Project ID:

Black-Breasted Puffleg Habitat Conservation in Ecuador: Promoting Local Participation

Project Location: Mindo and western flanks of Pichincha volcano Important Bird Area, Ecuador

Aim: Improve the conservation status of the Black-breasted Puffleg *Eriocnemis nigrivestis*

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1. Summary

The Black-breasted Puffleg *Eriocnemis nigrivestis* , is a hummingbird endemic to Ecuador and regarded as 'Critically Endangered'. During August 2014 to October 2015 we implemented a participative project aimed to reduce main threats for the species at the north-western flanks of Pichincha Volcano. Our project focused on three main areas, namely: 1) Reduce the conversion of forest cover into pastures for cattle growth, 2) rise awareness among landowners and key local stakeholders and 3) increase the ecological knowledge for the species. In order to achieve this, we installed irrigation systems in properties of 1ten landowners so they improve the already existing pastures, also diffusion events like workshops and festivals were held in Nono town, finally participatory field searches and monitoring were conducted to gather more information on the distribution of the Black-breasted Puffleg.

No new localities for the species were found, despite intensive field searches at three sites, one of them being a historical occurrence site. On the other hand during this project we developed a new monitoring protocol based on time-lapse cameras and motion detection software, which seems promising to unravel feeding patterns for the species in the future.

Further conservation actions should address restoration of degraded habitats and enhance forest patch connectivity. We also identified the need of spread sustainable and environmental friendly practices in the area, such as organic farming and agroecology. These practices will both benefit the conservation of remnant habitat for the species by reducing the impact of human activities and local farmers since the use of toxic agrochemical is intensive and widespread.

2. Introduction

The Black-breasted Puffleg *Eriocnemis nigrivestis* , is a hummingbird endemic to Ecuador and regarded as 'Critically Endangered' (BirdLife International 2015). Two arguments support this conservation status. The first is its limited global distribution (~ 68 km 2, Figure 1) which is divided into two confirmed subpopulations, one on the north-western flanks of Pichincha volcano, in Pichincha province, and the other located in the Toisán mountain range in Imbabura province (BirdLife International 2015). The second argument is its small population size, recently estimated in the range of 250–999 individuals (Jahn 2008).

The conservation status of these two subpopulations is quite different. While the Toisán sub-population is located within a large protected area (although somehow threatened by large-scale mining projects), Black-breasted Puffleg habitat at Pichincha Volcano its rapidly disappearing due to human activities like charcoal production and extensive cattle pastures. These threats are exacerbated by the proximity of a large city.

The Black-breasted Puffleg inhabits high-Andean forest in northwestern Ecuador. High-Andean forest are ecosystems of major regional importance due to 1) the outstanding biodiversity and endemism levels that they hold (Mittermeier et al., 1998) and 2) the ecosystems services that they

provide to human settlements nearby, among them; a remarkable capacity of fresh water catchment and supply and carbon storage (Soethe et al., 2007). However, it is not less true that Andean forested landscapes face severe threats due to human activities that jeopardize their long-term persistence and functioning. Among these threats land-use conversion and slash-and-burn agriculture are probably the most detrimental practices for biodiversity (Kambach et al., 2013). For instance, it has been estimated that around the 93% of the Black-breasted Puffleg suitable habitat within its historical range has been destroyed in the Pichincha subpopulation (Jahn and Santander 2008).

Recent efforts to study this species have been difficult and alarming because the scarce number of observations. Moreover, the fact that the species seems to avoid forest borders (Guevara et al., 2014) pose a great challenge to perform detailed studies on various aspects of its ecology (e.g. feeding Ecology) since large forest tracts are scarce and remote.

The current CLP project was designed to address the problems of habitat loss and the scarcity of knowledge on the Ecology of the Black-breasted Puffleg. We report the outputs of management, research and awareness activities that took place in the western flanks of Pichincha volcano during the period August 2014 – August 2015.

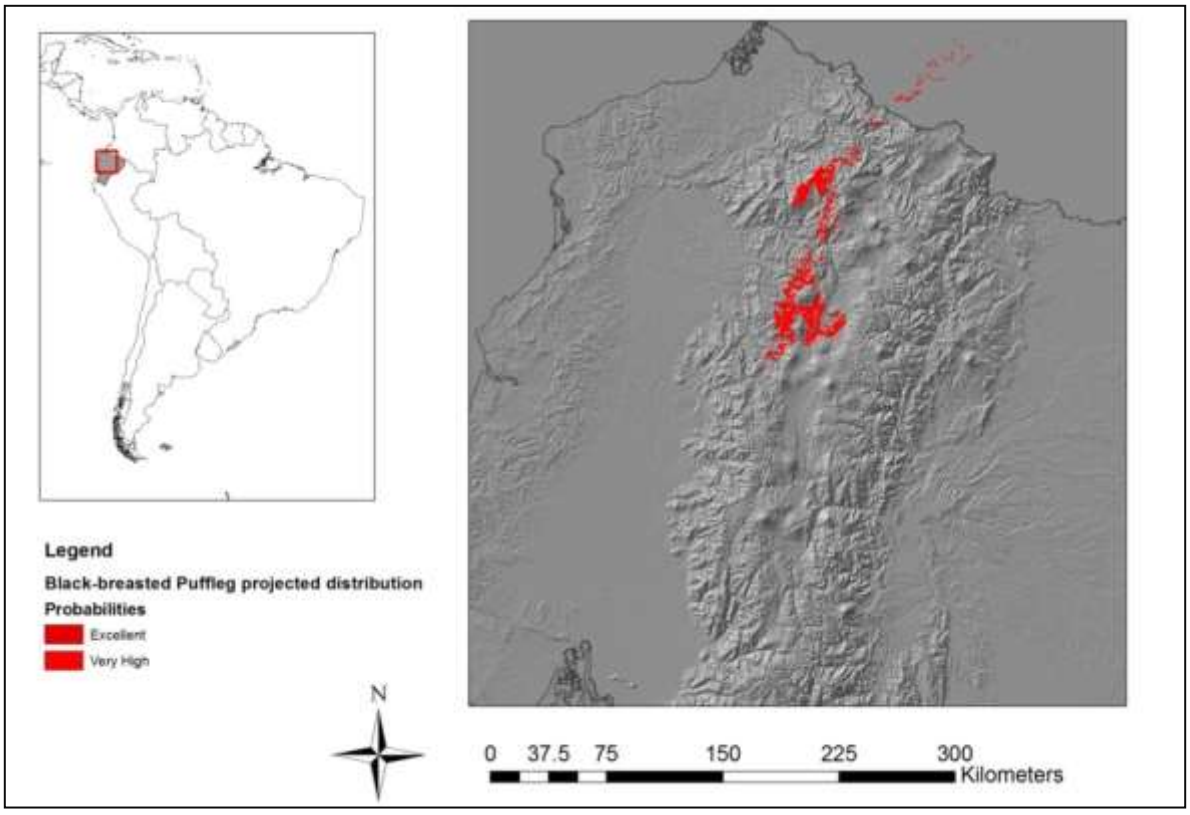


Figure 1. Potential distribution of the Black-breasted Puffleg developed on the basis of climate variables and occurrence sites (Espíndola et al., in prep). Estimated global distribution would not exceed 70 square kilometers.

