Cusuco National Park, Honduras

2010 status report

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SERVIMOS NATURALEZA

OPERATION WALLACEA

EXPEDICIONES Y SERVICIOS AMBIENTALES CUSUCO

UNIVERSITY OF OXFORD

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Introduction

Operation Wallacea is an international conservation research organization, specializing in tropical forest and coral reef ecology and conservation. Operation Wallacea has been monitoring cloud forest biodiversity in Parque Nacional Cusuco (PNC) since 2006 using standardized methods to investigate abundance, diversity and distribution of species, and to monitor the effects of habitat degradation and anthropogenic disturbance on biodiversity over time. Each year, research is conducted over a two month period from mid June to mid August. The research is lead by university academics, each specializing in specific taxa. These academics are joined by Honduran and international field assistants who are generally graduate students with experience working on tropical expeditions and research experience with their chosen taxa. Collectively, these academics and graduate assistants make up the science staff. The science staff are assisted by university students, who join the research teams either to collect data for their thesis projects or to gain field research experience as part of a university course. Also present at the field site are high school groups who join the projects to complete a tropical ecology and conservation field course, which involves lectures, practical sessions where they have the chance to observe the academics and university students, and forest structure surveys in which the school groups are responsible for collecting data under the supervision of their teachers and Operation Wallacea science staff. Schools and university students participating in the expeditions are primarily from the UK, Ireland, USA and Canada.

In delivering our scientific aims we also intend to give the students, on which the entire programme depends, the best possible learning experience. To achieve this goal, Operation Wallacea have designed an education programme with science teams investigating all major taxonomic groups, a genetics team running a field laboratory, and a canopy access team in addition to ecology training courses and evening lectures and seminars with visiting academics. This well designed programme, combined with the enthusiasm of all our staff has ensured positive feedback students every year with students reporting that they felt their contributions to the research were valued and that they learned useful skills whilst experiencing living and working in a tropical forest.

The Biodiversity Institute of Oxford (BIO) in the zoology department of the University of Oxford aims to develop a research agenda focused on the key challenges for global biological diversity in the 21st Century and to facilitate the translation of science into policy, planning and strategy. BIO has recently joined with Operation Wallacea to use the Operation Wallacea datasets to create a standardized model for biodiversity monitoring that may be applied to the United Nations Programme for Reducing Emissions from Deforestation and forest Degradation in Developing Countries (REDD). A key objective of our research in Honduras is to leverage funding to resource the conservation of PNC. This 2010 status report is a preliminary document that will form part of a larger grant application to procure funding for the sustainable management of Cusuco via investment in the carbon and biodiversity present in the park based on the REDD programme. The final grant application, that will adhere to the Climate, Community and Biodiversity (CCB) project design standards will be created in conjunction with the Honduran Instituto Nacional de Conservación y Desarrollo Forestal, Áreas Protegidas y Vida Silvestre (ICF). Dr Peter Long from BIO will be using the Cusuco long-term dataset to create a standard for biodiversity monitoring and will also provide estimates of the carbon tonnage at Cusuco using remote sensing. Dr Kathy Slater from Operation Wallace will be using the economic and agricultural data collected from buffer zone communities at PNC to determine how funds procured from REDD or similar programmes should be allocated to forest patrols to prevent further deforestation and sustainable development projects to reduce community dependence on forest resources.

Cusuco National Park is a 23,400ha protected area in the Merendon Mountains of northwest Honduras. The park ranges from just above sea level in the west to 2425m in the centre (Figure 1). The park comprises a 7690 hectare core zone surrounded by a 15,750 hectare buffer zone. Cusuco encompasses several major habit types including semi-arid pine forest, moist pine forest, moist broadleaf forest and dwarf forest (bosque enaño) at elevations above 2000m. The park is part of the Meso-American biodiversity hotspot (Conservation International 2006), a region characterised by exceptional species richness. Cusuco also has great diversity of habitats and high beta diversity in many groups due to the large elevational gradients in the park.

PNC supports exceptional biodiversity. Some of the key features of the park included the globally threatened taxa which the park protects, especially amphibians (table 1), Baird's tapir, the assemblage of montane forest specialist birds, jewel scarab beetles, and the globally rare "bosque enano" (dwarf forest) habitat which is characterised by *Orthea brachysiphon.* PNC is recognised as a Key Biodiversity Area (KBA) due to the overlapping ranges of several globally threatened amphibian species. Unfortunately the integrity of the ecosystem is threatened by land cover change and unsustainable land management practices – particularly conversion of forest to coffee plantations, by human population growth and infrastructure intensification, overexploitation of large mammals, the amphibian disease chytridiomycosis and climate change.

The aim of the this report is to detail the methods and spatial sampling structure used to monitor the status of biodiversity in Cusuco and to present indices of change in the condition of the park since 2006. The report will also provide a summary of the economic and agricultural data collected during interviews and farm surveys with buffer zone communities and use this information to suggest improvements to existing agriculture as a means of maximising economic gain for these communities, while at the same time promoting sustainability and preventing further habitat degradation.

Table 1. Globally threatened and near threatened species found in Cusuco National Park. Note that the majority of woody plants, reptiles and invertebrates recorded in the park have not yet been assessed against the IUCN criteria.

Class	Latin name	Common name	IUCN category
Plants	Cryosophila williamsii	Root-spine Palm	CR
	Amphitecna molinae		EN
	Tetrorchidium brevifolium		EN
	Cedrela odorata	Cigar-box Wood	VU
Amphibians	Duellmanohyla soralia		CR
	Craugastor chac		NT
	Craugastor charadra		EN
	Craugastor milesi		CR
	Craugastor rostralis		NT
	Bromeliahyla bromeliacia		EN
	Plectrohyla dasypus		CR
	Plectrohyla exquisita		CR
	Plectrohyla matudai		VU
	Ptychohyla hypomykter		CR
	Bolitoglossa conanti		EN
	Bolitoglossa diaphora		EN
	Bolitoglossa dolfeini		NT
	Bolitoglossa dunni		EN
	Cryptotriton nasalis		EN
	Bolitoglossa decora		CR
	Oedipina tomasi		CR
	Craugastor coffeus		CR
Birds	Electron carinatum	Keel-billed Motmot	VU
	Patagioenas leucocephala	White-crowned Pigeon	NT
	Amazilia luciae	Honduran Emerald	CR
	Penelopina nigra	Highland Guan	VU
	Crax rubra	Great Curassow	VU
	Pharomachrus mocinno	Resplendent Quetzal	NT
	Dendroica chrysoparia	Golden-cheeked Warbler	EN
Mammals	Tapirus bairdii	Baird's Tapir	EN
	Ateles geoffroyi	Central American Spider monkey	EN
	Tayassu pecari and Pecari tajacu	White lipped peccary and Collared peccary	NT
	Panthera onca	Jaguar	NT
	Bauerus dubiaquercus	Van Gelder's Bat	NT

Spatial sampling framework

Parque Nacional Cuscuo is an incredibly complex landscape with an elevation ranging from 60m to 2242m (Figure 1). There are three major forest structures within the park: Semi-arid Pine forest, Wet-deciduous forest and Cloud Forest. The “Semi-arid Pine Forest” faces in a south direction at an altitude of 800 to 1,500 metres. There are 11,100 hectares of Semi-arid Pine forest, of which 11,000 hectares were mature pine and the remaining 100 hectares consisted of immature plants less than 35 years old. The “Wet-deciduous Forest” covers the north facing mountain slopes at an altitude between 500 and 1,500 metres. This forest covers 1,600 hectares in a mixture of pine trees and broad leaf forest. The remaining 13,000 hectares of broad leaf forest lie within the Cloud Forest.

To accommodate this complex landscape, seven different research camps have been established, five of which are in the core zone and two are in the buffer zone (Figure 1). In total there are 145 sample sites distributed across these camps in which habitat surveys, bird point counts and dung beetle trapping are done (Figure 2). The aim is to sample all of these sites each year. In addition, there are 29 sample routes for large mammal monitoring and herpetofauna surveys (Figure 2). The large mammal team also use a further 6 sample routes in areas frequented by large mammals that are outside of our existing survey area and the herpetology team also do opportunistic surveys on other routes of their own devising. Captures are treated as opportunistic records. The bat team has 18 permanent mist netting sites (although not all will be visited in every season). Additionally there are a small number of cave roost sites.

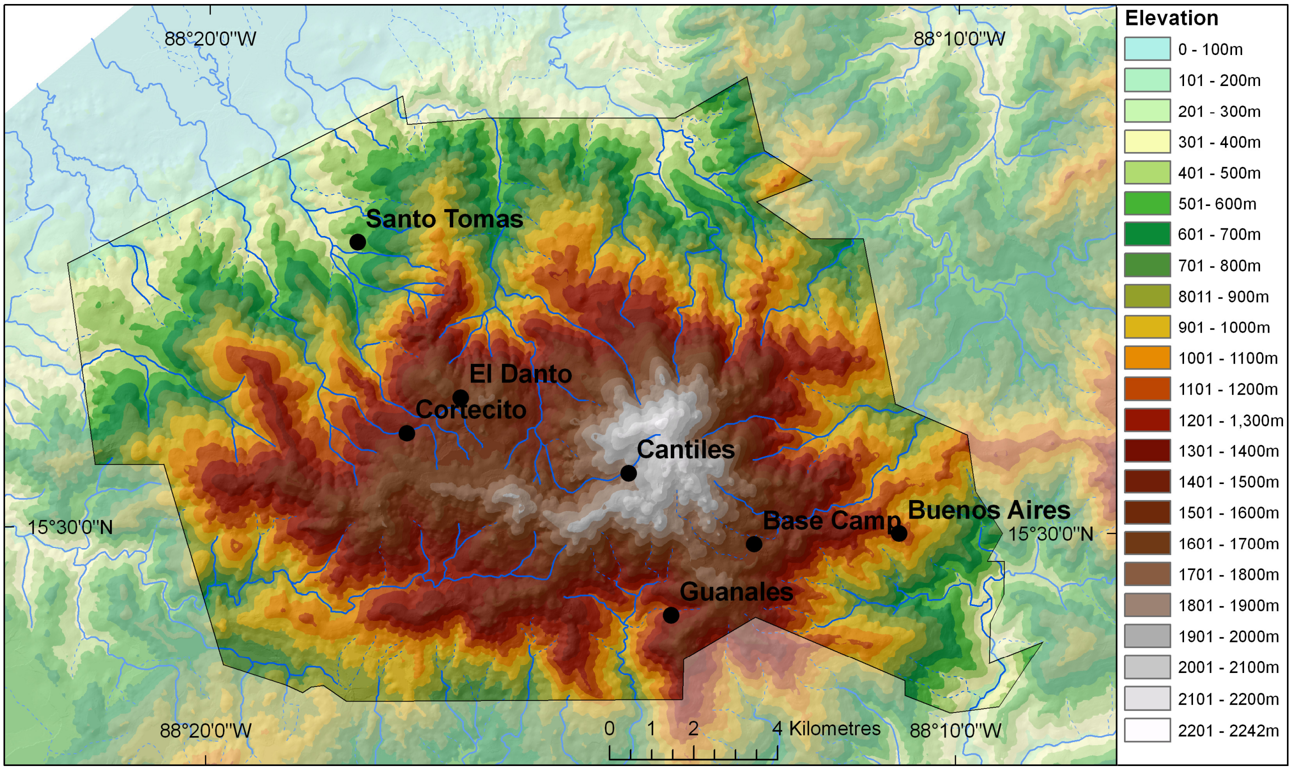

Figure 1: GIS map of the Cusuco National Park showing elevation and the location of the 7 research camps. Elevations in the park range from 60m to 2242m. For further details please see appendix. In the maps throughout this report we use the convention of a partially transparent mask over parts of the landscape outside the park.

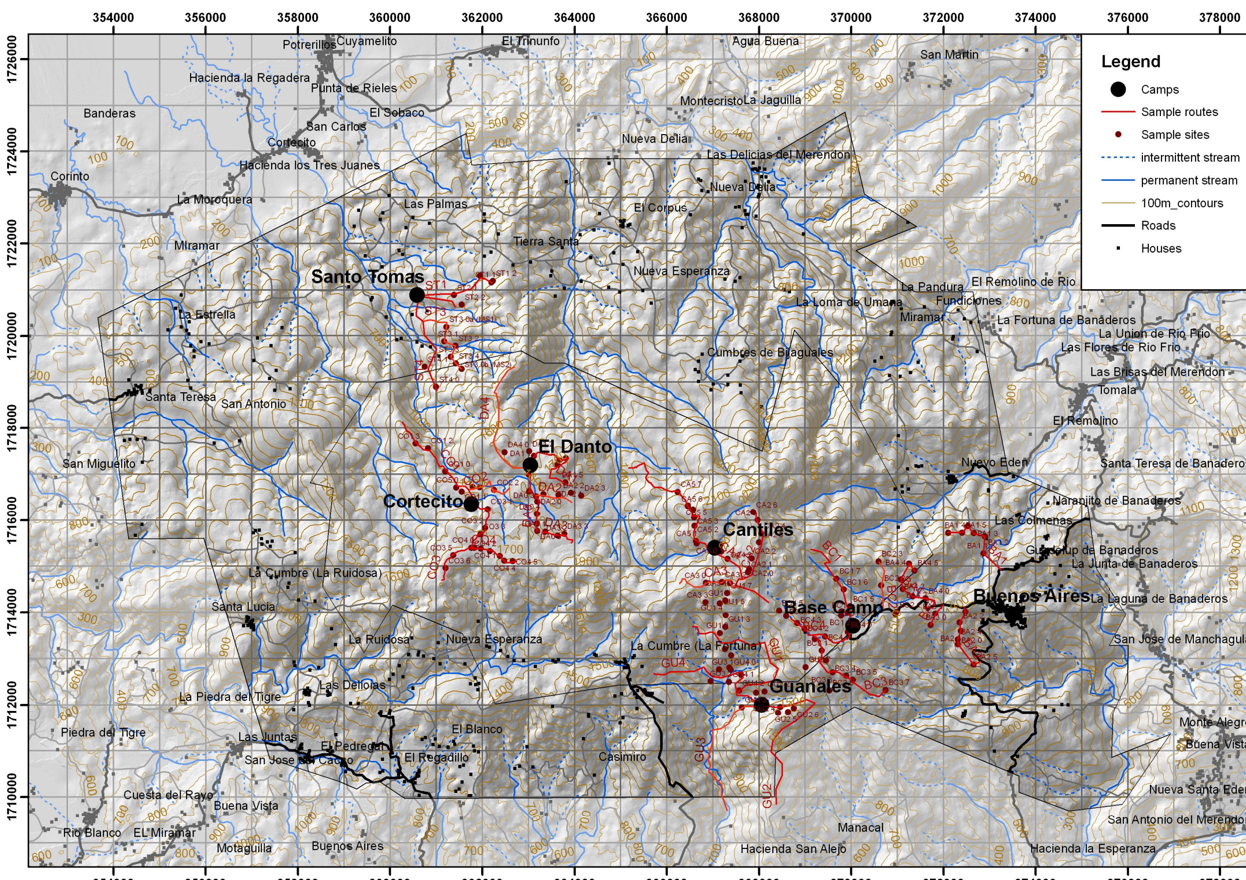

Figure 2: Topographic map of Cusuco showing research camps, sample route and sample sites.

