



Bird Monitoring Study Data Report

July 3 – August 18, 2017

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Cloudbridge Nature Reserve
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Juvenile Ornate Hawk-eagle (*Spizæetus ornatus*)

CONTENTS

Contents	i
Tables	ii
Figures.....	iii
1 Project Background	1
1.1 Project Goals	1
2 Locations	2
3 Methods.....	5
3.1.1 Training.....	5
3.1.2 Survey Timing.....	5
3.1.3 Point Counts	7
3.1.4 Walking Surveys	10
4 Data Summary	21
4.1 Species Identified	21
4.1.1 Threatened Species	21
4.2 Abundance	25
4.2.1 Threatened Species Abundance	35
4.3 Richness & Diversity	35
5 Acknowledgements.....	37
6 References	37

TABLES

Table 1: Summary Information on Current Bird Stations – March 2016 to Present.....	4
Table 2: Number of Point Counts Per Month – 2017	6
Table 3: Number of Point Counts Per Habitat Type – 2017	6
Table 4: Example Point Count Survey Schedule Including Walking Surveys.....	6
Table 5: Rain Class	8
Table 6: Wind Class.....	8
Table 7: Cloud Cover Class.....	8
Table 8: Bird Age Class.....	8
Table 9: Bird Breeding Status	9
Table 10: Bird Nesting Behaviour.....	9
Table 11: Suggested Walking Survey Routes by Survey Group.....	10
Table 12: Bird Species Identified, All Methods – July 3 rd - August 18 th , 2017.....	22
Table 7: Bird Abundance By Habitat – July 3 rd – August 18 th , 2017.....	26
Table 8: Raw Bird Species Abundance by Station – July 3 rd – August 18 th , 2017	27
Table 9: Bird Species Abundance Per 10 Point Counts by Station – July 3 rd – August 18 th , 2017.....	30
Table 10: Bird Species Abundance Per 10 Point Counts by Habitat – July 3 rd – August 18 th , 2017	33
Table 11: Richness and Diversity By Station – July 3 rd – August 18 th , 2017.....	36
Table 12: Richness and Diversity By Habitat – July 3 rd – August 18 th , 2017	36

FIGURES

Figure 1: Example of a bird station marker.....	2
Figure 2: Locations of point count stations, March 2016 to present.....	3
Figure 3: Point Count Survey Area.....	7
Figure 4: Inside vs Outside of Survey Area.....	7
Figure 5: Montaña and Chirripó Walking Survey From Station 1.....	11
Figure 6: Montaña and Chirripó Walking Survey From Station 9.....	12
Figure 7: Sentinel & Gavilan Walking Survey From Station 32.....	13
Figure 8: Sentinel & Gavilan Walking Survey From Station 34.....	14
Figure 9: Principal & Rio Walking Survey From Station 31.....	15
Figure 10: Rio & Principal Walking Survey From Station 20.....	16
Figure 11: Don Victor Walking Survey From Station 26.....	17
Figure 12: Don Victor Walking Survey From Station 22.....	18
Figure 13: El Jilguero Walking Survey From Station 30.....	19
Figure 14: El Jilguero Walking Survey From Station 12.....	20

1 PROJECT BACKGROUND

A bird monitoring study was initiated at Cloudbridge Nature Reserve (Cloudbridge) in 2013 to monitor the diversity and presence of birds within the reserve, as well as build a bird species list for the reserve. The study has been conducted regularly between 2013 and the present, with some breaks in data collection of between a couple weeks to several months. Data was collected by research interns trained in Costa Rican bird identification prior to beginning data collection.

Data was collected by conducting point count surveys at set locations throughout the reserve. The survey methodologies and locations have changed slightly over the duration of the project. In the spring of 2016, the survey methodology and locations were standardized and a protocol prepared. This was done to ensure the methods will remain consistent in the future and that the survey locations were similar to those used for other monitoring studies in the reserve.

This data report has been prepared to summarize the data collected during the project between the period of July 3rd and August 18th, 2017.

1.1 PROJECT GOALS

This study was set-up to accomplish two main goals:

1. Build and maintain a bird species list for Cloudbridge; and,
2. Assess differences in species composition and abundance between different successional habitat types, and monitor how that changes as the forest continues to regenerate.

Goal 1: Build and maintain a bird species list

To accomplish this goal, data from the point count surveys is combined with other bird observations from owl and breeding bird call-playback surveys, walking surveys, and incidental observations to update and maintain the Cloudbridge bird species list. The full bird species list can be found on the Species List page of the Cloudbridge website (Cloudbridge 2017).

Goal 2: Successional habitat bird study

This goal uses data collected from point count surveys to compare the differences in bird species composition and abundance between different successional habitat types throughout Cloudbridge. Bird point counts are surveyed regularly throughout the year in order to monitor seasonal changes in bird presence throughout the reserve and assess diversity and abundance in the different habitat types.

Successional habitat types include:

- 1) Planted areas (P),
- 2) Areas with both planted and naturally regenerated forest under 30 years old ($P/NR < 30$),
- 3) Naturally regenerated areas under 30 years old ($NR < 30$),
- 4) Naturally regenerated areas over 30 years old ($NR > 30$),
- 5) Naturally regenerated areas with forest both under and over 30 years old ($NR \pm 30$), and
- 6) Old growth forest (OG).

2 LOCATIONS

Since March 2016, 24 bird stations are surveyed as part of the point count study (Figure 2). Stations are marked with a small metal sign (Figure 1), which serves as the centre of the survey area (see Section 3.1.3). Stations are surveyed in groups of 5 per survey day, with one group containing only 4 stations. Summary information on each station is provided in Table 1 by survey group.



FIGURE 1: Example of a bird station marker.



FIGURE 2: Locations of point count stations, March 2016 to present.

TABLE 1: Summary Information on Current Bird Stations – March 2016 to Present

Survey Group	Bird Station	Habitat Type	Trail	Elevation (m)	Date First Surveyed	Latitude ¹	Longitude ¹
Montaña/Chirripó	1	P	Montaña	1730	25-Feb-2013	9.473409	-83.568988
	3	P	Montaña	1830	7-Feb-2013	9.471708	-83.568038
	5	NR<30	Montaña	1970	25-Feb-2013	9.469800	-83.565784
	7	NR<30	Montaña	2070	25-Feb-2013	9.467209	-83.565401
	9	OG	Chirripó	2140	7-Nov-2013	9.464493	-83.564908
Sentinel/Gavilan	34	OG	Gavilan	1950	22-Feb-2013	9.467410	-83.571020
	14	NR>30	Gavilan	1875	22-Feb-2013	9.468808	-83.571684
	15	P	Gavilan	1805	22-Feb-2013	9.470275	-83.572487
	16	P/NR<30	Gavilan	1735	22-Feb-2013	9.471758	-83.572306
	32	P	Sentinel	1725	16-Aug-2013	9.472040	-83.571150
Principal/Rio	31	NR<30	Principal	1625	16-Aug-2013	9.472500	-83.574651
	17	NR<30	Rio	1660	24-Jul-2013	9.473032	-83.572289
	18	P/NR<30	Rio	1650	28-Feb-2013	9.473445	-83.571454
	19	NR<30	Rio	1665	24-Jul-2013	9.474947	-83.569900
	20	P/NR<30	Rio	1710	28-Feb-2013	9.474391	-83.568103
Don Victor	22	NR<30	Don Victor	1810	26-Feb-2013	9.482593	-83.567272
	24	NR<30	Don Victor	1795	26-Feb-2013	9.480980	-83.567934
	25	NR<30	Don Victor	1770	6-Feb-2013	9.479409	-83.567758
	26	NR<30	Don Victor	1745	6-Feb-2013	9.477481	-83.568253
El Jilguero	30	P	El Jilguero	1640	2-Aug-2013	9.469620	-83.578210
	27	P	El Jilguero	1650	26-Jul-2013	9.470344	-83.577857
	28	NR<30	El Jilguero	1760	26-Jul-2013	9.468912	-83.575908
	33	NR±30	El Jilguero	1845	15-Mar-2016	9.467910	-83.574070
	12	OG	El Jilguero	1965	22-Feb-2013	9.466300	-83.571240

P = Planted, NR<30 = Natural Regeneration Under 30 Years, NR>30 = Natural Regeneration Over 30 Years, NR±30 = Natural Regeneration Over and Under 30 Years, P/NR<30 = Planted and Natural Regeneration Under 30 Years, OG = Old Growth.