3. Team Members

Esteban A. Guevara (team leader) is a biologist with almost six years of experience in the fields of bird research and conservation in Ecuador. Esteban´s interest lies on investigating the ecological factors that limits population of threatened bird species, specially the Black-breasted Puffleg. More recently Esteban is interested in understand how pollination networks respond to human-induced disturbances and in learning about the ecological role of Black-breasted Puffleg within these mutualistic networks. During the implementation of CLP project Esteban have become more interested in alternatives for agricultural production that are not detrimental for the environment and could improve community live standards.

Rolando Hipo (team member) is a leader by nature, both within his community and at other environments. Currently he is member of the Nono Parish and from this position Rolando has enabled a number of collaborations towards the improvement of livelihoods of several rural communities. For several years now Rolando is also a passionate birdwatcher, he has collaborated with the monitoring of Black-breasted Puffleg and the search for new localities for the species. As an inhabitant of the project area, Rolando has played a critical role in our CLP project.

Fernanda Coello (team member) holds a diploma on forestry engineering. Her professional experience is mostly focused on territory planning and management using biological monitoring as a tool. Beside that Fernanda has skills on project coordination, planning, and lobbying with local authorities. Fernanda´s work has been framed in the design of strategies to reach ecosystems conservation and sustainable use of natural resources. Her current position as a focal point of biosphere reserves within the Ministry Environment provided her with relevant experience that was critical during the design and recognition of a Municipal Protected Area within our CLP project area (see Achievements for further details).

Tatiana Santander is a biologist with and rich trajectory in the study and conservation of Ecuadorian avifauna. She has been part of the technical team that identified Important Bird Areas in Ecuador and part of the organizing committee of all Ecuadorian

Ornithology Congress. Beside that, Tatiana has extensive experience in the design and execution of conservation projects. Tatiana was more than external advisor for our CLP project, being involved in practically all project activities; she contributed with her experience and knowledge to sort out all the difficulties that our team experienced during project span. Furthermore she always found time to provide mentoring and advice to team members concerning conservation practice.

4. Aim and Objectives

Overall Aim: Improve the conservation status of the Black-breasted Puffleg at the northwestern flanks of Pichincha Volcano

Objective 1: Black-breasted Puffleg habitat pressure will be reduced.

Objective 2: More records on the Black-breasted Puffleg presence will be generated and ecological information will be gathered in order to enhance future habitat management and restoration plans.

Objective 3: Awareness on habitat threats and the importance of ecosystem services will be promoted among land owners and youngsters.

5. Methodology

5.1 Actions to palliate habitat loss

5.1.1 Project Socialization

The 21th of September of 2014 we carried out a meeting to socialize project activities. The meeting was held on the facilities of the Nono Parish and 30 persons participated (see photo appendix). Delegates from the Ministry of Environment, Quito Fire Department, Nono Parish and local communities were present. The socialization started with an introduction of each participant and a brief comment on which expectations they have regarding this project. Then Rolando Hipo explained his previous work in the project area and how it is related with Aves y Conservación. Thirdly Esteban Guevara and Fernanda Coello gave a brief talk on the functioning of Andean Forest emphasizing in the ecosystem services provided by them. Then, Subofficer Marcelo Gudiño from Quito Fire Department gave a talk about the risk of provoked fires on forested habitats. Finally, project advisor Tatiana Santander explained the scope of our project and provided details of planned activities. Afterwards we had a space so workshop participants could provide comments or ask questions. It was a fruitful start. This space gave us the opportunity to clarify the scope of the project and our objectives. Community members also had the chance to understand how they could be involved in the different project activities.

5.1.2 Development of fire warning system

On august 20th we organized a meeting in Nono with Quito´s fire department and inhabitants of several rural neighborhoods of the Nono parish. The aim of the meeting was to raise awareness on the prevention of forest fires and to recruit people willing to be part of a fire prevention brigade. We choose to do this during august since this is one of driest months of the year, when forest fires are more frequent and intense. We anticipate that an activity like this during the rainy season will not be of major interest of local inhabitants since during this period they will not perceive fires as a major threat. Later there will be training workshops with these volunteers to consolidate the brigade and provide them training on fires prevention and early warning systems. We have contacted Ing. Gustavo Galindo who is a forestry engineer with wide experience in forest fires prevention, to provide the required training to Nono volunteers.

5.1.3 Implementation of irrigation systems

To implement the irrigation system we identified main stakeholders which in this case were Yanacocha community members as future beneficiaries, Nono Parish, and Club Rotary. We had several meetings in order to coordinate with them the process of installation and awareness talks. During December 2014, we acquired 15 irrigation systems. Each irrigation systems consist of 100 m. of plastic hose and sprinklers equipment. After inquiries to local authorities and agricultural engineers that have been working in the project area, we choose to acquire Enki© sprinklers. These provide the advantage that once the sprinkler is installed the device could be moved to different pastures sections and also the device might be removed and stored during the rainy season when irrigation systems are less needed.

We choose farms in the Yanacocha community to install irrigation systems, since Yanacocha holds important forest remnants on the upper portion of Black-breasted Puffleg distribution. Furthermore cattle growth is one of the main activities at this community. We choose farms on the basis that they still keep forest remnants within and landowners agree to maintain these forest cover once the irrigation system is installed.

The installation of irrigation systems took place on Saturday august 22th 2015. Irrigation systems were installed on 15 farms.

5.2 Actions to improve Ecological knowledge

5.2.1 Participatory field searches

We conducted field trips to look for new occurrence localities for the Black-breasted Puffleg. During each field trip, we attempt to involve students from the Nono´s High School. We performed three field trips to the following sites within the northwestern flanks of Pichincha Volcano: Upper limits of Yanacocha reserve, La Merced de Nono ranch, and Chiquilpe forest. At each of these sites we looked for trails and pathways to perform bird observations. Field trips lasted one to five days, details of dates and coordinates of each site visits are provided in Table 1.

Table 1.- Sites and dates where field searches were conducted during 2015. “Hacienda La Merced de Nono” is an historic occurrence site where intensive field search was performed, despite this no record of the Black-breasted Puffleg was obtained.

Site	Visit dates	Latitude	Longitude	Elevation
San Juan (Lloa zone)	10-may-15	0°17'15.10"S	78°37'31.00"W	3040
Poste 66 (Lloa zone)	10-may-15	0°16'40.90"S	78°42'53.80"W	2203
Nonopungo	26-may-15	0° 3'2.33"S	78°35'32.97"W	2959
Hcda La Merced de Nono	7-12 may 2015	0° 2'33.52"S	78°32'58.90"O	2823

5.2.2 Bird monitoring at study transects

We conducted bird monitoring at two previously settled 1.2 km study transects located at Yanacocha and Verdecocha reserves respectively. Bird surveys were performed combining two methods. First we performed classic standardized audio-visual census technique, applying a shortened version of the “Multi-Time Window transect-mapping” (MTW) protocol for audio-visual monitoring studies (Jahn 2011). Each audio-visual census lasted two days and a rough total effort of 14 hours was achieved. The second census methods consisted on the use of time-lapse PlotWatcher Pro Cameras © settled at flowering plants in the aforementioned transects. Videos obtained were run using MotionMeerkat software (Weinstein 2015). MotionMeerkat is standalone free software designed and tested to extract motion events from a video stream; it has been tested in hummingbirds visiting plants (Weinstein 2015). The software output was then visually inspected and frames recording hummingbirds were stored. At the beginning of the project we used only one camera, by the end of the project we counted with seven cameras. We managed to record almost 1600 hours of video recording hummingbird’s visits to six flowering plants.

