.	Family	Species	Common name	Habit
118	Moraceae	*Naucleopsis naga* Pittier	Amargo	Tree
119	Muntingiaceae	*Muntingia calabura* L.	Capulin	Tree
120	Musaceae	*Musa paradisiaca* L.	Banano	Shrub
121	Myristicaceae	*Virola koschnyi* Warb.	Sangre	Tree
122	Myrtaceae	*Eugenia sp.*	Guayabo de cerro	Tree
123	Myrtaceae	*Psidium guayajava* L.	Guayabo	Shrub
124	Myrtaceae	*Syzygium jambos* (L.) Alston	Manzanita	Tree
125	Ochnaceae	*Cespedesia spathulata* (Ruiz & Pav.) Planch.	Tabacon	Shrub
126	Orchidaceae	*Comparettia falcata Poepp. & Endl.*		Epiphyte
127	Orchidaceae	*Epidendrum sp.* (1)		Epiphyte
128	Orchidaceae	*Epidendrum sp.* (2)		Epiphyte
129	Orchidaceae	*Mormolyca hedwigiae* (Hamer & Dodson) M.A. Blanco		Epiphyte
130	Orchidaceae	*Pleurothallis cardiothallis* Rchb. f.		Epiphyte
131	Orchidaceae	*Pleurothallis correllii* Luer		Epiphyte
132	Orchidaceae	*Pleurothallis sp.*		Epiphyte
133	Orchidaceae	*Prosthechea sp.*		Epiphyte
134	Passifloraceae	*Passiflora foetida* L.		Vine
135	Phyllanthaceae	*Hyeronima alchorneoides* Allemão	Rosita	Tree
136	Phytolaccaceae	*Phytolaca sp.*		Grass
137	Piperaceae	*Peperomia sp.*		Epiphyte
138	Piperaceae	*Piper aduncum* L.	Cordoncillo	Shrub
139	Piperaceae	*Piper arboreum* Aubl.	Cordoncillo	Shrub
140	Piperaceae	*Piper auritum* Trel.	Juniapa	Shrub
141	Piperaceae	*Piper jacquemontianum* Kunth	Cordoncillo	Shrub
142	Poaceae	*Arundinella deppeana* Nees ex Steud.	Cola de macho	Grass
143	Poaceae	*Brachiaria decumbens* Stapf		Grass
144	Poaceae	*Eleusine sp*	Pasto burro	Grass
145	Poaceae	*Hyparrhenia rufa* (Nees) Stapf	Jaragua	Grass
146	Poaceae	*Pennisetum purpureum* Schumach.	Zacate	Grass
147	Poaceae	*Panicum maximun* Jacq	Pasto Mombasa	Grass
148	Poaceae	*Paspalum botterii* (E. Fourn.) Chase		Grass
149	Polygonaceae	*Coccoloba sp.*	Papalón	Shrub
150	Polypodiaceae	*Phlebodium decumanum* (Willd.) J. Sm.	Calaguala	Grass
151	Primulaceae	*Ardisia sp.*		Shrub
152	Primulaceae	*Parathesis sp.*		Shrub
153	Rubiaceae	*Faramea occidentalis* (L.) A. Rich.		Shrub
154	Rubiaceae	*Genipa americana* L.	Jagua	Tree
155	Rubiaceae	*Hoffmannia sp.*		Shrub
156	Rubiaceae	*Psychotria poeppigiana* Müll. Arg.	Flor de beso	Grass
157	Rubiaceae	*Psychotria sp.*		Shrub
158	Rutaceae	*Esenbeckia sp.*		Tree

No.	Family	Species	Common name	Habit
159	Rutaceae	*Citrus aurantifolia* Swingle	Limon	Shrub
160	Rutaceae	*Citrus aurantium* L.	Naranja	Shrub
161	Rutaceae	*Zanthoxylum ekmanii* (Urb.) Alain	Cedro espino	Tree
162	Salicaceae	*Laetia procera* (Poepp.) Eichler	Magaleto	Tree
163	Salicaceae	*Macrohasseltia macroterantha* (Standl. & L.O. Williams)	Huecito	Tree
164	Sapinadaceae	*Nephelium lappaceum* L.	Licha y/o Rambután	Tree
165	Sapinadaceae	*Matayba oppositifolia* (A. Rich.) Britton	Limonaria	Tree
166	Sapotaceae	*Pouteria mammosa* (L.) Cronquist	Sapote	Tree
167	Selaginellaceae	*Selaginella sp.*		Grass
168	Simaroubaceae	*Simarouba glauca* DC.	Negrito	Tree
169	Solanaceae	*Lycianthes sp.*		Shrub
170	Solanaceae	*Solanum hirtum* Vahl		Shrub
171	Solanaceae	*Solanum linnaeanum* Hepper & P.-M.L.Jaeger		Grass
172	Thelypteridaceae	*Thelypteris hispidula* (Decne.) C.F. Reed	Canastilla	Fern
173	Ulmaceae	*Ampelocera hottlei* (Standl.) Standl.	Barrenillo	Tree
174	Ulmaceae	*Ulmus ser. Mexicanae* L.K. Fu	Membrillo	Tree
175	Urticaceae	*Cecropia peltata* L.	Guarumo	Tree
176	Urticaceae	*Pilea ecboliophylla* Donn. Sm.		Shrub
177	Urticaceae	*Urera baccifera* (L.) Gaudich. ex Wedd.	Pan caliente	Shrub
178	Verbenaceae	*Lantana sp*.	Cinco negritos	Grass
179	Vitaceae	*Cissus erosa* Rich.		Grass
180	Zingiberaceae	*Costus pulverulentus* C. Presl		Grass
181	Zingiberaceae	*Elettaria cardamomum* (L.) Maton	Cardamomo	Grass
182	Zingiberaceae	*Hedychium coronarium* J. Koenig	Mariposa	Grass

ANNEX 2. LIST OF HERPETOFAUNA FAMILIES IN THE STUDY AREA OF THE JILAMITO HYDROLECTRIC PROJECT

Table 2

Item	Order/Family	No. of species
	Caudata (salamanders)	
1	Pletodontidae (salamanders)	7
	Anura (toads and frogs)	
2	Bufonidae (toads)	3
3	Centrolenidae (glass frogs)	3
4	Craugastoridae (Rain frogs)	10
5	Hylidae (tree frogs)	5
6	Leptodactylidae (puddle frogs)	2
7	Ranidae (real frogs)	1
	Squamata (Lizards and snakes)	
8	Anguidae (Lizard)	1
9	Corytophanidae (Basilisk)	3
10	Dactyloidae (Anoles)	10
11	Geckonidae (Geckos)	1
12	Gymnophtalmidae (Lizards)	1
13	Iguanidae (Iguanas)	1
14	Mabuyidae (Lizards)	1
15	Phrynosomatidae	1
16	Phyllodactilidae (Gecko)	1
17	Polycrotidae (Monkey lizard)	1
18	Scincidae (Lizards)	1
19	Sphaerodactylidae (Dwarf Geckos)	2
20	Sphaenomorphidae (Lizards)	1
21	Teiidae (whiptails)	3
22	Xanthusidae (Night lizards)	1
23	Boidae (Boa)	1
24	Charinidae (Dwarf Boa)	1
25	Colubridae (snakes)	16
26	Dipsadidae (snakes)	15
27	Elapidae (Coral snakes)	1
28	Viperidae (viper)	5
Total species		**99**

List of registered species with general altitudinal range distribution, micro habitat and abundance of species according to area of encounter, per Wilson & McCranie (2004) and Wilson & Townsend (2007)

Table No. 3

Item	Species	Distribution	Altitudinal Range	Microhabitat	Abundance
1	*Incilius leucomyos*	H	0 - 1600	Te, Fo	C
2	*Rhinella horribilis*	WS	0 - 1435	Te, Fo, Ps	C
3	*Hyalinobatrachium fleschmanni*	WS	0 - 1550	Ar, St	C
4	*Teratohyla pulverata*	WS	100 - 950	Ar, St	R
5	*Craugastor aurilegulus*	H	50 - 1550	Te, St	C
6	*Craugastror chac*	NCA	20 - 1000	Te, Fo	R
7	*Craugastor laticeps*	NCA	650 - 1500	Te, Fo	R
8	*Craugastor noblei*	WS	40 - 1170	Te, Fo	I
9	*Atlantihyla cf spinipollex*	H	160 - 1580	Ar, St	C
10	*Duellmanohyla salvavida*	H	90 - 1400	Ar, St	I
11	*Plectrohyla chrysopleura*	H	930 - 1550	Ar, Te, Fo	I
12	*Smilisca baudinii*	WS	0 - 1610	Ar, Ps	C
13	*Leptodactylus fragilis*	WS	0 - 1530	Te, Ps	C
14	*Bolitoglossa nympha*	NCA	30 - 1400	Te, Fo	I
15	*Basiliscus vitattus*	WS	0 - 1400	Ar, Fo, St	C
16	*Corytophanes cristatus*	WS	0 - 1300	Ar, Fo	C
17	*Norops biporcatus*	WS	0 - 950	Ar, Fo	I
18	*Norops lemurinus*	WS	0 - 960	Ar, Fo	I
19	*Norops loveridgei*	H	550 - 1600	Ar, Fo	I
20	*Norops yoroenesis*	H	1180 - 1600	Ar, Fo	I
21	*Norops zeus*	H	90 - 900	Ar, Fo	I
22	*Marisora brachypoda*	NCA	0 - 1510	Te, Fo	C
23	*Thecadactylus rapicauda*	WS	0 - 750	Ar. Fo	I
24	*Pleistioson sumichrastri*	WS	30 - 880	Te, Fo	I
25	*Sphaerodactylus continenetalis*	NCA	0 - 1100	Ar, Fo	I
26	*Scincella cherriei*	WS	0 - 1860	Te, Fo	C
27	*Holcosus festivus*	WS	0 - 1400	Te, Fo	I
28	*Lepidophyma flavimaculatum*	WS	1 - 1400	Te, Fo	I
29	*Chironius grandisquamis*	WS	0 - 990	Ar, Fo	C
30	*Dendrophidion rufiterminorum*	WS	30 - 1000	Te, Fo	R
31	*Drymobius chloroticus*	WS	780 - 1900	Te, Fo, St	I

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Item	Species	Distribution	Altitudinal Range	Microhabitat	Abundance
32	*Leptophis continentalis*	WS	0 - 1680	Ar, Ps, St	C
33	*Tantilla excelsa*	H	30 -700	Te, Fo	R
34	*Coniophanes fissidens*	WS	0 - 1300	Te, Fo	I
35	*Imantodes cenchoa*	WS	0 - 1620	Ar, Fo	C
36	*Leptodeira septentrionalis*	WS	0 - 1940	Ar, Ps, St	I
37	*Sibon dimidiatus*	WS	950 - 1600	Ar, Fo	I
38	*sibon nebulatus*	WS	0 - 1690	Ar, Fo, St	C
39	*Micrurus nigrocinctus*	WS	0 - 1600	Te, Fo	C
40	*Atropoides mexicanus*	WS	0 - 1300	Te, Fo	C
41	*Bothriechis guifarroi*	H	1015-1450	Ar, Fo, St	R
42	*Bothriechis schlegelii*	WS	0 - 1300	Ar, Fo, St	I

Geographic Distribution --WS = generalized out of the Central American core area; NCA = restricted to sites within the Central American core area; H = Endemic of Honduras; EX = exotic. Microhabitat used: Ar = arboreal, Te = terrestrial, Fo = forest dweller, Ps = shore of ponds, St = lives in streams and/or river; Relative abundance: Common (C) = is regularly found, many individuals are found; Infrequent (I) = occurrence cannot be predicted; few individuals are seen; Rare (R) = it is rarely seen.

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List of herpetofauna detected in the study area of the Jilamito Hydrolectric Project

Table No. 4

Amphibians and Reptiles in the Study Area		
Item	Order/Family/Species	Common name
	ANURA	
	Bufonidae (Toads)	
1	*Incilius leucomyos*	Central forest Toad
2	*Rhinella horribilis*	Toad
	Centrolenidae (Glass frog)	
3	*Hyalinobatrachium fleschmanni*	Glass frog
4	*Teratohyla pulverata*	Glass frog
	Craugastoridae (Rain frog)	
5	*Craugastor aurilegulus*	Rain frog
6	*Craugastror chac*	Rain frog
7	*Craugastor laticeps*	Rain frog
8	*Craugastor noblei*	Rain frog
	Hylidae (Tree frog)	
9	*Atlantihyla cf spinipollex*	Climbing frog
10	*Duellmanohyla salvavida*	Red-eyed stream frog
11	*Plectrohyla chrysopleura*	Climbing frog
12	*Smilisca baudinii*	Climbing frog
	Leptodactylidae	
13	*Leptodactylus fragilis*	Puddle frog
	CAUDATA	
	Plethodontidae	
14	*Bolitoglossa nympha*	Salamander
	SQUAMATA (Lizards and snakes)	
	Corytophanidae (Basiliscus)	
15	*Basiliscus vitattus*	Basiliscus
16	*Corytophanes cristatus*	Chameleon
	Dactyloidae (Small lizards - Pichetes bandera)	
17	*Norops biporcatus*	Pichete bandera (small lizard)
18	*Norops lemurinus*	Pichete bandera (small lizard)
19	*Norops loveridgei*	Giant lizard
20	*Norops yoroenesis*	Pichete bandera (small lizard)
21	*Norops zeus*	Pichete bandera (small lizard)
	Mabuyidae (Lisas)	
22	*Marisora brachypoda*	Lisa (lizard)

Amphibians and Reptiles in the Study Area		
Item	Order/Family/Species	Common name
	Phyllodactilidae (Geckos)	
23	*Thecadactylus rapicauda*	Giant gecko
	Scincidae (Lisas)	
24	*Pleistioson sumichrastri*	Lisa (lizard)
	Sphaerodactylidae (Geckos enanos)	
25	*Sphaerodactylus continentalis*	Dwarf gecko
	Sphaenomorphidae (Lisas)	
26	*Scincella cherriei*	Lisa (lizard)
	Teiidae (Coujinas)	
27	*Holcosus festivus*	Coujina (lizard)
	Xanthusiidae (Night lizards)	
28	*Lepidophyma flavimaculatum*	Night lizard
	Colubridae (Snakes)	
29	*Chironius grandisquamis*	Ecuador Sipo
30	*Dendrophidion rufiterminorum*	Green Tamagas
31	*Drymobius chloroticus*	Green Tamagas
32	*Leptophis continentalis*	Green Tamagas
33	*Tantilla ecxelsa*	Snake
	Dipsadidae (Snakes)	
34	*Coniophanes fissidens*	Yellowbelly snake
35	*Imantodes cenchoa*	Blunthead tree snake
36	*Leptodeira septentrionalis*	*Northern Cat-eyed Snake*
37	*Sibon dimidiatus*	Slender snail sucker
38	*Sibon nebulatus*	Clouded snake
	Elapidae (Coral snakes)	
39	*Micrurus nigrocinctus*	Coral snake
	Viperidae (Viper)	
40	*Atropoides mexicanus*	Central American Jumping Pit Viper
41	*Bothriechis guifarroi*	Palm viper
42	*Bothriechis schlegelii*	Eyelash palm pitviper

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List of registered species with their environmental vulnerability status (EVS), status of conservation of the stock in their country, according to IUCN and CITES status, based on Mejía & House (2008); Wilson & Townsend (2007); Townsend & Wilson (2010), and Johnson et al. (2015)