Forest Encroachment

There are 38 communities in the buffer zone of PNC and all of these rely on agriculture as their primary source of income. Due to insufficient funds for forest patrols and unsustainable agricultural practices, forest encroachment to make way for agriculture has steadily increased since the creation of the park in 1987 (Figure 3). Forest encroachment is most severe on the western side of the park. The likely reason for this is the difference in land use between the eastern and western side of the park. On the eastern side of the park, the montane and cloud forest is suitable for coffee farming and thus agriculture on this side of the park is almost exclusively coffee farming. On the western side of the park, the moist b broadleaf forest is not suitable for coffee farming unless at higher elevations (i.e. in the core zone of the park) and thus agriculture in the buffer zone tends to be cattle farming mixed with low yield coffee plantations. Forest encroachment on the western side of the park is therefore twofold: forest clearance to make way for more cattle pasture and encroachment in to the core zone where the climate is more suitable for coffee plantations (Figure 4). Moreover, a recent rise in the value of Honduran coffee has triggered a peak in forest clearance.

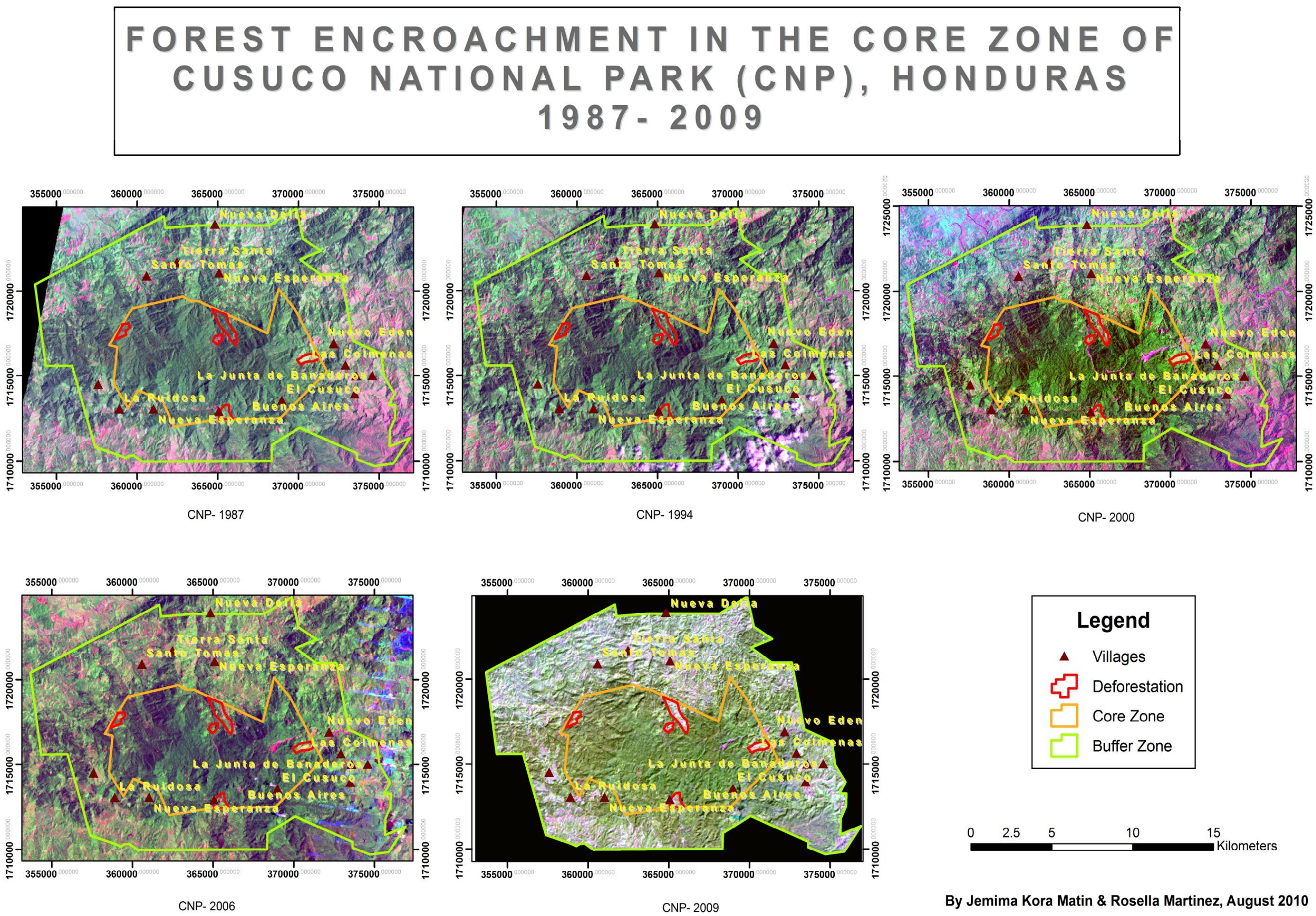

Figure 3: Landsat images indicating forest encroachment in PNC 1987-2009. Areas marked in red are not the only areas of deforestation in the core zone, but were huge areas close to the Danto research camp that were mapped out during the 2010 field season. Forest is represented by dark green colouration. From the 2009 landsat image it is clear that there is very little forest left in the buffer zone of the park, especially on the western side of the park.

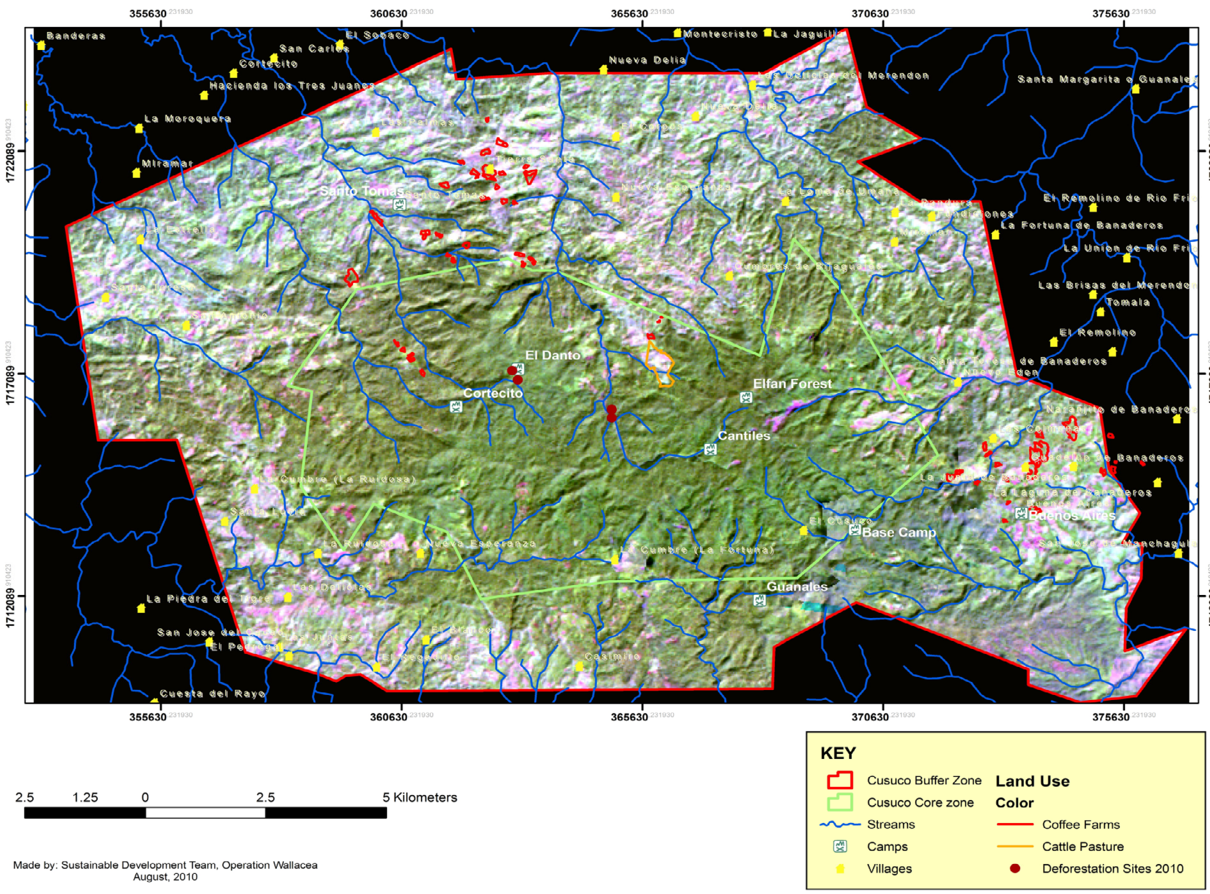

Figure 4: Map indicating different types of land use in PNC. Coffee plantations and cattle pasture indicated on the map were mapped during the 2010 field season. These are only a small proportion of the forest clearances and mapping of these areas will continue in subsequent field seasons. Forest is represented by dark green colour. Pink represents completely cleared land (i.e. bare soil) and yellow represents grass. Yellow and pink mosaic on this map indicates that virtually all the land in the buffer zone on the western side of the park has been used for cattle pasture.

Field methods for Biodiversity Monitoring

Dung beetles

Dung baited traps were run at each sample site on three occasions during a season. Traps consisted of two 16oz plastic cups (one inside the other) dug into the ground with their lip flush with the ground surface. A small (approx. 20g) of fresh horse dung wrapped in cheese cloth was tied onto a stick and placed across the plastic cup. Traps were emptied every four days.

Reptiles and Amphibians

The herpetology team walked the standard sample routes through a variety of habitats at a rate of 500 m/hr and recorded all individuals sighted or captured during that time. Data was recorded for each individual, including factors such as identification, morphological observations and measurements, habitat notes, and the location along the sample route where each individual was encountered.

The herpetology team also used opportunistic surveys. Searches were conducted day and night in locations that appeared to be productive habitats for finding reptiles and amphibians. Examples include river walks, night walks in a variety of habitats, and any other productive-looking areas which might not have been visited whilst performing transect line surveys. Looking under rocks, breaking up dead logs, and raking through leaf litter are all effective practices. This technique proved very useful for two main reasons: (1) It proved to be the main source of data for species which are primarily nocturnal (of which Cusuco has many), (2) Many streams and rivers are crossed by the transect lines but are not followed; without searching these habitats, amphibian encounters would be much lower and the data less complete.

For analyses, reptiles and amphibians were binned into the following functional groups: Arboreal snakes, Fossorial snakes, Lizards, Terrestrial snakes, Leaf-litter frogs, stream frogs, salamanders

Birds

10 minute point counts were conducted 3 times at each sample site along the 28 sample routes across seven camps within the park. During a point count when a bird was sighted or heard the following data were recorded: species, number in group, method of observation, distance, and habitat data. Additionally, cloud cover, rain and wind were each recorded on a five point scale.

The point count data was supplemented by mist-netting with 200ft of net from 0530-0830. When birds were removed from mist nets they were identified to species, aged, sexed, morphometric measurements taken, their moult condition was scored and all bird were ringed, except hummingbirds. A large number of informal opportunistic sightings at all camps were also made.

The more abundant bird species were assigned to the following functional groups to aid data analysis:

Montane forest specialist birds
- Slate-coloured solitaire, *Myadestes unicolor*
- Common bush tanager, *Chlorospingus opthalmicus*
- Emerald toucanet, *Aulacorhynus prasinus*
- Resplendent quetzal, *Pharomachrus mocinno*
- Grey-breasted wood wren, *Henicorhina leucophrys*
- Spectacled foliage-gleaner, *Anabacerthia variegaticeps*
- White-winged dove, *Zenaida asiatica*
- Brown-capped vireo, *Vireo leucophrys*
- Green-throated mountain gem, *Lampornis viridipallens*

Lowland forest specialist birds
- Red-capped mannakin, *Pipra mentalis*
- Long-tailed hermit, *Phaethornis superciliosus*
- Keel-billed toucan, *Ramphastos sulfuratus*
- White-crowned parrot, *Pionus senilis*

Birds with relatively wide elevational range
- Collared trogon, *Trogon collaris*
- Yellowish flycatcher, *Empidonax flavescens*
- Nightingale wren, *Microcerculus philomela*
- Slate-throated redstart, *Myioborus miniatus*
- Black-headed nightingale thrush, *Catharus mexicanus*

Disturbed habitat specialists
- Sulphur-bellied flycatcher, *Myiodynastes luteiventris*
- Blue-crowned motmot, *Momotus momota*
- Golden-fronted woodpecker, *Centurus aurifrons*
- White-collared seedeater, *Sporophila torqueola*
- Blue-black grassquit, *Volatinia jacarina*
- Yellow-faced grassquit, *Tiaris olivacea*

Large ground birds
- Highland guan, *Penelopina nigra*
- Crested guan, *Penelope purpurascens*
- Great currasow, *Crax ruba*
- Great tinamou, *Tinamus major*
- Little tinamou, *Crypturellus soui*

Large mammals

The large mammal team walk the standard sample routes in the park on as many occasions as possible each year recording visual observations, calls and sign of large mammals. For species that are encountered more frequently, density estimates can be produced using DISTANCE sampling. For species that are rarely seen or heard, abundance estimates may be produced using Patch Occupancy sampling. For analysis in this report, abundance estimates for large mammals are grouped into carnivores, deer, edentates, opposums, peccaries, rodents, primates and tapir.

Bats

Bat surveys were conducted at 18 standardized mist net sites across the different research camps. These locations were chosen to optimize bat capture rates. Mist net surveys were conducted for 6 hours per night from 6pm until 12am using five mist nets per site, each 6m long and 2.5m high (i.e. 450, m^2*hour per mist net site, per night). The nets were checked every 15 to 20 minutes during the first 3 hours of sampling and every 30 minutes for the last three. All the bats were extracted from the nets following standardized protocols so as to minimize the stress and will be kept in a capture bags for 30mins, maximum. Bat processing time varied depending on the size of the bat and the sex; pregnant females were immediately measured and released. All bats were weighed, sexed, and the length of the forearm, feet and leg were measured.

Small Mammals

Based on a comparative trial test of Sherman and Freya live traps in 2008, trap selectivity has proved to be a major factor in assessing small mammal populations in the Cusuco Park. Sherman traps have an internal spring-closing mechanism, and during 2008 trials with the standard peanut butter–granola–honey- vanilla essence bait mix always used for Freya traps quickly fouled and ultimately interfered with the Sherman mechanism. Sherman traps are easy to disassemble and clean with soap and water, but doing this every few days with 100 or more traps is a time consuming chore. Several 5-day Sherman trials with only breakfast oats or granola seemed not to affect catch rates significantly in 2008, but more data are needed to confirm this statistically.