5.2.3 Implementation of field protocols to record bird-plant interactions and resource abundance

During the period February-June of year 2017, we implemented two field protocols previously designed to quantify hummingbirds’ visits to flowering plants and quantification of plant resources for hummingbirds, these protocols have been designed in collaboration with Dr. Catherine Graham and Dr. Ben Weinstein from Stony Brook University. Data will be collected using these protocols already tested in the field. The transect protocol will be used to collect information on monthly flower abundance as well as hummingbird communities. Sampling have be done once per month at Yanacocha and Verdecocha. Data collected during this period included:

- Hummingbird counts: Any bird heard or seen at a distance of 20 meters.
- Interaction observations: Any flower where we observed a hummingbird.

- Flower counts: Any plant with hummingbird syndrome flowers within a distance of ~5 meters of the transect had been counted and identified to species whenever possible. Characteristics of a flower with the hummingbird syndrome include brightly colored flowers (purple, red, orange or yellow) with medium to long corollas.

The camera protocol consisted on the use of time-lapse cameras and motion detection software to capture plant-bird interactions. Time-lapse cameras, which take a picture every second, have been placed at individual flowers along the above described transects to capture visitation by hummingbird species. The cameras turned on at dawn and record an image every second for several days, resulting in a dataset of hundreds of images. These images were processed using Motion Meerkat (Weinstein 2015) which can be used to sort out images with hummingbirds which can be manually identified.

5.2.4 Data analyses

We present a summary of all records of the Black-breasted Puffleg obtained during the project span, both using audio-visual census methods and Plotwatcher Pro Cameras. Video streams obtained from time-lapse cameras were run using Motion Meerkat software (Weinstein et al., 2014). M. Descriptive statistics on Black-breasted Puffleg activity (i.e. foraging activity at different plants) are presented.

In addition we compiled all available records of the species from different sources including: eBird database, Aves y Conservacion data from period 2001-2014, Jahn and Santander (2008), Guevara et al., (2014) and personal communications. Records were classified according to altitudinal classes and by date, in order to get a better understanding on altitudinal patterns of the species.

We used the bipartite package (Dormann et al., 2008) in R to describe patterns of plant-hummingbird interactions and to illustrate the position of Black-breasted Puffleg in the network.

5.3 Awareness on habitat and species threats

5.3.1 Hummingbird identification and bird monitoring/Baseline survey and evaluation

We conducted a hummingbird identification and bird monitoring workshop directed mainly to young students of Nono high school and another IBA LCG members. The two day workshop contained a theory part which was thought on giving information about external features, ecology, habitat of hummingbirds at the study area in order to give them with tools for its identification, and raise awareness on the importance of their conservation and the ecological services they provide. In general we also carried out field visit promoting bird observation and looking for the Black-breasted Puffleg. We provided the students with field guides which were donated by

Jocotoco Fundation to the Nono Parish thankful to the request that Rolando made. Binoculars were also lent to each participant.

In order to establish a baseline survey about the knowledge of participants on the Black-breasted Puffleg and other aspects we considered important to be evaluated, we developed a questionnaire which was applied at the beginning of the training and at the end.

5.3.2 Production of awareness material

A booklet was produce to disseminate information and as awareness material to be share extensively in the study area. The booklet would help to strength knowledge of workshop´s participants but also to present easy to understand information about hummingbirds in general, the Black-breasted Puffleg (habitat, food, identification), conservation and environmental friendly alternatives as organic farming. A poster of the Black-breasted Puffleg was also produced and delivered during Nono festivities.

5.3.3 Awareness workshops

As we proposed on the project we took advantage of water irrigation meetings where people of Yanacocha community was gather and we presented short videos and awareness talks about water conservation, fires, deforestation, cattle, and waste production. We also had the collaboration of an environmental educator from the Water Protection Fund (FONAG) who gave a workshop at Alambi community where he applied a specific methodology for adults based on images and promoting participation (Fig.1). Finally, besides the workshops we participated during Nono festivities with a stand for children and a float.

Fig. 1 Environmental education material

6. Outputs and Results

6.1 Actions to palliate habitat loss

6.1.1 Project Socialization

We signed a cooperation agreement with the Nono Parish. The agreement content is aimed to enhance cooperation venues among the signing institutions. Common point of work between Nono Parish and Aves y Conservación is to advance and foster sustainable landuse practices within the Nono territory, so ecosystems extent and processes are preserved as well as the biodiversity within, including remining populations of the Black-breasted Puflleg. The agreement is valid for one year and could be renewed aftert this period, relevant terms of agreements are:

1. *Support the development and strengthening of public policies for the conservation of natural resources, biodiversity and the fostering of nature-oriented tourism that contribute to sustainable development of Nono parish.*

2. *Promote research, training, sustainable production and tourism activities as alternative economic incomes that involves and benefits the inhabitants of the parish*

Complete signed agreement could be found at the Appendix section

A second output is a database of stakeholders at the project area. During the socialization event we could gather contact information of all participants, including landowners, local authorities, staff from the ministry of environment and representatives from other organizations working in the area.

6.1.2 Development of fire warning system

To date we have organized one workshop with collaboration of members of the Fire Department of Quito. This workshop took place during august 20th, 86 local inhabitants attended and eight firemen organized the activities during the workshop. Unfortunately we have not been able to deepen the activities with the Fire Department of Quito towards the development of fire warning system. This is mostly because the intense forest-fires season that affected Quito surroundings during this last summer (Jun – mid September). During this period, staff of the Fire Department has been unavailable to attend our requests since they have been attending the many fire emergencies. More information on forest-fires in Quito surroundings could be found at (http://www.bbc.com/news/world-latin-america-34267806).
We expect to revisit this activity once the dry season is finished and forest fires frequency decrease. This could be around mid-October.

6.1.3 Implementation of irrigation systems

Five meetings were carried out in order to coordinate A total of 15 irrigation systems were acquired and these have been handed in to 15 landowners. To this date ten irrigation systems have been installed successfully. Limitations in water supply in the remaining five properties have prevented us to install a functional irrigation system on each farm. This is originated by obstructions in the already existing pipe system that prevents steady water flow. We are purchasing valves that may help to solve the problem; we expect to install these together with irrigation systems in the fore coming weeks. However, farms were irrigation systems have been installed successfully sum up to 130 ha. Within these farms a total extension 12ha of forest remains.

6.2 Actions to improve ecological knowledge

6.2.1 Participatory field searches

No records of the Black-breasted Puffleg were obtained during our exploratory field trips. Up to 11 persons, and an average of five persons per field trip, participated in the surveys, most of them were students from the Nono High-School.