¹, WGS84

3 METHODS

The methods described in this section have been in effect in their entirety since March 2016. Some aspects, such as the training requirements, may have been in effect for longer. Methods used previous to March 2016 are described in Powell 2017.

3.1.1 TRAINING

All bird research interns are required to individually pass a test on visual bird identification prior to conducting point counts. The test consists of 30 images of birds on the current bird species list, with each image shown for 15 to 45 seconds. While the images are being shown, interns can take notes and have access to a bird ID book. After all images are shown, interns are able to review their notes and work with a bird ID book to identify the birds. A passing grade is 28 out of 30. Interns can retake the test several times until a passing grade is reached.

3.1.2 SURVEY TIMING

During a survey period, all 5 survey groups shown in Table 1 are surveyed once per week. Point counts are conducted during the day, starting at approximately 6 am and are completed by 10 am at the latest.

The order in which the stations in each group are surveyed is varied between sampling events in order to ensure variation in survey results is not due to the time of day the sites were sampled. For example, if one week the El Jilguero group is surveyed in the following order: 30, 27, 28, 33, and 12; the next time it is sampled, it is surveyed in the other direction: 12, 33, 28, 27, and 30.

During the July 3rd – August 18th, 2017 period, point count stations were surveyed 7 times (Table 2). The breakdown of the number of surveys per habitat type is shown in Table 3.

Walking surveys were completed in conjunction with point count surveys. Each walking survey route is completed once in a 2 week period, scheduled every two days (Table 4). The first scheduled point count starts at, or after, 6:00 am, with the walking survey starting either on the way to the first point count, or immediately after the point count is complete. When the next bird station is reached, the point count is completed as usual. The last point count on the route is completed by 10:00 am at the latest, and the walking survey continues until around 11:30 am. The surveys are staggered in the schedule so that each route (Figures 5-14) is completed once a month.

During the July 3rd – August 18th, 2017 period, 19 walking surveys were conducted.

TABLE 2: Number of Point Counts Per Month – 2017

Station	1	3	5	7	9	12	14	15	16	17	18	19	20	22	24	25	26	27	28	30	31	32	33	34	Total
Jul	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	101
Aug	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	67
Total	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	168

TABLE 3: Number of Point Counts Per Habitat Type – 2017

Habitat	# Stations	July	Aug	Total
P	6	26	16	42
P/NR<30	3	12	9	21
NR<30	10	42	28	70
NR>30	1	4	3	7
NR±30	1	4	3	7
OG	3	13	8	21
Total	24	101	67	168

P = Planted, NR<30 = Natural Regeneration Under 30 Years, NR>30 = Natural Regeneration Over 30 Years, NR±30 = Natural Regeneration Over and Under 30 Years, P/NR<30 = Planted and Natural Regeneration Under 30 Years, OG = Old Growth.

TABLE 4: Example Point Count Survey Schedule Including Walking Surveys

Survey Week	Monday	Tuesday	Wednesday	Thursday	Friday
1	Montaña (1, 3, 5, 7, 9)	El Jilguero (30, 27, 28, 33, 12) & Walking Survey	Sentinel & Gavilan (32, 16, 15, 14, 34)	Don Victor (22, 24, 25, 26) & Walking Survey	Principal & Rio (31, 17, 18, 19, 20)
2	Montaña (9, 7, 5, 3, 1) & Walking Survey	El Jilguero (12, 33, 28, 27, 30)	Gavilan & Sentinel (34, 14, 15, 16, 32) & Walking Survey	Don Victor (26, 25, 24, 22)	Rio & Principal (20, 19, 28, 17, 31) & Walking Survey
3	Montaña (1, 3, 5, 7, 9) & Walking Survey	El Jilguero (30, 27, 28, 33, 12)	Sentinel & Gavilan (32, 16, 15, 14, 34) & Walking Survey	Don Victor (22, 24, 25, 26)	Principal & Rio (31, 17, 18, 19, 20) & Walking Survey
4	Montaña (9, 7, 5, 3, 1)	El Jilguero (12, 33, 28, 27, 30) & Walking Survey	Gavilan & Sentinel (34, 14, 15, 16, 32)	Don Victor (26, 25, 24, 22) & Walking Survey	Rio & Principal (20, 19, 28, 17, 31)

3.1.3 POINT COUNTS

Prior to beginning of each point count, the rain, wind, and cloud cover are recorded according to the classes presented in Tables 5 through 7. The start time is recorded and all birds seen or heard within or outside the survey area within the following 20 minutes are recorded. Garrigues and Dean (2007) is used as the main reference for bird identification and the Neotropical Birds website (CLO 2017b) is used to check current species names and classifications. The method of identification (visual, audio or audio/visual), and whether the bird was inside or outside of the survey area is also recorded. If birds cannot be identified to species, they are still recorded to the lowest identifiable taxon (ex. hummingbird, flycatcher, *Contopus sp.*, etc.) in order to record an accurate measure of overall abundance at the site. Within the 20 minutes, the presence of individual birds is broken into 5 different intervals: 0-2 mins, 2-5 mins, 5-10 mins, 10-15 mins, and 15-20 mins. This is done to allow the data to be comparable with other bird studies conducted with different survey durations. For example, a bird seen in the survey area from minute 9 of the survey to minute 16, would be recorded as present in the 5-10 minute, 10-15 minute, and the 15-20 minute intervals.

The survey area includes the area within a 25 m radius of the bird point count marker (measured horizontally out from the point), extending in a cylinder from the ground to the top of the canopy (Figure 3). Birds seen or heard outside of that cylinder, or which pass through, but do not utilize the habitat, are recorded as 'outside'. Birds passing through the area that do utilize the habitat (ex. catching bugs in flight, resting on vegetation, etc.), are recorded as inside (Figure 4).

In addition to the species or lowest identifiable taxonomic group of each bird, the following information is recorded whenever possible:

- Sex (male, female, or unknown),
- Age class (Table 8),
- Breeding status (Table 9), and
- Nesting behaviour (Table 10).

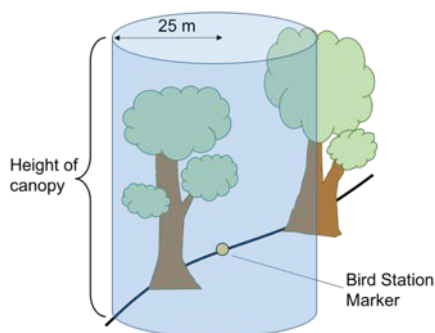


FIGURE 3: Point Count Survey Area

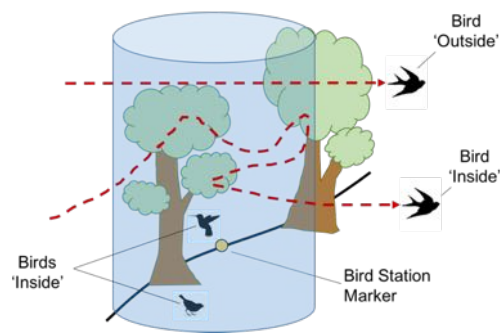


FIGURE 4: Inside vs Outside of Survey Area

TABLE 5: Rain Class

Rain Class		Conditions
0	None	No rain.
1	Drizzle	Barely raining. Tiny raindrops, very sparse or erratic rainfall. Rain gear not necessary.
2	Light	Rain falling at a steady rate, but sparse. Would get soaked if out for an extended period without rain gear.
3	Moderate	Rain constant and dense. Would get soaked in minutes without rain gear.
4	Heavy	Raindrops large and falling with force. Streams forming on some trails. Would get soaked immediately without rain gear.
5	Severe	Storm conditions. Sheets of rain falling from the sky. Trails become creeks. Dangerous to be out at all.