In 2010 a study comparing catch rates in three sizes and types of traps (Freya cage traps and two sizes of Sherman traps) was conducted from 50 Freya traps, 25 large Sherman traps and 25 small Sherman traps of each type (total 100 traps). The study was run at Base Camp in two different forest types. Trapping took place during June to early August 2010 in Cusuco National Park. 7 transects were covered, which included habitats in the Buffer zone and core zone. Each transect was sampled in a constant manner. 100 traps were set out: 50 Sherman traps; 50 Freya traps. The traps were baited each afternoon and checked every morning for captures, for five consecutive nights, thus with no false triggers giving a total of 500 trap nights per transect, 3500 trap nights in total.

Results

Reptiles and amphibians

Since 2006, reptiles and amphibians have been monitored by walking along 30 unique sample routes on 358 occasions. From 2006 to 2009, 19 of the routes have been sampled by the herpetology team at least once in all four years; 9 routes have only been sampled at least once in three out of four years; and 2 routes have only been sampled at least once in two out of four years. In 2010, the herpetofauna team walked 25 different sample routes on 44 occasions giving rise to 65 encounters of 18 different species. On 22 occasions, no herpetofauna were encountered. In addition, 136 opportunistic herp records were made of 40 different species. Two new species were discovered for the park: *Craugastor laticeps* (IUCN Near threatened) and *Craugastor laevissimus* (IUCN endangered). Given that a route has been used for monitoring reptiles and amphibians in a given year, the mean number of occasions on which walks have taken place is 2.93. However there is considerable variation in the number of repetitions that have taken place – the maximum number of sampling occasions on a route in a year has been 10 (on GU1 in 2006 and on ST1 in 2010). A more optimal strategy to enhance power would be to strive to equalize the number of walks on each sample route in future seasons. In the course of the herpetology walks, 886 individuals were observed of 58 species. Only 13 individuals (0.015%) were of unknown species. The mean abundance of reptile and amphibian groups between 2006 and 2010 are presented in figures 5 and 6 respectively.

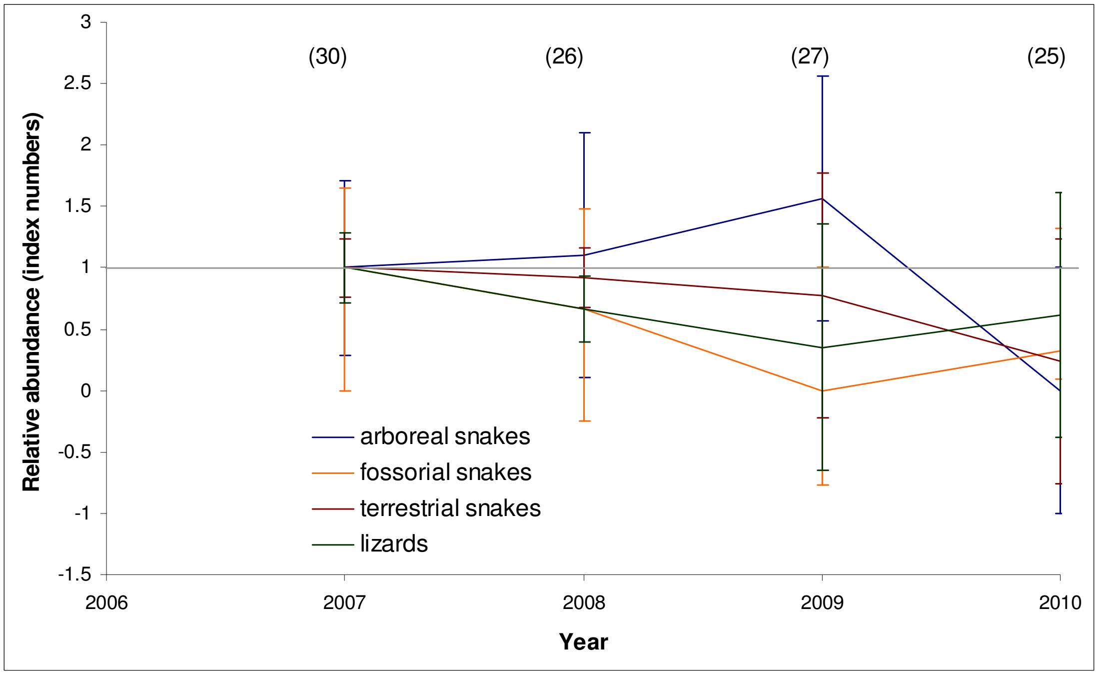

Figure 5: Trends in relative abundance of reptiles by groups. Reptile species have been assigned to a guild. Mean relative abundance (number of individuals observed metre walked) across all occasions in a given year has been transformed to an index number where 2007 = 1. The numbers in parentheses are the number of unique routes used in each year. Error bars are standard error of the mean relative abundance across all sample sites used in that year, again converted to index numbers using the same scale factor as for the relative abundance series. Note that this composite indicator does not take account of the effect of route (as a GLMM would).

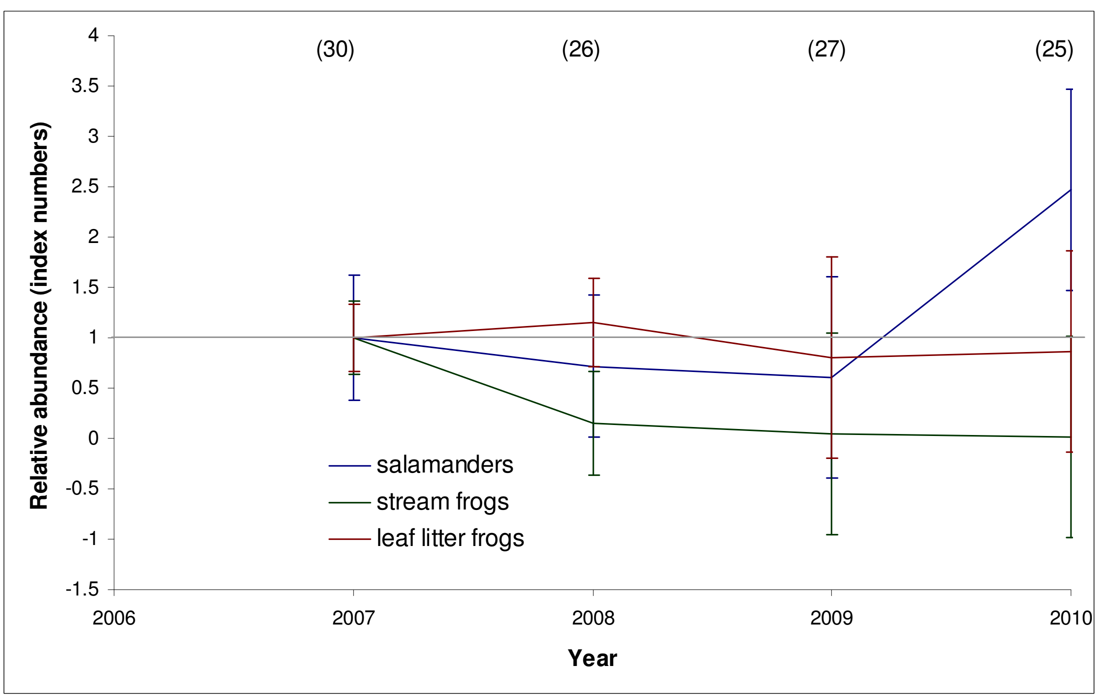

Figure 6: Trends in relative abundance of amphibians by groups. Amphibian species have been assigned to a guild. Mean relative abundance (number of individuals observed metre walked) across all occasions in a given year has been transformed to an index number where 2007 = 1. The numbers in parentheses are the number of unique routes used in each year. Error bars are standard error of the mean relative abundance across all sample sites used in that year, again

converted to index numbers using the same scale factor as for the relative abundance series. Note that this composite indicator does not take account of the effect of route (as a GLMM would).

Large mammals

Since 2006, large mammals have been monitored by walking along 34 unique sample routes on 256 occasions. In 2010, the large mammal team sampled 29 unique routes on 54 occasions in 2010. They detected 550 mammals or signs representing 15 species. The team also made 83 opportunistic observations of 10 species Fifteen of the routes have been walked at least once in all four years; 4 routes have been walked at least once in three out of four years; 13 routes have been walked at least once in two out of the last four years; and 3 routes (BA Toucan and AG1) have only been sampled in a single year out of the last four. Given that a route has been used at all by the large mammal team in a particular year, on average the route will have been surveyed on 2.04 occasions during that year. In the last four years of monitoring, 1564 large mammal records have been made representing 21 different species. 50 observations could not be identified to species. The majority of observations, 91%, were of signs; only 9% of observations were direct visual or auditory records. The mean abundance of large mammal groups from 2006 to 2010 is presented in Figure 7.

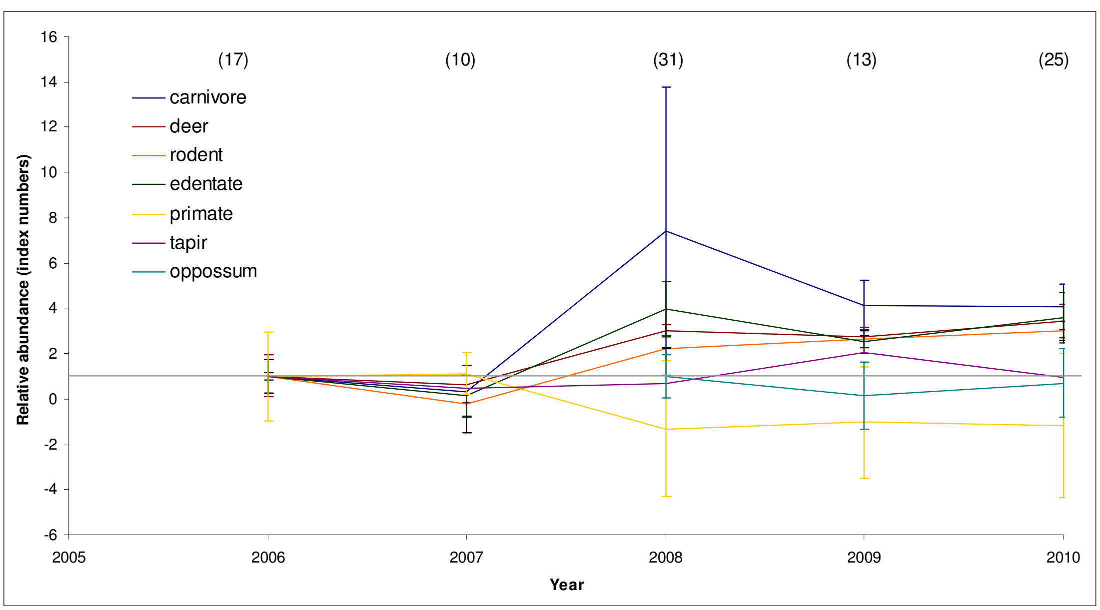

Figure 7: Trends in relative abundance of large mammals by groups. Large mammal species have been assigned to a group, with the exception of Baird's tapir. Mean relative abundance (number of individuals observed per metre walked) across all occasions in a given year has been transformed to an index number where 2006 = 1 (except opossums, for which the index year in 2008). The numbers in parentheses are the number of unique routes used in each year. Error bars are standard error of the mean relative abundance across all sample sites used in that year, again converted to index numbers using the same scale factor as for the relative abundance series. Note that this composite indicator does not take account of the effect of route (as a GLMM would).

Bird point counts

Since 2006, ten minute point counts have taken place at 143 unique sample sites on a total of 1771 occasions. In 2010 the bird team undertook point counts at 122 unique sites on 341 occasions in 2010. At 97 sample sites, point counts took place on 3 or more occasions. In the course of the point counts, 2283 individual birds in 1754 clusters were detected. These included 94 species. The bird team also used mist nets at 9 locations on 23 occasions in 2010 and caught 128 individuals of 29 species. Finally, the team collected 45 opportunistic bird observations in 2010.

From the point counts, only 2 individuals observed during point counts were of unknown species (0.08%). Eighty one sample sites have been point counted on at least one occasion in all four years; 46 sample sites have been point counted on at least one occasion in three out of the four years; 12 sample sites have been point counted on at least one occasion in two out of the last four years; and only two sample sites have only been visited on at least one occasion in a single year out of the last four. However, given that a site is used for point counts in a particular year, the mean number of occasions on which bird point counts have taken place at that site is 2.78, which is very close to our target of three repetitions for every site used.

During the course of these point counts, 11420 records of groups of birds were made, representing 13194 individuals. 1702 (12.9%) of these individuals were of unknown species. Of the 239 bird species that have ever been recorded in the park (by point counts, mist-netting or opportunistic sightings), 178 different species have been observed during point counts. The mean abundance of each bird guild from 2006 to 2010 is represented in Figure 8.

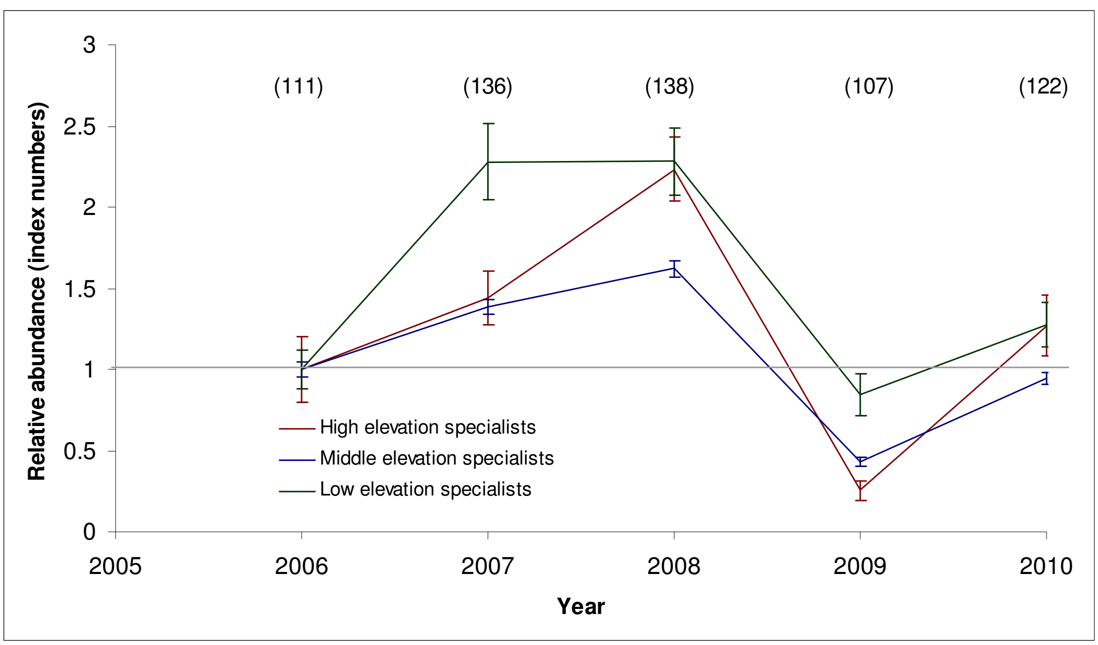

Figure 8: Trends in relative abundance of birds by groups. All bird species have been assigned to an elevation group following Stotz (1996). Low elevation is <500m, Middle is 500m- 1600m and High is >1600m. Mean relative abundance (number of individuals observed per minute) across all occasions in a given year has been transformed to an index number where 2006 = 1. The numbers in parentheses are the number of unique sample sites used in each year. Error bars are standard error of the mean relative abundance across all sample sites used in that year, again converted to index numbers using the same scale factor as for the relative abundance series. Note that this composite indicator does not take account of the effect of sample site (as a GLMM would). The deep dip in 2009 may be an artefact.