6.2.2 Bird monitoring

During bird audiovisual census we recorded up to 85 Andean bird species, including the Black-breasted Puffleg. The Puffleg was recorded in the two transects at Yanacocha and Verdecocha respectively, although it was much more common at Verdecocha transect. Through audiovisual census we obtained ten records of the species. On the other hand through the use of Plotwatcher Pro cameras we have obtained 76 records of the species visiting flowering plants. Most visited plants by the Black-breasted Puffleg were *Palicourea fuchsioides* (51) and *Thibaudia floribunda* (14). Black-breasted Puffleg was only recorded at Verdecocha using the Plotwatcher Cameras. Table 2 summarizes all the Black-breasted Puffleg obtained during the span of this project using both audiovisual census and camera records. Most of the records obtained during July 2014 and July 2015 period correspond to male individuals.

Table 2.- Records of the Black-breasted Puffleg obtained during period July-2014 to July 2015. Site column refers to 1.2 km transects established in Yanacocha (YANA01) and Verdecocha (VECO01) reserves. Survey methods include audiovisual census (Census) and camera deployment (Camera).

Sex	N individuals	Date	Site	Survey method
Male	1	07/08/2014	VECO01	Camera
Male, Female	2	16/09/2014	VECO01	Camera
Male, Female	2	17/09/2014	VECO01	Camera
Male, Female	2	18/09/2014	VECO01	Camera
Male	1	29/01/2015	VECO01	Census
Male	1	29/01/2015	VECO01	Census
Male	1	29/01/2015	VECO01	Census
Male	1	29/01/2015	VECO01	Census
Male	1	30/01/2015	VECO01	Census
Male	1	30/01/2015	VECO01	Census
Female	1	08/05/2015	YANA01	Census
Male	1	22/05/2015	VECO01	Census
Female	1	23/05/2015	VECO01	Census
Male	1	23/05/2015	VECO01	Census
Male	1	21/07/2015	VECO01	Camera

We compiled 131 occurrence historical and current records from the period 2001-2014, most of them came from the Pichincha subpopulation. The majority of records are concentrated during June at 3400-3500 altitudinal range. Figure 2 illustrates the abundance of observations across altitudinal ranges and year periods. Since this concentration of records at 3400-3500 m. elevation may be a reflect on higher observation effort (due to the frequency of visitors at Yanacocha reserve), we decided to explore how records of the species are distributed in this elevational range. Same pattern was found being June and July months of higher concentration of records, this is illustrated in Figure 3.

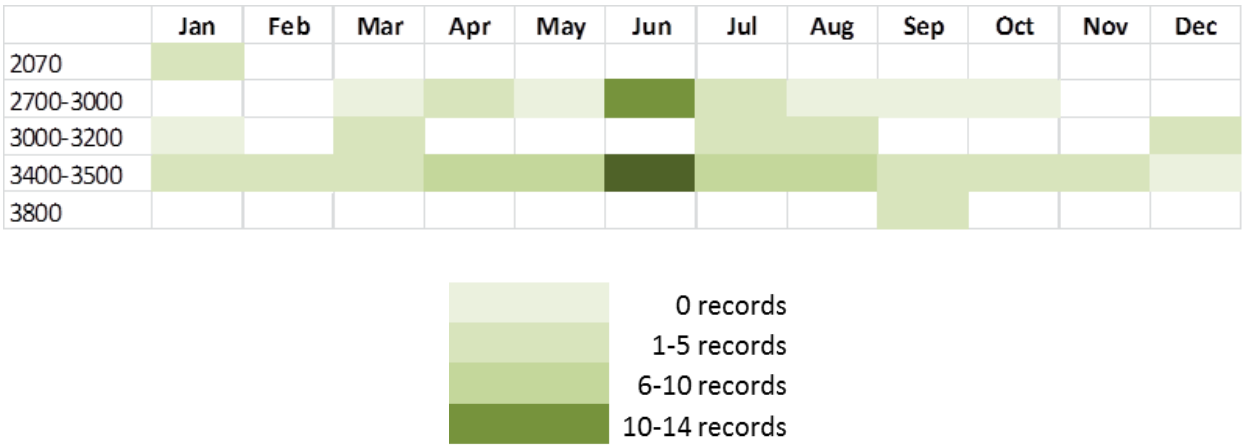


Figure 2.- Number of records of the Black-breasted Puffleg, depicted per month and per altitudinal range, in the northwestern flanks of the Pichincha volcano. The majority of records are concentrated during June at 3400-3500 altitudinal range, perhaps biased by the increasing observation effort at this range.

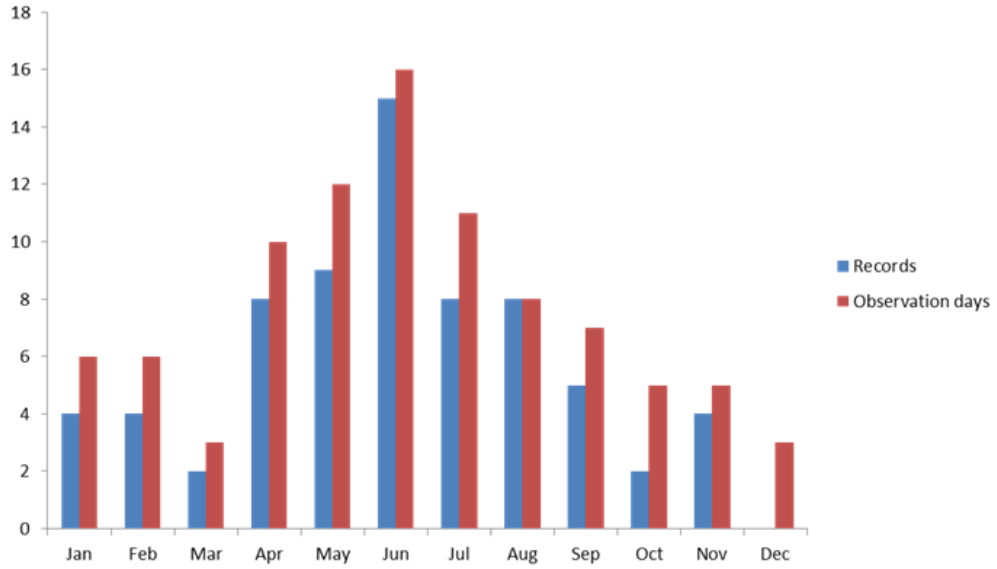


Figure 3.- Number of monthly records and observation days (included whenever possible) of the Black-breasted Puffleg at 3400-3500 m. elevation.

Data from camera monitoring was analyzed using regression models to explore foraging preferences of the species. Results from this analysis are detailed in Appendix 3 which is in the format of academic paper that we intend to submit shortly. Main finding that came up from this particular work is that Black-breasted Puffleg exhibit a strong link with a rare shrub *Palicourea fuchsioides* which is also an endemic and threatened plant. Figure 4 illustrates how bird-plant interactions were recorded using plotwatcher cameras.