TABLE 6: Wind Class

Wind Class		Conditions
0	Calm	Calm. Smoke rises vertically.
1	Faint	Fog and smoke drift indicates wind direction. Leaves stationary.
2	Light	Wind felt on exposed skin. Leaves rustle.
3	Moderate	Leaves and small twigs constantly moving. Light flags extended. Dust and loose paper raised. Small branches begin to move.
4	Strong	Branches of a moderate size move. Small trees in leaf begin to sway. Large branches in motion. Umbrella use becomes difficult. Empty plastic bins tip over.
5	Severe	Whole trees in motion. Effort needed to walk against the wind.

TABLE 7: Cloud Cover Class

Cloud Class		Conditions
0	Clear	No clouds.
1	Mostly Clear	A few scattered clouds.
2	Partly Cloudy	An equal amount of clouds and clear sky.
3	Mostly Cloudy	More clouds than clear sky.
4	Overcast	Full cloud cover.
5	Misty	Low lying clouds (fog).

TABLE 8: Bird Age Class

Age Class		Description
A	Adult	Bird displaying adult plumage.
J	Juvenile	Bird displaying juvenile plumage.
F	Fledgling	Juvenile bird that has left the nest, but is still being fed by adults.
C	Chick	Juvenile bird still in the nest.

TABLE 9: Bird Breeding Status

Breeding Status		Description
B	Breeding	Bird displaying breeding plumage, or displaying breeding behaviours (i.e. nesting, mating, caring for chicks, etc.).
NB	Non-Breeding	Bird of a species with distinct breeding and non-breeding plumage displaying non-breeding plumage.
U	Unknown	Bird of a species without distinct breeding plumage not observed displaying breeding behaviours.

TABLE 10: Bird Nesting Behaviour

Nesting Behaviour		Description
M	Mating	Adult bird observed actively mating.
NB-1	Nest Building-1	Adult bird observed carrying nest building materials in the beak or feet.
NB-2	Nest Building-2	Adult bird observed actively building a nest.
B	Brooding	Adult bird observed sitting on eggs.
F	Feeding	Adult bird observed feeding chicks, or interacting with chicks in the nest.

3.1.3.1 DATA ANALYSIS

Abundance

When summarizing abundance data, only birds that were visually identified inside the survey area were counted. This is done to make the data comparable between stations and habitats. As bird research interns are not trained in audio identification, it is typically only the birds with the most distinctive calls that are identified by call, and many species are challenging to identify correctly. Therefore, audio identifications provide supplementary information on the birds present in the reserve, but result in biases if included in comparisons between stations, and so are excluded. Similarly, birds seen outside the survey areas provide supplementary data, but cannot be used for comparisons between stations.

As there were unequal numbers of point counts conducted between habitat types, the average number of birds per point count was calculated to allow more accurate comparison between habitats.

Richness

All species identified during point counts and walking surveys in the October to December 2016 period were summarized to assess general species presence. For comparisons between stations and sites, only the birds identified visually during point counts within the survey area were counted. For summary purposes, birds that were not identified to species level were reported as the lowest identified taxon and included in a family richness summary. Species richness was also reported with non-species level taxa removed from the data set.

As there were unequal numbers of point counts conducted between habitat types, the average number of species per point count was calculated to allow more accurate comparison between habitats.

Diversity

Simpson's Index of Diversity (SID) was calculated to compare the diversity between sites. SID is a measure of the likelihood that two individuals drawn at random from a population will be from the same species. The index ranges between 0 and 1, with 0 representing no diversity all 1 equaling high diversity. The index uses the following formula:

$$\text{Simpson's Index of Diversity} = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

It should be noted that abundances were not adjusted for differences in sample sizes. As such the diversity numbers are not directly comparable between habitats but are directly comparable between stations.

3.1.4 WALKING SURVEYS

Walking surveys consist of walking slowly along the trails of the reserve and recording every bird seen or heard. These are done to survey bird presence within the entire reserve that may not be captured at the point counts, and potentially record rare or uncommon birds. Walking surveys are done in conjunction with the point count surveys.

3.1.4.1 LOCATIONS

Walking survey locations depend on which bird point counts are being surveyed (and in which order) on a walking survey day (Table 10). Suggested routes (Figures 5 to 14) are provided to interns in an effort to have all the trails (including side trails) in Cloudbridge surveyed during the walking surveys. Additional trails can be added if time allows and surveyors have the option of focusing on specific areas if there is high bird presence in one area over another.

TABLE 11: Suggested Walking Survey Routes by Survey Group

Survey Group	Station Order	Figure Showing Suggested Route	Trails Covered
Montaña/Chirripó	1, 3, 5, 7, 9	5	Montaña, Chirripó, top portion of El Jilguero, Gavilan/El Jilguero connector
	9, 7, 5, 3, 1	6	Chirripó, Montaña, Principal, Heliconia
Sentinel/Gavilan	32, 16, 15, 14, 34	7	Sentinel, Gavilan, top portion of El Jilguero, Chirripó
	34, 14, 15, 16, 32	8	Gavilan, Sentinel, Heliconia
Principal/Rio	31, 17, 18, 19, 20	9	Principal, Rio, Waterfall
	20, 19, 18, 17, 31	10	Rio, Principal, Waterfall, road to San Gerardo
Don Victor	22, 24, 25, 26	11	Don Victor, Los Quetzales, Vulture Rock, Cloudbridge North and South connector
	26, 25, 24, 22	12	Don Victor, Los Quetzales, Vulture Rock, Cloudbridge North and South connector
El Jilguero	30, 27, 28, 33, 12	13	El Jilguero, Chirripó
	12, 33, 28, 27, 30	14	El Jilguero, road to San Gerardo

