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MAPPING BIODIVERSITY IN CUBA

Earthwatch 2023 Field Report

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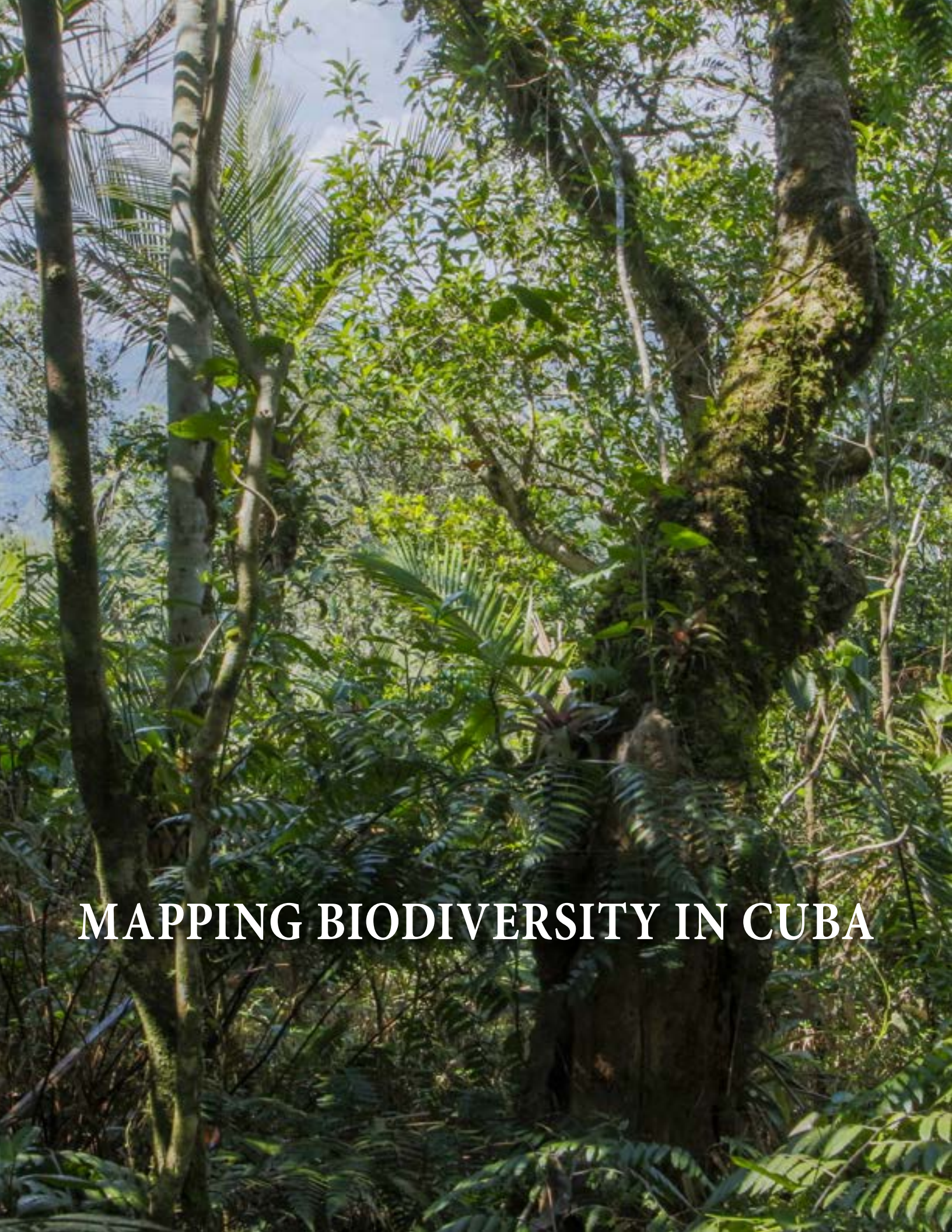

MAPPING BIODIVERSITY IN CUBA

Letter to Volunteers

Dear Earthwatch volunteers,

2023 was a special year for our project, as it saw your return to the Lomas de Banao after two years away due to the global health situation caused by the pandemic. Get ready to know all about what we have achieved in the last year thanks to our joint efforts for the conservation of Cuba's biodiversity, as well as the challenges that lie ahead of us in 2024, to all of you volunteers joining our expeditions this year.

Nature brings people together! To everyone that shares a passion for the wilderness and protecting the amazing life it harbors, here are the highlights of 2023 project year in Lomas de Banao Ecological reserve.

During 2023, we continued to support the conservation of this reserve's extraordinary biodiversity. Bats were deliberately included in our monitoring system to demystify the bad reputation that the pandemic has given this group of mammals. In this first year of bat monitoring, we deepened our understanding of this key group in the natural restoration of Cuban forests. The nights of work were not in vain, as we captured 235 bats belonging to nine species, members of three familes. We deepened our understanding of the seasonal dynamics of birds in Banao by studying the behavioral adjustments of native birds when they suddenly have to cope with the arrival of numerous winter migrants. The keen eyesight of our volunteers allowed us to record for the first time for the central region of Cuba and for the 5th time for the island, the presence of the Ruby-Crowned Kinglet (*Regulus calendula*). We discovered that the low availability of nesting cavities and changes in forest structure caused Cuban Parakeets to shift their nesting areas to the northern part of the Reserve. With the help of volunteers, we built and placed artificial nests to assist the reproduction of Cuban Trogons, Cuban Pygmy Owls and Bare-legged Owls, all endemic species that are limited by the low availability of nesting sites.

Thanks to your commitment, motivation, and insatiable desire to do, we planted more than 1500 native trees, including seedlings of Sabina (*Podocarpus angustifolius*), the reserve's flagship tree, and 120 seeds of Mantequero (*Magnolia cubensis*), both ancient and endangered species in Cuba and conservation targets for the reserve, which are now being nursed and will enrich the forest for generations to come. We also monitored the Sabina trees planted in previous years and the census recorded 201 surviving individuals in La Sabina. We were also monitoring over 6000 trees in our permanent vegetation plots, a titanic task that is not possible without the support of all of you.

The best part, is that we continue to grow as a team of volunteers, scientists, guides, park staff and surrounding communities. This 2023 we were pleasantly surprised by the return of volunteers from previous editions who who chose to repeat the experience of working with our project. We have no words to express our gratitude for their continued support and suggestions to make this a project of excellence. We thank you for becoming part of our family and encourage you to stay connected and come back to the Lomas de Banao Ecological Reserve.

Thank you very much for your work, the Project has grown significantly this 2023!

Con todo nuestro cariño,

Chino, Aslam, Carlos, Luci, Pedro, Maikel y Natalia

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SURVEY METRICS: 2023

24 BIRD TRANSECTS SURVEYED COVERING 24 KM

384 NETS/HOURS FOR BATS

BATS RECORDING 960 HOURS

35 VEGETATION PLOTS SURVEYED COVERING 14 000 M^2

59 TOTAL BIRD SPECIES RECORDED

1 NEW BIRD FOR LOMAS DE BANAO ECOLOGICAL RESERVE

9 BATS SPECIES RECORDED

140 TOTAL PLANT SPECIES RECORDED

6,316 TREES SURVEYED

340 TREES PLANTED

1,100 SEEDLINGS NURSED

201 SABINA TREES CENSUSED

SUMMARY

During the third year of our project and with the sustained field support of Earthwatch volunteers, we continue monitoring the composition and structure of 35 permanent vegetation plots of 400 m^2 each one, in Lomas de Banao Ecological Reserve (LBER). The monitoring protocol for these plots allows to inventory, label and locate each of the plants on an area of in order to evaluate their development in the short, mid and long-term. Faunal surveys included the identification and estimation of relative abundance for birds and bats across the year. We conducted two bird surveys during the summer residence season and two during the winter residence period. Similar to previous years, the largest differences in bird community composition occurred between the migratory and non-migratory (breeding) periods, rather than between field sites. Because the activity of native birds is altered by the arrival of migratory birds, which can be numerically dominant during the winter, we initiated a study on bird behavior looking at niche partitioning across groups. The results of our sampling suggest that the species diversity recorded in birds and bats is still far from the expected values, and more sampling effort is needed to approach the effective species diversity values. Our work has informed managers of LBER and provided important recommendations for the recovery of threatened species. As we move into a new project year, our collective research will contribute to the conservation of unique species and ecosystems with the valuable support of Earthwatch volunteers and locals.

GOALS, OBJECTIVES, AND RESULTS

Our project advanced our proposal objectives as follows:

1) Investigate the effect of altitude and temperature on the density of birds and bats of LBER

BIRD SURVEY METHODS

To characterize the bird assemblage at each locality we conducted line transect counts (González *et al.* 2017). We recorded all individuals detected along and on both sides of the transects. At each sampling site (Jarico and La Sabina, **Figure 1**) we delimited three 1 km long transects distant more than 300 m from each one, to ensure greater representativeness of the sampling area and independence of the data.

We conducted four surveys (April, June, July and November) at each locality. The transects were walked since 8:00 to 11:00 a.m., which represents the time of greatest bird activity. In all cases we recorded all individuals seen or heard on both sides of the transect up to a maximum distance of 100 m. We defined the limits perpendicular distance to the transect with a laser meter.

BAT SURVEY METHODS

Two survey methods were applied in the study of bat populations, capture using mist nets and acoustic monitoring. These methods complement each other and allow the detection of a greater number of species. Mist nets prove more effective in the survey of slow-flying bats at low altitudes with lower intensity echolocation calls, e. g. phytophagous species of the family Phyllostomidae, whereas acoustic monitoring is essential in detecting insectivorous species with greater speed and altitude that emit higher intensity calls (Mancini *et al.* 2022).

The survey was executed in both locations three consecutive nights in April, June, July and November 2023. A transect was selected in each of the locations, where between three and four mist nets were installed (ground level, 9 or 12 × 3 m; 14 mm mesh size) approx. 50 m apart from one another. Additionally, three passive-monitoring recorders were placed (AudioMoth; Hill **et al**. 2018) 1.5 m above the ground and approx. 20 m away from the nets. Nets were kept active for four to five hours during the night, whereas the recorders remained from dusk till dawn, programmed to record every 20 seconds, procuring an average sampling rate of 384 Hz.