Figure 4.- Feeding events captured with time-lapse cameras and returned after image processing with Motion Meerkat 1.5 software. Upper photo female Black-breasted Puffleg feeding at Macleania rupestris at Esperanza Hill in a forest border. Bottom photo male Black-breasted Puffleg feeding at Palicourea fuchsioides in Verdecocha reserve, inside mature Andean forest.

6.2.3 Implementation of field protocols to record bird-plant interactions and resource abundance

Field protocols described in section 5.2.3 were successfully implemented from February-June 2017 in Yanacocha reserve and from March-June 2017 in Verdecocha reserve. Field protocols were designed to quantify: 1) monthly abundances of floral resources and 2) interaction patterns of plant-hummingbird interaction. Flower abundance varied dramatically among sites and between

months (Figure 5), for instance at Yanacocha total flower abundance increased markedly from april to june, being the last counts in june four times greater than first counts in February (Figure5). In Verdecocha an increase in total flower abundance was also recorded, also from april, but numbers didn´t reach the abundances detected in Yanacocha. Flower abundance at Yanacocha was influenced mostly by the abundances of *Salvia pichinchensis*, whereas in Verdecocha *M. rupestris* contributed mostly (Figure 6). These preliminary patterns suggest that flowering peaks in the region might be around may-june, which is coincident with the highest number of records of the species (Figure 3). To confirm these patterns a whole-year sampling season is still needed, in this sense flower monitoring will continue in the upcoming two years thanks to funding obtained by Dr. Catherine Graham and a second Rufford Grant obtained by team leader Esteban A. Guevara.

Even though there were more resources available in Yanacocha transect we did not observed any Puffleg in this transect, records from this observation period were only obtained at Verdecocha transect. We recorded Pufflegs feeding at *Tillandsia* sp. (Bromeliaceae) and at *Palicourea fuchsioides* (Rubiaceae) on april 4th and may 5th respectively. Interestingly these two species were absent in Yanacocha transect whereas present relatively in high abundances in Verdecocha (Fig. 6). The patterns of plants and habitat use by Black-breasted Pufflegs are described in a paper developed by our team which is conditionally accepted in the Journal of Field Ornithology. Data for this paper were obtained during the CLP grant period and reports the recurrent use of *Palicourea fuchsioides* and *Macleania rupestris* by Black-breasted Pufflegs (Guevara et al., in review).

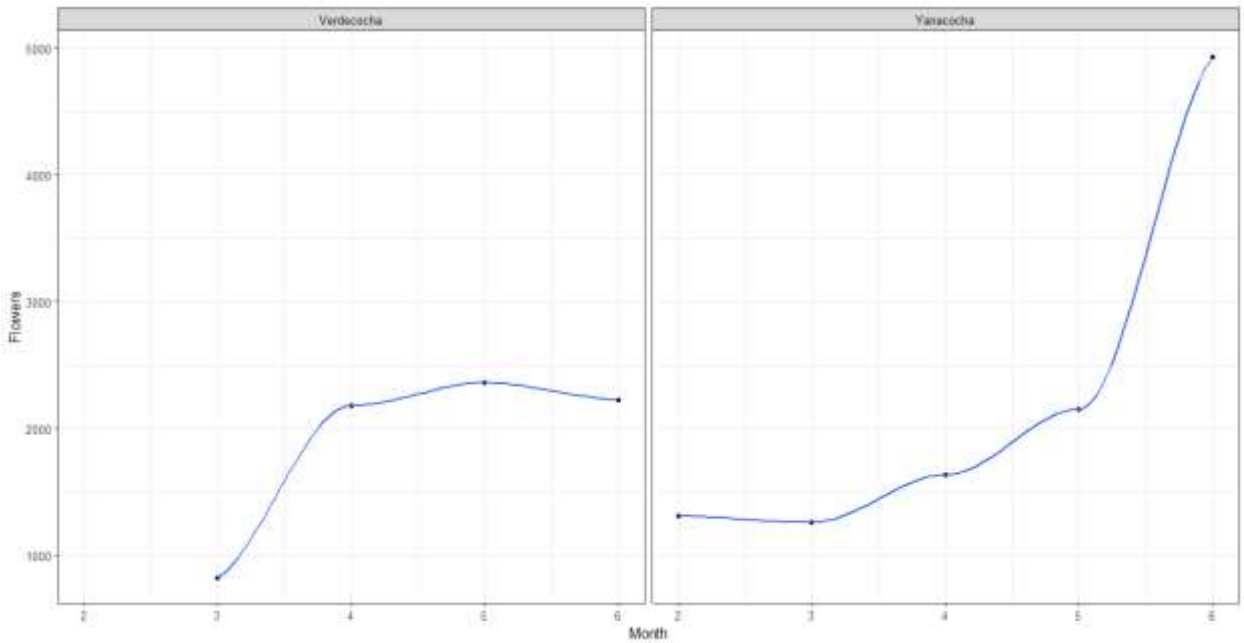


Figure 5. Total flower abundance at Yanacocha and Verdecocha reserves during February-June 2017 period.