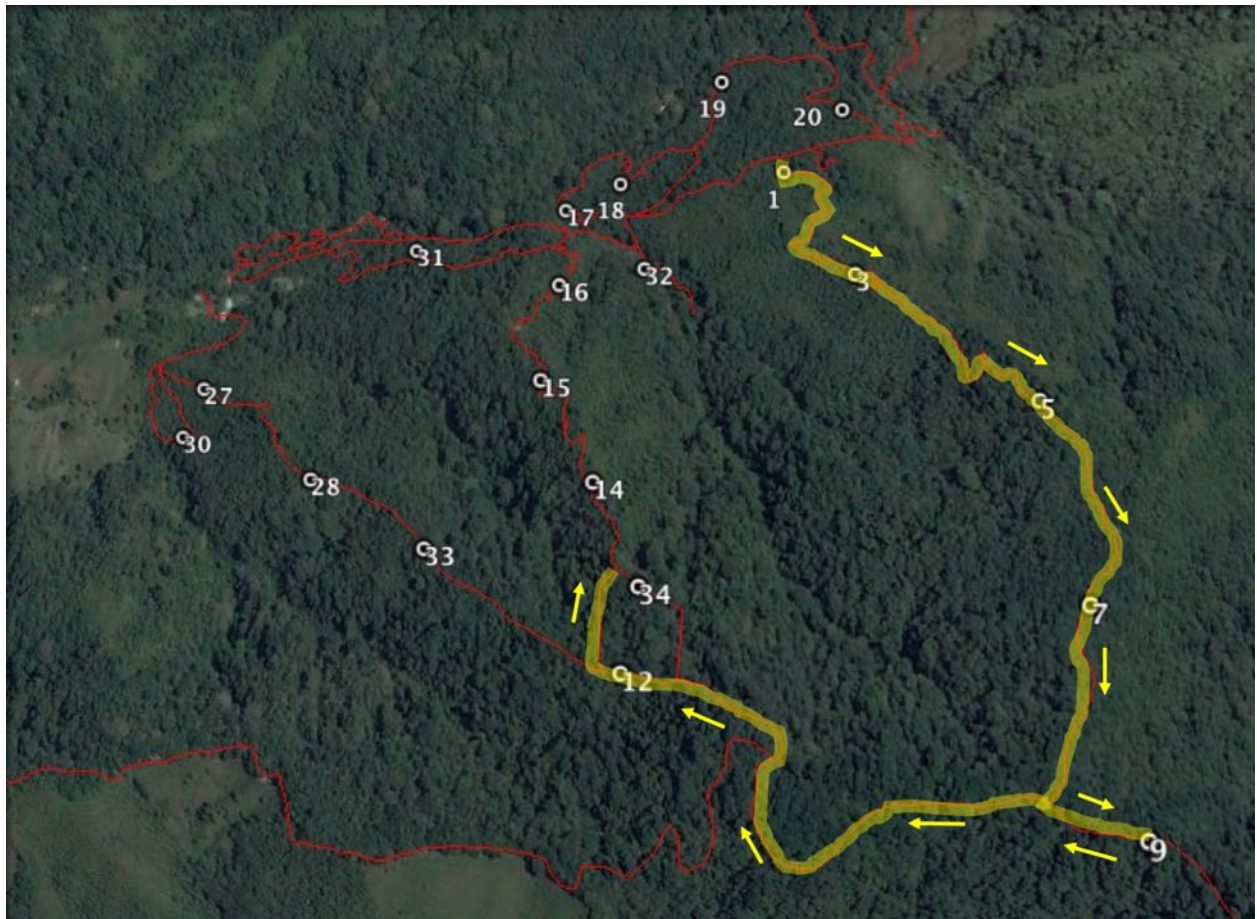


FIGURE 5: Montaña and Chirripó Walking Survey From Station 1.

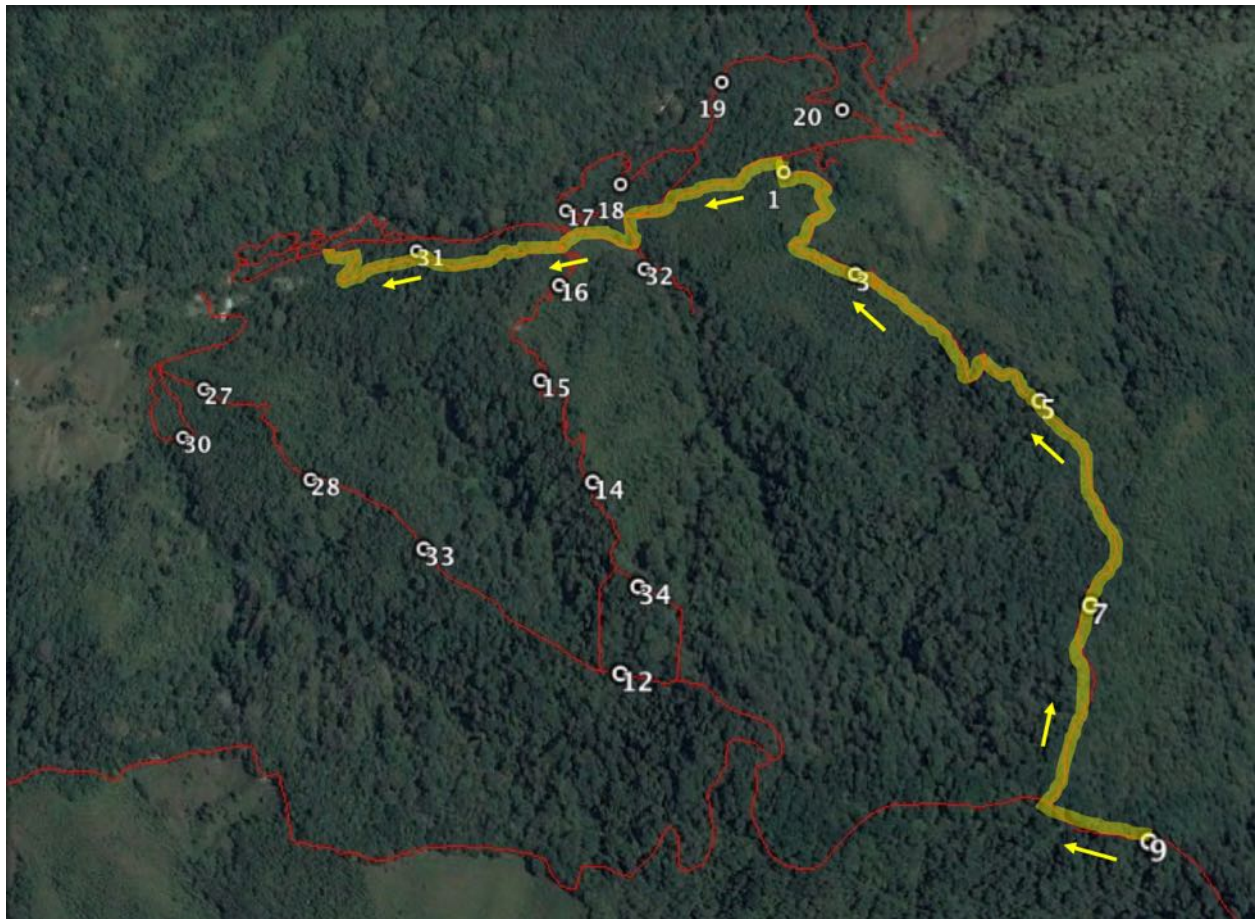


FIGURE 6: Montaña and Chirripó Walking Survey From Station 9.



FIGURE 7: Sentinel & Gavilan Walking Survey From Station 32.