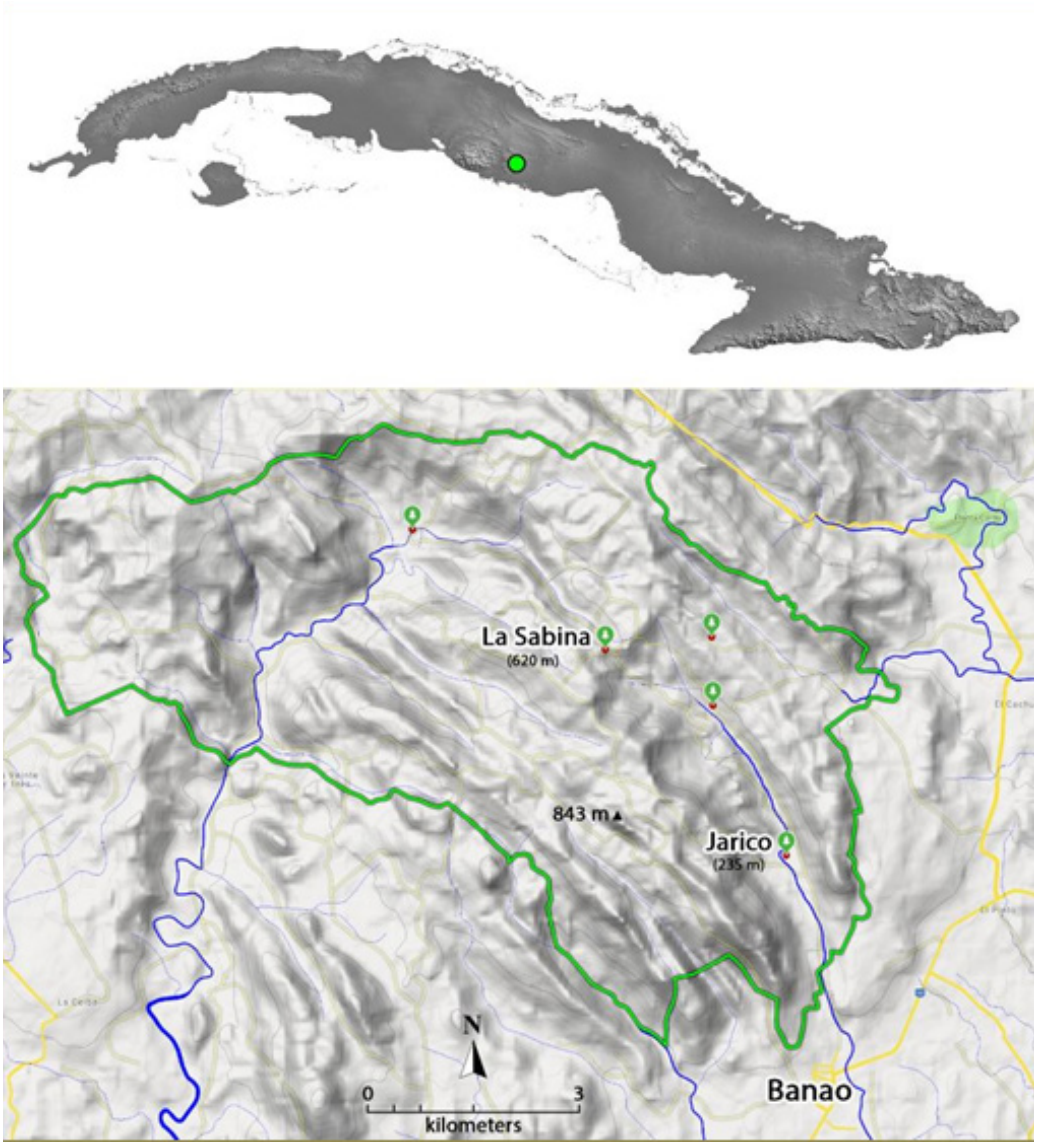

Figure 1. Lomas de Banao Ecological Reserve demarcated by green line. Location of field stations are indicated with green.

FLORA AND VEGETATION STRUCTURE CHARACTERIZATION

For the characterization of the floristic structure and composition of the forests, a total of 35 plots of 400 m^2 were resampled, 19 plots in Jarico and 16 in La Sabina. The following data were collected in each plot: tree species richness, number of individuals per tree species, diameter at breast height of adult trees and saplings, canopy cover, shrub species present and density of shrubs, vines species, herbaceous species, herbaceous stratum cover and litter cover. Canopy height and coverage, undergrowth height and density, ground coverage, tree abundance and density, as well as wood volume of each plot were quantified.

Plant species were mostly identified "*in situ*", but in some cases it was necessary to collect specimens following traditional methods of pressing and drying. All plants were identified basically using the "Flora de Cuba" (León 1946; León & Alain 1951; Alain 1953, 1957, 1964). For updating the nomenclature of the species the criteria of Greuter & Rankin (2022) were followed, for assigning the conservation status the criteria of González *et al.* (2016), for assigning the invasive alien species categories we followed the criteria of Oviedo & González-Oliva (2015) and for the common names the criteria of Roig (1965).

DATA ANALYSIS OF BIRD AND BAT SPECIES

In order to profile bird communities, the species' abundance index (S), as well as the inverse Simpson's index (Feinsinger 2003) were applied. The abundance-rank curves were drafted according to the richness and abundance values shown by the bird communities, using the total data per locality during the periods of winter and summer residency. Aggrupation in trophic guilds were simplified as proposed by Kirkconnell *et al.* (1992).

Captured bat individuals were put into fabric bags for processing and subsequent release. Each individual was identified, date and time of capture, sex and apparent age (subadult or adult), body mass, forearm length, presence of ectoparasites as well as reproductive status (not reproducing, lactant, postlactant and pregnant) were registered. However, most female individuals caught with a clear status of sexual activity were immediately released. Echolocation calls were processed and identified using the program Kaleidoscope® (version 5.5.0, Wildlife Acoustics, USA), which automatically fragments stored WAV sound files into 5 s tracks. In order to ensure the detection of echolocation calls, only files with more than two pulses, between 8 and 200 kHz with a duration of 2 to 500 ms and a maximum of 500 ms between syllables were taken into account.

A matrix with the number of captured individuals per location was generated in order to analyze the diversity values obtained through bat capture and bird observation; the maximum of registered individuals was used as an approximate to their abundance. Rarefaction curves were drafted based on sample size (Colwell *et al.* 2012) to the accumulated richness on iNEXT (Hsieh *et al.* 2016); additionally, Hill numbers regarding species richness (q = 0), the exponential Shannon index (q = 1) and the inverse Simpson's index (q = 2) were estimated. Each one of these values as the effective number of equally frequent species showcased during the surveys and is subjected to the abundance values of rare and dominant species (Chao *et al.* 2014).

RESULTS

FOREST BIRD ASSEMBLAGES

A total of 51 bird species were registered during the 4 expeditions, 451 individuals for 40 species in Jarico and 598 individuals of 41 species in La Sabina. Although species numbers appear very similar, 10 of the species registered in Jarico were not registered in La Sabina. In the same way, 9 of the species registered in La Sabina were not detected in Jarico. *Turdus plumbeus* and *Priotelus temnurus*, both of which are native species, were the two most abundant species on throughout both localities. Both sites included a group of five to six dominant species, whereas the remaining species were observed in a significantly reduced proportion (**Fig. 2**).

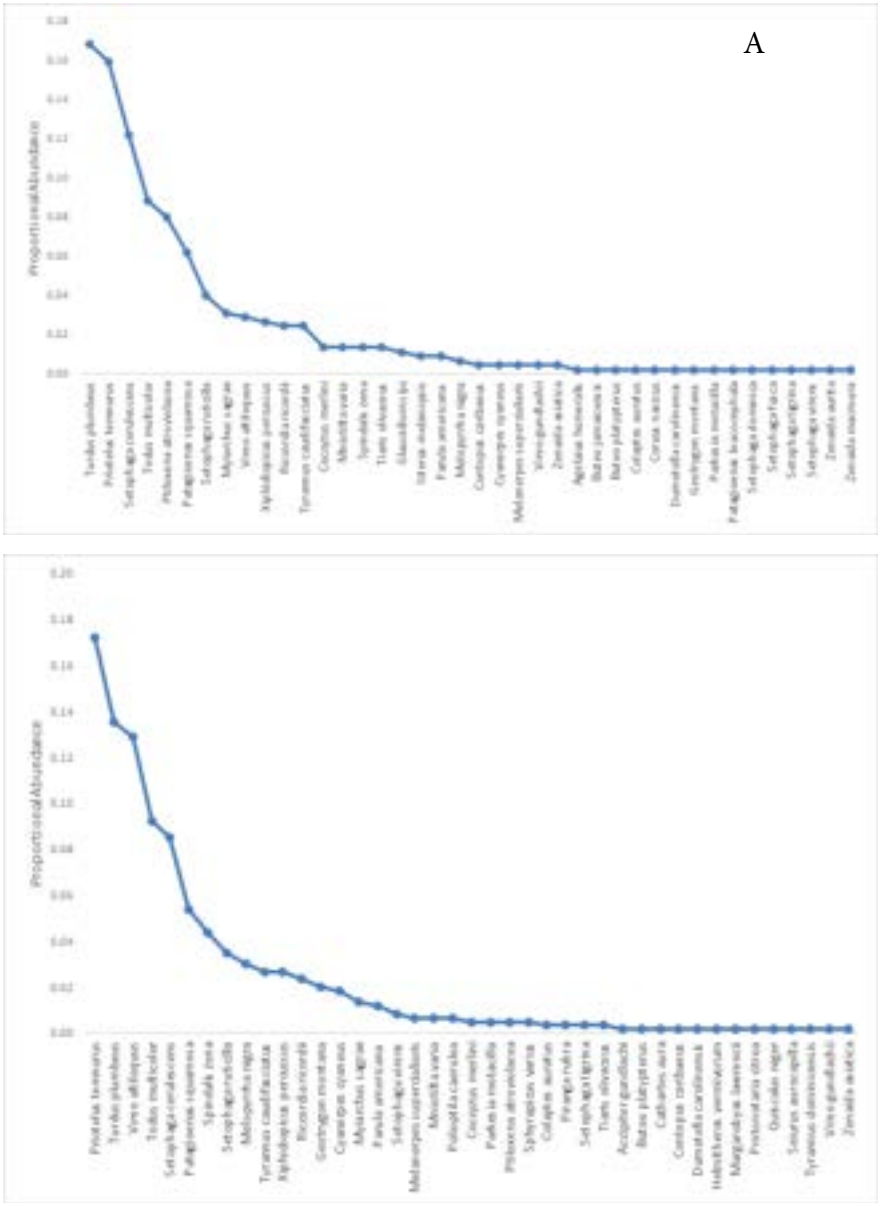

Figure 2. Proportional abundance of bird species at the Jarico (A) and La Sabina (B) study sites.