Invertebrates

Dung beetles were trapped at 36 unique sample sites on 95 occasions in 2010. 3356 individuals of 15 species were captured. Across all years, there were 889 sampling occasions in which 5484 beetles were caught. These data were added to the survey data from previous years (Figure 9) to monitor trends in abundance. Sphingid moths and jewel scarab beetles were light-trapped at 7 locations on 59 occasions in the 2010 season. 497 individuals of 73 species were captured.

Bats

This year, the bat team used mist nets at 19 locations on 53 occasions. 385 individuals of 33 species were caught. Across all years there were 371 sampling occasions were in which 2093 bats were caught of 61 different species. These data were added to that of previous years to monitor trends in bat abundance over time (Figure 10). No visits were made to bat roosts in 2010.

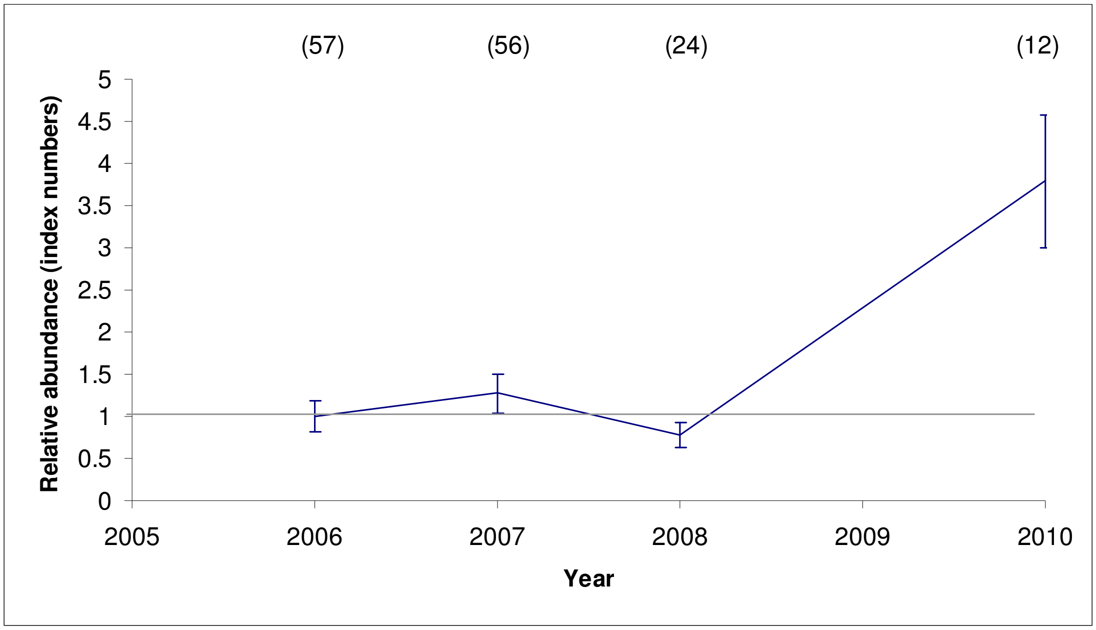

Figure 9: Trends in dung beetle abundance. All dung beetle species considered together. Mean relative abundance (number of individuals caught per trap night) across all occasions at a each sample site in a given year has been transformed to an index number where 2006 = 1. The numbers in parentheses are the number of unique sample sites used in each year. Error bars are standard error of the mean relative abundance across all sample sites used in that year, again converted to index numbers using the same scale factor as for the relative abundance series. Note that this composite indicator does not take account of the effect of which sites were sampled (as a GLMM would).

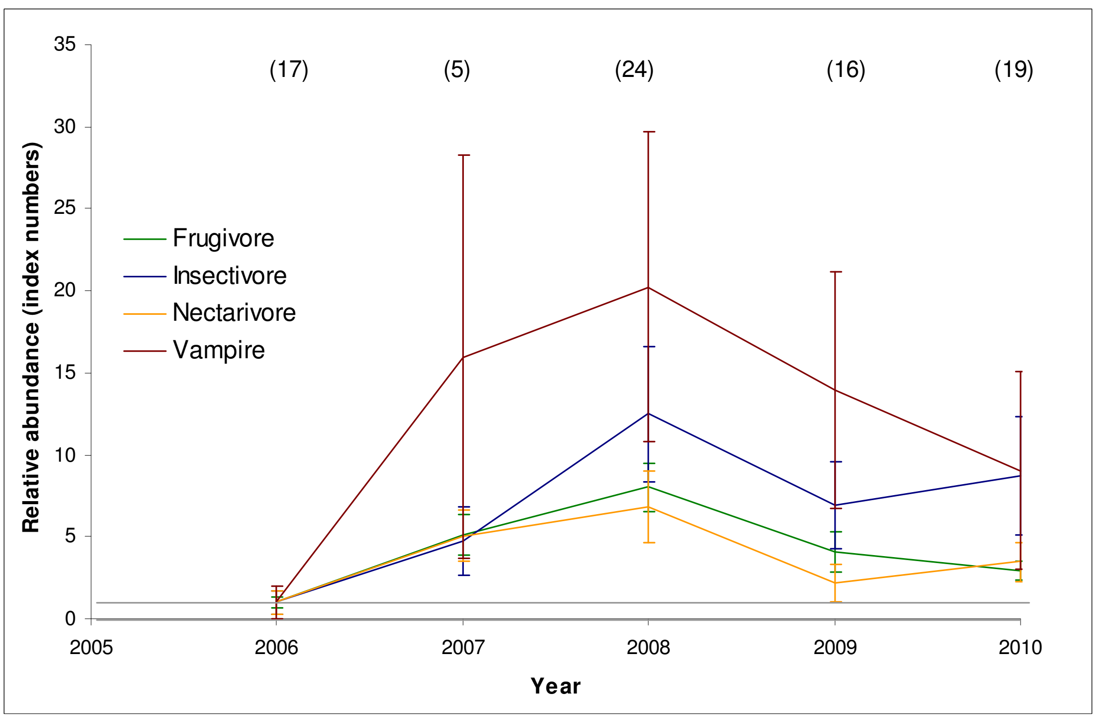

Figure 10: Trends in bat abundance over time. All bat species have been assigned to a guild. Mean relative abundance (number of individuals caught per hour*m2 net) across all occasions in a given year has been transformed to an index number where 2006 = 1. The numbers in parentheses are the number of unique net locations used in each year. Error bars are standard error of the mean relative abundance across all net locations used in that year, again converted to index numbers using the same scale factor as for the relative abundance series. Note that this composite indicator does not take account of the effect of net location (as a GLMM would).

Small Mammals

The total number of captures was 563; 271 of which were in the Freya traps and 292 of which were in the Sherman traps. There were 37 recaptures of individuals, who had previously been marked with an ear clipping. The percentage of false triggers of the traps are as follows, the Freya traps false trigger 417 times out of 1745 of which were set, therefore 23.8% of the Freya traps were ineffective, in comparison to 9.9 % of the Sherman traps which false triggering 174 times out of the 1745 that were set.

The trap effectiveness of Freya's was 20.4% compared to 18.5 % for the Sherman's. Originally the amount of traps set over a 5 night period for 7 weeks would create 1750 traps available for the small mammals, however due to traps being stolen, washed away and breaking whilst on the transect line there were 5 Sherman's and 5 Freya's that were not set on separate nights on different transects.

One new species for Cusuco Park was caught on transect 4, 100m from Basecamp – the *Sylviagus gabbii (*Forest Rabbit) was caught in a large Sherman trap.

The 2010 study has proven that there is little variation between the amount of captures in Freya and Sherman traps. Freya's false trigger a lot more than Sherman's, with 417 Freya's to 174 Sherman's, due to there more open mechanism. The lack of solid roofing and wire structure exposed the treadle to being triggered by environmental elements, such as heavy rainfall.

However when false triggers and capture rate is taken into account, the Freya's are the more efficient trap by 1.9 %. There is a higher capture of species diversity in the Sherman traps in comparison to the Freya traps, by one additional species. Therefore a full analysis between the two trap types reveals that neither can be discounted from the study. Certain species such as the *Didephis marsupialis* favour the Freya trap, whereas the Sherman's are easier to take out into the field, due to there flat packed design and have captured some of the interesting individuals, such as *Mustela frenata* and *Sylviagus gabbii.*

Economic Assessment of Buffer Zone Communities

Parque Nacional Cusuco (PNC) is located in the Merendon Mountain range in North West Honduras and consists of 23,440 acres including a buffer zone (15, 650 hectares) and a central core area (7,790 hectares). There are three main forest types within the park: broadleaf, pine and dwarf forests with zones of transition, agriculture, shade coffee plantations and recently logged areas. The park was created in 1987 and has been managed by Corporacion Hondurena de Desarollo Forestal (CODEFOR) until CODEFOR changed to Instituto Conservacion Forestal (ICF) in 2008. There are 38 small coffee producing villages in the buffer zone of the Cusuco National Park. Standardized collection of economic and agricultural data has been collected in 5 of these communities since 2008: Buenos Aires, Bañaderos and Las Juntas on the eastern side of the park and Santo Tomas and Tierra Santa on the western side of the park. Data were collected using structured interviews with the farmers at their house followed by an accompanied visit to their farm where the boundaries of the farm were mapped using a handheld GPS unit, and an additional structured interview was conducted followed by a visual farm survey.

Buenos Aires consists of 102 houses, and 594 people. Attached to Buenos Aires is the community of Bañaderos, which is also the location of some of the agricultural land owned by residents of Buenos Aires. Bañaderos contains 45 houses and 238 people. La Juntas contains 26 houses and 138 people. Of the two villages on the western side of the park, Santo Tomas contains 18 houses and 87 people, whereas Tierra Santa contains 39 houses and 251 people. All interviewees stated that their primary source of income was agriculture. As none of the villagers interviewed kept any kind of records regarding their annual income and expenditure, economic status of each household was assessed using a five point scale (1 being the lowest status category) based on the characteristics of their property (see Figure 1). Economic status was generally lower in the western communities with few or no villagers belonging to the top two status categories (Figure 1). Although economic status was generally higher in the eastern communities, Buenos Aires had the highest proportion of villagers in the lowest status category (Figure 1). The high instance of low economic status in Buenos Aires is best explained by the proportion of villagers that were land owners (Figure 2).

The number of farms and mean size of farms is presented in Table 1. Although all interviewees stated that their major source of income was from agriculture, not all interviewees owned their own land. In 56% of cases (n=21) where the interviewee did not own his own land, the land was owned by another member of the same community, with the remaining land owners coming from other communities within Cusuco (5%, n=2), the San Pedro Sula district (24%, n=13) and outside of Honduras (5%, n=2). In Bañaderos where the interviewee did not own his own land 33% (n=4) of the landowners were from within Bañaderos, 17% (n=2) were from other Cusuco communities, 25% (n=3) were from the San Pedro Sula district, 17% (n=2) were from elsewhere in Honduras and 8% (n=1) were from outside Honduras. In Las Juntas, 50% (n=3) were from within Las Juntas and 50% (n=3) were from other Cusuco communities. In Santo Tomas 20% (n=1) were from within Santo Tomas, 40% (n=2) were from the Omoa district and 40% (n=2) were from outside Honduras. In Tierra Santa, 50% (n=2) were from within Tierra Santa and 50% (n=2) were from the Omoa district.

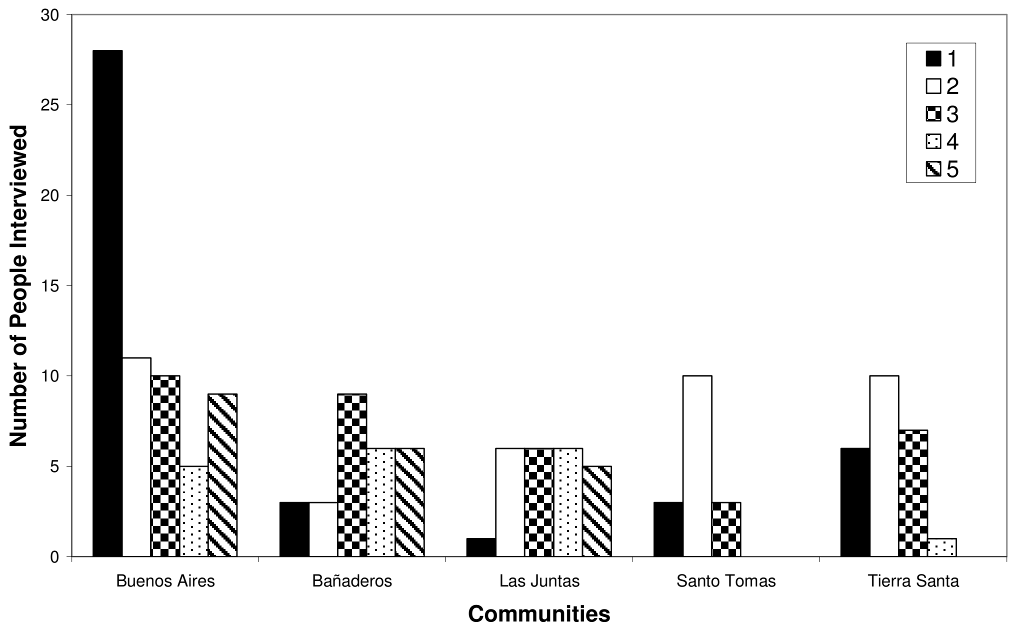

Figure 1: Economic status of 5 buffer zone communities in Cusuco National Park. *Categories were determines as follows: Category 1: poor quality house with a mud floor, mud, plaster or wooden walls that are poorly kept, a tin roof usually in disrepair, and very few personal possessions; Category 2: slightly better quality house with a mud floor, mud, plaster or wooden walls that are reasonably well maintained, a better quality tin roof, and more possessions such as cooking utensils or furniture; Category 3: reasonable quality house with a concrete floor and possibly concrete walls, a roof in good condition, and more possessions; Category 4: good quality house with concrete floor and walls, many ornaments and possessions, and obvious signs of wealth such as a solar panel, television, or DVD player; Category 5: ownership of a vehicle in addition to all the criteria of category 4*

Table 1: Summary of the number of farms and size of farms in the 5 target communities