Table No. 5

Item	Species	EVI/Category		Conservation status	UICN - Red list	List of Special Concern (Country level)	CITES
1	*Incilius leucomyos*	12	Medium	D	EN	X	N/A
2	*Rhinella horribilis*	3	Low	Es	LC	N/A	N/A
3	*Hyalinobatrachium fleschmanni*	8	Low	ND	LC	N/A	N/A
4	*Teratohyla pulverata*	12	Medium	ND	LC	N/A	N/A
5	*Craugastor aurilegulus*	15	High	D	EN	N/A	N/A
6	*Craugastror chac*	16	High	ND	NT	N/A	N/A
7	*Craugastor laticeps*	12	Medium	ND	NT	N/A	N/A
8	*Craugastor noblei*	16	High	ND	LC	N/A	N/A
9	*Atlantihyla cf spinipollex*	12	Medium	D	EN	N/A	N/A
10	*Duellmanohyla salvavida*	13	Medium	D	CR	N/A	N/A
11	*Plectrohyla chrysopleura*	13	Medium	D	CR	N/A	N/A
12	*Smilisca baudinii*	3	Low	Es	LC	N/A	N/A
13	*Leptodactylus fragilis*	5	Low	Es	LC	N/A	N/A
14	*Bolitoglossa nympha*	16	Low	ND	NE	N/A	N/A
15	*Basiliscus vitattus*	7	Low	Es	NE	N/A	N/A
16	*Corytophanes cristatus*	10	Medium	Es	NE	N/A	N/A
17	*Norops biporcatus*	9	Low	ND	NE	N/A	N/A
18	*Norops lemurinus*	7	Low	Es	NE	N/A	N/A
19	*Norops loveridgei*	14	High	Es	EN	N/A	N/A
20	*Norops yoroenesis*	15	High	Es	NE	N/A	N/A
21	*Norops zeus*	15	High	Es	NE	N/A	N/A
22	*Marisora brachypoda*	6	Low	Es	LC	N/A	N/A
23	*Thecadactylus rapicauda*	8	Low	Es	NE	N/A	N/A
24	*Pleistioson sumichrastri*	12	Medium	D	LC	N/A	N/A
25	*Sphaerodactylus continentalis*	15	High	Es	LC	N/A	N/A
26	*Scincella cherriei*	7	Low	ND	LC	N/A	N/A
27	*Holcosus festivus*	6	Low	ND	LC	N/A	N/A
28	*Lepidophyma flavimaculatum*	9	Low	ND	LC	N/A	N/A
29	*Chironius grandisquamis*	11	Medium	D	LC	N/A	N/A
30	*Dendrophidion rufiterminorum*	16	High	ND	NE	N/A	N/A
31	*Drymobius chloroticus*	8	Low	ND	LC	N/A	N/A

Item	Species	EVI/Category		Conservation status	UICN - Red list	List of Special Concern (Country level)	CITES
32	*Leptophis continentalis*	10	Medium	ND	NE	N/A	N/A
33	*Tantilla ecxelsa*	19	High	ND	NE	N/A	N/A
34	*Coniophanes fissidens*	7	Low	Es	LC	N/A	N/A
35	*Imantodes cenchoa*	6	Low	ND	NE	N/A	N/A
36	*Leptodeira septentrionalis*	7	Low	Es	LC	N/A	N/A
37	*Sibon dimidiatus*	10	Medium	ND	LC	N/A	N/A
38	*sibon nebulatus*	5	Low	ND	NE	N/A	N/A
39	*Micrurus nigrocinctus*	10	Medium	Es	LC	N/A	**III**
40	*Atropoides mexicanus*	11	Medium	ND	LC	N/A	N/A
41	*Bothriechis guifarroi*	19	High	D	NE	N/A	N/A
42	*Bothriechis schlegelii*	11	Medium	ND	NE	N/A	N/A

Symbology: EVI (Environmental Vulnerability Index) 3-9 Low, 10-13 medium, and 14-19 High. General Conservation Status for species: Es - Stable populations, D - All known populations are declining, ND - No data. Pursuant to the Red List of UICN. CR = in critical danger, EN = Endangered, VU = Vulnerable, NT = Near threathened, LC = Least concern, DD = Data deficient, and y NE = Not evaluated. According to the Special Concern List: X (Applicable), Not Applicable =N/A, and according to CITES categories: I, II, III y N/A = Not Applicable.

Relative Abundance per Transect and Opportunistic Sightings

Table Nº 6 – Relative opportunistic abundance by species

Item	Species	# of Individuals	Total Individuos per all Sites	Location	# de Persons	Duration - Hrs	Total Hrs among all areas	OP_ Relative Abundance (Pi)	OP_% Relative Abundance (Pi)
1	*Incilius leucomyos*	4	**9**	La Quebradona	6	6	14	1.555555556	155.5555556
		1		Penstock and Cable car	6	6			
		4		Los Olivitos	7	4			
2	*Craugastor aurilegulus*	4	**15**	Powerhouse - Downstream	7	6	20	0.75	75
		1		Penstock and Cable car	6	6			
		4		La Quebradona	6	4			
		6		Los Olivitos	7	4			
3	*Atlantihyla aff Spinipollex*	3	**44**	La Quebradona	6	4	24	1.833333333	183.3333333
		10		Los Olivitos	7	4			
		3		Main water intake	4	6			
		20		Quebrada El Danto	5	4			
		8		Upstream Jilamito River	5	6			
4	*Duellmanohyla salvavida*	14	**47**	Powerhouse - Downstream	7	6	30	1.566666667	156.6666667
		2		Main water intake	4	6			
		1		Secondary water intake	4	6			
		10		Los Olivitos	7	4			
		14		Quebrada El Danto	5	4			
		6		Upstream Jilamito River	5	4			
5	*Plectrohyla chrysopleura**	1	**8**	Quebrada El Danto	5	4	8	1	100
		7		Upstream Jilamito River	5	4			
6	*Norops loveridgei*	1	**1**	Upstream Jilamito River	5	4	4	0.25	25

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Item	Species	# of Individuals	Total Individuos per all Sites	Location	# de Persons	Duration - Hrs	Total Hrs among all areas	OP_ Relative Abundance (Pi)	OP_% Relative Abundance (Pi)
7	*Norops yoroensis**	1	**5**	Campamento - Pressure pipe	6	6	20	0.25	25
		1		Secondary water intake	4	6			
		2		Quebrada El Danto	5	4			
		1		Upstream Jilamito River	5	4			
8	*Norops zeus**	2	**3**	La Quebradona	6	4	10	0.3	30
		1		Penstock - Cable car	6	6			
9	*Tantilla excelsa*	1	**1**	Los Olivitos	7	4	4	0.25	25
10	*Bothriechis guifarroi**	1	**4**	Main water intake	4	6	10	0.4	40
		3		Upstream Jilamito River	5	4			

Tabla Nº 7 – Relative abundance transects per species

Item	Species	# de Individuals	Total of Individuals per all T	# of Transect	Area M2	Location	# de Persons	Duration - Hrs	Relative Abundance (Pi)	T_% of Relative Abundance
1	*Craugastor aurilegulus*	5	**5**	T2	600	Downstream Powerhouse	4	3	0.064935065	**6.493506494**
2	*Atlantihyla aff spinipollex*	1	**20**	T8	200	Main water intake	4	3	0.25974026	**25.97402597**
		15		T9	600	Secondary water intake	4	3		
		4		T10	600	Secondary water intake	4	3		
3	*Duellmanohyla salvavida*	5	**38**	T3	600	Mountain camp/Pressure pipe	4	3	0.493506494	**49.35064935**
		1		T4	600		4	3		
		5		T5	400		4	3		
		9		T7	600	Main water intake	4	3		
		7		T8	200		4	3		
		2		T9	600	Secondary water intake	4	3		
		9		T10	600		4	3		
4	*Norops yoroenesis*	1	**9**	T4	600	Mountain camp/Pressure pipe	4	3	0.116883117	**11.68831169**
		1		T5	600		4	3		
		1		T6	400	Botaderos	4	3		
		1		T7	600	Main water intake	4	3		
		1		T8	200		4	3		
		3		T9	600	Secondary water intake	4	3		
		1		T10	600		4	3		
5	*Norops zeus*	2	**5**	T1	600	Powerhouse	4	3	0.064935065	**6.493506494**
		1		T2	600		4	3		
		1		T4	600	Mountain camp/Pressure pipe	4	3		
		1		T5	400		4	3		
Total number of individuals among all species			**77**							

Relative abundance is to be understood as the relation between the number of individuals and a given area or an effort within a period of time.

Observation of endemic species in the study area of the Jilamito Hydroelectric Project

Table Nº 8

Item	Project area	Location	Coordinates/Elev./Transects/Observations								Species	Additional Information
			# of Transect (T)/Oppor-tunist (OP)	Beginning		Elev. (M)	Final		Elev. M	Distance (M)		
1	Area of direct influence	Area of the Powerhouse	T1	465677	1719405	291	465656	1719258	296	150	*Norops zeus*	These transects are not located on the structure. The sampled sites belong 200 m downstream below this structure.
			T2	465677	1719563	265	465583	1719507	281	150	*Craugastor aurilegulus* *Norops zeus*	
			OP	465677	1719405	291	Coordenate for reference				*Duellmanohyla salvavida*	
2		Penstock and Aerial tram	OP	466461	1718611	617	Coordenate for reference for the mentioned species				*Incilius leucomyos*	
			OP	466278	1718873	617					*Craugastor aurilegulus*	
3		Mountain camp/Pressure pipeline	T3	466717	1718316	745	466562	1718304	711	150	*Duellmanohyla salvavida*	T3: Corresponds to the site called El Derrumbe: T4: Is over the penstock; T5 Intermittent creek called Champa-Esin
			T4	466883	1718151	829	467003	1718047	869	150	*Norops yoroensis* *Norops zeus*	
			T5	467018	1718026	887	467002	1717932	854	100	*Norops yoroensis* *Norops zeus*	
4		Landfills	T6	467280	1717656	995	467379	1717697	1002	100	*Norops yoroensis*	

Jilamito Hydroelectric Project

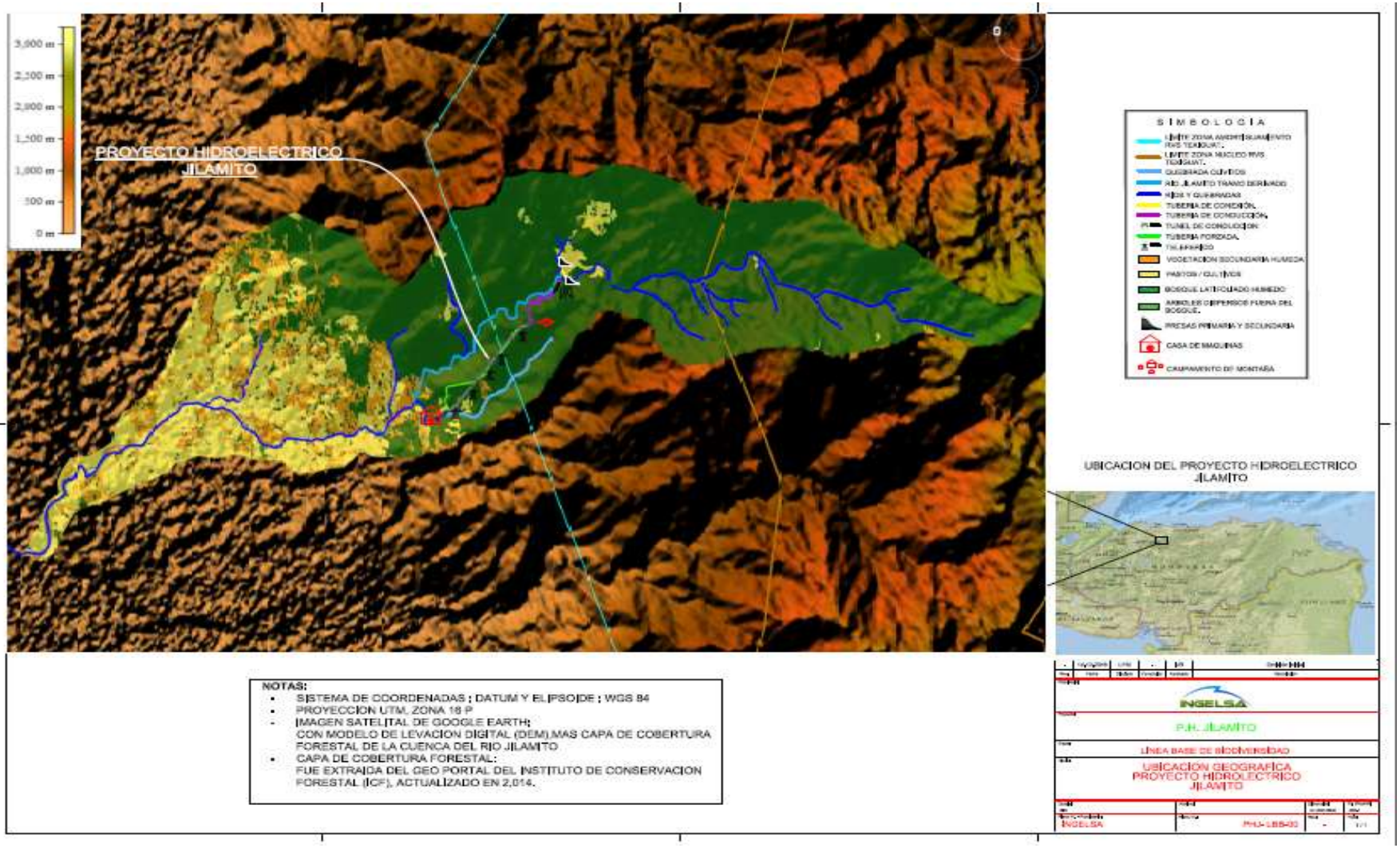
Item	Project area	Location	Coordinates/Elev./Transects/Observations								Species	Additional Information
			# of Transect (T)/Oppor-tunist (OP)	Beginning		Elev. (M)	Final		Elev. M	Distance (M)		
5		Main water intake	T7	468122	1717045	1004	468206	1717153	987	150	*Duellmanohyla salvavida*	
											Norops yoroensis	These transects are found in the main river and the secondary tributary. T9 is upstream of the secondary water intake
			T8	468155	1717128	995	468110	1717091	987	50	*Atlantihyla aff spinipollex*	
											Duellmanohyla salvavida	
											Norops yoroensis	
			OP	468135	1717060	1013					*Bothriechis guifarroi*	
6		Secondary water intake	T9	468556	1717128	1023	468698	1717094	1056	150	*Atlantihyla aff spinipollex*	
											Duellmanohyla salvavida	
											Norops yoroensis	
			T10	468435	1717189	1008	468311	1717150	999	150	*Atlantihyla aff spinipollex*	
											Duellmanohyla salvavida	
											Norops yoroensis	
7	**Control areas**	La Quebradona	OP	467261	1719084	737	These three coordenates are for reference for all the mentioned species.				*Incilius leucomyos*	
			OP	467383	1718966	731					*Craugastor aurilegulus*	
			OP	467159	1719053	738					*Atlantihyla aff spinipollex*	
			OP								*Norops zeus*	