The average abundance expressed in number of individuals was 43.6 ± 8.8 (standard error) in Jarico and 54.8 ± 6.7 in La Sabina, although these differences are not significant (U = 45.5, P = 0.13). In Jarico the average abundance between summer (June and July) and winter (April and November) residency was significantly different (U = 5.0, P = 0.03), while in La Sabina it was not different (U = 8, P = 0.11) (**Fig. 3**). During the summer period in La Sabina the abundance of individuals was higher than in Jarico, although the difference was not significant (U = 5.5, P = 0.051). In the months of November-April the results were very similar for both localities (U = 16.0, P = 0.79).

The **Table 1** displays the observed richness (Jarico = 40 and Sabina = 41), and the values of the three diversity estimators of Hill's series (richness, Shannon and Simpson) based on an asymptotic analysis (S) that predicts that, depending on the number of individuals, 56 spp. could be detected in Jarico and 63 spp. in La Sabina (see **Figure 4** and **Table 1**).

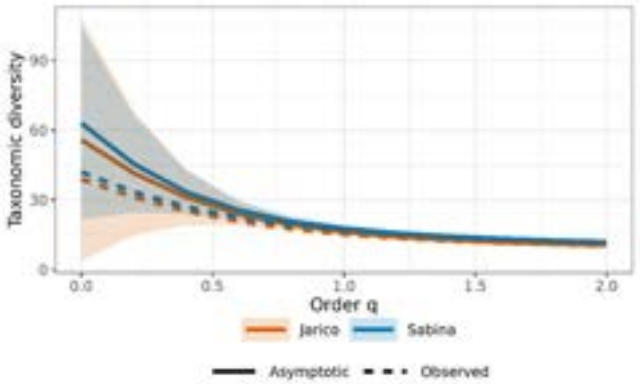

Figure 4. The asymptotic estimates of diversity profiles (solid lines) and empirical diversity profiles (dotted lines) for forest bird assemblages in Lomas de Banao.

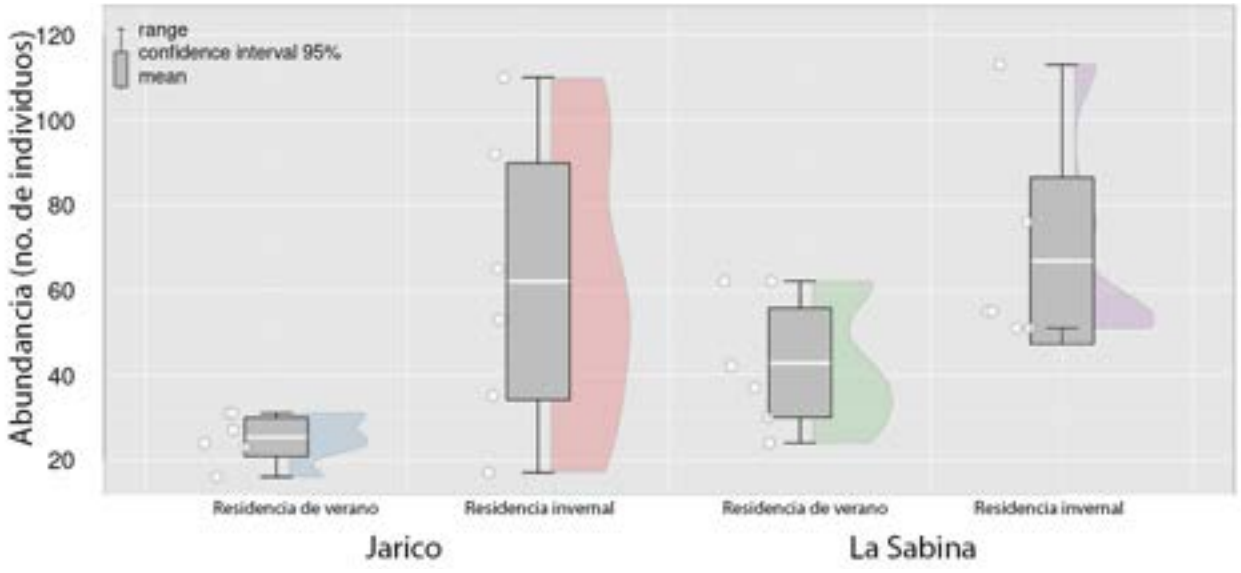

Figure 3. Abundance of birds in two localities of Lomas de Banao during winter and summer resident periods.

The completeness analysis shows that the sampling effort (in this case based on the number of individuals observed) is still incomplete for reaching the expected richness (based on the proportional abundance of each species). In Jarico 70% of the expected richness was reached while in La Sabina 67% (**Figure 5**). In the case of diversity of order 1 (Shannon) and 2 (Simpson) the sample (empirical value) reached the asymptotic value.

The number of individuals observed in Jarico was 451 individuals and 598 individuals in La Sabina. Based on rarefaction the three estimators were similar in both localities (see **table 2**), which indicates that the differences observed between both localities are more related to the difference in the number of individuals observed (451 vs. 598) than to the effective number of species. In **figure 6** it becomes clear, evident by the large overlap in the confidence intervals.

Table 1. Observed and expected values of diversity of order 0 (richness), 1 (Shannon's exponential index) and Simpson's inverse, 2. Estimated values based on 100 bootstrap.

Assemblage	Taxonomic.Diversity	Observed	Estimator	Standard Error	LCL	UCL
Jarico	Species richness	40	55.87	16.03	39	87.28
Jarico	Shannon diversity	15.31	16.21	0.86	14.53	17.9
Jarico	Simpson diversity	10.37	10.56	0.56	9.45	11.66
Sabina	Species richness	41	63.09	17.94	42	98.25
Sabina	Shannon diversity	16.83	17.68	0.82	16.08	19.27
Sabina	Simpson diversity	11.7	11.89	0.55	10.81	12.98

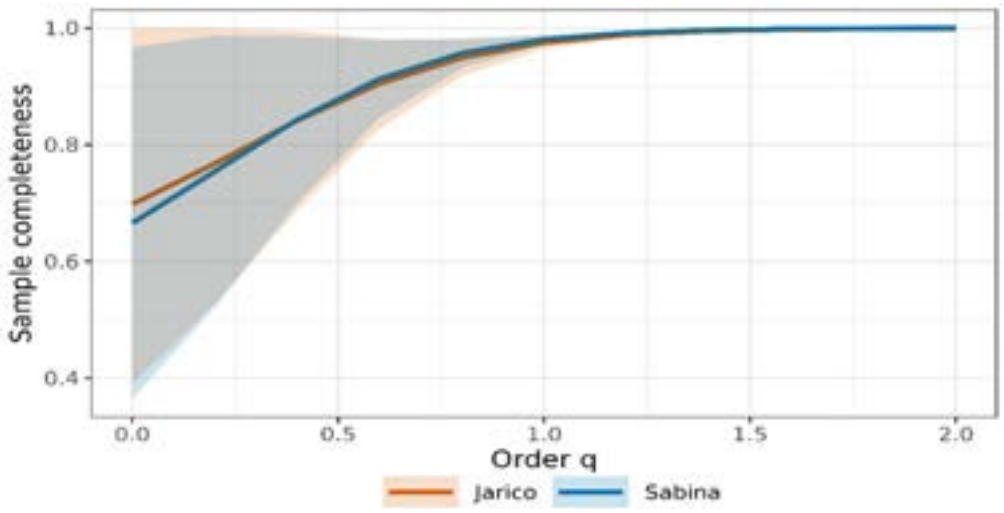

Figure 5. Sample completeness curve for Jarico and La Sabina localities based on data from observations by direct counts (A) and expected diversity of order (q) 0 (richness), 1 (Shannon's exponential index) and Simpson's inverse 2, based on rarefaction and extrapolation of observational data. Shaded areas represent 95% confidence intervals calculated using 1000 bootstraps.

Table 2. Non-asymptotic coverage-based rarefaction and extrapolation analysis

	q = 0	q = 1	q = 2
Jarico	48.06	15.84	10.46
La Sabina	50.52	17.26	11.79

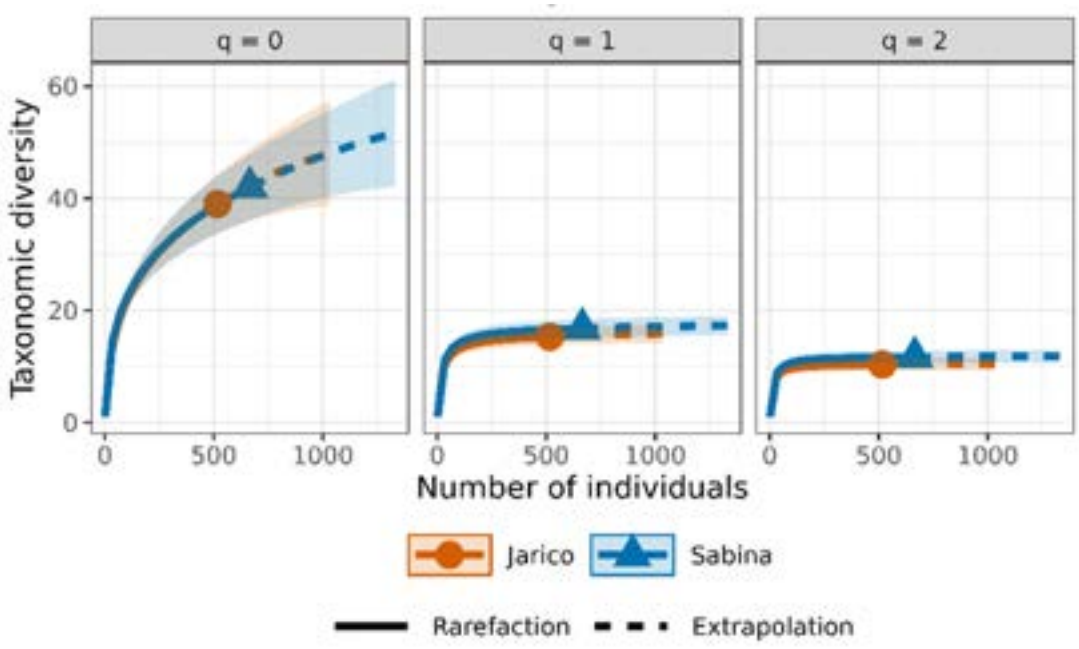

Figure 6. Sample-size-based rarefaction (solid lines) and extrapolation (dashed lines) of bird species diversity based on the Hill numbers (q 0, 1, 2).