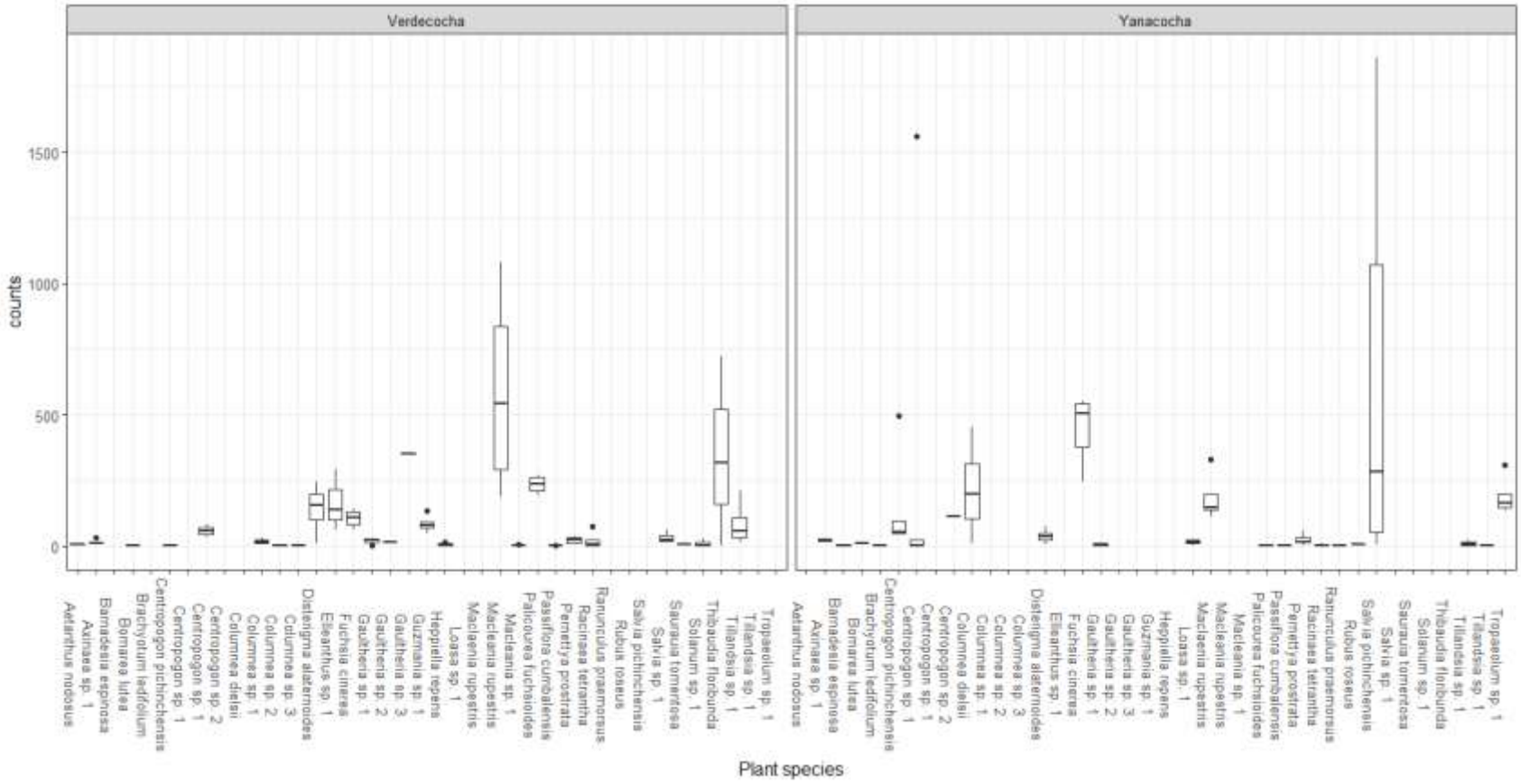


Figure 6. Abundances of flowering plants at Verdecocha and Yanacocha reserves during February – June 2017 period.

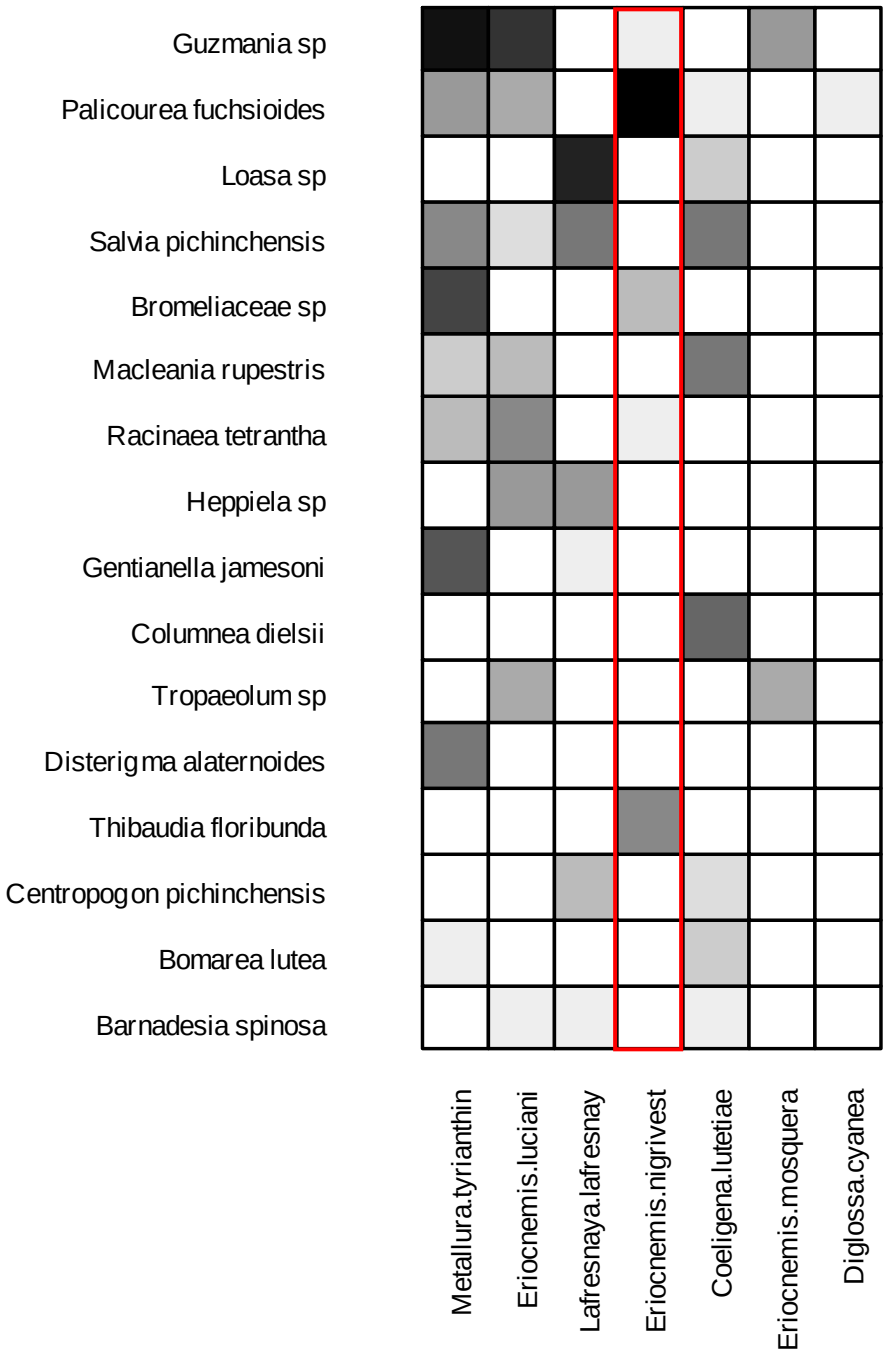


Figure 7.- Interaction pattern of the plant-hummingbird communities in Yanacocha and Verdecocha, recorded with the camera protocol. The red box indicates plants used by the Black-breasted Puflleg, among them the most visited plant was the also endemic and threatened *Palicourea fuchsioides.*

The interaction matrix of the plant-hummingbird communities indicates that Black-breasted Pufflegs visited three plant species during this period (Figure 7), also the interaction matrix suggest that the strongest interaction was detected with *Palicourea fuchsioides.* Based on the interaction matrix we applied we calculated the specialization degree for each hummingbird in the community (Table 3). The specialization degree index estimate how strongly a species observed interactions deviate from those expected by random (Dormann et al., 2008), the index ranges from 0 (no specialisation) to 1 (perfect specialist). Results from this analysis suggest that Black-breasted Puffleg might be a specialized species concerning its diet (Table 3).