Jilamito Hydroelectric Project

Item	Project area	Location	Coordinates/Elev./Transects/Observations						Species	Additional Information
			# of Transect (T)/Oppor-tunist (OP)	Beginning		Elev. (M)	Final	Elev. M / Distance (M)		
8		Los Olivitos Creek	OP	465778	1719097	346	All these species were observed in different points of Los Olivitos Creek		*Incilius leucomyos*	Observations were made between points were audiomoths were found
			OP	465656	1719258	316			*Craugastor aurilegulus*	
			OP	466254	1718037	574			*Atlantihyla spinipollex*	
			OP	466419	1717963	600			*Duellmanohyla salvavida*	
			OP	467065	1717354	817	Right coordenate for this species.		*Tantilla excelsa*	Last point of audiomoth of los Olivitos creek
9		Control point /El Danto Creek	OP	469008	1716959	1086	Coordinates for reference for mentioned species		*Atlantihyla aff spinipollex*	These species were seen upstream from the secondary water intake and the main water intake
			OP						*Duellmanohyla salvavida*	
			OP	468928	1716961	1128			*Plectrohyla chrysopleura*	
			OP						*Norops yoroensis*	
10		Upstream - Control point /Main water intake - Jilamito River-Water intake	OP	467924	1715570	1152	These three coordenates are for reference for all the mentioned species.		*Atlantihyla aff spinipollex*	

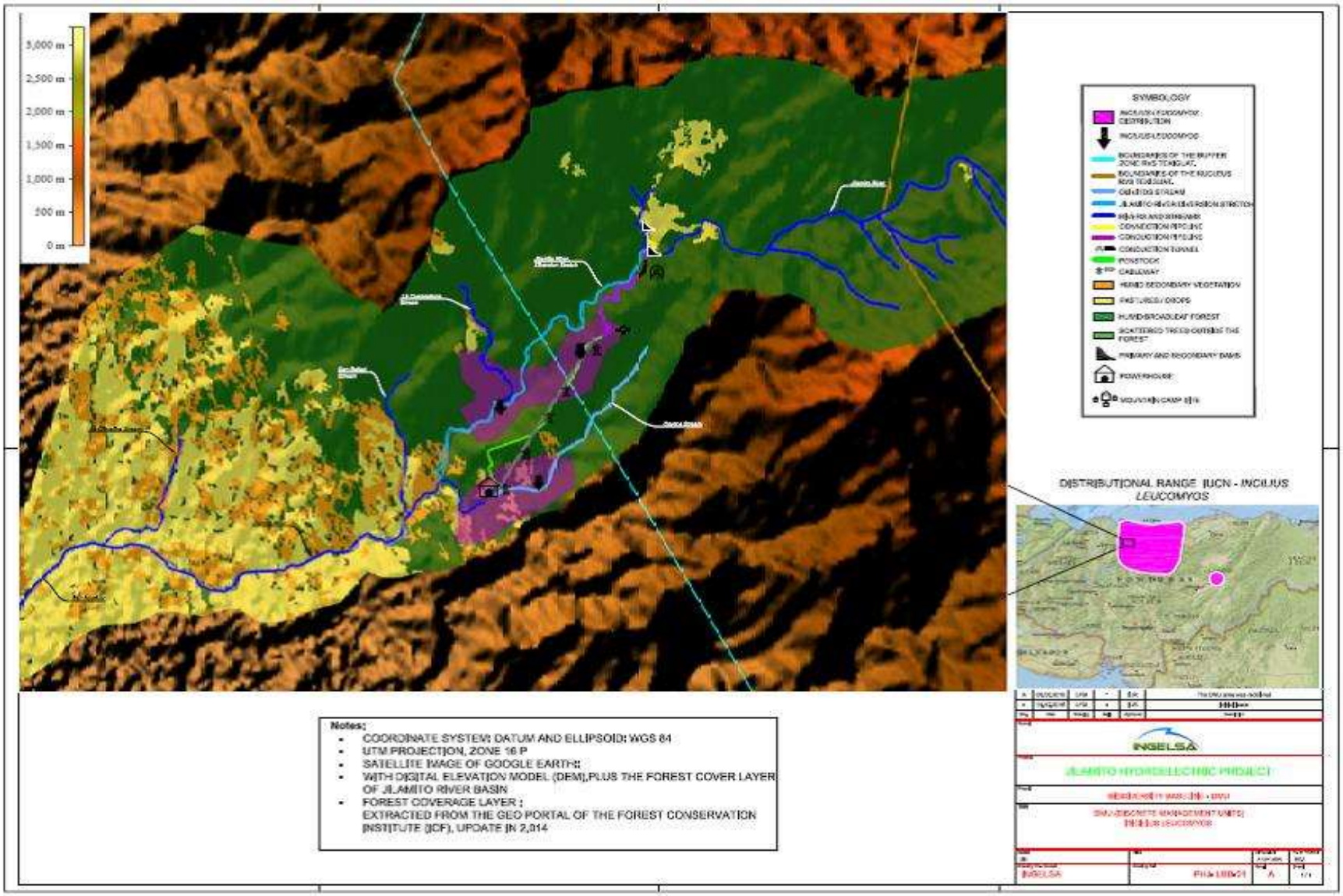
ANNEX 3. MAPS OF PROJECT LOCATION, DISTRIBUTION (DMU) PER SPECIES, TRANSECTS, AND OPPORTUNISTIC SIGHTINGS.

- Project location, Study area. (Map Nº PHJ-LBB- 0)



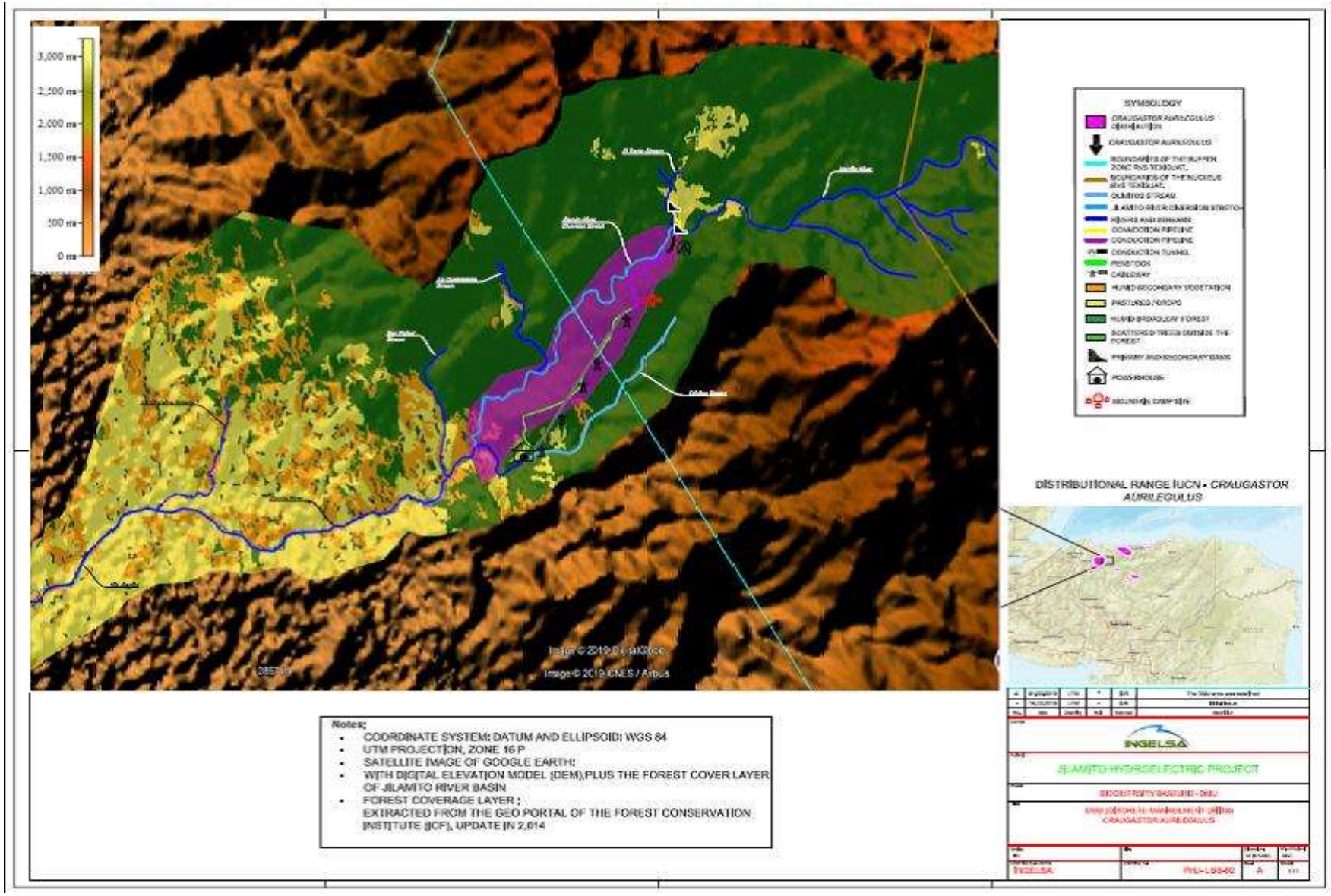
Jilamito Hydroelectric Project

- DMU Map (Discrete Management Unit) of ***Incilius Leucomyos*** (Map Nº PHJ- LBB-01)



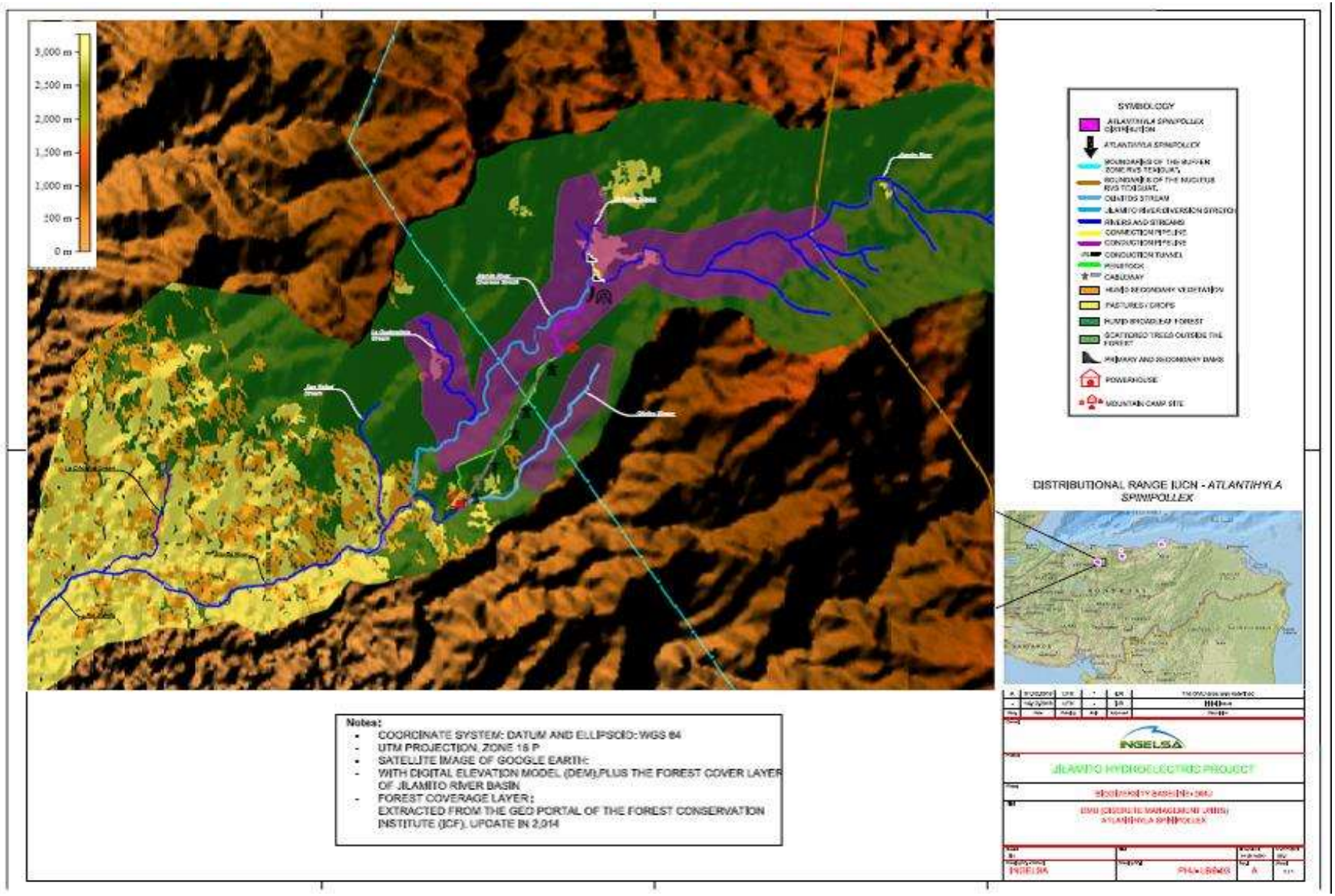
Jilamito Hydroelectric Project

- DMU Map (Discrete Management Unit) of ***Craugastor Aurilegulus*** (Map Nº PHJ- LBB-02)



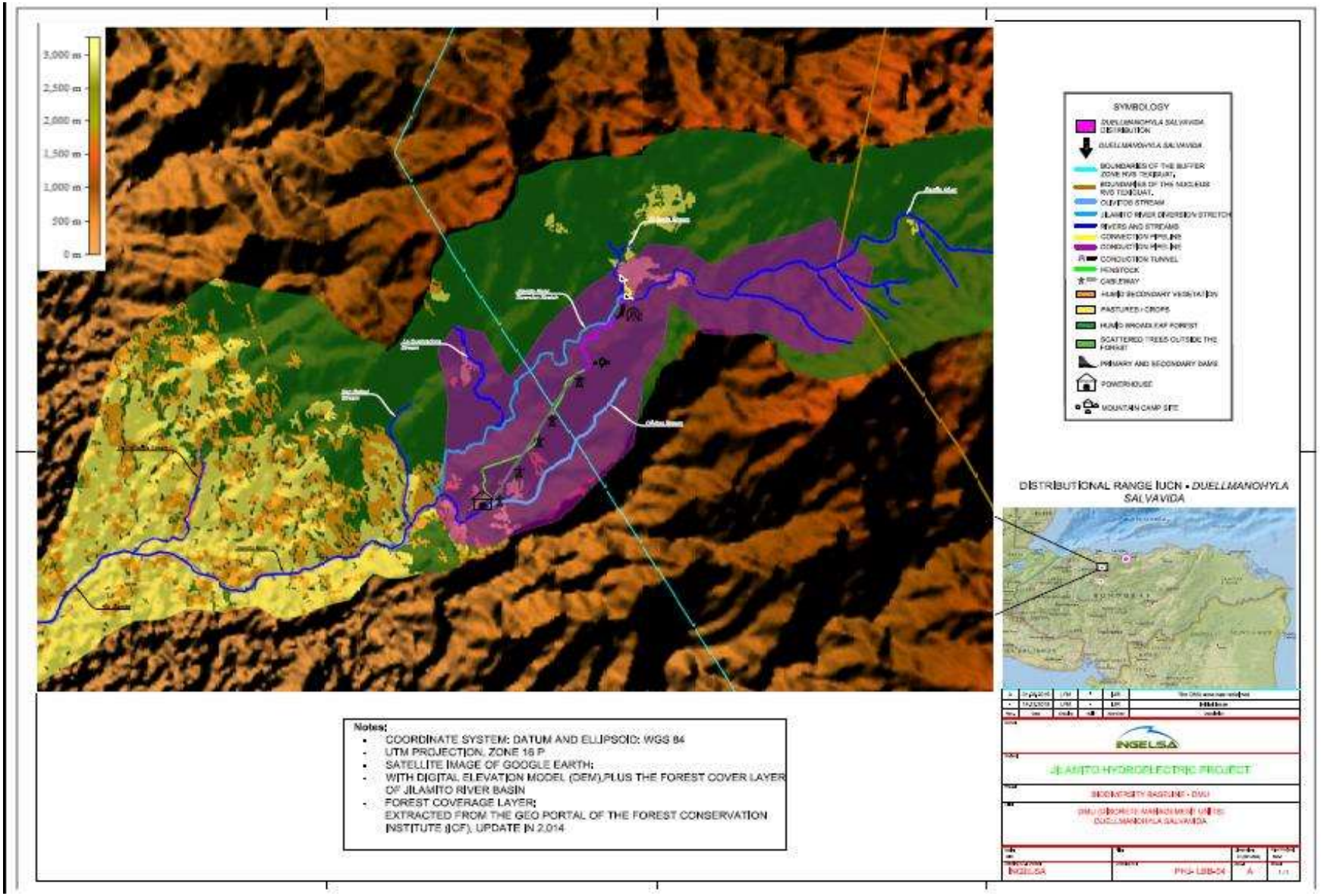
Jilamito Hydroelectric Project

- DMU Map (Discrete Management Unit) of ***Atlantihyla Spinipollex*** (Map Nº PHJ- LBB-03)