Community	**Total Number of Coffee Farms (owned or rented)**	**Total Number of Cattle Farms (owned or rented)**	**Mean (± SD) size of coffee farm**	**Mean (± SD) size of cattle pasture**
Buenos Aires	62	0	2.23ha ± 3.68	n/a
Bañaderos	39	0	3.56ha ± 3.99	n/a
Las Juntas	21	0	4.46ha ± 4.68.	n/a
Santo Tomas	15	8	2.48ha ± 1.24	15.00ha ± 10.25
Tierra Santa	24	16	3.13ha ± 2.69	13.06ha ± 12.76

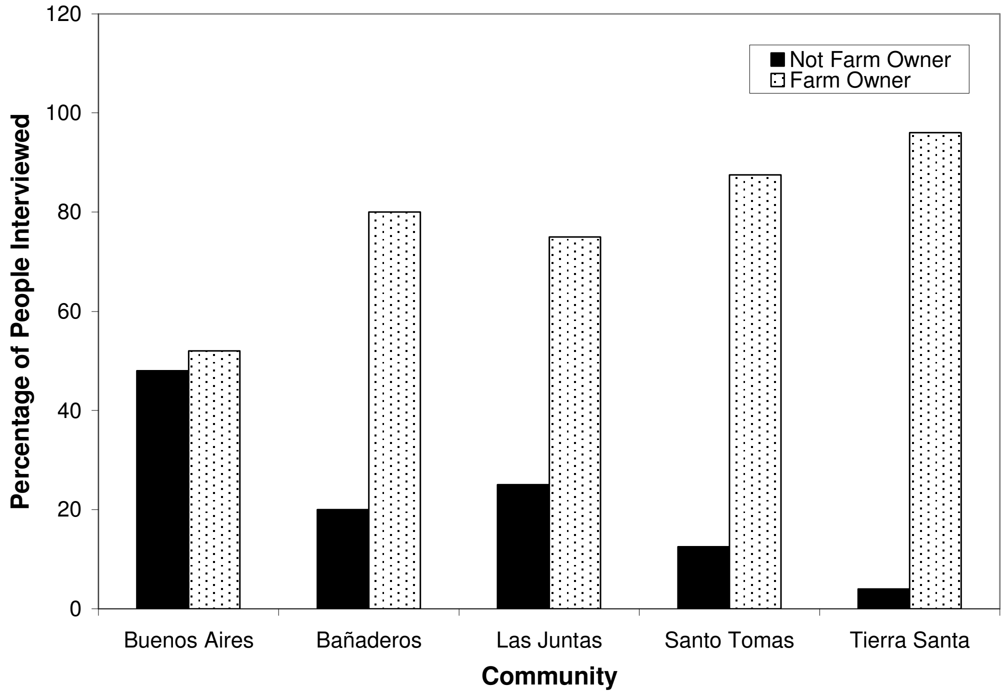

Figure 2: Percentage of people interviewed that owned their own farm in 5 buffer zone communities of Cusuco National Park.

Income for buffer zone communities generated from agriculture

All 38 buffer zone communities in Cusuco generate income from agriculture. The major cash crop for these communities is coffee. Some communities on the western side of the park also generate income from cattle farming, whereas on the eastern side of the park the second cash crop is tomatoes. The use of tomatoes as a cash crop varies considerably from year to year due to the unreliability of the crop (the crops often fail resulting in losses for the farmer, but a successful crop can generate a significant income). Details of the types of agriculture used in each of the target 5 communities can be seen in Figure 3. In addition to cash crops, each farmer cultivated a small amount of corn and beans for subsistence.

Over 95% of all the coffee farms in the 5 target communities can be classified as small holder size by IHCAFE (2008) classification (<10.5 ha). Due to the small scale of these coffee farms, none of the farmers have access to drying apparatus for the coffee and thus all farmers sell their coffee in the washed, but otherwise unprocessed form known locally as café húmedo. None of the farmers interviewed kept records of the gross or net income of their farm, but could provide an approximation of maximum coffee yield and the average price earned per lb bag of unprocessed coffee beans. These data were combined with the total area mapped out for each farm to calculate gross income per ha for each farm and thus mean gross income per ha for each community (Figure 4).

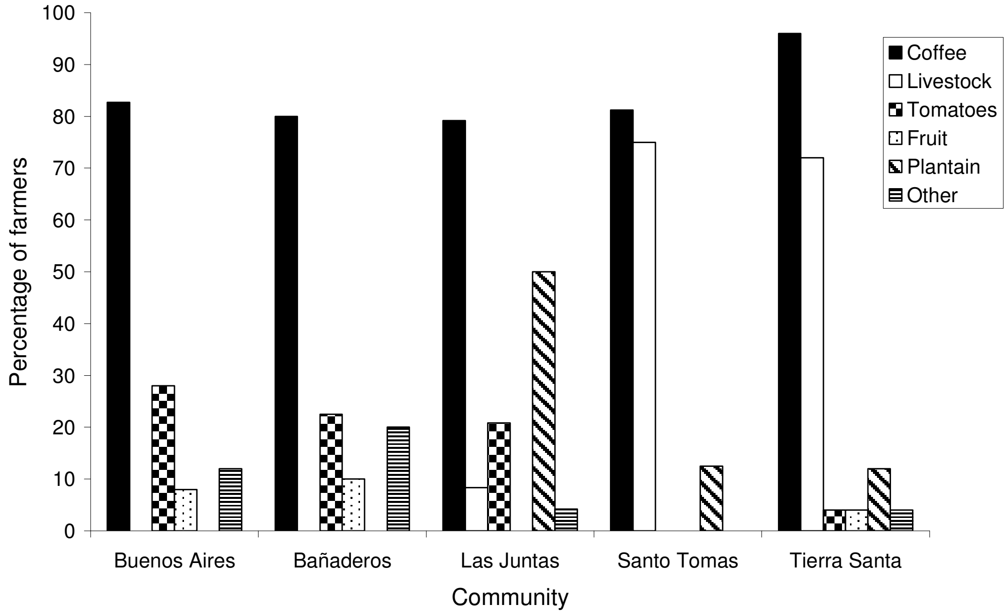

Figure 3: The percentage of farmers interviewed that generated income from various forms of agriculture. The other category included a mixture of different vegetables, corn and beans.

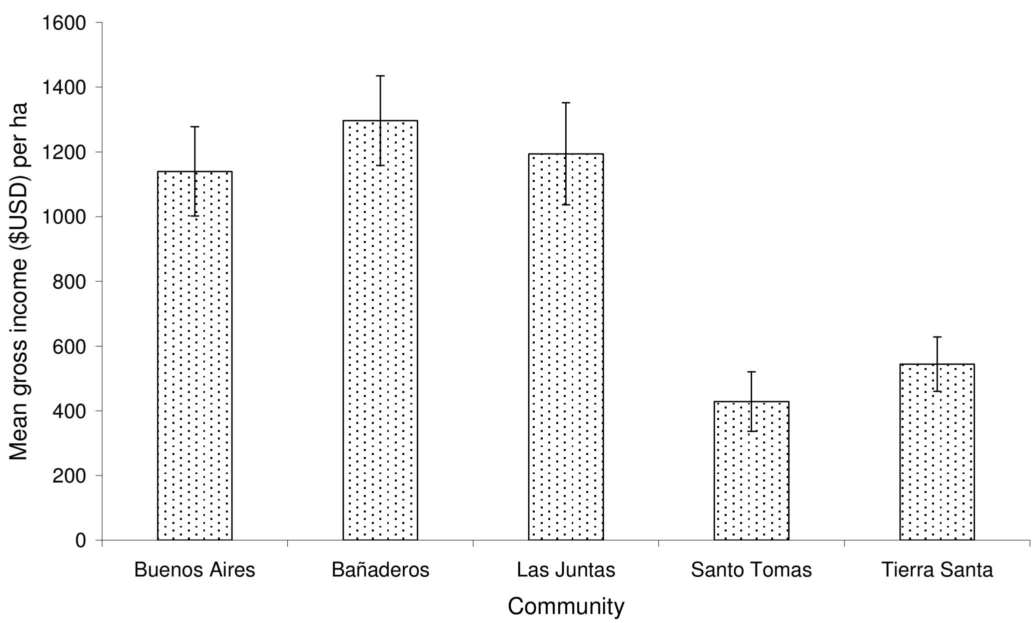

Figure 4: Mean (±SEM) annual gross income from coffee farming per hectare for 5 buffer zone communities of Cusuco National Park.

Gross income generated from coffee farming is considerably lower for the western communities in Santo Tomas and Tierra Santa caused by lower crop yields per ha and a lower price earned per lb bag of café humedo. Further inspection of these farms indicated that the coffee plants were not well maintained, had no, or extremely limited, shade cover, and the plants showed evidence of disease. During farm visit interviews in these western communities, farmers explained that as the coffee generated little income they had no funds to invest in labour or fertilizers to maintain the crops, and when grown in the shade, the coffee plants had even greater problems with disease. Further investigation of this problem with the Honduran Coffee Institute (IHCAFE) indicated that the western side of the park has the wrong climate for growing coffee as the mean annual temperature is too high as a result of the lower elevation of these villages and the weather is too windy and wet due because this side of the mountain faces the coast. This combination of climatic variables has resulted in damaged and diseased coffee plants with low yields. Interestingly, IHCAFE informed us that the climate in Santo Tomas and Tierra Santa is the correct climate for cocoa farming, which is another shade grown crop.

Farmers did not keep records of the type, amount and cost of fertilizers used on their farms. However, some farmers were able to estimate the number of bags of each type of fertilizer used per year. Based on the current market value of each type of fertilizer we were able to calculate an approximate expenditure on fertilizers for those farmers who could provide this information. On average these farmers spent 52% of their gross income on fertilizers. This high value is partly due to the increasingly expensive prices of fertilizers and partly because the farmers have no idea what fertilizers they should be using and therefore tend to use a mixture of all fertilizers available. As the cost of fertilizers were so expensive, farmers with holdings <1ha generally did not use fertilizers. Similarly, as gross income from coffee in the western communities was so low, few farmers invested in fertilizers. However, pest control was a major issue for coffee farmers in the western communities and this money was invested in pesticides. Pesticides were not used by coffee farmers in the eastern communities. Farmers did not keep records of the annual cost of labour to maintain and harvest the coffee, but some farmers could provide an estimate of the number of permanent and seasonal labourers they employed and the daily wages paid to each type of labourer (100 lempira per day for permanent workers, 25 lempira per 100lb of coffee harvested for seasonal workers). Based on these figures it was possible to produce rough estimates of annual labour costs for this subset of farmers. On average, farmers spent 20% of their gross annual income on labour costs. If the mean fertilizer cost estimate and mean labour cost estimate are applied to all farmers then the mean net annual income for each community per ha of coffee plantation is as follows:

- Buenos Aires $319.14 ± 267.34
- Bañaderos $363.09 ± 211.86
- Las Juntas $334.45 ± 187.35
- Santo Tomas $120.00 ± 92.78
- Tierra Santa $152.45 ± 115.28

As coffee farming in these western communities does not provide a viable income farmers have resorted to two alternative plans: illegally planting coffee at the higher elevation forest in the core zone of the park, and cattle farming in the buffer zone and parts of the core zone. Mean number of cattle owned by each farmer in Santo Tomas was 10 and mean area of cattle pasture was 15ha. Mean number of cattle owned by each farmer in Tierra Santa was 10.3 and mean area of cattle pasture was 13ha. On average, 1ha of pasture can support 1 cow and each cow can be sold for approximately 5000 lempira. The area of cattle pasture per farmer was calculated by marking the boundaries with a GPS unit and calculating the area contained within this polygon and the number of cows in each pasture was obtained from interviews with the farmers. Based on these figures and the mean market value per cow, mean gross income per ha from cattle farming was $276.03 ± 106.45 for Santo Tomas and $281.45 ± 23.45 for Tierra Santa. Farmers did not keep detailed records of the costs associated with cattle farming. Under normal circumstances, cattle farming would have an associated cost of grass seed and maintaining the pasture. However, all cattle farmers in Santo Tomas and Tierra Santa However admitted that they simply cleared sections of forest and allowed the grass to grow naturally. When this pasture was no longer productive they simply cleared more forest. Some farmers were however able to estimate the quantities of vaccinations and vitamins given to the cattle. Based on current market prices of these items it was possible to calculate the approximate cost of keeping their herd. Based on the number of cattle in each herd, it was then possible to estimate the mean cost of cattle farming per cow of 152.39 Lempira. Taking this into account it was then possible to estimate the net income of cattle farming per ha of pasture. These values were as follows

- Santo Tomas $160.10 ± 110.15
- Tierra Santa $199.64 ± 218.17

If the mean net income for cattle farming for is combined with the mean net income from coffee farming then mean net income per ha from agriculture for the 5 communities is as follows:

- **Buenos Aires $319.14**
- **Bañaderos $363.09**
- **Las Juntas $334.45**
- **Santo Tomas $280.01**
- **Tierra Santa $352.09**

Proposed sustainable agriculture projects with buffer zone communities as part of a long-term conservation project for Cuscuo National Park.

Proposed sustainable agriculture projects

Investment in local communities in vital to the protection of the forest as a means of reducing community reliance on forest resources and preventing further forest encroachment to make way for agricultural land. In the buffer zone communities of Buenos Aires, Bañaderos and Las Juntas, all farmers reported that they would welcome agricultural assistance in the form of training, farm equipment and seeds. These coffee producers all use over 50% of their gross income to purchase fertilizers, but confess that they have no idea which fertilizers they should be using or when they should apply them to the farm. Farmers also do not have access to coffee drying polytunnels and therefore have to sell their coffee in the unprocessed café humedo form. Café humedo starts to degrade within hours of harvesting from the plant and thus farmers have a 24hour window to sell the coffee, leaving them absolutely no bargaining power with exporters or middlemen. Many farmers reported that they now understood that their farms needed more shade cover, but did not have sufficient funds to purchase tree saplings, and all farmers reported that they would welcome agricultural advice in general.

The Honduran Coffee Institute IHCAFE has programmes to address all these issues. Soil samples can be taken from 5 locations within a 1ha farm and sent to IHCAFE for analysis for the cost of 1000 HNL (200HNL per sample). Based on the results of the soil analysis IHCAFE can explain to the farmer exactly what nutrients are lacking in the soil, what fertilizers they need, the quantity and number of applications per year, and can even mix 100lb bags of tailor-made fertilizer for the farmer sold at the same price as regular nitrogen-based fertilizer (UREA). As the tailor-made fertilizer will be more effective that applying a wide range of often unnecessary fertilizers, farmers will need to purchase less bags of fertilizer using the tailor made project, thus saving money. Moreover, the quality and quantity of the coffee produced should be greatly improved, which will also increase income generated from the farm. IHCAFE can also provide the technical assistance to teach farmers how to use the outer pulp of the coffee to create organic fertilizer (lubricompost), provided that the materials to create the compost are paid for by the community. The use of lubricompost in conjunction with tailor-made fertilizers to address nutrient deficiency in the soil will save the farmers even more money

To add value to the coffee crop produced, IHCAFE can provide technical assistance to build drying polytunnels, provided that the communities can cover the costs of the building materials. Each polytunnel is 10m long x 3m wide, covered by a transparent plastic cover, containing wire trays that allow air flow, in order to dry coffee beans quicker and more evenly. Polytunnels are capable of drying 1400lbs of coffee at a time and cost 12,000 HNL. IHCAFE's technical assistance for building and demonstration lasts approximately 2 days. IHCAFE also runs a tree replanting program whereby they will bring hardwood saplings to the farms, assist with planting and certify each tree as part of a sustainable project, provided that the farmers pay for the saplings. Once the trees have matured, each farmer has permission to legally harvest a small percentage of the trees for timber.