BATS: PRELIMINARY RESULTS

A total of 235 individuals were captured, belonging to nine species, included in three families (**Table 3**). More individuals were captured in Jarico, although the number of species was lower. A preliminary analysis shows differences in in assemblage composition between these two localities, in addition to differences in the capture rate of the most frequent, relatively common species in La Sabina, such as the Cuban Fig-eating Bat (*Phyllops falcatus*) and Buffy Flower Bat (*Erophylla sezekorni*) are rare or were not captured in Jarico. Based on the capture data, the level of richness completeness (q = 0) was higher at Jarico (0.98) than at La Sabina (0.89), suggesting that additional species might be captured at the latter location. However, when abundance (q = 1) and dominant species (q = 2) are weighted proportionally, at both localities the effective number of species reached the completeness asymptote (**Fig. 7A**). Based on the catch data, both localities appear to harbor assemblages of similar structure in terms of species richness and proportional abundance; however, La Sabina shows slightly higher diversity values than Jarico (**Fig. 7 B**).

Table 3. Species of bats captured during the year 2023 in two areas of the "Lomas de Banao" Ecological Reserve.

Family	Species	Common name	Jarico	La Sabina
Mormoopidae	*Pteronotus macleayii*	MacLeay's Mustached Bat	2	1
	Pteronotus quadridens	Sooty Mustached Bat	2	-
Vespertilionidae	*Eptesicus fuscus*	Big Brown Bat	-	1
Phyllostomidae	*Artibeus jamaicensis*	Jamaican Fruit-eating Bat	28	37
	Phyllops falcatus	Cuban Fig-eating Bat	1	14
	Monophyllus redmani	Leach's Single-leaf Bat	24	10
	Brachyphylla nana	Cuban Fruit-eating Bat	85	14
	Phyllonycteris poeyi	Cuban Flower Bat	2	4
	Erophylla sezekorni	Buffy Flower Bat	-	10

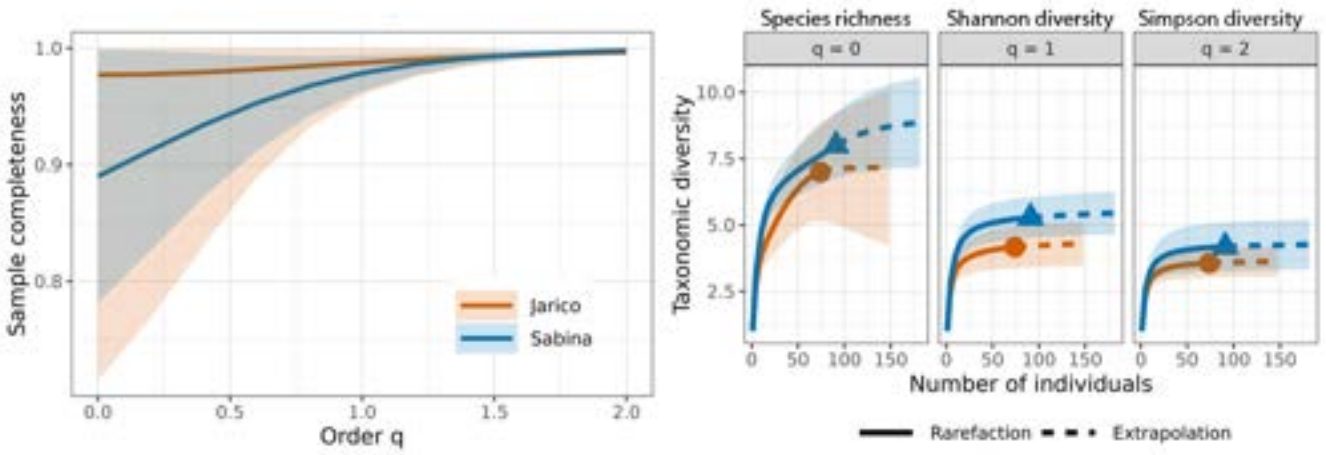

Figure 7. Sample completeness curve for Jarico and La Sabina localities based on net capture data (A) and expected diversity of order (q) 0 (richness), 1 (Shannon's exponential index) and Simpson's inverse 2, based on rarefaction and extrapolation of capture data. Shaded areas represent 95% confidence intervals calculated using 1000 bootstraps.

Data based on acoustic monitoring indicate high insectivorous bat activity in both localities, notably higher than that recorded in other localities in western and eastern Cuba (Mancina, pers. ob. 2023). A total of 183 978 insectivorous bat pulses were recorded. Using the level of acoustic activity (number of echolocation pulses) as a proxy for abundance, no significant differences were obtained between the two localities in any of the months sampled (April: U = 14.0, P = 0.2562; July: U = 6.0, P = 0.07; November: U = 3.0, P = 0.69) (Fig. 8).

The **Figure 9** illustrates the nocturnal activity pattern of the insectivore assemblage at the two localities in the three months analyzed. In general, a more bimodal pattern is observed in Jarico, in correspondence with the crepuscular activity peaks described for many insectivorous species. In La Sabina this pattern of activity is not very evident and activity is more evenly distributed throughout the night. Using the automatic acoustic classifiers incorporated in Kaleidoscope® (AutoID for bats) several species were identified, which were later validated manually, based

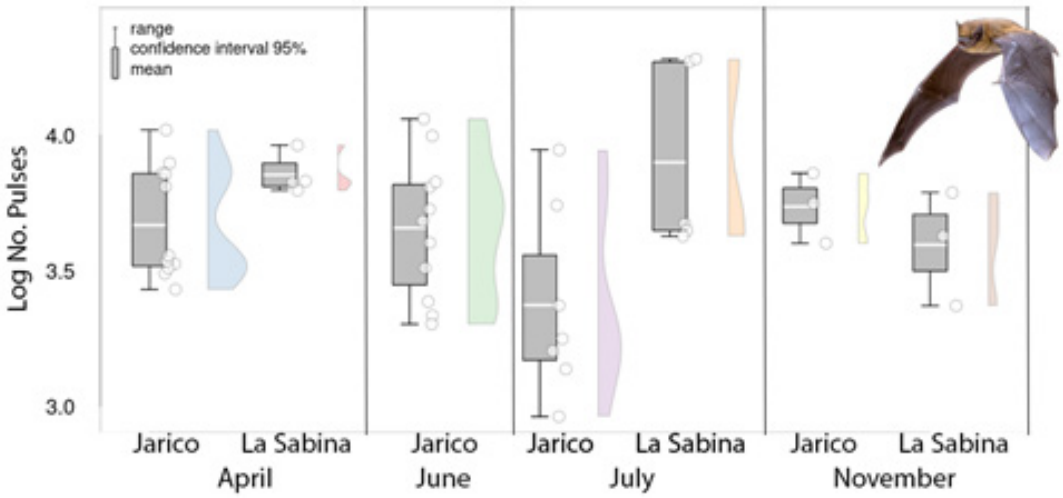

Figure 8. Acoustic activity of the insectivorous bat assemblage in two localities of the Lomas de Banao Ecological Reserve; due to a technical malfunction in the audio storage equipment, it has not yet been possible to recover the recordings from La Sabina in June.

on published call parameters and with the help of an acoustic library generated from recordings in Cuba. Among the most common species in the acoustic inventories were the Big Brown Bat (*Eptesicus fuscus*), MacLeay's Mustached Bat (*Pteronotus macleayi*), Sooty Mustached Bat (*Pteronotus quadridens*), Antillean Ghost-faced Bat (*Mormoops blainvillei*), Common Mustached Bat (*Pteronotus parnellii*) and Brazilian Free-tailed Bat (*Tadarida brasiliensis*), only the last three were not captured in the nets, however, they are common species in Cuban ecosystems.

To date, based on a cluster analysis performed in the Kaleidoscope® program, 34 phonic groups or sonotypes have been identified in the Banao Ecological Reserve. In many cases these sonotypes have not been identified to species level, in some cases AutoID has identified them as extremely rare species such as the Pallid Bat (*Antrozous pallidus*), Cuban Yellow Bat (*Lasiurus insularis*) or Broad-eared Free-tailed Bat (*Nyctinomops laticaudatus*). Since echolocation calls from continental populations were used for the development of these identifiers, and it is known that there are regional variations in bat repertoires, validating their presence in Banao would require the capture of some individual. On the other hand, we know that some of the unidentified sonotypes are part of the acoustic repertoire of common species, so we are working on the creation of filters that allow us to recognize these variations.

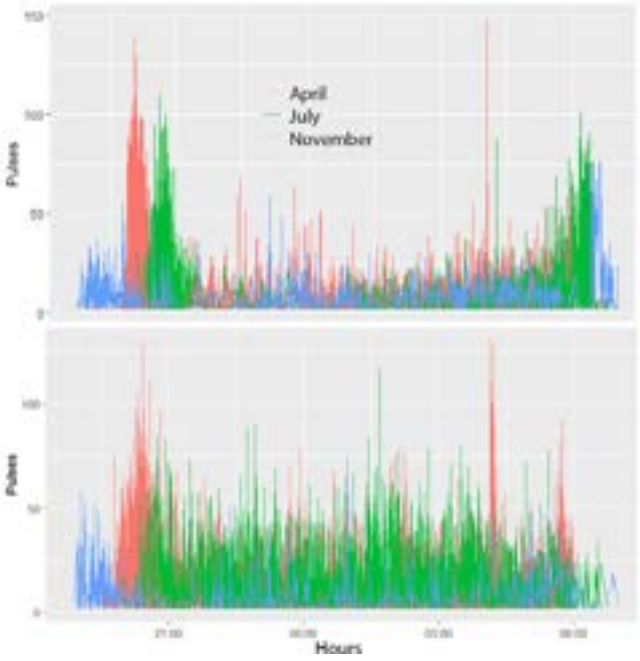

Figure 9. Acoustic activity levels (total number of pulses) at two locations in the Lomas de Banao Ecological Reserve, Jarico (top) and La Sabina (bottom). The colors of the lines indicate three months sampled.