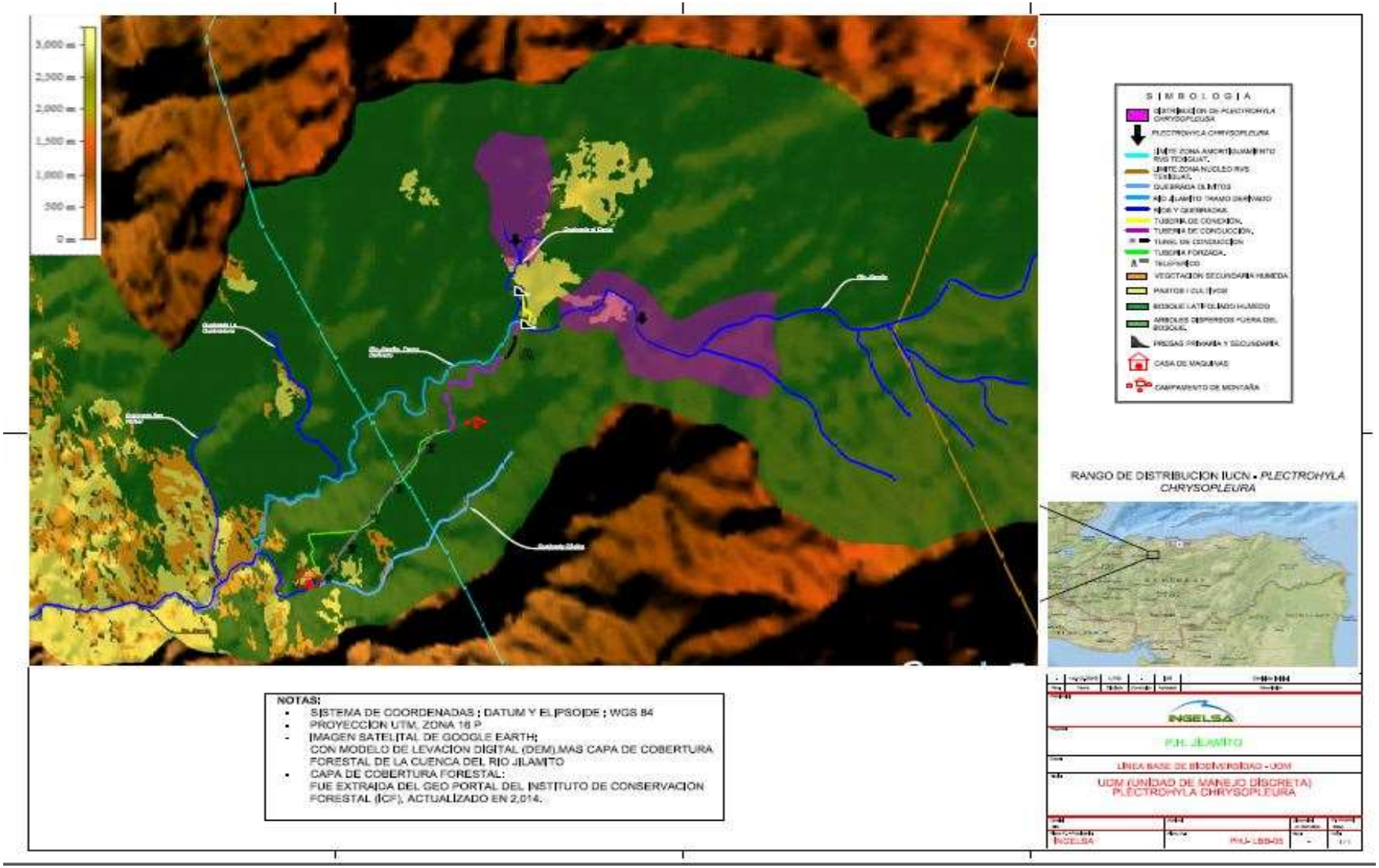


Jilamito Hydroelectric Project

- DMU Map (Discrete Management Unit) of ***Duellmanohyla salvavida*** (Map Nº PHJ- LBB-04)

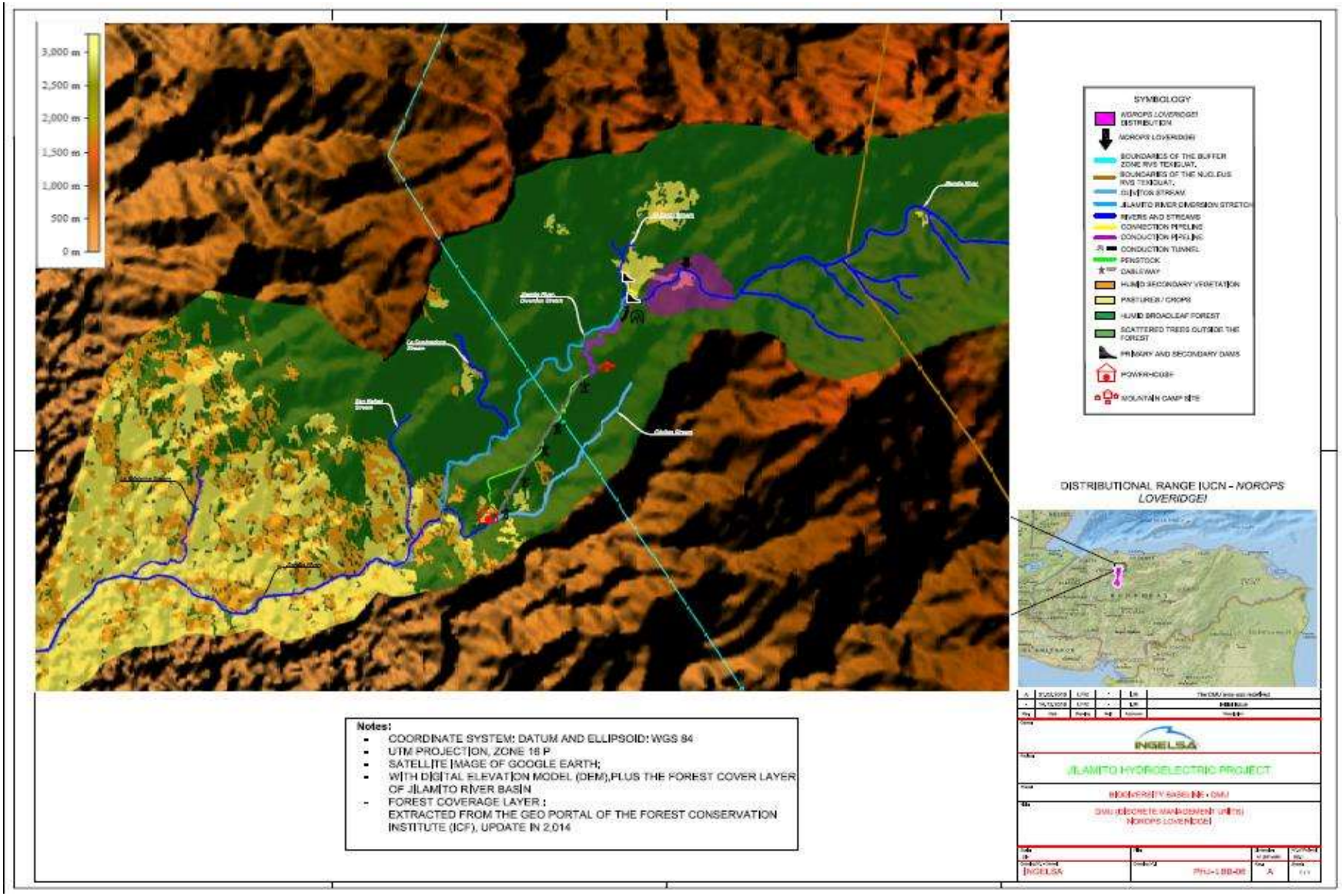


- DMU Map (Discrete Management Unit) of ***Plectrohyla Chrysopleura*** (Map Nº PHJ- LBB-05)



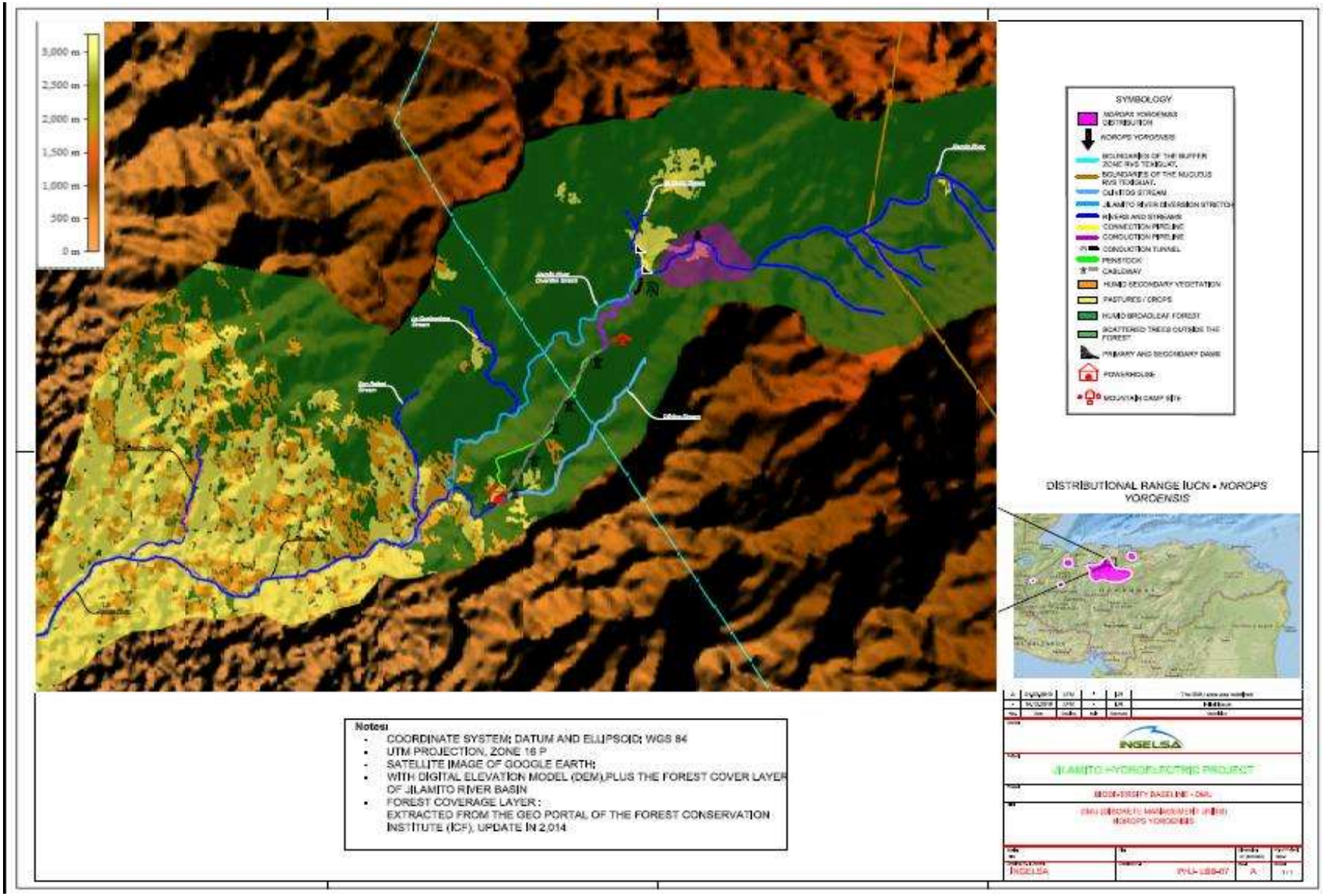
Jilamito Hydroelectric Project

- DMU Map (Discrete Management Unit) of ***Norops loveridgei*** (Map Nº PHJ- LBB-06)



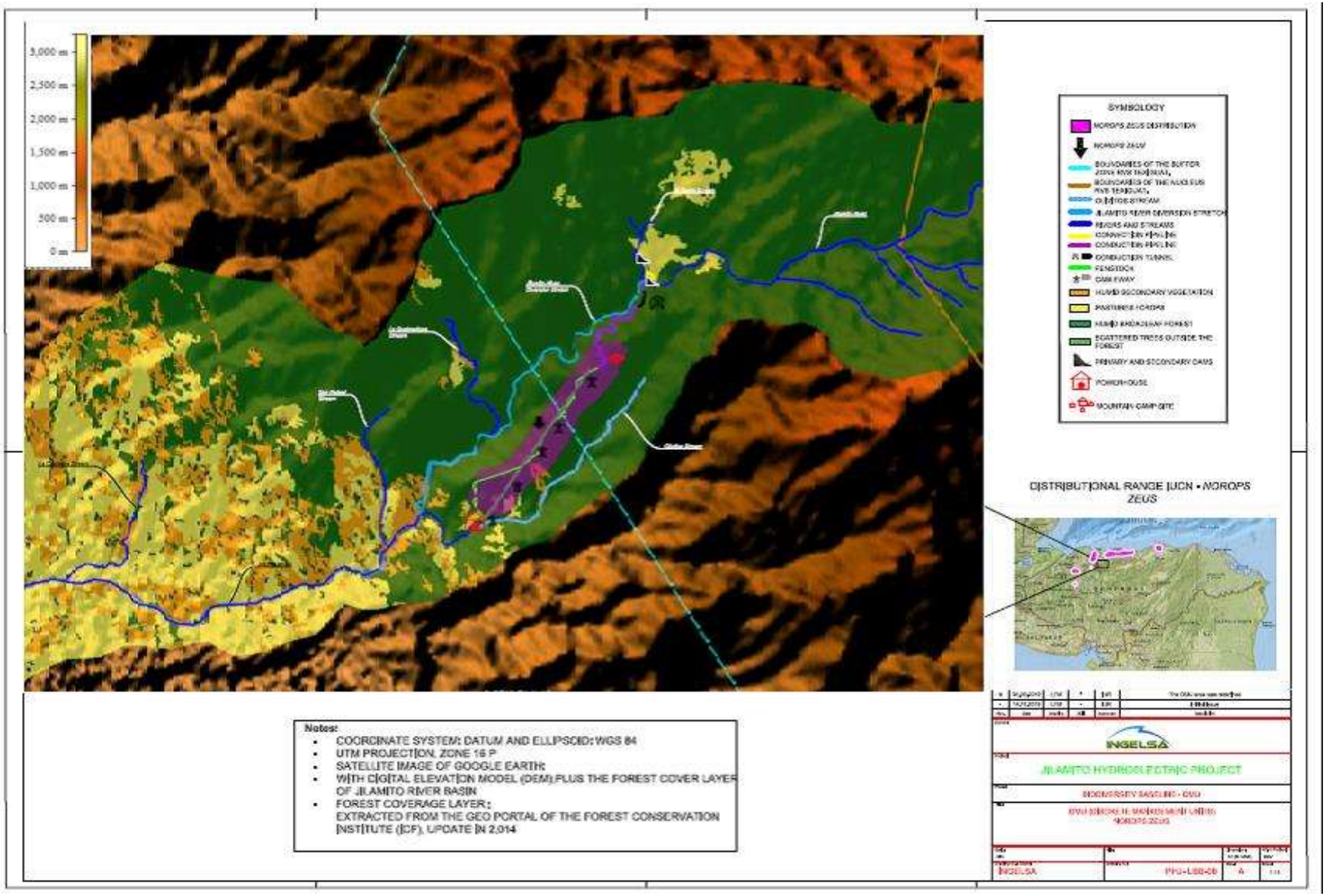
Jilamito Hydroelectric Project

- DMU Map (Discrete Management Unit) of ***Norops yoroensis*** (Map Nº PHJ- LBB-07)