For the buffer zone communities of Tierra Santa and Santo Tomas a different approach is needed because the land is not suitable for coffee farming. Thus investment is needed in different crops for agriculture. IHCAFE run two programmes for communities in this situation: tilapia fish farming and cocoa farming. The lower elevation, and thus warmer temperatures, at Santo Tomas and Tierra Santa are ideal for tilapia farming. Up to 1000 fish can be kept in a small pond of 2m x 4m with a depth of 1m. Sustainable tilapia farming is generally accompanied by small scale chicken farming because the tilapia can be fed on chicken excrement. Thus each household can keep chickens for subsistence in the form of meat or eggs, feed the chicken waste to the tilapia, and sell the tilapia for cash. IHCAFE can provide all the training needed for sustainable tilapia farming, provided that the community can cover the start up costs (e.g. chickens, chicken feed, materials for the chicken coop, and the young fish). IHCAFE has recently formed a sister organization of the Honduran Cocoa Institute to provide coca farmers will the same assistance that IHCAFE provides to coffee farmers. Thus the cocoa institute can provide all the necessary training to assist farmers with cocoa plantations provided that the communities cover the start up costs (cocoa plants, tree saplings to provide shade, fertilizers etc). Planting one hectare of cocoa will cost approximately 28,000 HNL.

Appendix – Species lists

Woody plants

Family	Species
A. Tree ferns	
Cyatheaceae	Alsophila erinacea (H. Karst.) D.S. Conant vel aff.
	Alsophila salvinii Hook.
	Cyathea bicrenata Liebm.
	Cyathea divergens Kunze var. tuerckheimii (Maxon) Tryon
	Cyathea valdecrenata Domin
	Sphaeropteris horrida (Liebm.) Tryon
B. Conifers	
Pinaceae	Pinus oocarpa Schiede ex Schtdl. var. oocarpa
	Pinus maximinoi H.E. Moore
Podocarpaceae	Podocarpus oleifolius J.D. Sm.
C. Angiosperms (Flowering Plants)	
Actinidiaceae	Saurauia conzattii Busc.
Annonaceae	Guatteria cf. chiriquensis R.E. Fr.
	Guatteria dolichopoda Donn. (?)
Apocynaceae	Tabernaemontana amygdalifolia Jacq.
Aquifoliaceae	Ilex gracilipes I. M. Johnst. ?
	Ilex guianensis (Aubl.) O. Kuntze
	Ilex lamprophylla Standl.
Araliaceae	Dendropanax arboreus (L.) Decne & Planch.
	Oreopanax geminatus Marchal
	Oreopanax nicaraguensis M.J. & J.F.M.Cannon
Arecaceae	Chamaedorea arenbergiana H. Wendl.
	Chamaedorea costaricana Oerst.
	Chamaedorea pinnatifrons (Jacq.) Oerst.
	Cryosophila williamsii Allen vel aff.
	Geonoma undata Klotzsch
	Synechanthus fibrosus (H. Wendl.) H. Wendl.
Asteraceae	Eupatorium hypomalacum var. wetmorei B.L. Robins
Betulaceae	Carpinus tropicalis (Donn. Sm.) Lundell
Bignoniaceae	Amphitecna molinae L.O. Wms
Brunelliaceae	Brunellia mexicana Standley
Caprifoliaceae	Viburnum hartwegii Benth.
Clethraceae	Clethra macrophylla Mart. & Gal.
	Clethra occidentalis (L.) O. Kuntze
Clusiaceae	Calophyllum brasiliense var. rekoi (Standl.) Standl.
	Chrysochlamys sp.
	Clusia salvinii Donn. Sm.
	Garcinia intermedia (Pittier) Hammel
	Vismia baccifera (L.) Triana & Planch.

Cunoniaceae	Weinmannia balbisiana Kunth
Elaeocarpaceae	Sloanea meianthera Donn. Sm.
Ericaceae	Gaultheria acuminata Schlecht. & Cham.
	Orthaea brachysiphon (Sleumer) Luteyn
	Vaccinium poasanum Donn. Sm.
	Vaccinium stenophyllum Steud.
Euphorbiaceae	Acalypha macrostachya Jacq.
	Alchornea latifolia Sw
	Croton draco Cham. & Schtdl.
	Hieronyma oblonga (Tul.) Muell. Arg.
	Tetrorchidium brevifolium Standl. & Steyerm.
Fabaceae	Dussia cuscatlantica (Standl.) Standl. & Steyerm.
	Ormosia isthmensis Standl.
Fagaceae	Quercus cortesii Liebm.
Hamamelidaceae	Liquidambar styraciflua L.
Hippocastanaceae	Billia hippocastanum Peyr
Juglandaceae	Alfaroa costaricensis Standl.
Lauraceae	Cinnamomum triplinerve (Ruiz & Pavon) Klosterm.
	Ocotea helicterifolia (Meissn.) Hemsl.
	Persea vesticula Standl. & Steyerm.
Magnoliaceae	Magnolia guatemalensis subsp. hondurensis (A.R. Molina) A. Vazquez
	Talauma gloriensis Pittier
Malvaceae	Malvaviscus arboreus Cav.
Melastomataceae	Henriettea fascicularis (Sw.) Gomez
	Miconia trinervia (Sw.) D. Don ex Loud.
Meliaceae	Cedrela odorata L.
Mimosaceae	Inga laurina (Sw.) Willd.
	Inga punctata Willd.
	Inga vera Willd.
Monimiaceae	Mollinedia guatemalensis Perk.
	Siparuna grandiflora (H.B.K.) A.DC.
Moraceae	Castilla elastica Sesse in Cerv.
	Cecropia peltata L.
	Ficus sp.
	Perebea xanthochyma H. Karst. vel aff.
	Trophis mexicana (Liebm.) Bureau
Myricaceae	Morella cerifera (L.) Small
Myrsinaceae	Gentlea micranthera (Donn. Sm.) Lundell
	Myrsine coriacea (Sw.) R.Br. ex Roem. & Schult.
	Synardisia nervosa (Masters) Lundell
Myrtaceae	Eugenia sp.
	Myrcia splendens (Sw.) DC.
	Syzygium jambos (L.) Alston
Poaceae	Chusquea heydei Hitchc. ?
Proteaceae	Roupala montana Aubl.
Rosaceae	Prunus brachybotrya Zucc.
Rubiaceae	Elaeagia auriculata Hemsl.
	Faramea occidentalis (L.) A. Rich
	Genipa americana L.
	Psychotria luxurians Rusby
	Randia matudae Lorence & Dwyer?
Rutaceae	Zanthoxylum melanostictum Schtdl. & Cham.
Sapotaceae	Pouteria durlandii (Standl.) Baehni ?
	Pouteria reticulata (Engl.) Eyma
Saxifragaceae	Phyllonoma cacuminis Standl. & Steyerm. vel aff.
Simaroubaceae	Picramnia antidesma ssp. fessonia (DC.) W.W.Thomas

Staphyleaceae	Turpinia occidentalis (Sw.) G. Don
Symplocaceae	Symplocos vernicosa L.O. Wms.
Theaceae	Ternstroemia tepazapote Schtdl. & Cham.
Tiliaceae	Heliocarpus appendiculatus Turcz.
	Mortoniodendron cf. pilosum Meijer ined.
	Trichospermum galeottii (Turcz.) Klosterm. vel aff.
Ulmaceae	Trema micrantha (L.) Blume
Urticaceae	Myriocarpa heterospicata Donn. Sm.
	Myriocarpa longipes Liebm.
Verbenaceae	Citharexylum donnell-smithii Greenm.
	Cornutia pyramidata L.
Winteraceae	Drimys granadensis L.f.

Dung beetles

Dung beetle RTU	Authority
Ateuchuis spp agg.	
Copris nubilosus	(Kohlman, Cano, Delgado 2003)
Dichotomius satanus	(Harold 1867)
Eurysternus magnus	(Castelnau 1840)
Canthidium aff ardens	
Onthophagus cyanellus	(Bates 1887)
Cryptocanthon nov. sp	
Onthophagus aff subcancer	
Uroxys bidentis	
Canthon vazquezae	(Martinez, Halfter, Halfter 1964)
Phanaeus endymion	(Harold 1863)
Canthidium vespertinium	(Howden & Young 1981)
Dichotomius annae	(Kohlmann & Solis 1997)
Canthidium macroculare	(Howden & Gill 1987)
Copris laeviceps	(Harold 1869)
Onthophagus sp1	
Copris nov sp	
Onthophagus aff anthracinus	
Deltochilum pseudoparile	(Paulian 1938)
Onthophagus sp2 (rhino07)	
Onthophagus aff longimanus	
Onthophagus brevicornis	
Onthophagus sp3 (rhino06)	
Canthidium centrale	(Boucomont 1928)
Deltochilum mexicanum	(Burnmeister 1898)
Canthidium cf ardens sp2	
Eurysternus foedus	(Guerin-Meneville 1844)
Uroxys dybasi	(Howden & Young 1981)
Uroxys sp1	
Copris lugubris	(Boheman 1858)
Canthidium sp1	
Onthophagus aff petenesis	
Unknown	

Jewel scarab beetles

Species
Chrysina spectabilis
Chrysina quetzalcoatli
Chrysina pastori
Chrysina karschi
Platycoelia humeralis
Chrysina sp 1
Chrysina strasseni

Species
Chrysina plusiotis

Sphingid moths

Species
Adhemarius dariensis
Adhemarius gannascus gannascu
Adhemarius ypsilon
Callionima parce
Cocytius antaeus
Cocytius lucifer
Erinnyis oenotrus
Enyo lugubris
Enyo ocypete
Eumorpha triangulum
Manduca florestan
Manduca pelenia
Nyceryx eximia
Protambulyx eurycles
Stolidoptera tachasara
Xylophanes amadis
Xylophanes belti
Xylophanes ceratomoide
Xylophanes pluto
Xylophanes germen
Xylophanes neoptolemus
Xylophanes porcus
Xylophanes titana
Xylophanes tyndarus

Reptiles and amphibians

Latin name	Class	Group
Bolitoglossa conanti	Amphibian	Salamander
Plectrohyla dasypus	Amphibian	Stream frog
Plectrohyla exquisita	Amphibian	Stream frog
Plectrohyla matudai	Amphibian	Stream frog
Plectrohyla sp.	Amphibian	Stream frog
Ptychohyla hypomykter	Amphibian	Stream frog
Bromeliahyla bromeliacia	Amphibian	Tree frog
Smilisca baudinii	Amphibian	Tree frog
Bolitoglossa diaphora	Amphibian	Salamander
Bolitoglossa dolfeini	Amphibian	Salamander
Bolitoglossa rufescens	Amphibian	Salamander
Cryptotriton nasalis	Amphibian	Salamander
Nototriton sp.	Amphibian	Salamander
Oedipina sp.	Amphibian	Salamander
Bromeliahyla sp.	Amphibian	Tree frog
Rana maculata	Amphibian	Leaf litter frog
Craugastor coffeus	Amphibian	Leaf litter frog
Bolitoglossa dunni	Amphibian	Salamander
Anura sp.	Amphibian	Other
Oedipina tomasi	Amphibian	Salamander
Bufo marinus	Amphibian	Other
Bufo valliceps	Amphibian	Other
Nototriton barbouri	Amphibian	Salamander
Duellmanohyla soralia	Amphibian	Stream frog
Craugastor sp.	Amphibian	Leaf litter frog
Bolitoglossa decora	Amphibian	Salamander
Hyalinobatrachium fleischmanni	Amphibian	Tree frog
Craugastor chac	Amphibian	Leaf litter frog

Latin name	Class	Group
Craugastor rostralis	Amphibian	Leaf litter frog
Craugastor milesi	Amphibian	Leaf litter frog
Craugastor charadra	Amphibian	Leaf litter frog
Unknown	Other	Other
Norops capito	Reptile	Lizard
Basiliscus vittatus	Reptile	Lizard
Norops sp.	Reptile	Lizard
Norops petersii	Reptile	Lizard
Norops ocelloscapularis	Reptile	Lizard
Norops lemurinus	Reptile	Lizard
Norops johnmeyerii	Reptile	Lizard
Norops cusuco	Reptile	Lizard
Norops sericeus	Reptile	Lizard
Norops biporcatus	Reptile	Lizard
Norops amplisquamosis	Reptile	Lizard
Mesaspis morelettii	Reptile	Lizard
Lepidophyma flavimaculatum	Reptile	Lizard
Laemanctus longipes	Reptile	Lizard
Corytophanes hernandezii	Reptile	Lizard
Celestus montanus	Reptile	Lizard
Ameiva festiva	Reptile	Lizard
Norops tropidonotus	Reptile	Lizard
Sphenomorphus incertus	Reptile	Lizard
Corytophanes cristatus	Reptile	Lizard
Colubridae sp.	Reptile	Other
Ninia pavimentata	Reptile	Fossorial snake
Ninia sebae	Reptile	Fossorial snake
Omoadiphas aurula	Reptile	Fossorial snake
Pseustes poecilonotus	Reptile	Semi-arboreal snake
Rhadinaea montecristi	Reptile	Terrestrial snake
Rhadinaea sp.	Reptile	Terrestrial snake
Scaphiodontophis annulatus	Reptile	Terrestrial snake
Sibon nebulatus	Reptile	Arboreal snake
Sceloporus variabilis	Reptile	Lizard
Sphenomorphus sp.	Reptile	Lizard
Micrurus nigrocinctus	Reptile	Fossorial snake
Hemidactylus frenatus	Reptile	Lizard
Spilotes pullatus	Reptile	Semi-arboreal snake
Bothriechis schlegelii	Reptile	Semi-arboreal snake
Typhlops stadelmani	Reptile	Other
Sphaerodactylus millepunctatus	Reptile	Lizard
Geophis immaculatus	Reptile	Fossorial snake
Oxybelis aeneus	Reptile	Arboreal snake
Tropidodipsas sartorii	Reptile	Terrestrial snake
Pliocercus elapoides	Reptile	Terrestrial snake
Stenorrhina degenhardtii	Reptile	Terrestrial snake
Dryadophis melanolomus	Reptile	Terrestrial snake
Sceloporus malachiticus	Reptile	Lizard
Sphenomorphus cherriei	Reptile	Other
Geophis nephrodrymus	Reptile	Fossorial snake
Adelphicos quadrivirgatus	Reptile	Fossorial snake
Atropoides nummifer	Reptile	Terrestrial snake
Bothriechis marchi	Reptile	Terrestrial snake
Bothrops asper	Reptile	Terrestrial snake
Cerrophidion godmani	Reptile	Terrestrial snake
Coniophanes sp.	Reptile	Terrestrial snake
Ninia espinali	Reptile	Fossorial snake
Dryadophis dorsalis	Reptile	Terrestrial snake
Ninia diademata	Reptile	Fossorial snake
Drymarchon melanurus	Reptile	Terrestrial snake
Drymobius chloroticus	Reptile	Terrestrial snake