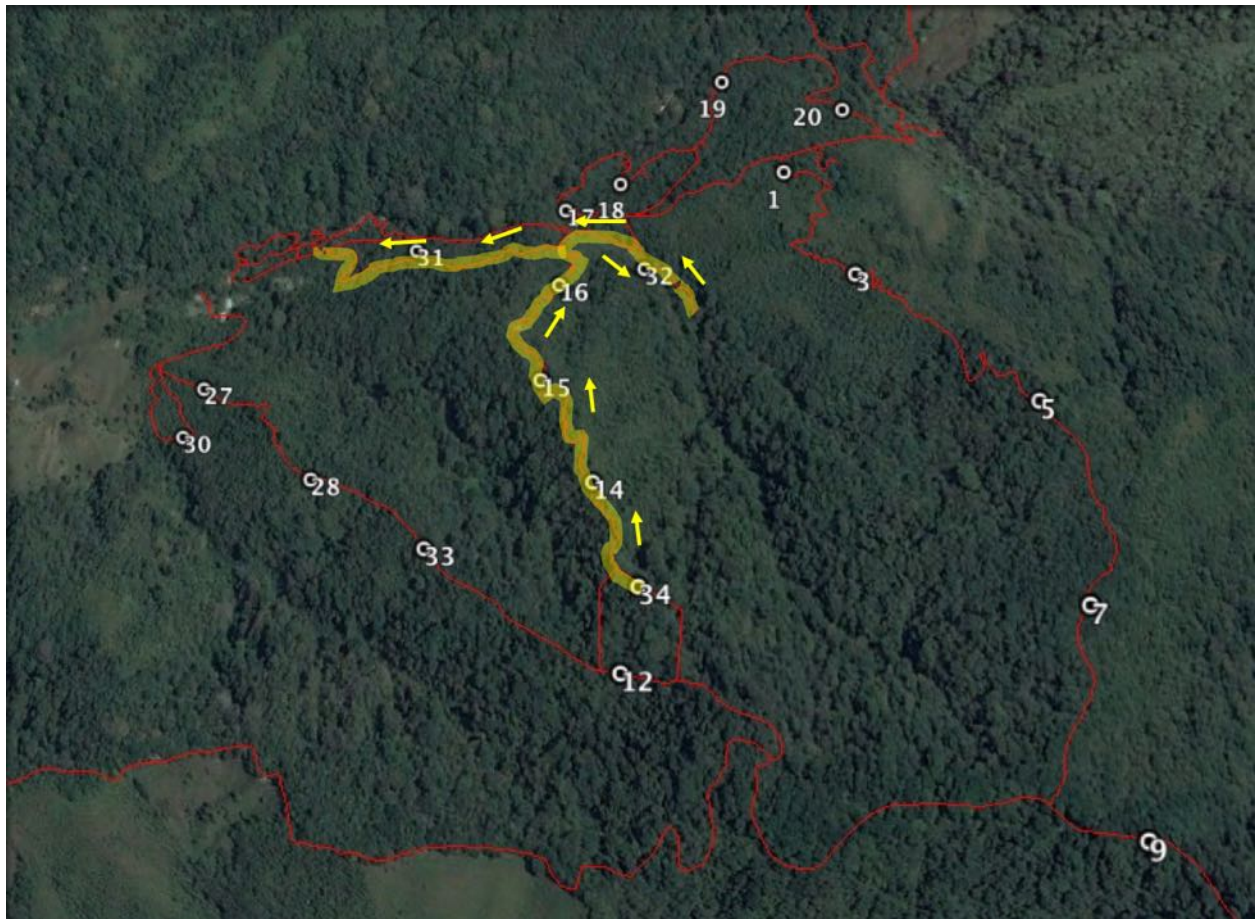


FIGURE 8: Sentinel & Gavilan Walking Survey From Station 34.

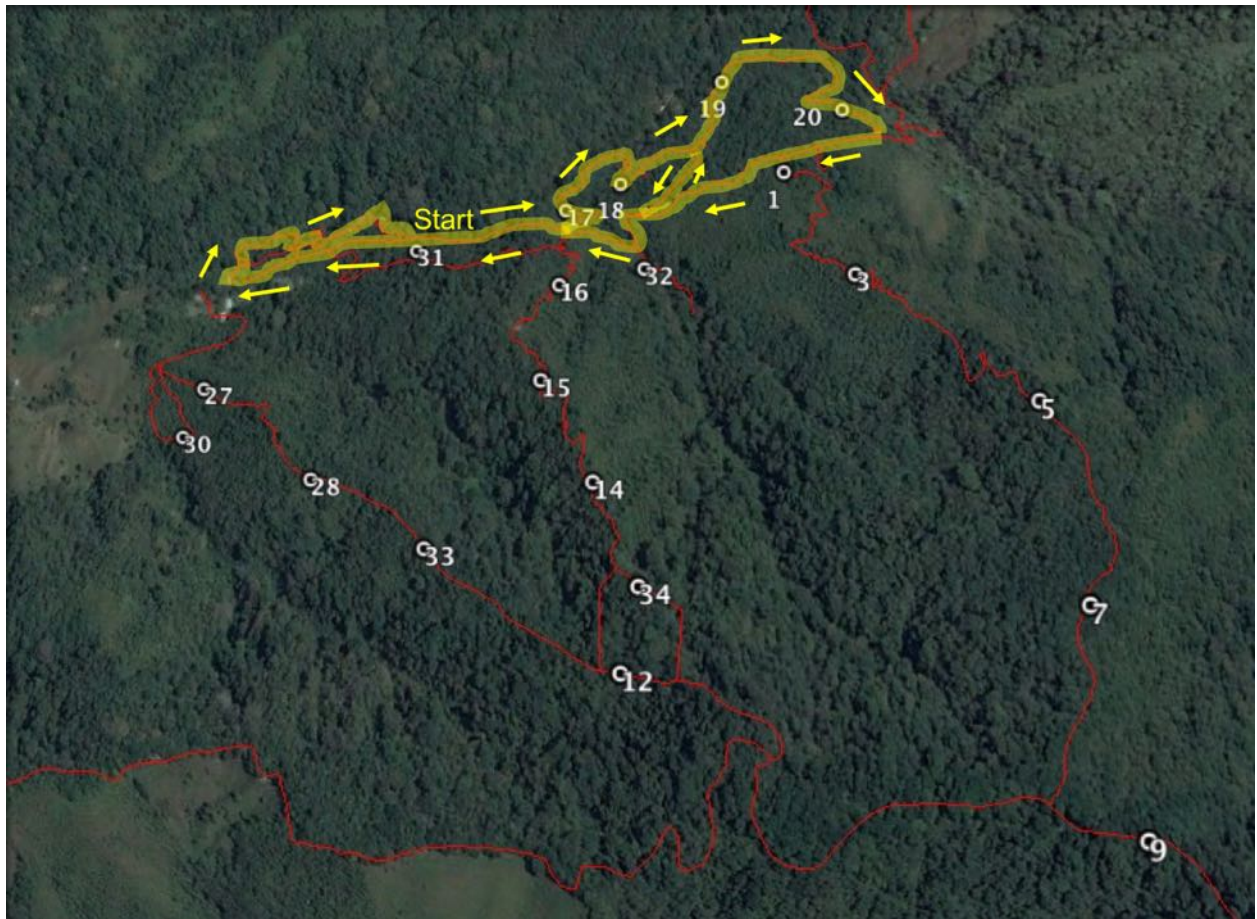


FIGURE 9: Principal & Rio Walking Survey From Station 31.