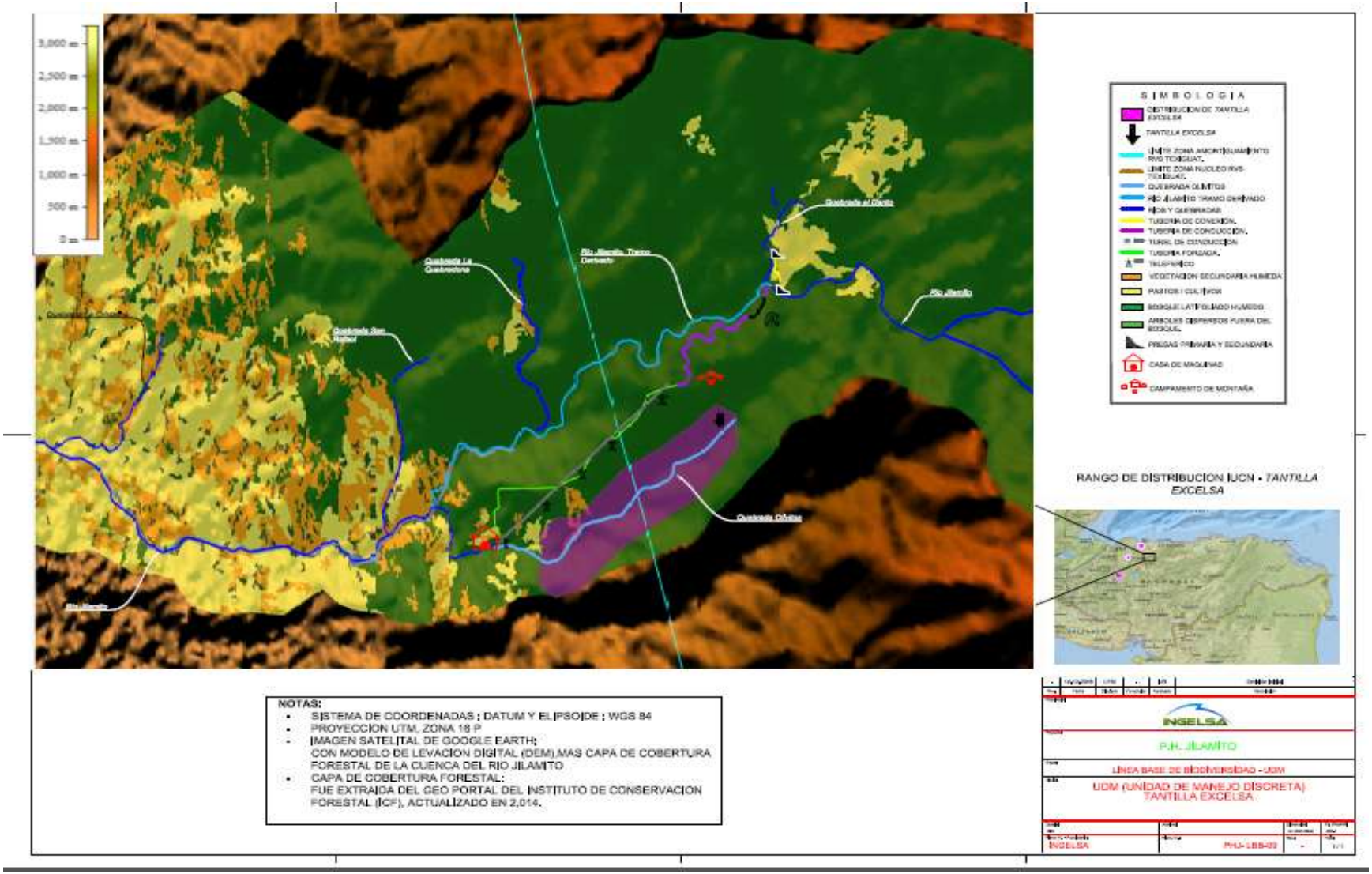


Jilamito Hydroelectric Project

- DMU Map (Discrete Management Unit) of ***Norops zeus*** (Map Nº PHJ- LBB-08)

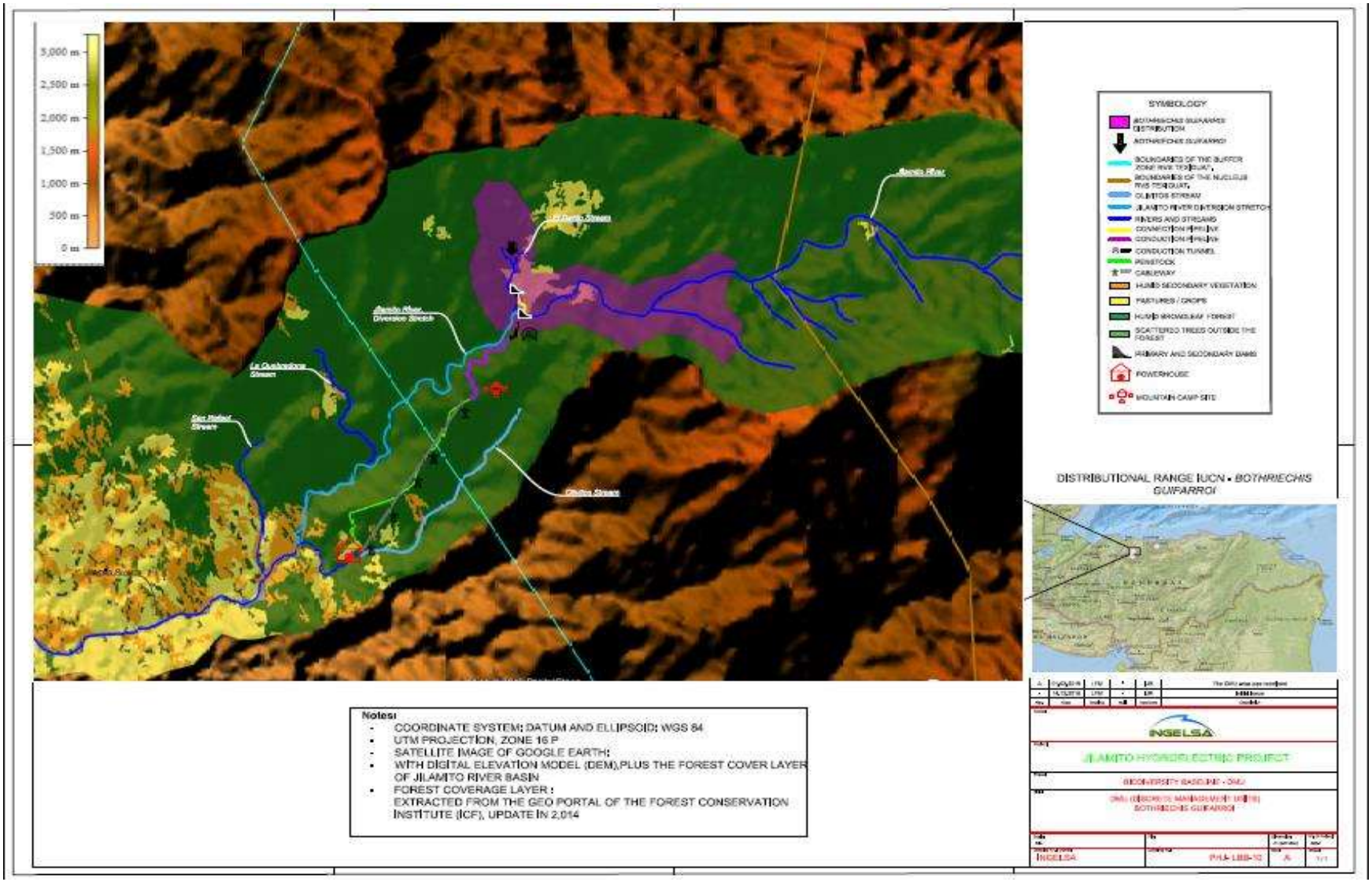


- DMU Map (Discrete Management Unit) of ***Tantilla excelsa*** (Map Nº PHJ- LBB-09)



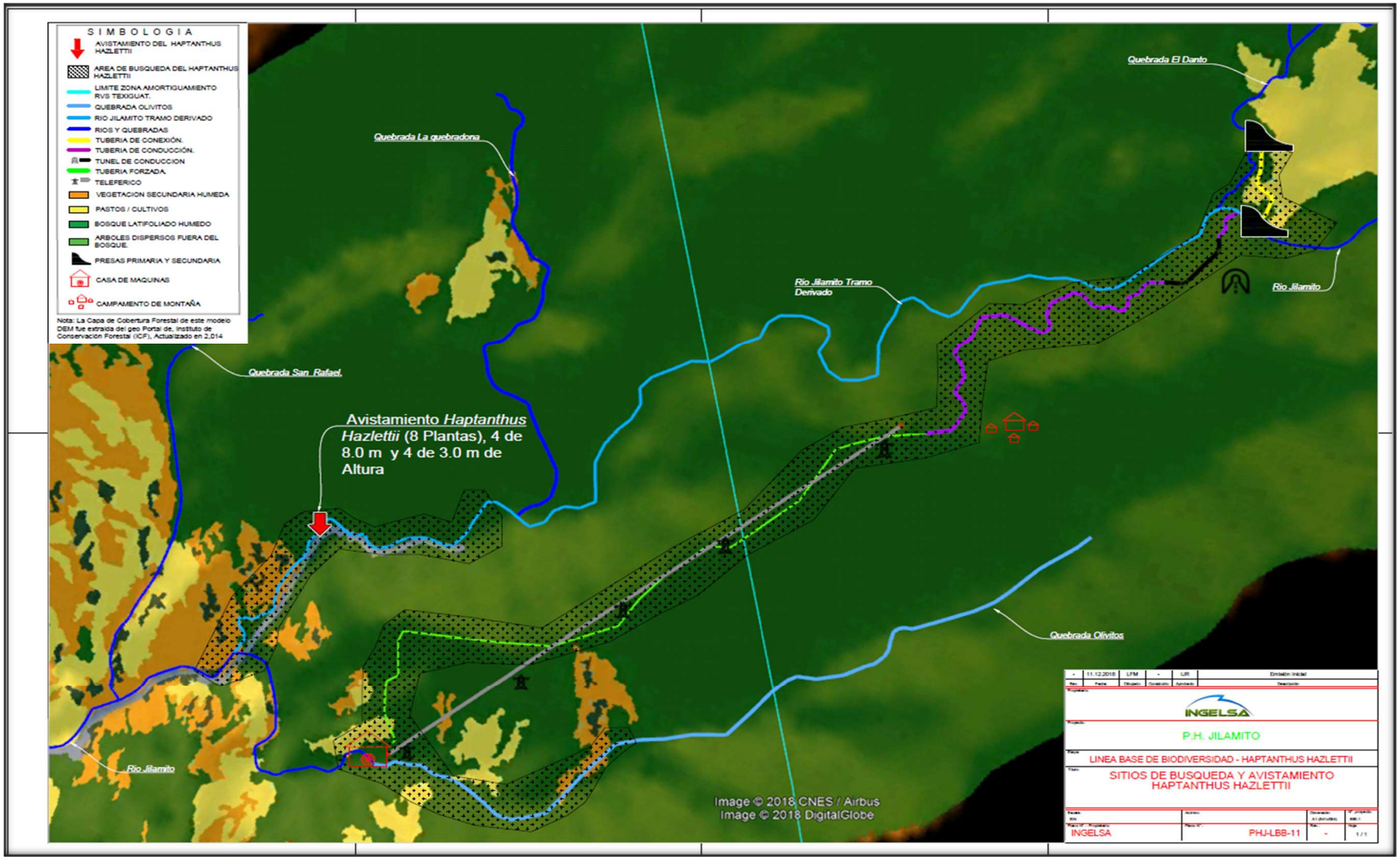
Jilamito Hydroelectric Project

- DMU Map (Discrete Management Unit) of ***Bothriechis guifarroi*** (Map Nº PHJ- LBB-10)



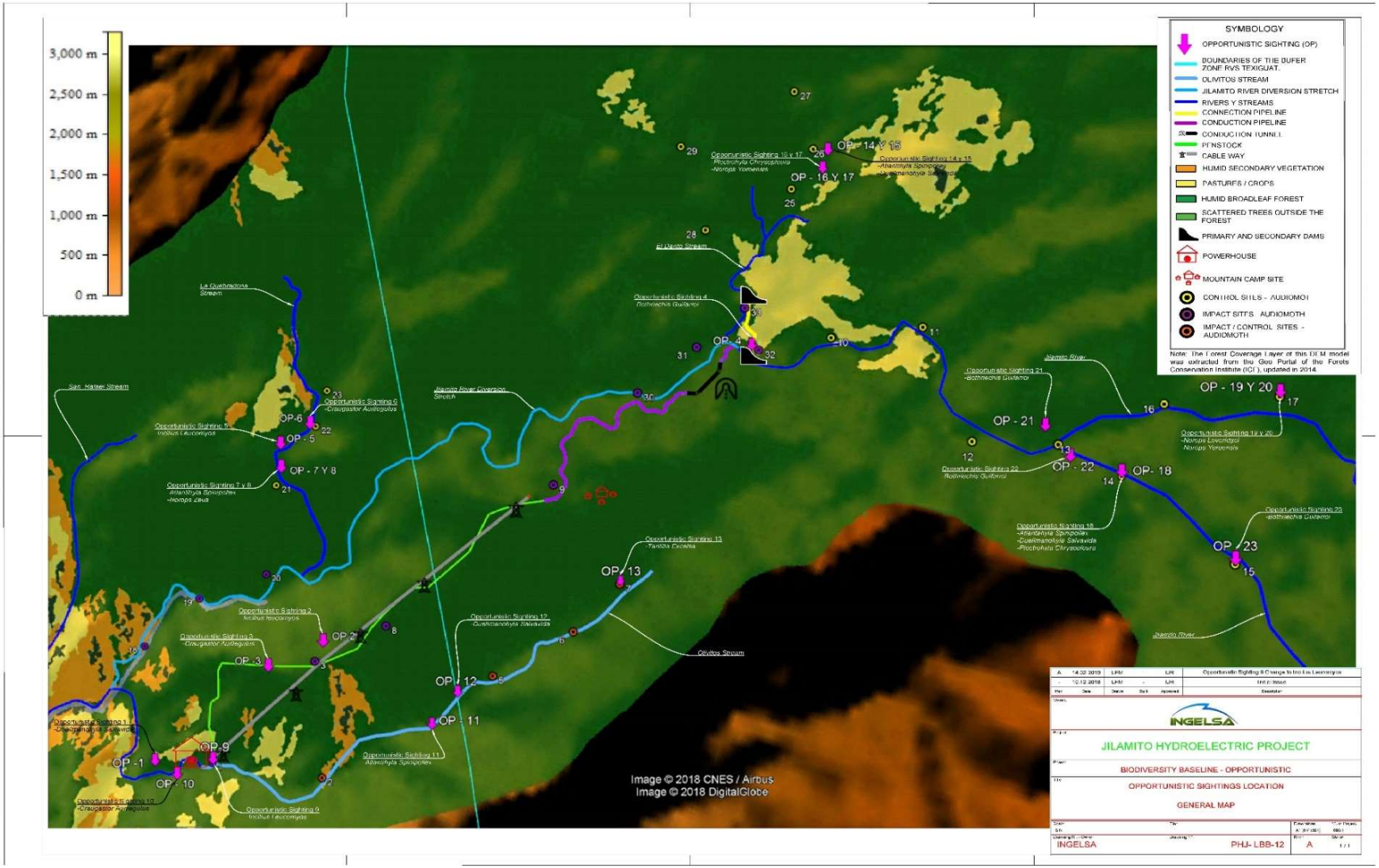
Jilamito Hydroelectric Project

- Map of comprehensive search sites for the arboreal species *Haptanthus hazlettii* (Map Nº PHJ-LBB-11)