Latin name	Class	Group
Drymobius margaritiferus	Reptile	Terrestrial snake
Geophis sp.	Reptile	Fossorial snake
Imantodes cenchoa	Reptile	Arboreal snake
Lampropeltis triangulum	Reptile	Terrestrial snake
Leptophis ahaetulla	Reptile	Arboreal snake
Micrurus diastema	Reptile	Fossorial snake
Norops uniformis	Reptile	Lizard
Dendrophidion nuchale	Reptile	Terrestrial snake

Birds

Latin name	English name	Group
Unknown	Unknown	Other
Tinamus major	Great Tinamou	Large ground birds
Crypturellus soui	Little Tinamou	Large ground birds
Crypturellus boucardi	Slaty-breasted Tinamou	Other
Coragyps atratus	Black Vulture	Other
Cathartes aura	Turkey Vulture	Other
Sarcoramphus papa	King Vulture	Other
Elanoides forficatus	Swallow-tailed Kite	Other
Accipiter striatus chionogaster	White-breasted Hawk	Other
Buteogallus anthracinus	Common Black-Hawk	Other
Buteo nitidus	Grey Hawk	Other
Buteo brachyurus	Short-tailed Hawk	Other
Buteo albonotatus	Zone-tailed Hawk	Other
Buteo jamaicensis	Red-tailed Hawk	Other
Spizaetus tyrannus	Black Hawk-Eagle	Other
Micrastur ruficollis	Barred Forest-Falcon	Other
Micrastur semitorquatus	Collared Forest-Falcon	Other
Ortalis vetula	Plain Chachalaca	Other
Penelope purpurascens	Crested Guan	Large ground birds
Penelopina nigra	Highland Guan	Large ground birds
Crax rubra	Great Curassow	Large ground birds
Dendrortyx leucophrys	Buffy-crowned Wood-Partridge	Other
Odontophorus guttatus	Spotted Wood-Quail	Other
Patagioenas flavirostris	Red-billed Pigeon	Other
Patagioenas nigrirostris	Short-billed Pigeon	Other
Zenaida asiatica	White-winged Dove	Montane forest specialists
Leptotila plumbeiceps	Grey-headed Dove	Other
Leptotila cassini	Grey-chested Dove	Other
Geotrygon albifacies	White-faced Quail-Dove	Other
Geotrygon montana	Ruddy Quail-Dove	Other
Aratinga nana	Olive-throated Parakeet	Other
Bolborhynchus lineola	Barred Parakeet	Other
Pionus senilis	White-crowned Parrot	Lowland forest specialists
Piaya cayana	Squirrel Cuckoo	Other
Crotophaga sulcirostris	Groove-billed Ani	Other
Dromococcyx phasianellus	Pheasant Cuckoo	Other
Geococcyx velox	Lesser Roadrunner	Other
Strix virgata	Mottled Owl	Other
Lophostrix cristata	Crested Owl	Other
Glaucidium brasilianum	Ferruginous Pygmy-Owl	Other
Streptoprocne rutila	Chestnut-collared Swift	Other
Streptoprocne zonaris	White-collared Swift	Other
Chaetura vauxi	Vaux's Swift	Other
Phaethornis superciliosus	Long-tailed Hermit	Lowland forest specialists
Campylopterus hemileucurus	Violet Sabrewing	Other
Colibri thalassinus	Green Violet-ear	Other
Abeillia abeillei	Emerald-chinned Hummingbird	Other
Lophornis helenae	Black-crested Coquette	Other
Chlorostilbon canivetii	Canivet's Emerald	Other
Eupherusa eximia	Stripe-tailed Hummingbird	Other
Thalurania colombica	Crowned Woodnymph	Other
Hylocharis eliciae	Blue-throated Goldentail	Other
Hylocharis leucotis	White-eared Hummingbird	Other
Amazilia tzacatl	Rufous-tailed Hummingbird	Other
Agyrtria candida	White-bellied Emerald	Other

Latin name	English name	Group
Agyrtria cyanocephala	Azure-crowned Hummingbird	Other
Lampornis viridipallens	Green-throated Mountain-gem	Montane forest specialists
Eugenes fulgens	Magnificent Hummingbird	Other
Atthis ellioti	Wine-throated Hummingbird	Other
Trogon melanocephalus	Black-headed Trogon	Other
Trogon violaceus	Violaceous Trogon	Other
Trogon mexicanus	Mountain Trogon	Other
Trogon collaris	Collared Trogon	Birds with relatively wide elevational range
Pharomachrus mocinno	Resplendent Quetzal	Montane forest specialists
Chloroceryle americana	Green Kingfisher	Other
Hylomanes momotula	Tody Motmot	Other
Momotus momota	Blue-crowned Motmot	Disturbed habitat specialists
Eumomota superciliosa	Turquoise-browed Motmot	Other
Pteroglossus torquatus	Collared Aracari	Other
Ramphastos sulfuratus	Keel-billed Toucan	Lowland forest specialists
Aulacorhynchus prasinus	Emerald Toucanet	Montane forest specialists
Melanerpes formicivorus	Acorn Woodpecker	Other
Melanerpes aurifrons	Golden-fronted Woodpecker	Disturbed habitat specialists
Picoides villosus	Hairy Woodpecker	Other
Picoides fumigatus	Smoky-brown Woodpecker	Other
Colaptes rubiginosus	Golden-olive Woodpecker	Other
Celeus castaneus	Chestnut-colored Woodpecker	Other
Dryocopus lineatus	Lineated Woodpecker	Other
Campephilus guatemalensis	Pale-billed Woodpecker	Other
Xenops minutus	Plain Xenops	Other
Anabacerthia variegaticeps	Spectacled Foliage-gleaner	Montane forest specialists
Automolus ochrolaemus	Buff-throated Foliage-gleaner	Other
Automolus rubiginosus	Ruddy Foliage-gleaner	Other
Sclerurus mexicanus	Tawny-throated Leaftosser	Other
Sclerurus guatemalensis	Scaly-throated Leaftosser	Other
Dendrocincla homochroa	Ruddy Woodcreeper	Other
Sittasomus griseicapillus	Olivaceous Woodcreeper	Other
Glyphorynchus spirurus	Wedge-billed Woodcreeper	Other
Xiphocolaptes promeropirhynchus	Strong-billed Woodcreeper	Other
Xiphorhynchus flavigaster	Ivory-billed Woodcreeper	Other
Xiphorhynchus erythropygius	Spotted Woodcreeper	Other
Lepidocolaptes souleyetii	Streak-headed Woodcreeper	Other
Lepidocolaptes affinis	Spot-crowned Woodcreeper	Other
Thamnophilus doliatus	Barred Antshrike	Other
Dysithamnus mentalis	Plain Antvireo	Other
Myrmotherula schisticolor	Slaty Antwren	Other
Formicarius analis	Black-faced Antthrush	Other
Grallaria guatimalensis	Scaled Antpitta	Other
Pipra mentalis	Red-capped Manakin	Lowland forest specialists
Mionectes oleagineus	Ochre-bellied Flycatcher	Other
Leptopogon amaurocephalus	Sepia-capped Flycatcher	Other
Oncostoma cinereigulare	Northern Bentbill	Other
Rhynchocyclus brevirostris	Eye-ringed Flatbill	Other
Tolmomyias sulphurescens	Yellow-olive Flycatcher	Other
Platyrinchus cancrominus	Stub-tailed Spadebill	Other
Myiobius sulphureipygius	Sulphur-rumped Flycatcher	Other
Mitrephanes phaeocercus	Tufted Flycatcher	Other
Contopus cinereus	Tropical Pewee	Other
Empidonax flavescens	Yellowish Flycatcher	Birds with relatively wide elevational range
Sayornis nigricans	Black Phoebe	Other
Attila spadiceus	Bright-rumped Attila	Other
Myiarchus tuberculifer	Dusky-capped Flycatcher	Other
Pitangus sulphuratus	Great Kiskadee	Other
Megarynchus pitangua	Boat-billed Flycatcher	Other
Myiozetetes similis	Social Flycatcher	Other
Myiodynastes luteiventris	Sulphur-bellied Flycatcher	Disturbed habitat specialists
Legatus leucophaius	Piratic Flycatcher	Other
Tyrannus melancholicus	Tropical Kingbird	Other
Pachyramphus aglaiae	Rose-throated Becard	Other
Tityra semifasciata	Masked Tityra	Other
Cinclus mexicanus	American Dipper	Other
Campylorhynchus zonatus	Band-backed Wren	Other

Latin name	English name	Group
Thryothorus maculipectus	Spot-breasted Wren	Other
Thryothorus modestus	Plain Wren	Other
Troglodytes aedon	House Wren	Other
Troglodytes rufociliatus	Rufous-browed Wren	Other
Henicorhina leucosticta	White-breasted Wood-Wren	Other
Henicorhina leucophrys	Grey-breasted Wood-Wren	Montane forest specialists
Microcerculus philomela	Nightingale Wren	Birds with relatively wide elevational range
Myadestes unicolor	Slate-colored Solitaire	Montane forest specialists
Catharus frantzii	Ruddy-capped Nightingale-Thrush	Other
Catharus mexicanus	Black-headed Nightingale-Thrush	Birds with relatively wide elevational range
Catharus dryas	Spotted Nightingale-Thrush	Other
Turdus infuscatus	Black Thrush	Other
Turdus plebejus	Mountain Thrush	Other
Turdus grayi	Clay-colored Thrush	Other
Turdus assimilis	White-throated Thrush	Other
Ramphocaenus melanurus	Long-billed Gnatwren	Other
Cyanocorax yncas	Green Jay	Other
Cyanocorax morio	Brown Jay	Other
Cyanolyca cucullata	Azure-hooded Jay	Other
Vireo leucophrys	Brown-capped Vireo	Montane forest specialists
Hylophilus ochraceiceps	Tawny-crowned Greenlet	Other
Hylophilus decurtatus	Lesser Greenlet	Other
Parula pitiayumi	Tropical Parula	Other
Dendroica chrysoparia	Golden-cheeked Warbler	Other
Dendroica occidentalis	Hermit Warbler	Other
Dendroica dominica	Yellow-throated Warbler	Other
Dendroica graciae	Grace's Warbler	Other
Mniotilta varia	Black-and-white Warbler	Other
Setophaga ruticilla	American Redstart	Other
Seiurus motacilla	Louisiana Waterthrush	Other
Geothlypis poliocephala	Grey-crowned Yellowthroat	Other
Myioborus miniatus	Slate-throated Redstart	Birds with relatively wide elevational range
Basileuterus culicivorus	Golden-crowned Warbler	Other
Basileuterus rufifrons	Rufous-capped Warbler	Other
Coereba flaveola	Bananaquit	Other
Chlorospingus ophthalmicus	Common Bush-Tanager	Montane forest specialists
Habia rubica	Red-crowned Ant-Tanager	Other
Habia fuscicauda	Red-throated Ant-Tanager	Other
Piranga flava	Hepatic Tanager	Other
Piranga bidentata	Flame-colored Tanager	Other
Piranga leucoptera	White-winged Tanager	Other
Ramphocelus sanguinolentus	Crimson-collared Tanager	Other
Ramphocelus passerinii	Scarlet-rumped Tanager	Other
Thraupis episcopus	Blue-grey Tanager	Other
Thraupis abbas	Yellow-winged Tanager	Other
Euphonia hirundinacea	Yellow-throated Euphonia	Other
Euphonia gouldi	Olive-backed Euphonia	Other
Chlorophonia occipitalis	Blue-crowned Chlorophonia	Other
Tangara larvata	Golden-hooded Tanager	Other
Chlorophanes spiza	Green Honeycreeper	Other
Cyanerpes cyaneus	Red-legged Honeycreeper	Other
Volatinia jacarina	Blue-black Grassquit	Disturbed habitat specialists
Sporophila torqueola	White-collared Seedeater	Disturbed habitat specialists
Oryzoborus funereus	Thick-billed Seed-Finch	Other
Tiaris olivacea	Yellow-faced Grassquit	Disturbed habitat specialists
Diglossa baritula	Cinnamon-bellied Flowerpiercer	Other
Arremon brunneinucha	Chestnut-capped Brush-Finch	Other
Arremon aurantiirostris	Orange-billed Sparrow	Other
Aimophila rufescens	Rusty Sparrow	Other
Saltator maximus	Buff-throated Saltator	Other
Saltator atriceps	Black-headed Saltator	Other
Caryothraustes poliogaster	Black-faced Grosbeak	Other
Cyanocompsa cyanoides	Blue-black Grosbeak	Other
Dives dives	Melodious Blackbird	Other
Quiscalus mexicanus	Great-tailed Grackle	Other
Molothrus aeneus	Bronzed Cowbird	Other
Icterus chrysater	Yellow-backed Oriole	Other