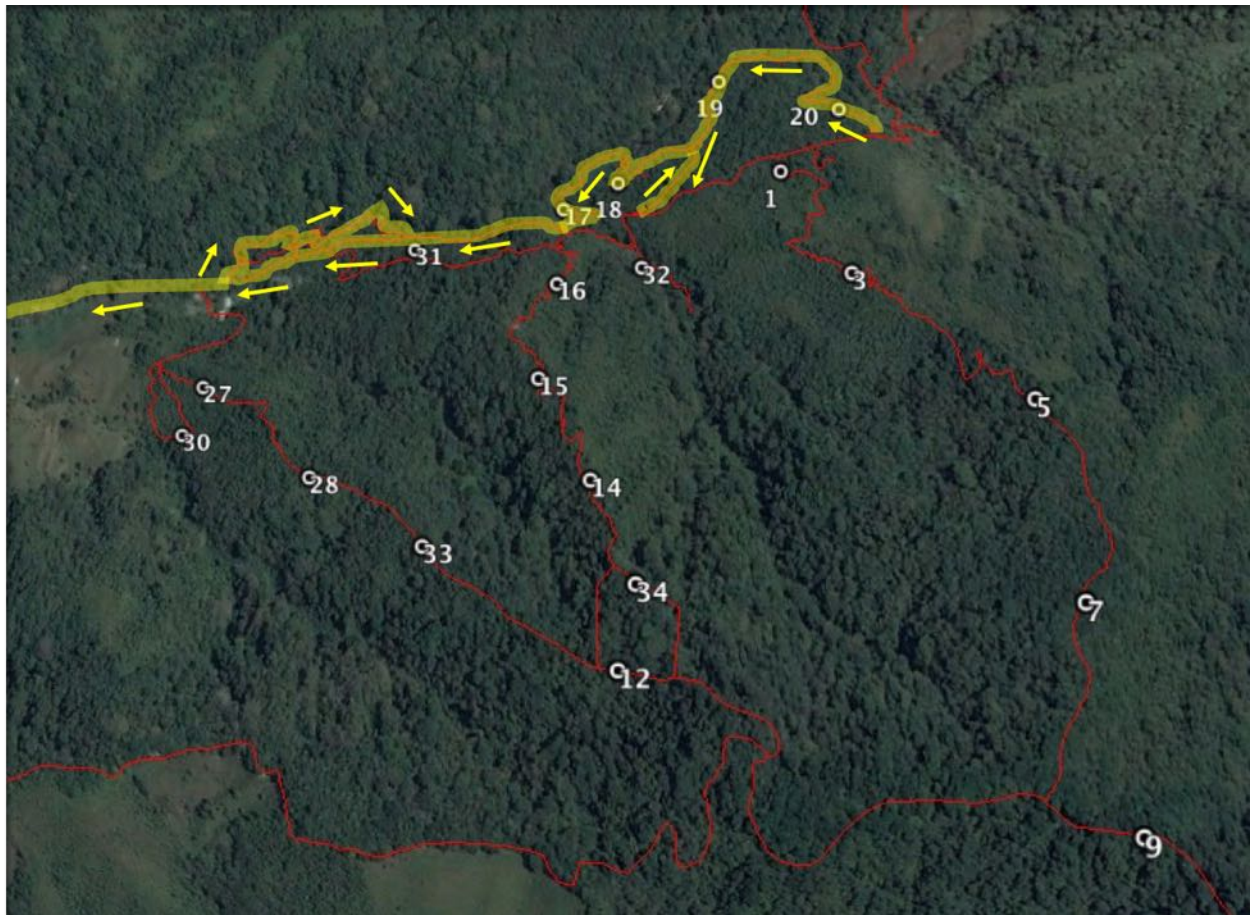


FIGURE 10: Rio & Principal Walking Survey From Station 20.

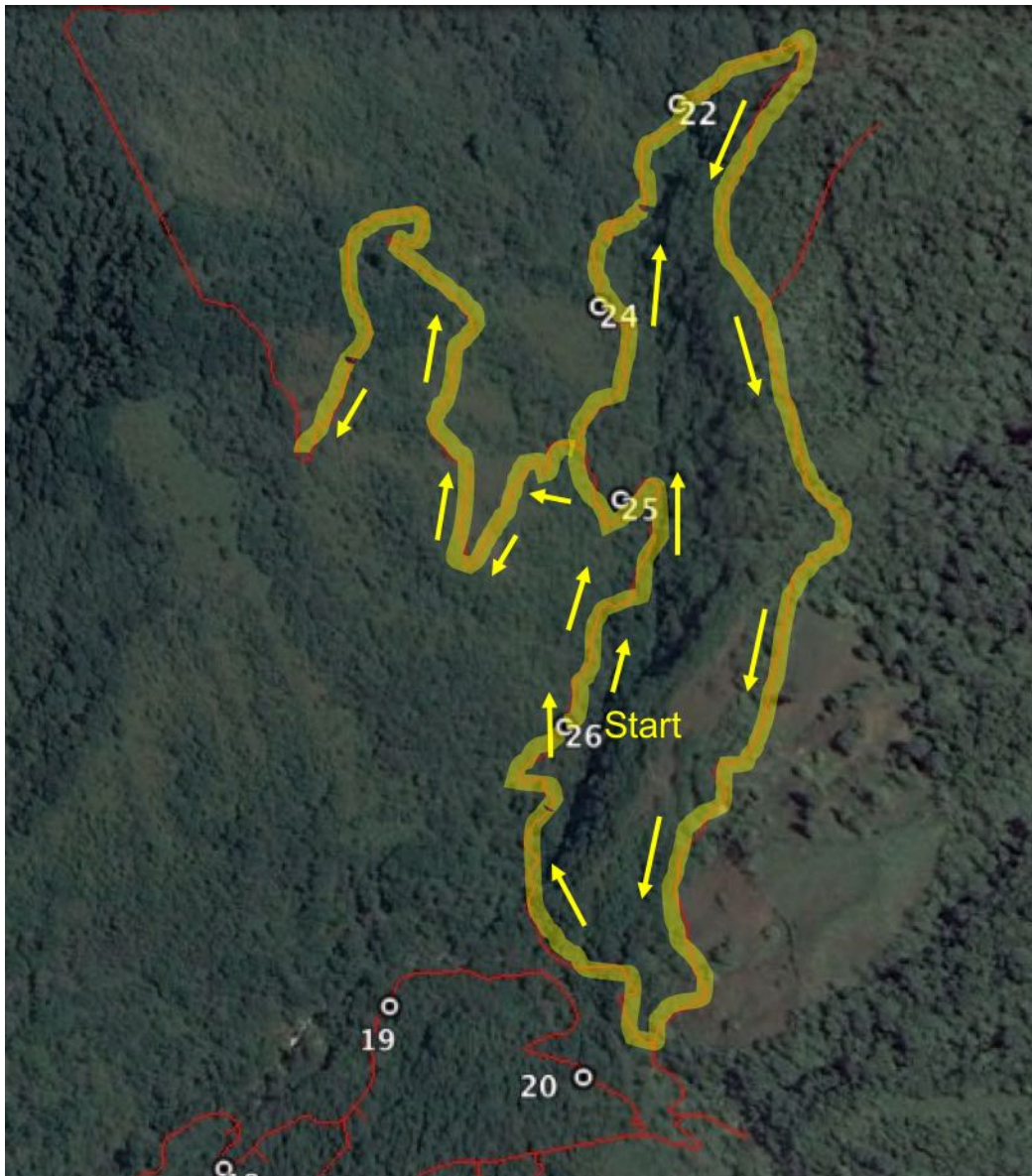


FIGURE 11: Don Victor Walking Survey From Station 26.