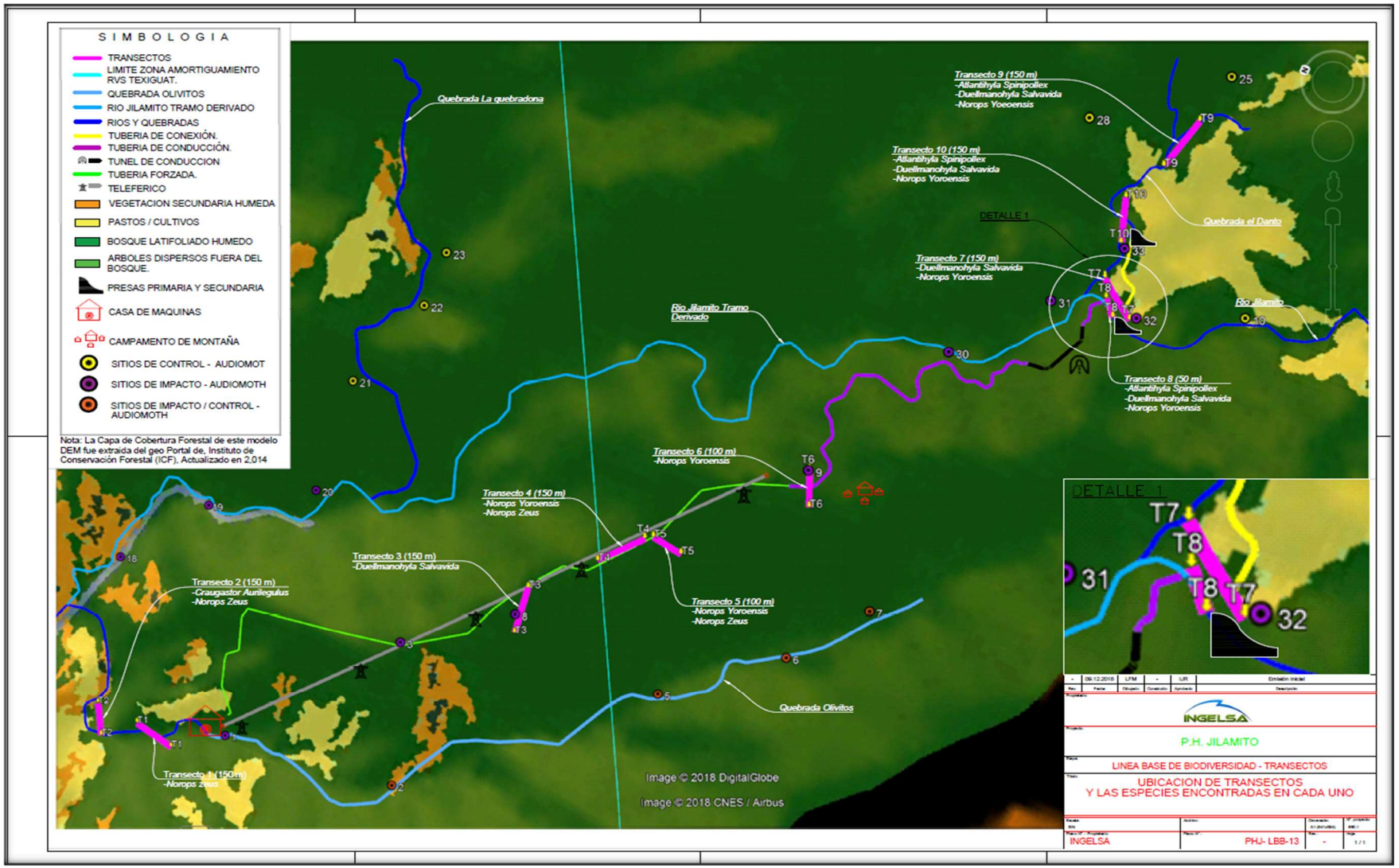
Jilamito Hydroelectric Project

- Map of opportunistic sites for herpetofauna (Map Nº PHJ-LBB-12)



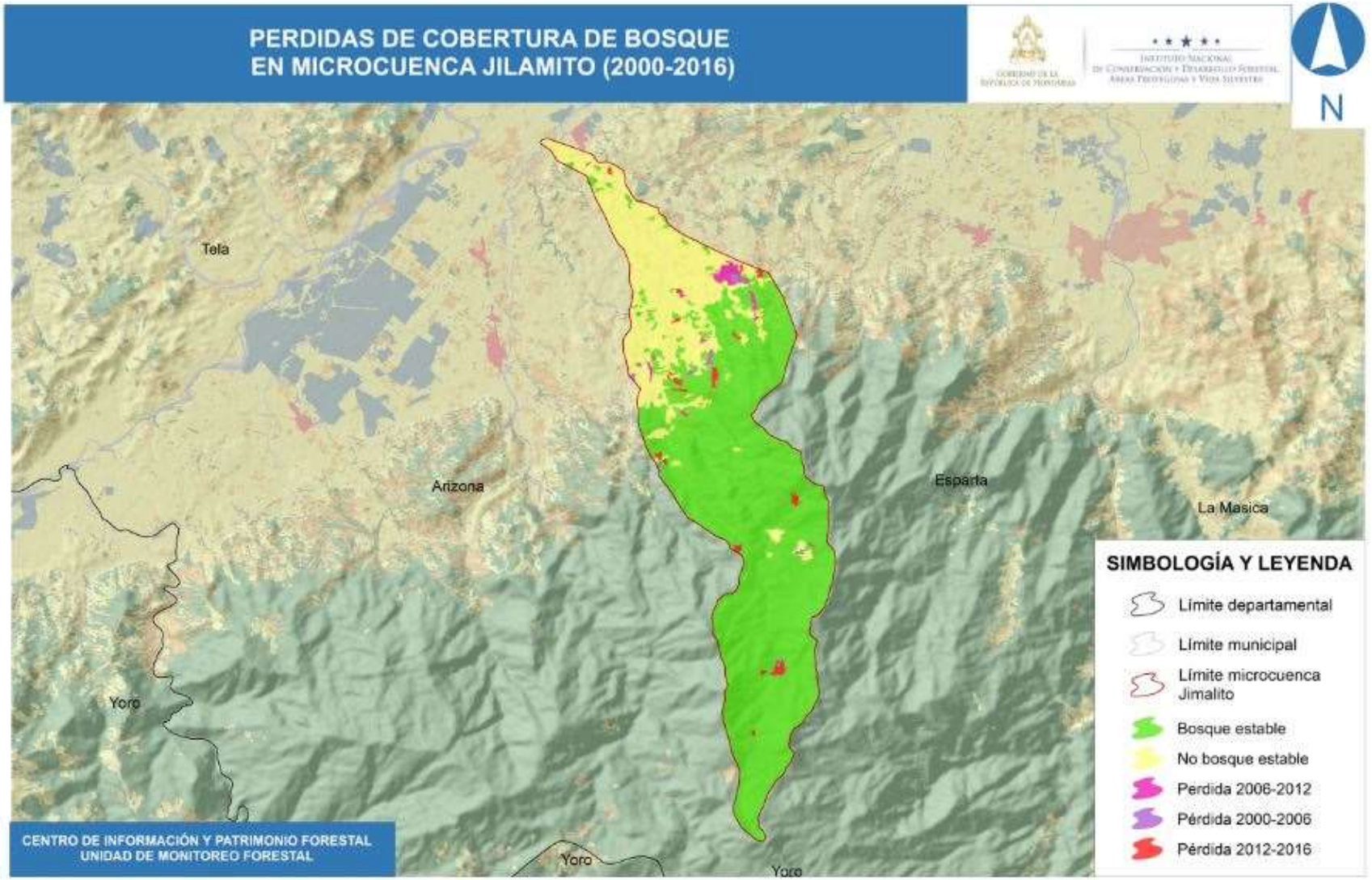
Jilamito Hydroelectric Project

- Map of transects for the detection of amphibians and reptiles (Map Nº PHJ-LBB-13)



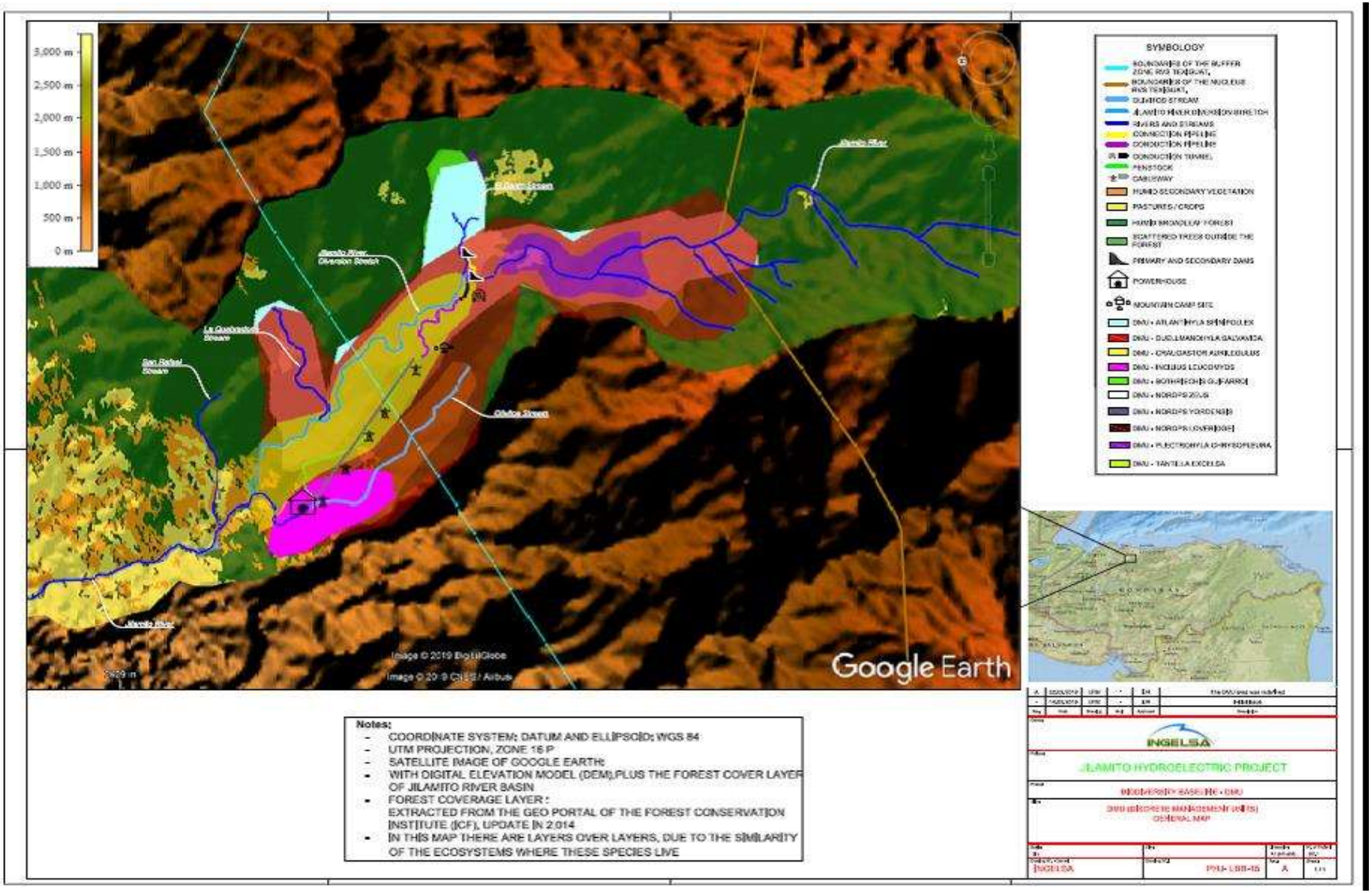
Jilamito Hydroelectric Project

- Map #14 Loss of forest coverage for Jilamito Micro-Basin (2000-2016).



Jilamito Hydroelectric Project

- Global Map of all species found during the Biodiversity Baseline Survey of Jilamito Hydroelectric Project (Map PHJ-LBB-15)



ANNEX 4. IMPACT GRID FOR BIODIVERSITY BASELINE IN THE DIFFERENT STAGES OF THE PROJECT FOR THE 10 MOST IMPORTANT SPECIES.