PLANTS: PRELIMINARY RESULTS

A total of 140 plant species were identified in the 35 resampled plots, of which 105 were trees and the rest are shrubs, herbs, epiphytes or vines (**Table 4**). A total of 6 316 trees were sampled, of which 2 942 corresponded to the 19 plots studied in Jarico and 3 374 to the 16 plots in La Sabina. Although the number of plots resampled in Jarico was higher than in La Sabina, more trees were sampled in La Sabina, indicating that there is a higher density of trees in that locality than in Jarico.

Among the 6316 trees sampled in both localities, the most abundant species was Guarea guidonia "yamagua" represented by 29 % of all trees. The predominance of this species is evident both in Jarico represented by 33 % and in La Sabina, where it constitutes 26 % of the trees (**Figures 10 and 11**). *Guarea guidonia* is a tree of the Meliaceae family with a wide distribution in the Neotropics, whose fruits are dehiscent, that is, they open when ripe and expose the seeds covered with an orange sarcotesta (Figure 12). These seeds are ingested and dispersed by birds (ornithopterous dispersal) (Albert 2005). Other tree species that are also abundant in Jarico and La Sabina are Cinnamomum cubense (Lauraceae) and *Cupania americana* (Sapindaceae). In the case of Lauraceae they possess berry fruits dispersed by birds or mammals (Rohwer 2014), or in the case of Cupania americana they possess seeds with orange aril suggesting ornithochory (Acevedo-Rodríguez 2014). *Casearia*, *Psychotria* and many *Miconia* species, genera well represented in La Sabina, also have fleshy fruits or fruits with arils attractive to birds that could be ingested by birds and bats.

Among the inventoried species there are four classified with some category of threat, although many species have not yet been assessed or are considered DD (data deficient) according to the criteria compiled in the work of González-Torres et al. (2016). Within the plots, 13 introduced species were also identified that are considered invasive or potentially invasive according to Oviedo & González-Oliva (2015).

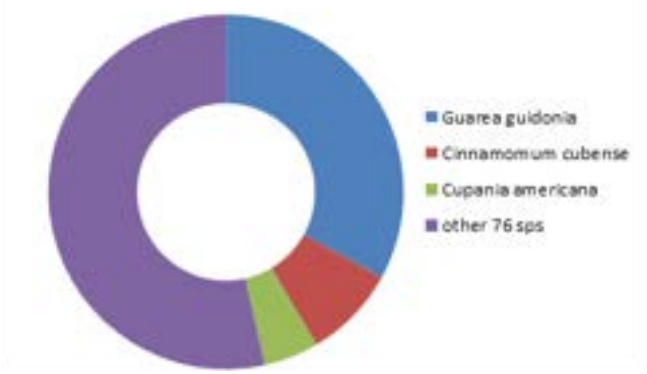

Figure 10. The most abundant tree species in Jarico.

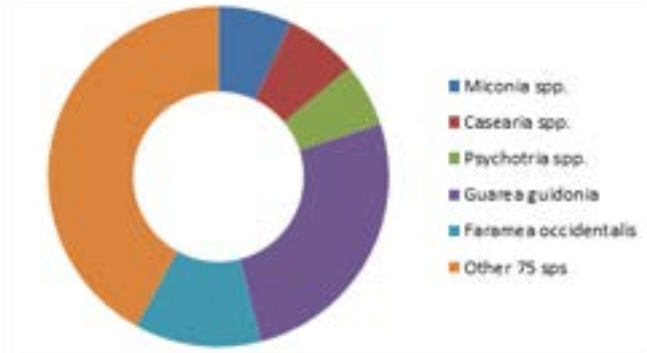

Figure 11. The most abundant tree species in La Sabina.

Figure 12. Ripe fruits of *Guarea guidonia* (Yamagua) showing the seeds covered with an orange sarcotesta.

Table 4. Plant species identified in the vegetation plots of two localities of Lomas de Banao during 2023. The names are organized alphabetically taking into account the scientific names of the species. Legend: (A) Threatened, (CR) Critically Endangered, (E) Endangered, (DD) Data Deficient, (LC) Lower Concern, (NE) Not Evaluated, (NT) Near Threatened. We follow the criteria of Oviedo & González-Oliva (2015) to assign categories for invasive alien species. * Invasive, ** Potentially invasive

Family	Scientific name	Habit	Common name	Conservation status
Euphorbiaceae	*Adelia ricinella*	Small tree	Jía	LC
Lauraceae	*Aiouea montana*	tree	Boniato	A
Euphorbiaceae	*Alchornea latifolia*	tree		LC
Sapindaceae	*Allophylus cominia*	tree	Palo de caja	NE
Fabaceae	*Andira cubensis*	tree	Yaba	NE
Fabaceae	*Andira sp.*	tree	Yaba	
Annonaceae	*Annona montana*	tree		NE
Annonaceae	*Annona muricata*	tree	Guanábana	
Polygalaceae	*Badiera oblongata* *	small tree	Pico de gallo	LC
Lauraceae	*Beilschmiedia pendula*	tree		E
Burseraceae	*Bursera simaruba*	tree	Almácigo	NE
Calophyllaceae	*Calophyllum antillanum*	tree	Ocuje	LC
Rubiaceae	*Calycophyllum candidissimum*	tree	Dagame	NT
Arecaceae	*Calyptronoma plumeriana*	tree	Palma Manaca	NE
Samydaceae	*Casearia aculeata*	Small tree	Jía brava	LC
Samydaceae	*Casearia laetioides*	tree	Guaguasí	LC
Samydaceae	*Casearia mollis*	Small tree	Raspalengua	NE
Samydaceae	*Casearia sylvestris subsp. sylvestris*	Small tree	Sarnilla	LC
Cecropiaceae	*Cecropia peltata*	tree	Yagruma	NE
Meliaceae	*Cedrela odorata*	tree	Cedro	LC
Bombacaceae	*Ceiba pentandra*	tree	Ceiba	NT
Cannabaceae	*Celtis trinervia*	tree	Ramón de Sierra	NE
Oleaceae	*Chionanths domingensis*	tree		LC
Sapotaceae	*Chrysophyllum oliviforme*	Small tree	Caimitillo	LC
Lauraceae	*Cinnamomum cubense*	tree	Boniato	NE
Vitaceae	*Cissus sp.*	vine		
Verbenaceae	*Citharexylum spinosum*	Small tree	Guayo blanco	NE
Rutaceae	*Citrus ×aurantium* **	Small tree	Naranja agria	
Rutaceae	*Citrus ×limon* **	Small tree	Limón	
Rubiaceae	*Coffea arabica* **	shrub	Café	
Fabaceae	*Cojoba arborea*	tree	Moruro rojo	LC
Rhamnaceae	*Colubrina arborescens*	tree	Bijáguara	NE
Boraginaceae	*Cordia collococca*	tree	Ateje	LC
Boraginaceae	*Cordia gerascanthus*	tree	Baría	LC
Boraginaceae	*Cordia valenzuelana*	tree	Ateje hembra	CR
Sapindaceae	*Cupania americana*	tree	Guárano	NE
Sapindaceae	*Cupania glabra*	tree	Guárano	NE
Araliaceae	*Dendropanax arboreus*	tree		NE
Fabaceae	*Desmodium canum*	herb.	Amor seco	NE

Family	Scientific name	Habit	Common name	Conservation status
Fabaceae	*Dichrostachys cinerea* *	Small tree	Marabú	
Dioscoreacea	*Dioscorea sp.*	vine		
Dilleniaceae	*Doliocarpus dentatus*	vine	Bejuco Guajamón	NE
Putranjivaceae	*Drypetes alba*	tree	Hueso	NE
Putranjivaceae	*Drypetes sp.*	tree	Hueso	
Erythroxylaceae	*Erythroxylum havanensis*	shrub	Jibá	NE
Myrtaceae	*Eugenia axillaris*	Small tree	Guairaje	LC
Myrtaceae	*Eugenia sp.*	Small tree		
Rubiaceae	*Exostema ellipticum*	tree	Plateado	LC
Sapindaceae	*Exothea paniculata*	tree	Yaicuaje	NE
Rubiaceae	*Faramea occidentalis*	tree	Café cimarrón	LC
Moraceae	*Ficus americana*	tree	Jagüey	LC
Moraceae	*Ficus aurea*	tree	Jagüey	LC
Moraceae	*Ficus cf. wrightii*	tree	Jagüey	
Fabaceae	*Gliricidia sepium*	tree	Piñón florido	
Rhamnaceae	*Gouania sp.*	vine		
Meliaceae	*Guarea guidonia*	tree	Yamagua	LC
Byttneriaceae	*Guazuma ulmifolia*	tree	Guásima	LC
Bromeliaceae	*Guzmania monostachia*	Epiphyte	Curujey	LC
Zingiberaceae	*Hedychium coronarium* *	herb.	Mariposa	
Malpighiaceae	*Heteropterys laurifolia*	vine	Bejuco tortuga	LC
Chrysobalanaceae	*Hirtella triandra*	Small tree	Hicaco de aura	NE
Tapisciaceae	*Huertea cubensis*	tree		DD
Aquifoliaceae	*Ilex nitida var. repanda*	tree		NE
Poaceae	*Lasiacis divaricata*	Grass	Pitillo de monte	NE
Fabaceae	*Leucaena leucocephala* *	tree	Ipil-ipil	
Lauraceae	*Licaria triandra*	tree	Leviza	NE
Poaceae	*Lithachne pauciflora*	grass		NE
Fabaceae	*Lonchocarpus heptaphyllus*	tree	Guamá	NT
Fabaceae	*Lonchocarpus sp.*	tree	Guamá	
Sparmanniaceae	*Luehea speciosa*	tree	Guásima varía	NE
Lygodiaceae	*Lygodium sp.*	vine	Helecho	
Anacardiaceae	*Mangifera indica* **	tree	Mango	
Sapindaceae	*Matayba domingensis*	tree	Macurije	NE
Melastomataceae	*Miconia impetiolaris*	Small tree		LC
Melastomataceae	*Miconia aff. laevigata*	Small tree		LC
Melastomataceae	*Miconia prasina*	Small tree		LC
Melastomataceae	*Miconia sp.*	Small tree		
Asteraceae	*Mikania aff. micrantha*	vine		LC
Myrtaceae	*Myrciaria floribunda*	Small tree		DD
Myrsinaceae	*Myrsine coriacea*	tree		LC
Lauraceae	*Nectandra coriacea*	tree	Cigua	LC
Lauraceae	*Ocotea cuneata*	tree	Canelón	NE
Lauraceae	*Ocotea floribunda*	tree	Boniato laurel	LC
Lauraceae	*Ocotea leucoxylon*	tree	Aguacatillo	LC
Poaceae	*Olyra latifolia*	Grass		NE
Annonaceae	*Oxandra lanceolata*	tree	Yaya	NE