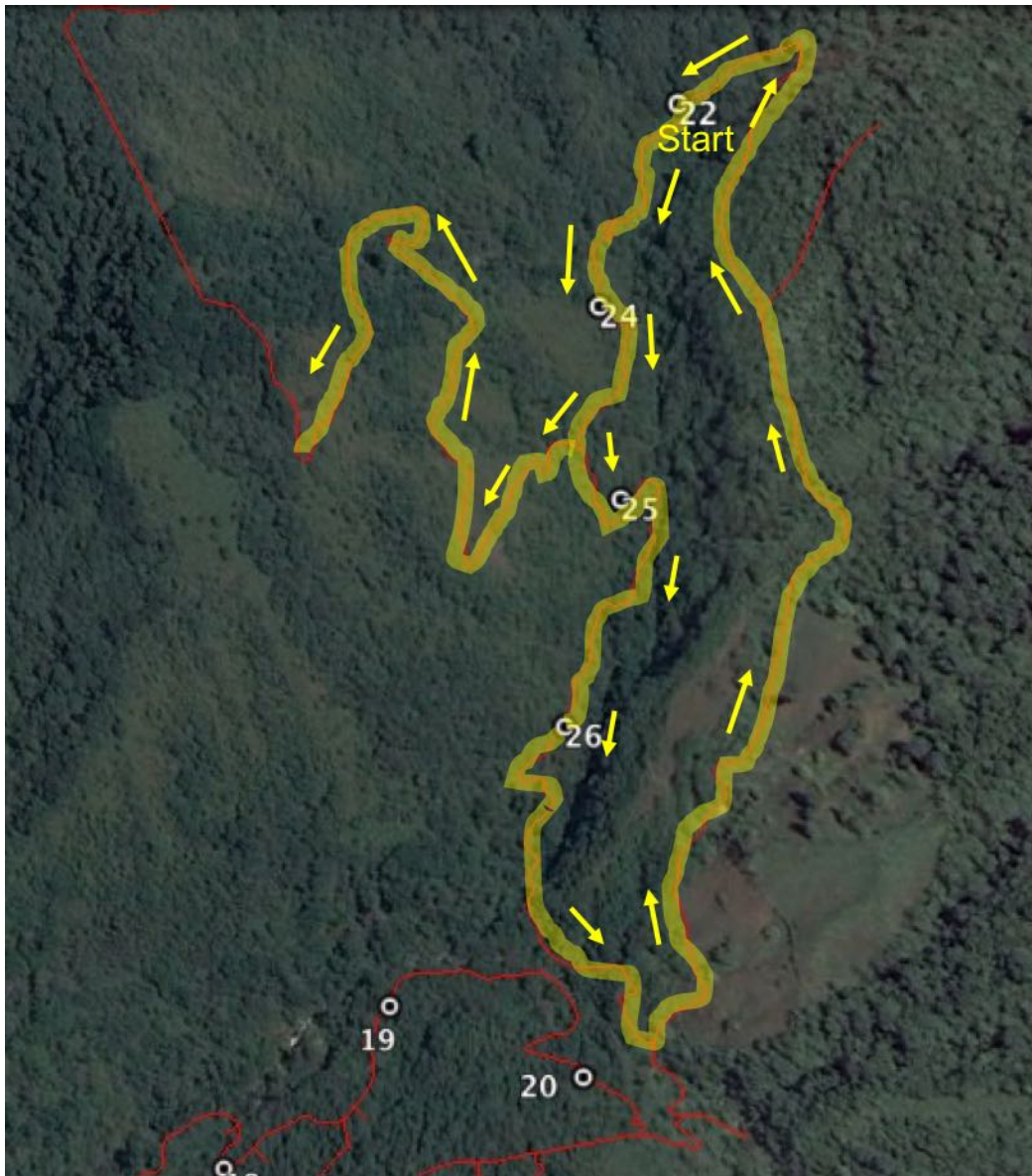


FIGURE 12: Don Victor Walking Survey From Station 22.

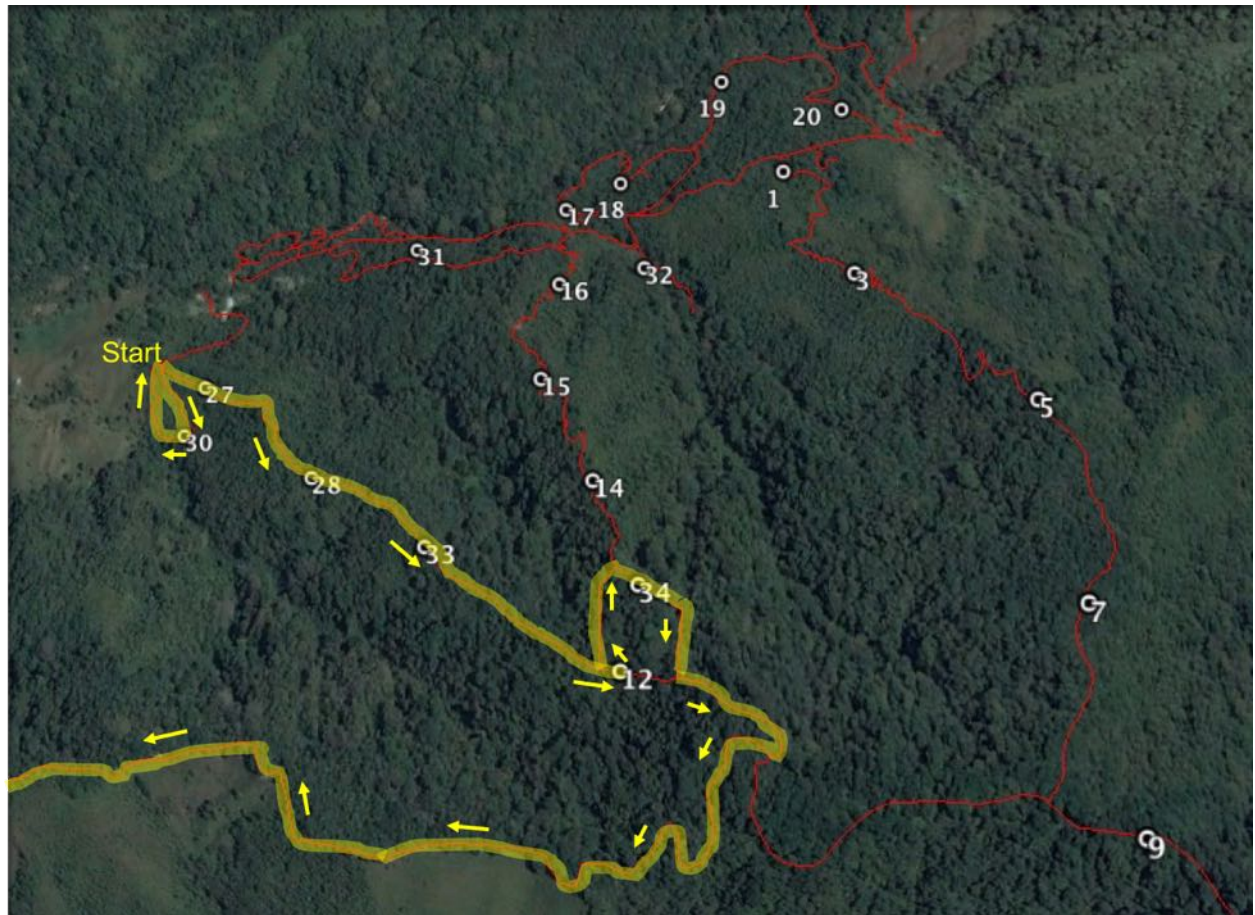


FIGURE 13: El Jilguero Walking Survey From Station 30.

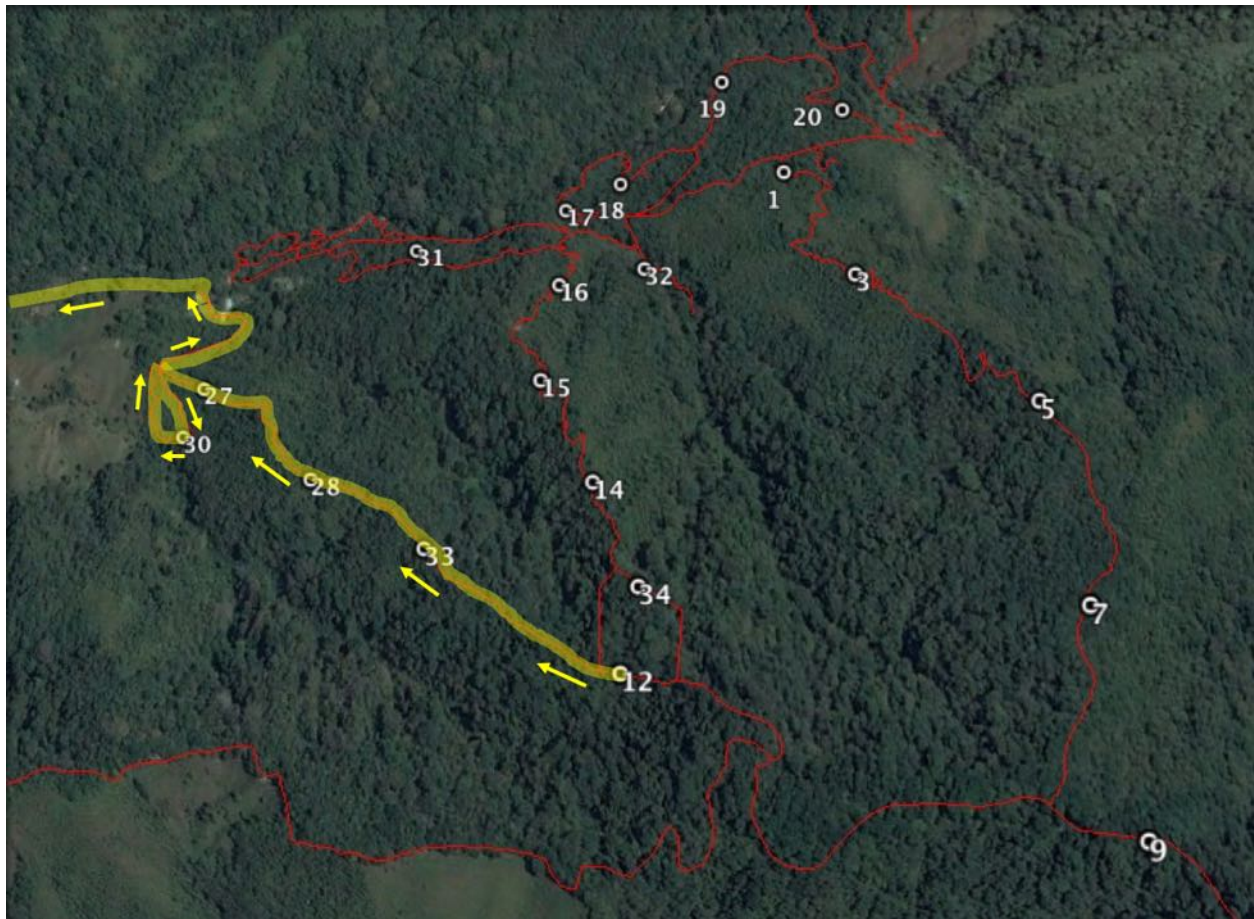


FIGURE 14: El Jilguero Walking Survey From Station 12.