ANNEX 4.1 - GRID FOR AMPHIBIANS

BASE LINE BIODIVERSITY IMPACT GRID IN DIFFERENT STAGES OF THE PROJECT FOR 10 SPECIES OF HIGHER IMPORTANCE

N°	Construction stage	*Duellmanohyla salvavida*							*Craugastor aurilegulus*							*Incilius leucomyos*							*Atlantihyla spinipollex*							*Plectrohyla chrysopleura*							
	AMPHIBIANS	Removal of Vegetation	Erosion and Sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration in water quality	Alteration in population dynamics	Removal of vegetation	Erosion and sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration in water quality	Alteration in population dynamics	Removal of vegetation	Erosion and sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration in water quality	Alteration in population dynamics	Removal of vegetation	Erosion and sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration in water quality	Alteration in population dynamics	Removal of vegetation	Erosion and sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration in water quality	Alteration in population dynamics
1	Open roads	C	C	B	C	B	C	A	C	C	B	B	C	C	C	C	A	A	B	C	B	B	B	A	B	B	C	C	C	A	A	A	A	A	A	A
2	construction of fords and bridges	C	C	B	C	C	C	C	C	C	B	B	C	C	C	C	C	B	B	C	B	B	B	B	B	B	C	C	C	A	A	A	A	A	A	A
3	Transportation of material, equip, and personnel	A	A	A	B	A	B	A	A	A	A	B	A	B	A	B	A	A	B	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A
4	extraction of quarry materials and aggregates	A	A	A	A	A	A	A	A	A	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
5	construction of powerhouse	B	C	B	C	A	C	B	B	C	B	C	B	C	C	C	C	B	C	B	C	A	C	C	B	C	A	B	C	A	A	A	A	A	A	A
6	construction of Jilamito and Lean substations	B	B	B	B	A	A	A	B	B	B	C	A	A	B	A	A	A	B	A	A	A	C	C	B	B	A	B	B	A	A	A	A	A	A	A
7	construction of cable car	B	B	B	B	A	A	A	C	B	B	B	B	B	B	B	B	B	B	A	A	A	B	B	B	A	A	A	A	A	A	A	A	A	A	A
8	construction of transmission line	A	A	B	A	A	A	A	B	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
9	cut construction trees for penstock	C	C	C	C	A	B	C	C	C	C	C	C	B	C	C	C	C	C	C	C	C	B	B	B	B	B	B	B	A	A	A	A	A	A	A
10	construction of tanque de carga	C	C	C	C	A	A	C	C	C	C	C	C	B	C	C	C	C	C	C	C	C	B	B	B	B	B	B	B	A	A	A	A	A	A	A
11	cut construction trees for pipeline	B	C	C	C	A	B	C	C	C	C	C	C	B	C	C	C	C	C	C	C	C	B	B	B	C	B	B	C	A	A	A	A	A	A	A
12	Disposal of dredged material	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	B	C	C	C	C	C	C	A	A	C	A	A	A	A
13	construction of main and secondary dams	C	B	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	B	C	C
14	Environmental mitigation measures	3	3	3	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3
	Operation phase																																			
1	Power generation	A	A	A	B	A	A	B	A	A	A	B	A	A	B	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2	Maintenance and operation	B	A	A	A	B	A	B	A	A	A	B	A	A	A	A	A	B	A	A	B	B	B	B	B	B	B	B	B	A	A	A	A	A	A	A
3	Environmental mitigation measures	3	3	3	3	3	3	3	3	2	2	2	3	3	2	3	3	3	2	2	3	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2

Positive impact	1	Low	2	Moderate	3	High
Negative Impact	A	Low	B	Moderate	C	High

ANNEX 4.2 - GRID FOR REPTILES

BASE LINE BIODIVERSITY IMPACT GRID IN DIFFERENT STAGES OF THE PROJECT FOR 10 SPECIES OF HIGHER IMPORTANCE

REPTILES

N°	Etapa de Construccion	*Norops yoroensis*							*Norops zeus*							*Norops loveridgei*						
		Removal of vegetation	Erosion and sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration of water quality	Alteration of population dynamics	Removal of vegetation	Erosion and sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration of water quality	Alteration of population dynamics	Removal of vegetation	Erosion and sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration of water quality	Alteration of population dynamics
1	Open roads	A	A	A	A	A	A	A	B	A	B	A	B	A	B	A	A	A	A	A	A	A
2	construction of fords and bridges	A	A	A	A	A	A	A	B	A	B	A	B	A	B	A	A	A	A	A	A	A
3	Transportation of material, equip, and personnel	A	A	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A
4	extraction of quarry materials and aggregates	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A
5	construction of powerhouse	A	A	A	A	A	A	A	B	B	A	A	A	A	B	A	A	A	A	A	A	A
6	construction of Jilamito and Lean substations	A	A	A	A	A	A	A	B	B	A	A	A	A	B	A	A	A	A	A	A	A
7	construction of cable car	B	B	C	B	B	A	B	B	B	B	B	B	A	B	A	A	A	A	A	A	A
8	construction of transmission line	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A	A	A	A	A	A	A
9	cut construction trees for penstock	C	A	C	C	C	C	C	C	C	C	C	C	B	C	A	A	A	A	A	A	A
10	construction of tanque de carga	C	A	C	C	A	B	C	C	C	C	C	C	B	C	A	A	A	A	A	A	A
11	cut construction trees for pipeline	C	A	C	C	C	C	C	C	C	C	C	C	B	C	A	A	A	A	A	A	A
12	Disposal of dredged material	C	A	C	C	C	C	C	C	C	C	C	C	B	C	A	A	C	A	A	A	A
13	construction of main and secondary dams	C	A	A	C	B	C	B	B	B	A	C	C	C	B	C	C	C	C	B	C	C
14	Environmental mitigation measures	3	2	2	2	3	3	3	2	2	3	2	3	3	3	3	3	3	3	2	3	3
	Operation phase																					
1	Power generation	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2	Maintenance and operation	A	A	A	B	A	A	A	A	A	A	B	A	A	B	A	A	A	A	A	A	A
3	Environmental mitigation measures	3	2	2	2	1	2	3	2	2	3	2	2	3	3	2	2	2	2	2	2	2

Positive impact	1	Low	2	Moderate	3	High	
Negative Impact	A	Low	B	Moderate	C	High	

ANNEX 4.3 – GRID FOR SNAKES

BASE LINE BIODIVERSITY IMPACT GRID IN DIFFERENT STAGES OF THE PROJECT FOR 10 SPECIES OF HIGHER IMPORTANCE

N°	Etapa de Construccion	*Bothriechis guifarroi*							*Tantilla ecxelsa*						
	SNAKES	Removal of vegetation	Erosion and sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration of water quality	Alteration of population dynamics	Removal of vegetation	Erosion and sedimentation	Landslides and washouts	Vibrations and noise	Alteration of natural drainage	Alteration of water quality	Alteration of population dynamics
1	Open roads	A	A	A	A	A	A	A	B	C	C	C	C	C	C
2	construction of fords and bridges	A	A	A	A	A	A	A	B	C	C	C	C	C	C
3	Transportation of material, equip, and personnel	A	A	A	A	A	A	A	A	B	C	C	C	C	C
4	extraction of quarry materials and aggregates	A	A	A	A	A	A	A	A	A	B	B	B	B	C
5	construction of powerhouse	A	A	A	A	A	A	A	B	C	C	C	B	C	C
6	construction of Jilamito and Lean substations	A	A	A	A	A	A	A	A	B	B	C	B	B	C
7	construction of cable car	A	A	A	A	A	A	A	B	B	B	B	B	B	C
8	construction of transmission line	A	A	A	A	A	A	A	A	A	A	A	A	A	C
9	cut construction trees for penstock	A	A	A	A	A	A	A	B	B	B	B	B	A	C
10	construction of tanque de carga	A	A	A	A	A	A	A	A	B	B	B	B	A	C
11	cut construction trees for pipeline	A	A	A	A	A	A	A	A	A	A	A	A	A	A
12	Disposal of dredged material	A	A	C	A	A	A	A	A	A	A	A	A	A	A
13	construction of main and secondary dams	C	C	C	C	B	C	C	A	A	A	A	A	A	A
14	Environmental mitigation measures	3	3	3	3	2	3	3	3	3	3	3	3	3	3
	Operation phase														
1	Power generation	A	A	A	A	A	A	A	A	A	A	A	A	A	A
2	Maintenance and operation	A	A	A	A	A	A	A	A	A	A	A	A	A	A
3	Environmental mitigation measures	2	2	2	2	2	2	2	1	2	2	3	3	3	3

Positive impact	1	Low	2	Moderate	3	High	
Negative Impact	A	Low	B	Moderate	C	High	

ANNEX 5. RECOMMENDATIONS AND MITIGATION MEASURES FOR OUTSTANDING SPECIES

Table Nº 9

GENERAL MITIGATION MEASURES FOR ALL SPECIES
The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains. In addition, the correct storage of materials should be observed, making ditches around the sites with spill potential, such as stacked material and hydrocarbons.
In the case of construction of camps, rules must be established for wastewater management.
Dust emissions, haulage material, and road traffic should be avoided during construction. Therefore, it should be moistened periodically in the busiest areas, tents must be used for the reduction of suspended particles. If the use of water in the area is not adequate, the roads should be covered with gravel to minimize the emission of dust into the atmosphere. The use of burned oil will not be allowed to prevent this impact.
Use tarpaulin or plastic to completely cover the stacks of particulate and aggregate material to minimize dust emission or sediment entrainment due to rain. Protect the stacks also with removable boards (wood, for example) to ensure their containment.
The reforestation plan of the area according to the existing impact without the project will be a measure of compensation/mitigation; the areas to be reforested and compensated with trees under criterion 3 to 1 as a minimum can be selected with ICF and UMA.
Strictly prohibit project staff, individuals, and contractors carrying out collection activities, to extract fauna from the project area and surrounding areas.

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GENERAL MITIGATION MEASURES FOR ALL SPECIES
The project staff must respect the biological corridors and inform area residents. This disclosure refers to signs or any other means that the proponent considers appropriate.
The introduction of wildlife species of any kind to the project area is prohibited.
Establish a quarterly monitoring and follow up of water quality during the construction period.
Civil stabilization works must be installed in the water intake site, powerhouse, and venting channel, in order to avoid erosion and sedimentation of the channel. Wherever possible, the planting of local vegetation perpendicular to the ground will be used to reduce erosion.
Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them.

ANNEX 5.1. Mitigation Measures for *Incilius leucomyos*

Table No. 10

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Incilius leucomyos	POWERHOUSE	Opening of roads	Slopes must be stabilized Construction of bioengineering works. Install sediment traps, ditches, and energy dissipaters Prohibition of the burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.
		Construction of fords and bridges	Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.

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SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	INSTALLATION OF PENSTOCK, AERIAL TRAM, PRESSURE SURGE	Tree felling, Construction of penstock	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.
	CONSTRUCTION OF LOADING CHAMBER	Construction of the Cargo Tank	Prohibition of burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose, and must be authorized by management and/or by the supervisor of the project. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	INSTALLATION OF PIPELINE, CONSTRUCTION OF THE TUNNEL	Tree felling, Construction of pipeline	In case a tunnel is built, the material generated by the excavation should be used in construction activities within the project, if possible. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. In the selection of the area to deposit materials, it should be kept in mind that this is not to be located in areas identified as unstable or close to sectors of geological faults with development of gap zones. It is necessary to evaluate the feasibility of access to the site and locate the property on the intervened corridor. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.
	CONSTRUCTION OF MOUNTAIN CAMP, INSTALLATION OF LANDFILLS	Disposal of dredged material	The disposal of sterile material, not suitable for use as an aggregate in the construction, should be done on surfaces with little slope, away from water sources and stacked in such a way that it allows revegetation. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. Use tarpaulin or plastic to completely cover the stacks of particulate and aggregate material to minimize dust emission or sediment entrainment. Protect the stacks also with removable boards (wood, for example) to ensure their containment.

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SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF WORKS OF THE MAIN AND SECONDARY WATER UPTAKES, CONSTRUCTION OF DESANDER	Construction of Main and Secondary Dam	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. When the construction of the work requires the construction of dams, these will be conditioned preferably using rocks or coarse granular material, thus avoiding the discharge of fine particles and their subsequent sedimentation in the water bodies. A sediment barrier or curtain must be installed to hold these downstream during the construction of the dike.

Jilamito Hydroelectric Project

ANNEX 5.2 Mitigation Measures for *Craugastor aurilegulus*

Table No. 11

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Craugastor aurilegulus	POWERHOUSE	Opening of roads	Slopes must be stabilized Construction of bioengineering works. Install sediment traps, ditches, and energy dissipaters Prohibition of the burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
		Construction of fords and bridges	Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.
	INSTALLATION OF PENSTOCK, AERIAL TRAM, PRESSURE SURGE	Tree felling, Construction of penstock	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.
	CONSTRUCTION OF LOADING CHAMBER	Construction of the Cargo Tank	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose, and must be authorized by management and/or by the supervisor of the project. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	INSTALLATION OF PIPELINE, CONSTRUCTION OF THE TUNNEL	Tree felling, Construction of pipeline	In case a tunnel is built, the material generated by the excavation should be used in construction activities within the project, if possible. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. In the selection of the area to deposit materials, it should be kept in mind that this is not to be located in areas identified as unstable or close to sectors of geological faults with development of gap zones. It is necessary to evaluate the feasibility of access to the site and locate the property on the intervened corridor. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.
	CONSTRUCTION OF MOUNTAIN CAMP, INSTALLATION OF LANDFILLS	Disposal of dredged material	The disposal of sterile material, not suitable for use as an aggregate in the construction, should be done on surfaces with little slope, away from water sources and stacked in such a way that it allows revegetation. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. Use tarpaulin or plastic to completely cover the stacks of particulate and aggregate material to minimize dust emission or sediment entrainment. Protect the stacks also with removable boards (wood, for example) to ensure their containment.

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SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF WORKS OF THE MAIN AND SECONDARY WATER UPTAKES, CONSTRUCTION OF DESANDER	Construction of Main and Secondary Dam	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. When the construction of the work requires the construction of dams, these will be conditioned preferably using rocks or coarse granular material, thus avoiding the discharge of fine particles and their subsequent sedimentation in the water bodies. A sediment barrier or curtain must be installed to hold these downstream during the construction of the dike.

ANNEX 5.3 Mitigation Measures for *Atlantihyla spinipollex*

Table No. 12

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Atlantihyla spinipollex	POWERHOUSE	Opening of roads	Slopes must be stabilized Construction of bioengineering works. Install sediment traps, ditches, and energy dissipaters Prohibition of the burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.
		Construction of fords and bridges	Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
			components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.
	INSTALLATION OF PENSTOCK, AERIAL TRAM, PRESSURE SURGE	Tree felling, Construction of penstock	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.
	CONSTRUCTION OF LOADING CHAMBER	Construction of the Cargo Tank	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose, and must be authorized by management and/or by the supervisor of the project. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	INSTALLATION OF PIPELINE, CONSTRUCTION OF THE TUNNEL	Tree felling, Construction of pipeline	In case a tunnel is built, the material generated by the excavation should be used in construction activities within the project, if possible. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. In the selection of the area to deposit materials, it should be kept in mind that this is not to be located in areas identified as unstable or close to sectors of geological faults with development of gap zones. It is necessary to evaluate the feasibility of access to the site and locate the property on the intervened corridor. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.
	CONSTRUCTION OF MOUNTAIN CAMP, INSTALLATION OF LANDFILLS	Disposal of dredged material	The disposal of sterile material, not suitable for use as an aggregate in the construction, should be done on surfaces with little slope, away from water sources and stacked in such a way that it allows revegetation. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. Use tarpaulin or plastic to completely cover the stacks of particulate and aggregate material to minimize dust emission or sediment entrainment. Protect the stacks also with removable boards (wood, for example) to ensure their containment.

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SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF WORKS OF THE MAIN AND SECONDARY WATER UPTAKES, CONSTRUCTION OF DESANDER	Construction of Main and Secondary Dam	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. When the construction of the work requires the construction of dams, these will be conditioned preferably using rocks or coarse granular material, thus avoiding the discharge of fine particles and their subsequent sedimentation in the water bodies. A sediment barrier or curtain must be installed to hold these downstream during the construction of the dike.

Jilamito Hydroelectric Project

ANNEX 5.4 Mitigation Measures for *Duellmanohyla salvavida*

Table No. 13

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Duellmanohyla salvavida	POWERHOUSE	opening of roads	Slopes must be stabilized Construction of bioengineering works. Install sediment traps, ditches, and energy dissipaters Prohibition of the burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
		Construction of fords and bridges	Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.
	INSTALLATION OF PENSTOCK, AERIAL TRAM, PRESSURE SURGE	Tree felling, Construction of penstock	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.
	CONSTRUCTION OF LOADING CHAMBER	Construction of the Cargo Tank	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose, and must be authorized by management and/or by the supervisor of the project. Respect the natural drainage patterns existing in the area, in order to practice a

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
			good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting.
	INSTALLATION OF PIPELINE, CONSTRUCTION OF THE TUNNEL	Tree felling for construction of conduction pipeline	In case a tunnel is built, the material generated by the excavation should be used in construction activities within the project, if possible. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. In the selection of the area to deposit materials, it should be kept in mind that this is not to be located in areas identified as unstable or close to sectors of geological faults with development of gap zones. It is necessary to evaluate the feasibility of access to the site and locate the property on the intervened corridor. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.