Species	Specialization degree index
Lafresnaya lafresnayi	0.74360205
Eriocnemis nigrivestis	**0.70717326**
Coeligena lutetiae	0.59697152
Eriocnemis mosquera	0.47914754
Metallura tyrianthina	0.43851745
Eriocnemis luciani	0.35922443
Diglossa cyanea	0.0640263

Palicourea fuchsioides is an endangered Rubiaceae shrub known from only a few locations in the Andes of western Ecuador (Jaramillo et al. 2004). It produces relatively short-corolla flowers and with usually high sucrose concentration (corolla length 21.7 ± 3.0, N = 12; sucrose concentration 22.58% ± 3.9 N = 12, Guevara et al., submitted). Although not known to occur in any Ecuadorian government protected areas, this shrub could be present in the El Angel Ecological and Cotacachi-Cayapas Ecological reserves (Jaramillo et al. 2004). At our study sites, the plant was present in a ridge-crest elfin forest at Verdecocha where it formed large flowering patches, and was also present at much lower densities in mature forest and forest borders at Yanacocha (Figure 6). During our study, *P. fuchsioides* was visited by eight species of hummingbirds, suggesting that Black-breasted Pufflegs are not its exclusive pollinator. Nonetheless, its apparent rarity and importance in the diet of Black-breasted Pufflegs suggest that additional study of its phenology, pollination ecology, and distribution is needed. Further conservation initiatives should consider propagating this feeding resource into restored sites.

6.3 Awareness on habitat and species threats

6.3.1 Hummingbird workshops

In total we carried out four, two day workshops (theory and practice). We had a total of 17 participants, 11 men and 6 women. We developed courses focus on High-Andean hummingbird's identification, birdwatching good practices, and monitoring methodology. We visited three reserves (Yanacocha, Tamboquinde y Pacha Quindi) covering an elevation range between 1800 to 3700 m a.s.l., and we received support of reserve owners to enter to these properties, in the case of Pacha Quinde, Tony Nunnery (expert bird guide) gave us a talk about hummingbirds.

6.3.2 Baseline survey about Black-breasted Puffleg

As we mentioned, we applied a questionnaire to all participants of the hummingbird workshop at the beginning and at the end of training. There were 9 questions related to bird observation and identification, hummingbirds and threats. The average grade during the first evaluation was 3.04/10 and at the end was 7.98/10. Although not all the participants were the same we can see an improvement on their knowledge.

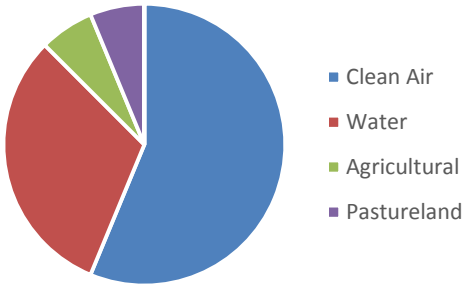
6.3.3 Production of awareness material

A 15-page awareness booklet was produced in Spanish. It contains information on Black-breasted natural history (movements, habitat and preferred plants), as well its identification and main threats to its habitat. It also contains messages aimed to improve productive practices in the area, which include agroecological farming. With the support of CLP and further institutions (Rufford Foundation and USFWS), we printed 500 copies of the booklet which are being distributed among local stakeholders. The full booklet is included in Appendix 4.

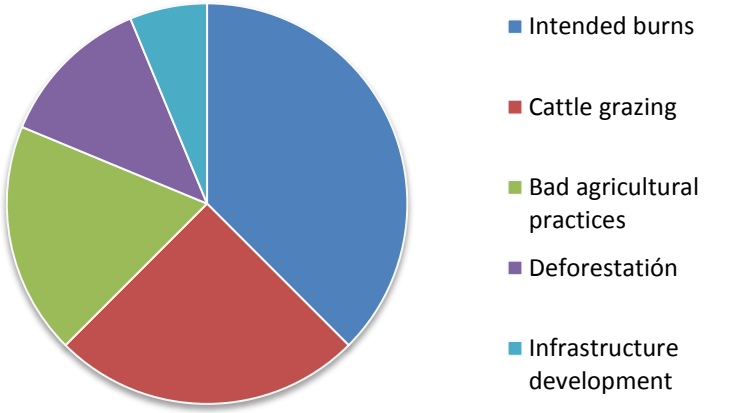
6.3.4 Awareness workshops

We conducted a total of four awareness sessions. We had between 12-18 people from Yanacocha community who were the beneficiaries of the water irrigation project and 16 from Alambi. Considering that Yanacocha community is constituted mainly with elder people we choose short presentations and videos in order to keep their attention. We talk about the páramos, water conservation, and waste management.

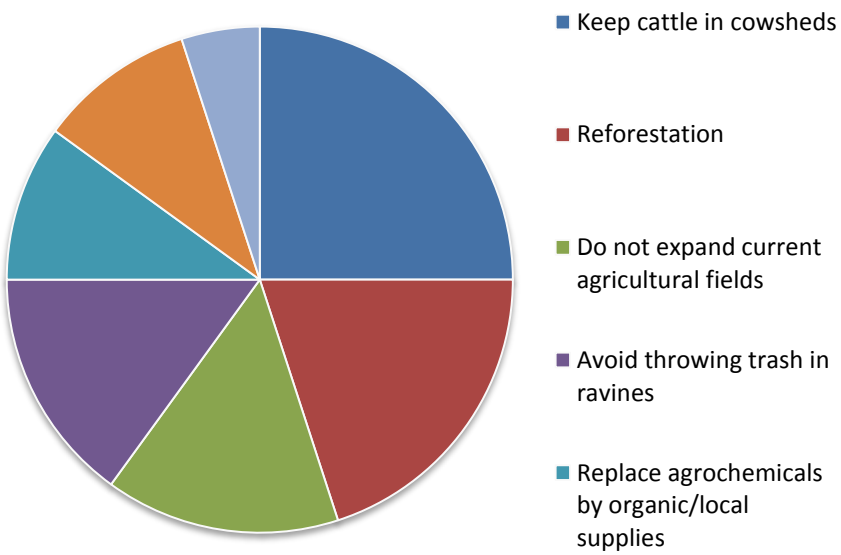
At Alambi the workshop has another dynamic since the group of people is much younger and we had the participation of Marcelo Armijos, environmental educator of FONAG. Through the images we could understand people´s opinion about the forest and the relation with them and their activities. Following we presented some graphics summarizing the answers of Alambi community.



What are the benefits for the community to conserve páramos, forests and ravines?



What kind of human activities threaten these ecosystems?



What kind of alternatives could be implemented in support of these ecosystems?

We also participated at Nono festivities in August during two weekends. One weekend we had a stand focus on the Black-breasted Puffleg and waste management. Four Environmental Educators prepared several activities including painting, bird masks, and puppets. Next week we support Alambi community with the preparation of a float where they wanted to represent the live of a farmer in armory with nature. In total we have reached around 1000 people.

7. Achievements

1. *Agreement with Nono Parish*.- At the beginning of our project, and thanks to Rolando Hipo´s lobbying, we sign a cooperation agreement with the current Nono parish. The agreement was signed by the Nono parish and Aves y Conservación, our host institution in Ecuador. Both institutions agree to boost and foster projects and programs aimed to improve the livelihoods our inhabitants of Nono through the implementation of sustainable and environmental friendly practices (e.g. organic farming). The agreement also includes the production of awareness material. The scanned signed agreement could be found in the Appendix section.

2. *Leverage of additional funding*. - During the implementation of our CLP project we managed to secure additional funding (c. USD 43,000) to cover complementary activities at our project area. These activities were designed to benefit the habitat of the Black-breasted Puffleg and to increase knowledge on the species. Specifically we obtained funding from two sources that we detail below.