Family	Scientific name	Habit	Common name	Conservation status
Annonaceae	*Oxandra laurifolia*	tree	Yaya	NE
Rubiaceae	*Palicourea deflexa*	shrub		NE
Rubiaceae	*Palicourea domingensis*	shrub	Taburete	LC
Bignoniaceae	*Parmentiera aculeata* *	tree		
Vitaceae	*Parthenocissus quinquefolia*	vine		NE
Malvaceae	*Pavonia fruticosa*	herb	Tábano	LC
Peraceae	*Pera oppositifolia*	tree	Huevo de gallo	CR
Poaceae	*Pharus lappulaceus*	grass		NE
Picramniaceae	*Picramnia pentandra*	shrub	Aguedita	NE
Pinaceae	*Pinus caribaea*	tree	Pino macho	LC
Piperaceae	*Piper aduncum*	shrub	Platanillo de Cuba	NE
Piperaceae	*Piper auritum*	shrub	Anisón	NE
Piperaceae	*Piper umbellatum*	shrub		LC
Nyctaginaceae	*Pisonia aculeata*	Liana/shrub	Zarza	NE
Fabaceae	*Poeppigia procera*	tree	Tengue	NE
Sapotaceae	*Pouteria sapota*	tree	Mamey colorado	
Rosaceae	*Prunus occidentalis*	tree	Cuajaní	NE
Moraceae	*Pseudolmedia spuria*	tree	Macagua	LC
Rubiaceae	*Psychotria costivenia*	Small tree	Lengua de vaca	LC
Rubiaceae	*Psychotria cf. horizontalis*	shrub		
Rubiaceae	*Psychotria lasiophthalma*	Small tree		DD
Zingiberaceae	*Renealmia aromatica*	herb.	Cojate	NE
Arecaceae	*Roystonea regia*	tree	Palma real	LC
Fabaceae	*Samanea saman* *	tree	Algarrobo del país	
Euphorbiaceae	*Sapium laurifolium*	tree	Piñí	LC
Araliaceae	*Schefflera morototoni*	tree	Yagruma macho	NE
Fabaceae	*Senegalia tenuifolia*	vine	Tocino	LC
Fabaceae	*Senna spectabilis* *	Small tree	Algarrobillo	
Sapotaceae	*Sideroxylon foetidissimum*	tree	Jocuma	LC
Smilacaceae	*Smilax domingensis*	vine	Bejuco chino	LC
Solanaceae	*Solanum americanum*	herb	Hierba mora	LC
Solanaceae	*Solanum schlechtendalianum*	shrub		LC
Bignoniceae	*Spathodea campanulata* *	tree	Tulipán africano	
Anacardiaceae	*Spondias mombin*	tree	Ciruela	LC
Meliaceae	*Swietenia macrophylla* *	tree	Caoba hondureña	
Meliaceae	*Swietenia mahagoni*	tree	Caoba	LC
Myrtaceae	*Syzygium jambos* *	tree	Pomarrosa	
Bignoniaceae	*Tabebuia sp.*	tree	Roble blanco	
Apocynaceae	*Tabernaemontana alba*	Small tree	Pegojo	NE
Malvaceae	*Talipariti elatum*	tree	Majagua	LC
Dichapetalaceae	*Tapura cubensis*	tree	Vigueta de lechuza	NE
Combretaceae	*Terminalia buceras*	tree	Júcaro	NE
Combretaceae	*Terminalia tetraphylla*	tree	Júcaro amarillo	NE
Commelinaceae	*Tradescantia zebrina* *	herb	Cucaracha	
Euphorbiaceae	*Tragia cf. volubilis*	vine	Ortiguilla	LC

Family	Scientific name	Habit	Common name	Conservation status
Cannabaceae	*Trema micranthum*	tree	Almez de flores pequeñas	NE
Meliaceae	*Trichilia havanensis*	tree	Siguaraya	LC
Meliaceae	*Trichilia hirta*	tree	Cabo de hacha	LC
Moraceae	*Trophis racemosa*	tree		LC
Urticaceae	*Urera baccifera*	shrub	Chichicate	LC
Vitaceae	*Vitis tiliifolia*	vine	Parra cimarrona	LC
Myrsinaceae	*Wallenia laurifolia*	Small tree	Casmagua	NE
Rutaceae	*Zanthoxylum coriaceum*	tree	Bayúa	LC
Rutaceae	*Zanthoxylum martinicense*	tree	Ayúa	NE

2) Evaluate the use of artificial nest boxes in the breeding density of Cuban parrots

We assessed Cuban Parakeet's nests in Jarico and found that changes in the structure of the surrounding vegetation likely caused the Cuban Parakeets to abandon Jarico's nesting area. Usually, Cuban Parakeets nest in isolated dead palms (or artificial nests in live palms), located above the forest canopy and with the front of open vegetation, allowing them a direct flight from and to the nest and great visibility. Because of forest management at LBER after its creation, Jarico's pastures were restored into native, dense forest. Cuban parakeets lots the optimal conditions for nesting in Jarico and left this area moving their nesting grounds to the north end of the reserve, into Hoyo del Naranjal field site.

In addition to investigating and aiding psittacid nesting, we built and set 20 artificial nests to increase the availability of cavities for the endemic's Cuban Trogon, Cuban pygmy Owl and bare-legged Owl. The nests were prepared and set before the start of the 2019 breeding season. In addition to researching and assisting psittacine nesting, we constructed and placed 20 artificial nests to increase cavity availability for Cuban trogon, Cuban Pygmy Owl and short-eared owl. The nests were prepared and placed prior to the start of the 2023 breeding season. Twenty wooden nests were built by volunteers last season and were placed in the pine forest of La Sabina. Eight nests were occupied by Cuban trogon, one nest by Cuban Pygmy Owl and one by Cuban Black birds, all endemic Cuban species. We were unable to monitor breeding success, given that no expedition to Banao coincided with the hatching period. Ten new nests are being prepared for the next breeding season and the 20 nests located at La Sabina were maintained. The available nests will be focused mainly on Cuban trogon breeding.

Figure 13. Bare-legged Owl in artificial nest-box, La Sabina, Lomas de Banao Ecological Reserve

DEVELOP A COMMUNITY OUTREACH PROGRAM TO IMPLEMENT WITH THE RURAL COMMUNITIES OF BANAO LBER, WHERE TARGETED SPECIES SURVIVE

Throughout 2023, our community outreach program engaged LBER staff and local schools and focused on two main objectives, these being 1) training in bird identification and monitoring in the field, and 2) engaging locals and volunteers in seed collection and planting of important trees for wildlife. Birds are not only critical for the ecosystem functioning of the evergreen forest, but but are also charismatic and attractive tourist attractions, as well as a symbol of pride for the local communities. Engaging people in learning about their birds of LBER proved a successful tool in raising awareness about their conservation and provided an important link to understanding the importance of keeping a healthy forest.

Our support to the LBER Reforestation Program constitutes another powerful awareness-raising and community-engaging tool. As part of our project, the Earthwatch volunteers planted over 1000 seedlings of endemic and critically endangered forest species, including 10 saplings of *Pera oppositifolia*, 130 saplings of Juglans jamaicensis, 1000 seedlings of the reserve's flagship tree *Podocarpus angustifolius*, and recollected and nursed 120 seeds of *Magnolia cubensis*, both last species are ancient tree species. In addition, we provided support for the maintenance of the trees planted in former project year. with the help of Earthwatch volunteers, all the saplings that had survived the titanic efforts described above were carefully counted. To the delight of all, 201 saplings were counted, ranging in height from 50 cm to over 2 m. About 50 saplings are more than 2 m high, the females with such or higher are already producing fruits, which is the best indicator of the successful reintroduction of Podocarpus angustifolius in La Sabina, from where it had been extirpated decades ago.

PROJECT IMPACTS

1. Increasing Scientific Knowledge

a) Total citizen science research hours

Research hours	Time (hours) each group
Training	9 hours
Data collection in the field bird surveys: 3h daily, 6 transects, 4 groups	72 hours
Mist nets hours captures	384
Audiomoths records	960
Data entry	22 hours
Other activities (seedling collection, planting saplings, fixing artificial nesting boxes)	18 hours
Total	505 hours x 35 volunteers = 17,675 hours + 960 hours recording bats

b) Peer-reviewed publications

The thesis "Diversity y abundance of bird species in two sites at different altitude in Lomas de Banao Ecological Reserve, Sancti Spíritus, Cuba" was presented by Claudia Pérez Bernal as bachelor's dissertation at the Universidad Central de Las Villas, on December/ 2023.

Claudia's dissertation was carried out in the mesophilic evergreen forests located in Lomas de Banao Ecological Reserve, and its main objective was to characterize the composition of bird assemblages associated with two sites that differ in altitude during the periods of winter residence and summer residence.

The bird community was mostly composed of permanent resident species, which were also the most abundant. A total of 52 species belonging to 11 orders, 19 families and 36 genera were detected, with Passeriformes and Parulidae being the best represented order and family, respectively. Jarico was the locality with the highest number of species, with 48, while in Sabina 40 were recorded. The ornithocenosis had the highest values of species richness and abundance in winter residency. Insectivores were the predominant trophic guild in both periods and in both localities. The vegetation in Jarico had greater variability than in La Sabina, and that of the latter had a greater number of trees and greater basal area per surface. The presence of frugivorous birds was more strongly associated with the characteristics of the vegetation at La Sabina, and bird species typical of more open or anthropized ecosystems were more abundant at Jarico.

c) Non-peer reviewed publications

Social media publication by lead flora conservationists Oliver Valle Hernández (El Chino), Pedro A. González Gutiérrez and Lucia Hechavarria Schwesinger: "*Podocarpus angustifolius* returns to "La Sabina"

The La Sabina Biological Station is located in the heart of the Lomas de Banao Ecological Reserve, at 620 m.a.s.l. It is a place that stays in the memory of those who visit it, as it offers magnificent views of the surrounding mountains and, to the south, the Sancti Spiritus Plain and the Caribbean Sea. Among the fortunate explorers who have visited this paradise in the Escambray, Guamuhaya Espirituano, there have been many who have wondered about the origins of its name, the experts explained to them that Sabina is the common name of the species of tree described as *Podocarpus angustifolius* by the German botanist Heinrich Rudolph August Grisebach, they would have never guessed it, because all the trees of this species, endemic to Cuba and considered to be in danger of extinction, that once grew around La Sabina had been cut down for their wood and to use the land for cattle breeding.