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SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF MOUNTAIN CAMP, INSTALLATION OF LANDFILLS	Disposal of dredged material	The disposal of sterile material, not suitable for use as an aggregate in the construction, should be done on surfaces with little slope, away from water sources and stacked in such a way that it allows revegetation. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. Use tarpaulin or plastic to completely cover the stacks of particulate and aggregate material to minimize dust emission or sediment entrainment. Protect the stacks also with removable boards (wood, for example) to ensure their containment.
	CONSTRUCTION OF WORKS OF THE MAIN AND SECONDARY WATER UPTAKES, CONSTRUCTION OF DESANDER	Construction of main and secondary dam	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. When the construction of the work requires the construction of dams, these will be conditioned preferably using rocks or coarse granular material, thus avoiding the discharge of fine particles and their subsequent sedimentation in the water bodies. A sediment barrier or curtain must be installed to hold these downstream during the construction of the dike.

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ANNEX 5.5 Mitigation Measures for *Plectrohyla chrysopleura*

Table No. 14

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Plectrohyla chrysopleura	Upstream control sites of water intake works	Access to the surrounding forests Removal of plant material in the water intake works	Reforest with native plant species the considerable patches dedicated to livestock Restrict access of invaders to the protected area Report any illegal activity in the area Monitoring of existing populations surrounding the area of influence of the project

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ANNEX 5.6 Mitigation Measures for *Norops loveridgei*

Table No. 15

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Norops loveridgei	POWERHOUSE	Opening of roads	Slopes must be stabilized Construction of bioengineering works. Install sediment traps, ditches, and energy dissipaters Prohibition of the burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
		Construction of fords and bridges	Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.
	INSTALLATION OF PENSTOCK, AERIAL TRAM, PRESSURE SURGE	Tree felling, Construction of penstock	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF LOADING CHAMBER	Construction of the Cargo Tank	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose, and must be authorized by management and/or by the supervisor of the project. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	INSTALLATION OF PIPELINE, CONSTRUCTION OF THE TUNNEL	Tree felling, Construction of pipeline	In case a tunnel is built, the material generated by the excavation should be used in construction activities within the project, if possible. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. In the selection of the area to deposit materials, it should be kept in mind that this is not to be located in areas identified as unstable or close to sectors of geological faults with development of gap zones. It is necessary to evaluate the feasibility of access to the site and locate the property on the intervened corridor. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.

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SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF MOUNTAIN CAMP, INSTALLATION OF LANDFILLS	Disposal of dredged material	The disposal of sterile material, not suitable for use as an aggregate in the construction, should be done on surfaces with little slope, away from water sources and stacked in such a way that it allows revegetation. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. Use tarpaulin or plastic to completely cover the stacks of particulate and aggregate material to minimize dust emission or sediment entrainment. Protect the stacks also with removable boards (wood, for example) to ensure their containment.

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SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF WORKS OF THE MAIN AND SECONDARY WATER UPTAKES, CONSTRUCTION OF DESANDER	Construction of Main and Secondary Dam	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. When the construction of the work requires the construction of dams, these will be conditioned preferably using rocks or coarse granular material, thus avoiding the discharge of fine particles and their subsequent sedimentation in the water bodies. A sediment barrier or curtain must be installed to hold these downstream during the construction of the dike.

ANNEX 5.7 Mitigation Measures for *Norops yoroensis*

Table No. 16

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Norops yoroensis	POWERHOUSE	Opening of roads	Slopes must be stabilized ; construction of bioengineering works. Install sediment traps, ditches, and energy dissipaters ; prohibition of the burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
		Construction of fords and bridges	Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.
	INSTALLATION OF PENSTOCK, AERIAL TRAM, PRESSURE SURGE	Tree felling, Construction of penstock	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF LOADING CHAMBER	Construction of the Cargo Tank	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose, and must be authorized by management and/or by the supervisor of the project. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting.
	INSTALLATION OF PIPELINE, CONSTRUCTION OF THE TUNNEL	Tree felling, Construction of pipeline	In case a tunnel is built, the material generated by the excavation should be used in construction activities within the project, if possible. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. In the selection of the area to deposit materials, it should be kept in mind that this is not to be located in areas identified as unstable or close to sectors of geological faults with development of gap zones. It is necessary to evaluate the feasibility of access to the site and locate the property on the intervened corridor. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF MOUNTAIN CAMP, INSTALLATION OF LANDFILLS	Disposal of dredged material	The disposal of sterile material, not suitable for use as an aggregate in the construction, should be done on surfaces with little slope, away from water sources and stacked in such a way that it allows revegetation. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. Use tarpaulin or plastic to completely cover the stacks of particulate and aggregate material to minimize dust emission or sediment entrainment. Protect the stacks also with removable boards (wood, for example) to ensure their containment.

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SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF WORKS OF THE MAIN AND SECONDARY WATER UPTAKES, CONSTRUCTION OF DESANDER	Construction of Main and Secondary Dam	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. When the construction of the work requires the construction of dams, these will be conditioned preferably using rocks or coarse granular material, thus avoiding the discharge of fine particles and their subsequent sedimentation in the water bodies. A sediment barrier or curtain must be installed to hold these downstream during the construction of the dike.

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ANNEX 5.8 Mitigation Measures for *Norops zeus*

Table No. 17

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Norops zeus	POWERHOUSE	Opening of roads	Slopes must be stabilized Construction of bioengineering works. Install sediment traps, ditches, and energy dissipaters Prohibition of the burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
		Construction of fords and bridges	Respect the protection strip of water sources pursuant to the provisions of the Forestry Law in force. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. The contamination of water bodies with wastes from construction material should be avoided by the construction of sand filters or drains.
	INSTALLATION OF PENSTOCK, AERIAL TRAM, PRESSURE SURGE	Tree felling, Construction of penstock	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Avoid tree felling in the protection strips of the river bed, and measures must be taken to protect them. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF LOADING CHAMBER	Construction of the Cargo Tank	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose, and must be authorized by management and/or by the supervisor of the project. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting.
	INSTALLATION OF PIPELINE, CONSTRUCTION OF THE TUNNEL	Tree felling, Construction of pipeline	In case a tunnel is built, the material generated by the excavation should be used in construction activities within the project, if possible. Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. In the selection of the area to deposit materials, it should be kept in mind that this is not to be located in areas identified as unstable or close to sectors of geological faults with development of gap zones. It is necessary to evaluate the feasibility of access to the site and locate the property on the intervened corridor. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Burning or incineration of wastes will not be allowed. During the clearing and cleaning activity, trees that need to be cut must be cleared and cut so that if they fall they do not damage the surrounding vegetation.

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
	CONSTRUCTION OF MOUNTAIN CAMP, INSTALLATION OF LANDFILLS	Disposal of dredged material	The disposal of sterile material, not suitable for use as an aggregate in the construction, should be done on surfaces with little slope, away from water sources and stacked in such a way that it allows revegetation. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Respect the natural drainage patterns existing in the area, in order to practice a good management of rainwater and reduce erosion rates, especially in those areas subject to sliding and silting. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. Use tarpaulin or plastic to completely cover the stacks of particulate and aggregate material to minimize dust emission or sediment entrainment. Protect the stacks also with removable boards (wood, for example) to ensure their containment.
	CONSTRUCTION OF WORKS OF THE MAIN AND SECONDARY WATER UPTAKES, CONSTRUCTION OF DESANDER	Construction of Main and Secondary Dam	Prohibit burning or accumulation of solid waste of any composition or characteristic within and close to the project area. Residues from excavations and demolitions must be disposed of in previously selected, evaluated, and adequate sites for this purpose. Discharge of fuels and oil waste on the ground or in water bodies. These wastes should be moved outside the construction area, treated or marketed for reuse or transformation of its components. When the construction of the work requires the construction of dams, these will be conditioned preferably using rocks or coarse granular material, thus avoiding the discharge of fine particles and their subsequent sedimentation in the water bodies. A sediment barrier or curtain must be installed to hold these downstream during the construction of the dike.

ANNEX 5.9 Mitigation Measures for *Tantilla excelsa*

Table No. 18

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Tantilla excelsa	Control site	construction of cargo tank removal of vegetation cover Camp construction	Prohibit the dumping of fuels and oil waste on the ground or in water bodies Prohibit the introduction of wildlife species to the site

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ANNEX 5.10 Mitigation measures for *Bothriechis guifarroi*

Table No. 19

SPECIES	SIGHTING AREA	ACTIVITY	MITIGATION MEASURES
Bothriechis guifarroi	Upstream control sites of water intake works of Jilamito	Construction of main and secondary dam access to forests surrounding the area of direct influence	develop rescue program before carrying out construction activities Establish a quarterly monitoring and follow-up of water quality during the construction period reforest with native plant species the considerable patches dedicated to livestock Restrict the access of invaders to the protected area Report any illegal activity in the area Monitor existing populations surrounding the area of influence of the project Respect the forest surrounding the stream prohibit personnel and individuals from extracting or killing animals within the area. Train the personnel that will be in the works on the diagnosis and on how to act when encountering this species.

ANNEX 6. LIST OF HERPETOFAUNA DETECTED BY LOCATION

Table Nº 20

List of species of the Jilamito Hydroelectric Project												
Item	Species	Study area										Total
		Powerhouse and pipeline	Penstock and Aerial tram	Mountain camp	Landfills	Main water intake	Secondary water intake	La Quebradona	Quebrada Los Olivitos	El Danto Creek	Jilamito Upstream	
1	*Incilius leucomyos*	0	1	0	0	0	0	4	4	0	0	**9**
2	*Rhinella horribilis*	1	0	0	0	0	0	0	0	0	0	**1**
3	*Hyalinobatrachium fleschmanni*	6	0	0	0	5	12	0	0	7	0	**30**
4	*Teratohyla pulverata*	0	0	0	0	1	0	0	0	0	0	**1**
5	*Craugastor aurilegulus*	9	1	0	0	0	0	4	6	0	0	**20**
6	*Craugastror chac*	0	0	3	0	1	0	0	0	2	1	**7**
7	*Craugastor laticeps*	0	0	1	1	0	0	0	0	0	0	**2**
8	*Craugastor noblei*	0	0	1	0	0	0	0	0	0	0	**1**
9	*Atlantihyla aff spinipollex*	0	0	0	0	4	19	3	10	20	8	**64**
10	*Duellmanohyla salvavida*	14	0	11	0	18	12	0	10	14	6	**85**
11	*Plectrohyla chrysopleura*	0	0	0	0	0	0	0	0	1	7	**8**
12	*Smilisca baudinii*	0	0	0	0	2	2	0	0	0	0	**4**
13	*Leptodactylus fragilis*	0	0	0	0	20	0	0	0	0	0	**20**
14	*Bolitoglossa nympha*	0	0	1	0	0	0	0	1	0	0	**2**
15	*Basiliscus vitattus*	0	1	0	0	0	0	1	0	0	0	**2**
16	*Corytophanes cristatus*	2	0	1	0	0	0	0	0	0	0	**3**
17	*Norops biporcatus*	0	0	0	0	0	0	0	1	0	0	**1**
18	*Norops lemurinus*	4	1	1	3	0	4	2	0	0	0	**15**
19	*Norops loveridgei*	0	0	0	0	0	0	0	0	0	1	**1**
20	*Norops yoroenesis*	0	0	3	1	2	5	0	0	2	1	**14**
21	*Norops zeus*	3	1	2	0	0	0	2	0	0	0	**8**
22	*Marisora brachypoda*	1	0	0	0	0	0	0	0	0	0	**1**
23	*Thecadactylus rapicauda*	0	0	1	0	0	0	0	0	0	0	**1**
24	*Pleistioson sumichrastri*	1	1	0	0	0	0	0	0	0	0	**2**
25	*Sphaerodactylus continentalis*	0	0	1	0	0	0	0	0	0	0	**1**

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List of species of the Jilamito Hydroelectric Project												
Item	Species	Study area										Total
		Powerhouse and pipeline	Penstock and Aerial tram	Mountain camp	Landfills	Main water intake	Secondary water intake	La Quebradona	Quebrada Los Olivitos	El Danto Creek	Jilamito Upstream	
26	*Scincella cherriei*	0	0	0	0	0	0	1	1	0	0	**2**
27	*Holcosus festivus*	4	2	0	0	0	3	0	4	0	0	**13**
28	*Lepidophyma flavimaculatum*	0	0	0	0	0	2	0	0	0	0	**2**
29	*Chironius grandisquamis*	0	0	0	0	0	0	0	1	0	0	**1**
30	*Dendrophidion rufiterminorum*	0	0	0	0	0	0	0	1	0	0	**1**
31	*Drymobius chloroticus*	0	0	1	1	1	0	0	0	0	0	**3**
32	*Leptophis continentalis*	0	0	0	0	0	0	1	0	0	0	**1**
33	*Tantilla excelsa*	0	0	0	0	0	0	0	1	0	0	**1**
34	*Coniophanes fissidens*	0	0	0	0	1	0	0	0	0	1	**2**
35	*Imantodes cenchoa*	0	0	2	0	1	0	0	0	1	0	**4**
36	*Leptodeira septentrionalis*	0	0	0	0	0	0	0	0	1	0	**1**
37	*Sibon dimidiatus*	0	0	0	0	0	0	0	0	2	0	**2**
38	*sibon nebulatus*	0	0	0	0	0	0	0	0	1	0	**1**
39	*Micrurus nigrocinctus*	0	0	0	0	0	0	1	0	0	0	**1**
40	*Atropoides mexicanus*	0	0	0	0	1	1	0	0	1	0	**3**
41	*Bothriechis guifarroi*	0	0	0	0	1	0	0	0	0	3	**4**
42	*Bothriechis schlegelii*	0	0	0	0	0	0	1	0	0	0	**1**
Total		**45**	**8**	**29**	**6**	**58**	**60**	**20**	**40**	**52**	**28**	**346**

ANNEX 7. PHOTOGRAPHIC EVIDENCE

1 	**2** 
Photo 1. *Incilius leucomyos*	**Photo 2**. *Rhinella horribilis*
3 	**4** 
Photo 3. *Hyalinobatrachium fleishmanni*	**Photo 4**. *Craugastor aurilegulus*

5 	**6** 
Photo 5. *Atlantihyla cf. spinipollex*	**Photo 6**. *Duellmanohyla salvavida*

7 	**8** 
Photo 7. *Plectrohyla chrysopleura*	**Photo 8**. *Smilisca baudinii*

9 	 **10**
Photo 9. *Leptodactylus fragilis*	**Photo 10**. *Bolitoglossa nympha*
11 	**12** 
Photo 11. *Basiliscus vittatus*	**Photo 12**. *Corytophanes cristatus*

13 	**14** 
Photo 13. *Norops lemurinus*	**Photo 14**. *Norops loveridgei*
15 	**16** 
Photo 15. *Norops yoroensis*	**Photo 16**. *Thecadactylus rapicauda*

17 	**18** 
Photo 17. *Plestiodon sumichrastri*	**Photo 18**. *Sphaerodactylus continentalis*

19 	**20** 
Photo 19. *Drymobius chloroticus*	**Photo 20**. *Leptophis continentalis*

21 	**22** 
Photo 21. *Tantilla excelsa*	**Photo 22**. *Coniophanes fissidens*
23 	**24** 
Photo 23. *Micrurus nigrocinctus*	**Photo 24**. *Bothriechis guifarroi*

ANNEX 8. PLANT PHOTO CATALOG

Photo 25. *Acanthaceae - Aphelandra aurantiaca*

Photo 26. *Actinidaceae - Saurauia sp.*

Photo 27. *Araceae - Anthurium sp.*

Photo 28. *Araceae - Colocasia esculenta*

	
Photo 29. *Araceae - Monstera acuminata*	**Photo 30**. *Araliaceae - Dendropanax arboreus*