Latin name	English name	Group
Icterus prosthemelas	Black-cowled Oriole	Other
Amblycercus holosericeus	Yellow-billed Cacique	Other
Psarocolius wagleri	Chestnut-headed Oropendola	Other
Gymnostinops montezuma	Montezuma Oropendola	Other
Carduelis notata	Black-headed Siskin	Other
Carduelis psaltria	Lesser Goldfinch	Other
Phaethornis longuemareus	Little Hermit	Other
Atlapetes albinucha	White-naped Brushfinch	Other
Amazona albifrons	White-fronted parrot	Other
Amazona autumnalis	Red-lored Amazon	Other
Claravis mondetoura	Maroon-chested Ground-dove	Other
Columbina talpacoti	Ruddy Ground-dove	Other
Cypseloides niger	American Black Swift	Other
Dendrocolaptes sanctihomae	Northern Barred Woodcreeper	Other
Dendroica nigrescens	Black-throated Grey Warbler	Other
Electron carinatum	Keel-billed Motmot	Other
Empidonax albigularis	White-throated flycatcher	Other
Euphonia affinis	Scrub Euphonia	Other
Geothlypis trichas	Common Yellowthroat	Other
Melozone biarcuata	Prevost's Ground-sparrow	Other
Patagioenas fasciata	Band-tailed Pigeon	Other
Phaethornis longirostris	Long-billed hermit	Other
Picoides scalaris	Ladder-backed Woodpecker	Other
Piranga olivacea	Scarlet Tanager	Other
Poecilotriccus sylvia	Slate-headed Tody-flycatcher	Other
Pseudoscops clatamor	Striped Owl	Other
Sporophila corvina	Variable Seedeater	Other
Sporophila schistacea	Slate-coloured Seedeater	Other
Vermivora pinus	Blue-winged Warbler	Other
Vireolanius pulchellus	Green Shrike-vireo	Other
Amazilia rutila	Cinammon Hummingbird	Other
Amazona auropalliata	Yellow-naped Amazon	Other
Buteogallus urubitinga	Great Black-hawk	Other
Chondrohierax uncinatus	Hook-billed Kite	Other
Colibri delphinae	Brown Violet-ear	Other
Cypseloides cryptus	White-chinned Swift	Other
Dendrocolaptes picumnus	Black-banded Woodcreeper	Other
Elaenia flavogaster	Yellow-bellied Elaenia	Other
Euphonia elegantissima	Blue-rumped Euphonia	Other
Falco deiroleucus	Orange-breasted Falcon	Other
Falco rufigularis	Bat Falcon	Other
Glaucidium gnoma	Northern Pygmy-Owl	Other
Icterus pectoralis	Spot-breasted Oriole	Other
Leptotila verreauxi	White-tipped Dove	Other
Leucopternis albicollis	White Hawk	Other
Manacus candei	White-collared Mannakin	Other
Myioborus pictus	Painted Redstart	Other
Nyctidromus albicollis	Common Pauraque	Other
Patagioenas leucocephala	White-crowned Pigeon	Other
Tilmatura dupontii	Sparkling-tailed Hummingbird	Other
Tityra inquisitor	Black-crowned Tityra	Other
Lampornis sybillae	Green-breasted Mountain-gem	Other
Eurypyga helias	Sunbittern	Other
Passerina caerulea	Blue Grosbeak	Other
Amazilia luciae	Honduran Emerald	Other

Large mammals

Common name	Latin name	Group
Tayra	Eira barbara	Carnivore
Baird's Tapir	Tapirus bairdii	Tapir
Central American Spider monkey	Ateles geoffroyi	Primate
Virginia opossum	Didelphis virginiana	Opposum
Northern tamandua	Tamandua mexicana	Edentate
Nine banded armadillo	Dasypus novemcinctus	Edentate
White faced capuchin	Cebus capucinus	Primate
Mexican porcupine	Sphiggurus mexicanus	Rodent

Common name	Latin name	Group
Central american agouti	Dasyprocta punctata	Rodent
Paca	Agouti paca	Rodent
Northen raccoon	Procyon lotor	Carnivore
White-nosed coati	Nasua narica	Carnivore
Mantled Howler monkey	Alouatta palliata	Primate
Kinkajou	Potos flavus	Carnivore
Squirrel sp.	Sciurus sp.	Rodent
Skunk sp.	Mephitis sp.	Carnivore
Puma	Puma concolor	Carnivore
Margay	Leopardus wiedii	Carnivore
Ocelot	Leopardus pardalis	Carnivore
White lipped peccary / Collared peccary	Tayassu pecari / Pecari tajacu	Peccary
Red brocket deer	Manzama americana	Deer
White tailed deer	Odocoileus virginianus	Deer
"Gato de monte"	? Gato de monte	Carnivore
Gopher sp.	Orthogeomys sp.	Rodent
Jaguarundi	Puma yagouaroundi	Carnivore
Cacomistle	Bassariscus sumichrasti	Carnivore

<u>Bats</u>

Latin name	Common name	Group
Anoura geoffroyi	Geoffroy's Hairy-legged Bat	Nectarivore
Artibeus aztecus	Aztec Fruit-eating Bat	Frugivore
Artibeus intermedius	Intermediate Fruit-eating Bat	Frugivore
Artibeus jamaicensis	Jamaican fruit eating bat	Frugivore
Artibeus lituratus	Great Fruit-Eating Bat	Frugivore
Artibeus phaeotis	Pygmy fruit eating bat	Frugivore
Artibeus toltecus	Toltec fruit eating bat	Frugivore
Artibeus watsoni	Thomas' fruit eating bat	Frugivore
Bauerus dubiaquercus	Van Gelder's Bat	Insectivore
Carollia brevicauda	Silky short tail bat	Frugivore
Carollia castanea	Chestnut Short Tailed Bat	Frugivore
Carollia perspicillata	Seba's short tailed bat	Frugivore
Centurio senex	Wrinkle-faced Bat	Frugivore
Chiroderma salvini	Salvin's Big-eyed Bat	Frugivore
Chiroderma villosum	Hairy Big-eyed Bat	Frugivore
Desmodus rotundus	Common Vampire Bat	Vampire
Diaemus youngi	White-winged Vampire Bat	Vampire
Diphylla ecaudata	Hairy-legged vampire bat	Vampire
Enchisthenes hartii	Velvety Fruit-eating Bat	Frugivore
Eptesicus brasiliensis	Brazilian Brown Bat	Insectivore
Eptesicus furinalis	Argentine Bown Bat	Insectivore
Eptesicus fuscus	Big Brown Bat	Insectivore
Glossophaga commissarisi	Brown Long-tongued Bat	Nectarivore
Glossophaga leachii	Gray's long tongued bat	Nectarivore
Glossophaga soricina	Common long tongued bat	Nectarivore
Hylonycteris underwoodi	Underwood's long tongued Bat	Frugivore
Lasiurus blossevillii	Red Bat	Insectivore
Lonchophylla mordax	Goldman's Nectar Bat	Nectarivore
Lonchorhina aurita	Common Sword-nosed Bat	Insectivore
Lophostoma silvicolum	White-throated Round-eared Bat	Insectivore
Micronycteris microtis	Common Big-eared Bat	Frugivore
Micronycteris minuta	White-bellied Big-eared Bat	Frugivore
Micronycteris schmidtorum	Schmidt's Big-eared Bat	Insectivore
Molossus ater	Black Mastiff Bat	Insectivore
Molossus sinaloae	Sinaloan Mastiff Bat	Insectivore
Mormoops megalophylla	Ghost-faced Bat	Insectivore
Myotis albescens	Silver-haired Myotis	Insectivore
Myotis keaysi	Hairy legged myotis	Insectivore
Myotis nigricans	Black Myotis	Insectivore
Myotis velifer	Cave Myotis	Insectivore
Natalus stramineus	Mexican Funnel-eared Bat	Insectivore
Noctilio leporinus	Greater Fishing Bat	Other
Peropteryx kappleri	Greater Dog-like Bat image Peropteryx kappleri	Insectivore
Phyllostomus discolor	Pale Spear-nosed Bat	Frugivore
Phyllostomus hastatus	Greater Spear-nosed Bat	Frugivore

Latin name	Common name	Group
Pipistrellus subflavus	Eastern pipistrelle	Insectivore
Platyrrhinus helleri	Hellers Broad-nosed Bat	Frugivore
Pteronotus davyi	Davy's Naked-backed Bat	Insectivore
Pteronotus parnellii	Common mustached bat	Insectivore
Rhogeessa tumida	Black-winged Little Yellow Bat	Insectivore
Saccopteryx bilineata	Greater Sac-winged Bat	Insectivore
Saccopteryx leptura	Lesser Sac-winged Bat	Insectivore
Sturnira lilium	Little yellow shouldered bat	Frugivore
Sturnira ludovici	Highland yellow shouldered bat	Frugivore
Sturnira sp.		Frugivore
Tonatia saurophila	Stripe-headed Round-eared Bat	Insectivore
Trachops cirrhosus	Fringe-lipped Bat	Other
Unknown		Other
Uroderma bilobatum	Tent-making Bat	Frugivore
Vampyressa pusilla	Southern Little Yellow-eared Bat	Frugivore
Vampyrodes caraccioli	Great Stripe-faced Bat	Frugivore

Small mammals

Latin name	Common name
Heteromys desmarestianus	Desmarest's spiny pocket mouse
Peromyscus mexicanus	Mexican deer mouse
Scotinomys teguina	Short-tailed singing mouse
Nyctomys sumichrasti	Vesper rat
Reithrodontomys gracilis	Slender harvest mouse
Tylomys nudicaudus	Peters's climbing rat
Handleyomys alfaroi	Alfaro's rice rat
Baiomys musculus	Southern Pygmy Mouse
Mustela frenata	Long-tailed weasel
Didelphis marsupialis	Common opossum
Marmosa mexicana	Mexican mouse opossum
Marmosa robinsoni	Robinson's mouse opossum

Appendix – Spatial data holdings

Spatial data are available to download from:
http://www.bath.ac.uk/bio-sci/biodiversity-lab/honduras/

Four 1:50k topographical maps covering the park produced by IGN by photo-interpretation of stereo-pairs of aerial photos collected in 1970 were purchased at the end of the 2007 season. These were taken to the UK and scanned, then the originals map sheets were sent to Alex Tozer for safe-keeping. The scanned maps were each clipped, mosaiced together and geo-rectified to produce a 1m resolution 24-bit colour base map for the park and surrounding area with an overall root mean square error (RMSE) in x and y of 1.4m. This product is available to all science teams as a geotiff projected in UTM 16N.

All features were digitized from the basemap and annotated to produce a set of shapefiles covering the park and surrounding area projected in UTM 16N: Contour lines, spot heights, streams, roads, trails, settlements, houses in 1970 and landcover (forest/non-forest) in 1970. This set of ESRI shapefiles is available to all science teams.

Contours were cracked to vertices and, together with spot heights, were used in an exact local spatial interpolation procedure (regularized splines) to estimate elevation across the park and surrounding area at 10m resolution. This digital elevation model (DEM) is available to all science teams as a geotiff projected in UTM 16N. This product represents a considerable improvement of the 90m resolution DEM available last year (from SRTM). Although it has not been validated in the field with calibrated altimeters, typically DEMs derived from 1:50k topo maps with 20m contour intervals have better than 5m vertical accuracy.

A number of secondary data products have been produced from the 10m digital elevation model and shapefiles derived from the topographic maps. The following are all available as geotiffs projected in UTM 16N: slope, aspect, landform category, drainage basins, distance from streams, distance to trails, cost-distance to trails, density of houses, landcover (forest/non-forest) in 1970.

The most useful remote sensing products for Cusuco and the surrounding landscape are a collection of near-anniversary Landsat images (6 band multispectral, 30m resolution) collected in 1987, 1994, 2000 and 2006. The original scenes are available, however most scientists will probably find the processed scenes more useful. All bands of all scenes have been clipped to a region surrounding the park with the same extent as all other spatial data products. The scenes have now all been orthorectified, radiometrically corrected using sensor geometry metadata, atmospherically corrected using dark object subtraction and clouds in the 2000 scene and small artifacts in the 2006 scene have been masked. We also have an unprocessed SPOT scene (4 band multispectral, 20m resolution) covering the whole park collected in 2007 and two IKONOS scenes (4 band multispectral, 4m resolution) providing partial coverage of the park collected in 2000.

Climate data has been extracted from a global dataset available from www.worldclim.org The protocol used to generate the global dataset is described in Hijmans et al (2005). Data are the result of a spatial interpolation of weather station observations for the period 1950-2000. The data have not been specifically validated in Cusuco National Park, but the global dataset has been found to be highly accurate when validated against independent climate data in other parts of the world.

There are 48 layers of basic climate parameters:
- Mean monthly temperature: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec
- Mean monthly minimum temperature:Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec
- Mean monthly maximum temperature: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec
- Mean monthly precipitation: Jan,Feb,Mar,Apr,May,Jun,Jul,Aug,Sep,Oct,Nov,Dec

There are also a further 19 bio-climatic parameters:
Annual mean temperature, Mean diurnal temperature range, Isothermality, Temperature seasonality, Maximum temperature of warmest month, Minimum temperature of coldest month, Temperature annual range, Mean temperature of wettest quarter, Mean temperature of driest quarter, Mean temperature of warmest quarter, Mean temperature of coldest quarter, Annual precipitation, Precipitation of wettest month, Precipitation of driest month, Precipitation seasonality, Precipitation of wettest quarter, Precipitation of driest quarter, Precipitation of warmest quarter, Precipitation of coldest quarter.

In additional, we have data on the above climate parameters in Cusuco under future scenarios in global climate models: There are three sets of global climate models produced by the Canadian centre for climate modeling and analysis (CCCMA), the Hadley centre (HADCM3) and the Commonwealth scientific and industrial research organization (CSIRO). Each model has been run under two CO2 emission scenarios (A2A and B2B) out to three different time horizons (2020, 2050 and 2080). All climate data are available as geotiffs projected to UTM 16N. The spatial resolution of the raw climate data is 30 seconds = 930 metres. However, by further interpolations using splines, a second set of climate parameters at 30m resolution has also been produced.

Spatial data relating to the Operation Wallacea spatial sampling framework have been consolidated. Accurate shapefiles now exist describing the camps, all sample routes and sample sites.

Landsat images

Path/Row (WRS #)	Date	Sensor	SV	ID	Source
p019r049 (WRS 1)	04-Feb-1979	MSS	Landsat 1	01499092000120010	GLCF
p018r049 (WRS 2)	18-Mar-1987	TM	Landsat 5	01499060300380003	GLCF
p019r049 (WRS 2)	22-Jun-1994	TM	Landsat 5	53679153759	GLCF
P018r049 (WRS-2)	05-Mar-1994	TM	Landsat 5	LT5018049009406410_WO	USGS
p018r049 (WRS 2)	16-Mar-2001	ETM+	Landsat 7	L7CPF20010101_20010331_07	GLCF
p019r049 (WRS 2)	21-Mar-2006	ETM+	Landsat 7	701904900060909650	USGS
p018r049 (WRS 2)	14-Mar-2006	ETM+	Landsat 7	70180049000607351	USGS

Appendix – Key taxonomic resources for Cusuco

Howell SNG, Webb S (1995) Birds of Mexico and Northern Central America. Oxford University Press

Maas PJM, Westra LYT (2005) Neotropical plant families: a concise guide to families of vascular plants in the neotropics. 3rd edition. Gantner Verlag

Haber, W.A., Zuchowski, W., & Bello, E. (2000) An introduction to cloud forest trees. Monteverde, Costa Rica. 2nd edition. Mountain Gem publications

Farjon, A., Perez de la Rosa, J.A., & Styles, B.T. (1997) A field guide to the pines of Mexico and Central America. Royal Botanic Gardens Kew.

McGavin, G (2000) Insects, spiders and other terrestrial arthropods. Dorling Kindersley

McCranie JR, Wilson LD. (2002) Amphibians of Honduras. Society for the Conservation of Amphibians and Reptiles.

Kohler G (2003) Reptiles of Central America. Herpeton Elke Kohler

Reid FA (1997) A field guide to the mammals of Central America and Southeast Mexico. Oxford University Press.

Smith NP, Mori SA, Henderson A, Stevenson DWM, Heald S (2004) Flowering plants of the Neotropics. Princeton University Press.

Merritt RW, Cummins KW, Berg MB (2008) An introduction to the aquatic insects of North America. Fourth edition. Kendall Hunt.