According to the oldest inhabitants of this beautiful place, the last Sabina trees were felled in the 1960s in the town of the same name, more than 50 years ago. With the felling of the last Sabina trees, many other native trees were cut down, such as Yamaguas, Cedars, Aguacatillos, Cuban Mahogany and other species, leaving "La Sabina" without its main feature, the trees that gave it its name and its life, because with the felling of the last Sabina trees, birds, insects, mammals, reptiles and amphibians were also lost. If someone had thought of renaming the place, such an initiative would have erased its original name forever. With the creation of the reserve, efforts were made to protect the areas of natural vegetation and to save several species of plants and animals that were considered endangered, and it was time to save Podocarpus angustifolius from extinction. The staff of the Conservation Department of the Lomas de Banao Ecological Reserve and, for the past five years, volunteers from groups of nature lovers through Earthwatch, have been working to bring the *Podocarpus angustifolius* species back to 'La Sabina', helping in the rescue of this jewel of Cuban flora and to restore the meaning of the name of the place.

Figure 14. Entrance of La Sabina Biological Station at Loimas de Nanao Ecological Reserve

Each chapter of this endeavor to save the species begins in the rainforest of the Filos de Caja de Agua locality, in the heart of the protected area, 700 m.a.s.l., where majestic Sabina trees still grow in an environment of tree-like ferns and various species of bromeliads. The *Podocarpus angustifolius* trees of Filos de Caja de Agua are over 15-20m tall and produce a large number of seeds that successfully germinate near their trunks (Fig. 15).

Once the seedlings have reached a height of 30 to 40cm, they are carefully transported by pack mule to the surroundings of the La Sabina Biological Station, where they are planted in the hope that each one will grow into a tree as majestic as its ancestors.

In July 2023, with the help of Earthwatch volunteers (Fig. 17), all the saplings that had survived the titanic efforts described above were carefully counted. To the delight of all, 201 saplings were counted, ranging in height from 50 cm to over 2m. About 50 saplings are more than 2m high, the females with such or higher are already producing fruits. Thank you very much for your passion and support in the conservation of this emblematic tree species.

Figure 15. *Podocarpus angustifolius* seedlings collected in the wild to be planted in the nursery

Figure 16. Earthwatchers planting seedlings of *Podocarpus angustifolius* at Lomas de Banao Ecological Reserve Plant Nursery

Figure 17. Volunteers planting saplings of *Podocarpus angustifolius* at La Sabina, Lomas de Banao Ecological Reserve.

d) Presentations

1. Claudia Pérez Bernal. Claudia Pérez Bernal Bachelor's degree thesis Abundance and diversity of birds in sites at two different altitudes of the Lomas de Banao Ecological Reserve December 2023.
2. Carlos A. Mancina. 2023. Biodiversidad en sistemas montañosos de Cuba Central en un contexto de cambio climático. Congreso de Biodiversidad. La Habana
3. Olivier Valle Hernández. 2023. "Podocarpus angustifolius regresa a "La Sabina". Forum de Ciencia y Técnica. Yaguajay. Sancti Spíritus
4. Pedro Gonzalez. 2023. Composición florística de los bosques de Jarico y La Sabina en la Reserva Ecológica Lomas de Banao. Taller Flora de Cuba. La Habana

2. Mentoring

a) Graduate students

Student Name	Claudia Pérez Bernal
Graduate Degree	Bachelor's degree thesis
Project Title	Abundance and diversity of birds in sites at two different altitudes of the Lomas de Banao Ecological Reserve
Anticipated Year of Completion	December 2023

b) Community outreach

Name of school, organization, or group	Education level	Participants local or non-local	Details on contributions/ activities
School Comunidad de Banao	Primary school	Local participants	Training on bird identification and monitoring in the field Presentation of school theater play about biodiversity conservation in protected areas
School Comunidad de Banao	Primary school	Local participants	Seed collection and planting of important trees for wildlife
Lomas de Banao Ecological Reserve Staff	Rangers	Local participants	Training on bird identification and monitoring in the field

3. Partnerships

Partner	Support Type(s)	Years of Association
Wildlife Conservation Society	Collaboration, Funding, Logistics	2018–present
Instituto de Ecología y Sistemática (IES)	Academic Support, Permits, Collaboration	2018–present
Sociedad Cubana de Zoología (SCZ)	Technical Support, Collaboration	2018–present
Centro de Investigaciones y Servicios Ambientales (CISAT)	Academic Support, Permits	2018–present
San Cristóbal Travel Agency	Logistics, cultural support	2018–2021
Distal Caribe Travel Agency	Logistics, cultural support	2023
Lomas de Banao Ecological Reserve. National Enterprise for the Protection of Flora and Fauna	Logistics, cultural support	2018–present
Cuban PLants Specialist Group, Sociedad Cubana de Botánica	Academic support, scientific collaboration	2019-present

4. Contributions to management plans or policies

Plan/Policy Name	Type[2]	Level of Impact[3]	New or Existing?	Primary goal of plan/ policy[4]	Stage of plan/ policy[5]	Description of Contribution
Biological Diversity National Program	Management Plan of LBER	National	Existing	Species conservation	In-progress	Monitoring of bird, bat and tree populations at LBER contributing to the National Program for the conservation of threatened mountainous ecosystems. Acoustic monitoring as a baseline of insectivorous bat assemblages in forests of Central Cuba.
Updating of conservation targets	Management Plan of LBER	Local	Existing	Species conservation	Proposed	Inclusion of Tapura cubensis (a very rare endemic tree) and the CITES- protected species Cedrela odorata (a precious wood tree) as new conservation targets to be monitored at LBER
Assessment of conservation status	Cuban Red List of Flora IUCN Plant Specialist Group	National	Existing	Species conservation	Proposed	Assessment of conservation status of endemic and rare trees at LBER
Conservation of Cuban psitacids	Management Plan of LBER	National	Existing	Species Conservation	In-Progress	Monitoring and updating of the status of Cuban Amazon and Cuban parakeet
Monitoring of Cavity Nesting Birds	Management Plan of LBER	National	Existing	Species Conservation	In-Progress	Monitoring nesting selection and breeding success of endemic birds

5. Conserving natural and sociocultural capital

a) Conservation of taxa

Focal study species that not listed in most recent proposal

Species	Common name	IUCN Red List category	Distribution	Local/regional conservation status source
Juglans jamaicensis subsp. *jamaicensis*	Nogal del país	Endangered	Native	González *et al.* (2016), Greuter & Rankin (2022)
Magnolia cubensis subsp. *acunae*	Mantequero	Critically Endangered	Local endemic	González *et al.* (2016), Greuter & Rankin (2022)
Pera oppositifolia	Yayabacaná	Critically Endangered	Local endemic	González *et al.* (2016), Greuter & Rankin (2022)
Podocarpus angustifolius	Sabina	Critically Endangered	Local endemic	González *et al.* (2016), Greuter & Rankin (2022)
Tabernaemontana apoda	Huevo de gallo	Critically Endangered	Local endemic	González *et al.* (2016), Greuter & Rankin (2022)
Priotelus temnurus	Cuban Trogon	Least Concern	Endemic	Navarro (2023)
Margarobias lawrencii	Bare-legged Owl	Least Concern	Endemic	Navarro (2023)
Glaucidium siju	Cuban Pygmy Owl	Least Concern	Endemic	Navarro (2023)

Populations of species of conservation significance our project helped conserve in the past year.

Species	IUCN Red List category	Local/regional conservation status	Local/regional conservation status source	Description of contribution	Resulting effect
Podocarpus angustifolius	Critically Endangered	Critically Endangered	Local endemic, Critically Endangered	Planted 1000 seedlings as part of the Threatened Plants Conservation Program at LBER	65 % of survival of seedlings, some of the samplings were also shared with the National Park Topes de Collantes where the species was locally extirpated. Range increased, population increased, enhanced genetic diversity
Magnolia cubensis subsp. *acunae*	Critically Endangered	Critically Endangered	Local endemic, Critically Endangered	Nursed 120 seeds as part of the Threatened Plants Conservation Program at LBER	% of Germination will be available by the next project year
Pera oppositifolia	Critically Endangered	Critically Endangered	Endemic	Planted 10 saplings as part of the Threatened Plants Conservation Program at LBER	Landscape connectivity and forest enrichment
Juglans jamaicensis subsp. *jamaicensis*	Critically Endangered	Critically Endangered	Endemic	Planted 130 saplings as part of the Threatened Plants Conservation Program at LBER	Landscape connectivity and forest enrichment
Psittacara euops	Cuban parakeet	Endangered	Endemic to Cuba. Endangered	Planted tree species important for species diet	Improved habitat for species
Amazona leucocephala	Cuban Amazon	Vulnerable	Endemic to Cuba, Vulnerable	Planted tree species important for species diet	Improved habitat for species, range increased

b) Conservation of ecosystems

Habitats our project helped conserve/restore in the past year.

Habitat type	Habitat significance	Description of contribution	Resulting effect
Evergreen forest	Cover more than 60% of LBER corridor, migration path, critical habitat for endemic species, winter range, summer range, spring range, fall range breeding ground, and feeding sites for local fauna	• Floral and faunal characterization and monitoring; enriched forest with typical native species of diverse functionalities. Species included the endemics Podocarpus angustifolius (140), *Juglans jamaicensis* (130) and *Pera oppositifolia* (10).	Produced critical information for the conservation and management of the biodiversity.
		• Contribution to the recovery of endangered endemic trees by planting ~1120 seedlings for nursery: *Podocarpus angustifolius* (~1000) and *Magnolia cubensis* (~120)	Extent maintained, Improved connectivity and resilience.
		• Follow up and provide maintenance to trees planted in the previous project year (2018-2022).	5.5 hectares of forest enriched with native species
		• Carried out forest structure and composition survey in 35 permanent plots of 400 m2, in six transects of evergreen forest.	Maintenance of 3.8 hectares of planted trees (2018-2022)

c) Ecosystem services

Ecosystem service categories we are directly studying in your Earthwatch research

☐Food and water
☐Flood and disease control
X Spiritual, recreational, and cultural benefits
X Nutrient cycling

DETAILS

Our project registers the richness and abundance of species, as well as the timing of activity peaks and detectability of charismatic taxonomic groups, including birds and bats. We also document the structure and composition of the vegetation that supports this wildlife at LBER. This information is key, not only because it contributed to the effective management of LBER but also because it can promote responsible local and international ecotourism into the Reserve, providing recreational benefits. The conservation of endemic species as symbols of national pride is also part of the project's contribution to cultural benefits. By protecting the forests and key animal species of LBER (seed dispersers, insectivorous species, etc.) our project is contributing to the maintenance of the overall ecosystem health of this Reserve, including the cycling of nutrients and food chain dynamics.