   U.S Fish and Wildlife Service – Wildlife without borders Program: This project was granted a total amount of USD 36,631 during the last trimester of 2014. The purpose of this project is to implement sustainable and comprehensive farming activities in the high-Andean montane forests in northwestern Ecuador. This project is intended to optimize the use of natural resources and promote the conservation of wildlife by reducing the advance of unsustainable agricultural activities. Specific activities include: (1) identifying and designating natural restoration areas through an incentive program promoted by the national government; and (2) implementing natural and artificial fencing to avoid uncontrolled cattle grazing in the forest areas. More info on the program at: http://www.fws.gov/international/wildlife-without-borders/latin-america-and-the-caribbean/

   Rufford Foundation: We get an amount of £4775 (*c*. USD 7400) to study the effects of human-induced disturbance on plant – bird Interactions. Our study sites are embedded at CLP project area and despite it is not focused on the study of a single species (e.g. Black-breasted Puffleg). In this project we have been using time-lapse cameras and motion detection software to record hummingbird visitation to flowering plants. More details on this project could be found at: http://www.rufford.org/projects/esteban_guevara. Additionaly mr Guevara has obtained additional funding through a second Rufford Grant (http://www.rufford.org/projects/esteban_guevara_0).

3. Recognition of a Municipal Protected Area.- During the course of this project, our colleagues Tatiana Santander and Rolando Hipo have been working on the recognition of a Municipal Protected Area that cover our project sites. The official name of this area is "*Camino de los Yumbos"* and it is located at the northwest of Quito Metropolitan District in two rural parishes: Nono and Nanegalito. The area encompasses an extension of 18,711ha and includes high-Andean forests, crops and pasturelands. *The Camino de los Yumbos* area holds the so called "Sustainable Use and Conservation Area" management category which allows productive activities within the area as long as these are environmental friendly and sustainable. To this date, the Environment Secretary is preparing a presentation to the Municipality Metropolitan Council who are the ones that approve this nomination.
4. Agreements with 15 Yanacocha land owners to conserve forest remnants and to take care of irrigation tool kit.
5. Improve the knowledge and awareness on the Black-breasted Puffleg among project participants.
6. A paper detailing ecological aspects on Black-breasted Puffleg is conditionally accepted in the Journal of Field Ornithology. Final acceptance is contingent to small changes in the paper which are being addressed at the time this update report is submitted.

8. Conclusion

Overall we consider the project successful, in terms that most of the proposed activities and objectives settled were accomplished and some other unplanned activities were also performed. The remaining activity that we haven't been able to do is the development of early of the early fire-warning system, for the reasons explained in section 6.1.2.

According to our monitoring data, the project area is of utmost importance for the conservation of our focal species, the Black-breasted Puffleg. The species was consistently recorded at our study transects and through census and camera recording. However, it is not less true that main threats persist (i.e. land use change, climate change and forest fires), at the project area. Several ongoing initiatives may help palliate the effect of these threats including the upcoming declaration of municipal protected area (point 3 in section 7).

Concerning the youngsters participating in this project, the awareness activities impacted positively their attitude and knowledge towards Black-breasted Puffleg and other hummingbird species. Noteworthy is that during the awareness a couple of landowners also involved in this activity despite it was aimed to high-school students.

The support provided from Conservation Leadership Programme was important in two main ways: First it served us very well to attract other sources of funding (see section 7 point 2) and through that deepen the impact of our activities at the project area. Secondly

the project provided unique opportunities for professional development of team members. For instance, the training that our team member Rolando Hipo received in Canada was in his own words “a fruitful and enduring learning experience”. The trained received regarding communication skills and leadership served Rolando very well at his further role as local authority. Other team member also was benefited, both to expand their network of collaborations and also to leverage new sources of support. For instance team leader Esteban Guevara was granted a prestigious small grant from Rufford Foundation, and through that keep studying hummingbird communities, this has served Esteban to make relevant contacts to pursue his doctoral studies.

9. Problems encountered and lessons learnt

Water management problems.- The installation of irrigation systems was delayed mostly due to problems related with the management of water supply. In first place several key stakeholders were involved in the improvement of main pipe system that distributes water to landowners. Our initial idea was very simple, to provide with irrigation systems to landowners, but during the last trimester of 2014 the Rotary Club of Ecuador was also working at the area. This situation raised the opportunity to improve storage systems and main pipe. Hence we couldn´t install irrigation systems until this previous work were done. The complexity of the improvements carried out by the Rotary Club delayed significantly the installation of irrigation systems.

On the other hand during meetings with landowners several problems related with water stewardship came to light. For instance, it is accorded among all landowners of the community that each farm is allowed to have only one catchment from the main pipe, but several landowners had installed two and even three catchments. This carries problems to other landowners, especially to those located in the lower portion of the community since the water flow reached these properties without enough power to make irrigation systems functional. All these problems had to be addressed before irrigation systems could be installed.

Perhaps main lessons learnt are, in first place that a large amount of effort should be devoted to recover the sense of community among the inhabitants of Yanacocha. Most of the problems related with water storage and supply could be solved by following simple rules and maintaining adequate venues of communication among landowners, this has been largely lost in Yanacocha.

Large proliferation of forest fires.- The extended dry season that we experience during period May – September 2015, generated a unexpected proliferation of forest fires, not only in Quito surroundings but in the whole inter-Andean valleys of Ecuador. Despite no

large forest fire occurred at our project area, this scenario provoked that fireman departments were too busy to attend our requests of involving in project activities. Hence, the development of early warning systems is still delayed. We planned this activity to occur during the dry season but, after this experience we learnt that activities that require the cooperation of fireman departments should be planned to occur during the last weeks of the rainy season.

10. In the future

The work performed in the project area over the last year gave us the chance to identify further conservation and research opportunities. For instance, we see room for working in the improvement of productive practices, especially concerning livestock grazing and agriculture. Inhabitants of Yanacocha community may be benefitted by capacity building activities in sustainable crop and livestock farming. The propagation of these practices will also benefit the environment in the area, since these practices aim to reduce the use of agrochemicals and make the most of the local resources, alleviating the pressure over forested habitats specially.

During year 2016 we also had the chance to meet colleagues from Stony Broook University who are working with hummingbirds communities at Santa Lucía Reserve, located c. 50 km to the north of our study area. They introduce us the Plotwatcher Pro Cameras as a monitoring method and also assisted our team in securing seed funding to get our own cameras (see section 7 point 2 for details). The camera trap technology and associated computer tools are very easy to implement and the capacity for data collection is remarkable. The further implementation of this monitoring approach will be of two-fold benefit. First it will enhance the ability of our team to track changes in pollination systems across different habitats. Since quantifying hummingbird-plant interactions can be very time-consuming as flowers are often dispersed in the forest and sporadically visited by hummingbirds, this approach will enable to gather ecological information at faster rate. Secondly thanks to this communication with academic fellows our team leader, Esteban A. Guevara, has found an opportunity to pursue a doctoral study. At the moment Esteban has submitted an application to join Catherine Graham´s lab, and hopefully his thesis will deepen in the effects of human-induced disturbance over bird-plant pollination networks, including a study on the feeding ecology of the Black-breasted Puffleg.

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12. Appendices (separate documents)