ACKNOWLEDGEMENTS

We thank all the Earthwatch volunteers for having joined our field team and our efforts to better protect the incredible biodiversity harbored at Lomas de Banao Ecological Reserve. Your enthusiasm, experience, critical feedback and passion inspired us and remains with us for the future. We are extremely thankful to all the staff of Lomas de Banao Ecological Reserve, especially to its Director Héctor Martín. We have become a family and your support has been key to our collective success. We thank the Travel Agency Distal Caribe, which has done an exceptional work in making possible our travels and provided us with fantastic guides who added cultural knowledge to our expeditions. We thank the Earthwatch Institute for its continuous support, feedback and ideas, and for helping make our expeditions smooth and successful.

Additional findings from 2023 Earthwatch expeditions in Cuba

Species (scientific name)	Type	Remarks
Ruby-Crowned Kinglet (*Regulus calendula*)	Bird	First record for Central Cuba and the fifth record for Cuba
White-crowned Pigeon (*Patagioenas leucocephala*)	Bird	First record for LBER
MacLeay's Mustached (*Pteronotus macleayii*)	Bat	First record for LBER
Sooty Mustached (*Pteronotus quadridens*)	Bat	First record for LBER
Cuban Fig-eating Bat (*Phyllops falcatus*)	Bat	First record for LBER

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Appendix 1: Annotated list of species including 3 years' project– Lomas de Banao Ecological Reserve

BIRDS

Species (common name)	Species (scientific name)
Gundlach's Hawk	*Accipiter gundlachi*
Sharp-shinned Hawk	*Accipiter striatus*
Tawny-shouldered Blackbird	*Agelaius humeralis*
Wood Duck	*Aix sponsa*
Cuban Amazon	*Amazona leucocephala*
Cuban Nightjar	*Antrostomus cubanensis*
Limpkin	*Aramus guarauna*
Stygian Owl	*Asio stygius*
Cattle Egret	*Bubulcus ibis*
Red-tailed Hawk	*Buteo jamaicensis*
Broad-winged Hawk	*Buteo platypterus*
Green-backed Heron	*Butorides virescens*
Turkey Vulture	*Cathartes aura*
Killdeer	*Charadrius vociferus*
Cuban Emerald	*Chlorostilbon ricordii*
Antillean Nighthawk	*Chordeiles gundlachii*
Great Lizard-Cuckoo	*Coccyzus merlini*
Yellow-shafted Flicker	*Colaptes auratus*
Northern Bobwhite	*Colinus virginianus*
Common Ground-Dove	*Columbina passerina*
Cuban Pewee	*Contopus caribaeus*
Eastern Wood Pewee *	*Contopus virens*
Cuban Crow	*Corvus nasicus*
Smooth-billed Ani	*Crotophaga ani*
Red-legged Honeycreeper	*Cyanerpes cyaneus*
Gray Catbird	*Dumetella carolinensis*
Little blue Heron *	*Egretta caerulea*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
American Kestrel	*Falco sparverius*
Common Yellowthroat	*Geothlypis trichas*
Gray-fronted Quail-Dove	*Geotrygon caniceps*
Key West Quail-Dove	*Geotrygon chrysia*
Ruddy Quail-Dove	*Geotrygon montana*
Cuban Pygmy-Owl	*Glaucidium siju*
Worm-eating Warbler	*Helmitheros vermivorum*
Cuban Oriole	*Icterus melanopsis*

BIRDS (CONT.)

Species (common name)	Species (scientific name)
Tennessee Warbler	*Leiothlypis peregrina*
Swainson's Warbler	*Limnothlypis swainsonii*
Bare-legged Owl	*Margarobyas lawrencii*
Belted Kingfisher	*Megaceryle alcyon*
West Indian Woodpecker	*Melanerpes superciliaris*
Northern Mockingbird	*Mimus polyglottos*
Black-and-White Wabler	*Mniotilta varia*
Shiny Cowbird	*Molothrus bonariensis*
La Sagra's Flycatcher	*Myiarchus sagrae*
Yellow-crowned Night-Heron	*Nyctanassa violacea*
Black-crowned Night-Heron	*Nycticorax nycticorax*
Louisiana Waterthrush	*Parkesia motacilla*
House Sparrow	*Passer domesticus*
Painted Bunting	*Passerina ciris*
Indigo Bunting	*Passerina cyanea*
White-crowned pigeon*	*Patagioenas leucocephala*
Scaly-naped Pigeon	*Patagioenas squamosa*
Cave Swallow	*Petrochelidon fulva*
Rose-breasted Grosbeak *	*Pheucticus ludovicianus*
Cuban Grassquit	*Phonipara canora*
Summer Tanager	*Piranga rubra*
Pied-billed Grebe*	*Podilymbus podiceps*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Cuban Trogon	*Priotelus temnurus*
Cuban Martin*	*Progne cryptoleuca*
Cuban Parakeet	*Psittacara euops*
Cuban Blackbird	*Ptiloxena atroviolacea*
Cuban Bullfinch	*Pyrrhulagra nigra*
Greater Antillean Grackle	*Quiscalus niger*
Ovenbird	*Seiurus aurocapilla*
Northern Parula	*Setophaga americana*
Black-throated Blue Warbler	*Setophaga caerulescens*
Yellow-rumped Warbler	*Setophaga coronata*
Prairie Warbler	*Setophaga discolor*
Yellow-throated Warbler	*Setophaga dominica*
Magnolia Warbler	*Setophaga magnolia*
Palm Warbler	*Setophaga palmarum*
American Redstart	*Setophaga ruticilla*
Cape May Warbler	*Setophaga tigrina*

BIRDS (CONT.)

Species (common name)	Species (scientific name)
Black-throated Green Warbler	*Setophaga virens*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Western Spindalis	*Spindalis zena*
White-collared Swift	*Streptoprocne zonaris*
Eastern Meadowlark	*Sturnella magna*
Antillean Palm-Swift	*Tachornis phoenicobia*
Yellow-faced Grassquit	*Tiaris olivaceus*
Cuban Tody	*Todus multicolor*
Red-legged Thrush	*Turdus rubripes*
Loggerhead Kingbird	Tyrannus caudifasciatus
Giant Kingbird*	Tyrannus cubensis
Gray Kingbird	Tyrannus dominicensis
Barn Owl	Tyto alba
Black-whiskered Vireo	Vireo altiloquus
White-eyed Vireo	Vireo griseus
Cuban Vireo	Vireo gundlachii
Red-eyed Vireo	Vireo olivaceus
Cuban Green Woodpecker	Xiphidiopicus percussus
White-winged Dove	Zenaida asiatica
Zenaida Dove	Zenaida aurita
Mourning Dove	Zenaida macroura
Ruby-Crowned Kinglet	Regulus calendula*

BATS

Species (common name)	Species (scientific name)
MacLeay's Mustached Bat	*Pteronotus macleayii*
Sooty Mustached Bat	*Pteronotus quadridens*
Big Brown Bat	*Eptesicus fuscus*
Jamaican Fruit-eating Bat	*Artibeus jamaicensis*
Cuban Fig-eating Bat	*Phyllops falcatus*
Leach's Single-leaf Bat	*Monophyllus redmani*
Cuban Fruit-eating Bat	*Brachyphylla nana*
Cuban Flower Bat	*Phyllonycteris poeyi*
Buffy Flower Bat	*Erophylla sezekorni*

AMPHIBIANS (FROM PREVIOUS YEARS)

Species (common name)	Species (scientific name)
Cuban Groin-spot Frog	*Eleutherodactylus atkinsi*
Cuban Telegraph Frog	*Eleutherodactylus auriculatus*
Trinidad Flathead Frog	*Eleutherodactylus casparii*
Cuban Long-legged Frog	*Eleutherodactylus dimidiatus*
Cuban Colin Frog	*Eleutherodactylus eileenae*
Cuban Grey's Frog	*Eleutherodactylus greyi*
Yellow-striped Dwarf Frog	*Eleutherodactylus limbatus*
Cuban Flathead Frog	*Eleutherodactylus planirostris*
Cuban Stream Frog	*Eleutherodactylus riparius*
Cuban Bromeliad Frog	*Eleutherodactylus varians*
Cuban Grass Frog	*Eleutherodactylus varleyi*
American Bullfrog	*Lithobates catesbeianus*
Cuban Treefrog	*Osteopilus septentrionalis*
Eastern Giant Toad	*Peltophryne peltocephala*
Cuban Spotted Toad	*Peltophryne taladai*

REPTILES (FROM PREVIOUS YEARS)

Species (common name)	Species (scientific name)
Escambray Blue-eyed Anole	*Anolis ahli*
Blue-eyed Twig Anole	*Anolis alutaceus*
Short-bearded Anole	*Anolis chamaeleonides*
Cuban Giant/Knight Anole	*Anolis equestris*
Escambray Twig Anole	*Anolis garridoi*
Cuban White-fanned Anole	*Anolis homolechis*
Dwarf Green Anole	*Anolis isolepis*
Slender Cliff Anole	*Anolis lucius*
Cuban Green Anole	*Anolis porcatus*
Cuban Brow Anole	*Anolis sagrei*
Cuban Lesser Racer	*Caraiba andreae*
Cuban Boa	*Chilabothrus angulifer*
Cuban Racer	*Cubophis cantherigerus*
Cuban Brown Curlytail	*Leiocephalus cubensis*
Cuban Whiptail	*Pholidoscelis auberi*
Ashy Sphaero	*Sphaerodactylus elegans*
Cuban Slider	*Trachemys decussata*
Cuban Water Snake	*Tretanorhinus variabilis*
Escambray White-necked Trope	*Tropidophis galacelidus*
Giant Trope	*Tropidophis melanurus*
Sancti Spiritus Trope	*Tropidophis spiritus*

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