3.1.4.2 DATA ANALYSIS

Walking survey data is only used to create a species list for the reserve during the survey period as well as to add to the Cloudbridge bird species list.

4 DATA SUMMARY

4.1 SPECIES IDENTIFIED

Overall, 106 unique bird species were identified during point count and walking surveys between July 3rd and August 18th, 2017 (Table 12). Point counts found 74 species, 71 of which were identified visually, within the survey area, meaning they can be used for future analysis and comparison between sites.

No species were identified by audio alone inside the survey area, however, there were three (3) species only identified outside of the survey area during point counts: Black Vulture (*Coragyps atratus*), Gray-cowled Wood-Rail (*Aramides cajaneus*), and White-collared Swift (*Streptoprocne zonaris*). Species only identified outside of the survey area are used to build the species list, but are not be used for analysis.

Walking surveys found 96 species. Of those, 29 were only identified during walking surveys and not during point counts (Table 12).

4.1.1 THREATENED SPECIES

Four (4) species on the IUCN Redlist of Threatened Species (www.iucnredlist.org) were identified during the survey period (Table 12). Of these, 1 species is considered Vulnerable (VU): The Ruddy Pigeon (*Patagioenas subvinacea*). The other 3 are considered Near Threatened (NT): Black Guan (*Chamaepetes unicolor*), Ornate Hawk-Eagle (*Spizaetus ornatus*), and Resplendent Quetzal (*Pharomachrus mocinno*). One species, Streaked Xenops (*Xenops rutilans*), has not yet been assessed.

TABLE 12: Bird Species Identified, All Methods – July 3rd - August 18th, 2017

English name	Scientific Name	IUCN Status ¹	Point Counts		Walking Surveys	
			IN Visual ²	OUT Only ³	All ⁴	WS Only ⁵
Cracidae						
Black Guan	<i>Chamaepetes unicolor</i>	NT	x		x	
Odontophoridae						
Spotted Wood-Quail	<i>Odontophorus guttatus</i>	LC	x		x	
Rallidae						
Gray-Cowled Wood-Rail	<i>Aramides cajaneus</i>	LC		x		
Cathartidae						
Black Vulture	<i>Coragyps atratus</i>	LC		x	x	
Accipitridae						
Ornate Hawk-Eagle	<i>Spizaetus ornatus</i>	NT	x		x	
Falconidae						
Barred Forest-falcon	<i>Micrastur ruficollis</i>	LC			x	x
Apodidae						
White-collared Swift	<i>Streptoprocne zonaris</i>	LC		x	x	
Trochilidae						
Bronzy Hermit	<i>Glaucis aeneus</i>	LC	x		x	
Green Hermit	<i>Phaethornis guy</i>	LC	x		x	
Green-crowned Brilliant	<i>Heliodoxa jacula</i>	LC	x		x	
Lesser Violetear	<i>Colibri cyanotus</i>	LC	x		x	
Purple-crowned Fairy	<i>Heliothryx barroti</i>	LC	x			
Rivoli's Hummingbird ⁶	<i>Eugenes fulgens</i>	LC	x		x	
Scintillant Hummingbird	<i>Selasphorus scintilla</i>	LC	x		x	
Snowy-bellied Hummingbird	<i>Amazilia edward</i>	LC	x			
Stripe-tailed Hummingbird	<i>Eupherusa eximia</i>	LC	x		x	
Violet Sabrewing	<i>Camphylopterus hemileucurus</i>	LC	x			
White-tailed Emerald	<i>Elvira chionura</i>	LC	x			
White-throated Mountain-gem	<i>Lampornis castaneiventris</i>	LC	x		x	
Columbidae						
Buff-fronted Quail-Dove	<i>Zentrygon costaricensis</i>	LC	x			
Chiriqui Quail-Dove	<i>Zentrygon chiriquensis</i>	LC			x	x
Ruddy Pigeon	<i>Patagioenas subvinacea</i>	VU	x		x	
Psittacidae						
Sulphur-winged Parakeet	<i>Pyrrhura hoffmanni</i>	LC	x		x	
Cuculidae						
Squirrel Cuckoo	<i>Piaya cayana</i>	LC	x		x	
Trogonidae						
Collared Trogon	<i>Trogon collaris</i>	LC	x		x	
Resplendent Quetzal	<i>Pharomachrus mocinno</i>	NT	x		x	
Momotidae						
Lesson's Motmot	<i>Momotus lessonii</i>	LC	x		x	
Capitonidae						
Red-headed Barbet	<i>Eubucco bourcierri</i>	LC	x		x	
Ramphastidae						
Northern Emerald-Toucanet	<i>Aulacorhynchus prasinus</i>	LC	x		x	
Picidae						
Acorn Woodpecker	<i>Melanerpes formicivorus</i>	LC	x			
Golden-olive Woodpecker	<i>Colaptes rubiginosus</i>	LC			x	x
Hairy Woodpecker	<i>Picoides villosus</i>	LC	x		x	
Olivaceous Piculet	<i>Picumnus olivaceus</i>	LC			x	x

English name	Scientific Name	IUCN Status ¹	Point Counts		Walking Surveys	
			IN Visual ²	OUT Only ³	All ⁴	WS Only ⁵
Furnariidae						
Buff-throated Foliage-gleaner	<i>Automolus ochrolaemus</i>	LC	x		x	
Lineated Foliage-gleaner	<i>Syndactyla subalaris</i>	LC	x		x	
Olivaceous Woodcreeper	<i>Sittasomus griseicapillus</i>	LC			x	x
Red-faced Spinetail	<i>Cranioleuca erythropis</i>	LC	x		x	
Spot-crowned Woodcreeper	<i>Lepidocolaptes affinis</i>	LC	x		x	
Spotted Barbtail	<i>Premnoplex brunnescens</i>	LC	x		x	
Streaked Xenops	<i>Xenops rutilans</i>	NA			x	x
Streak-headed Woodcreeper	<i>Lepidocolaptes souleyetii</i>	LC			x	x
Tawny-throated Leaftosser	<i>Sclerurus mexicanus</i>	LC			x	x
Thamnophilidae						
Slaty Antwren	<i>Myrmotherula schisticolor</i>	LC			x	x
Tyrannidae						
Black Phoebe	<i>Sayornis nigricans</i>	LC			x	x
Boat-billed Flycatcher	<i>Megarhynchus pitangua</i>	LC	x		x	
Dark Pewee	<i>Contopus lugubris</i>	LC	x			
Dusky-capped Flycatcher	<i>Myiarchus tuberculifer</i>	LC	x		x	
Eye-ringed Flatbill	<i>Rhynchocyclus brevirostris</i>	LC	x		x	
Golden-bellied Flycatcher	<i>Myiodynastes hemichrysus</i>	LC	x		x	
Mountain Elaenia	<i>Elaenia frantzii</i>	LC	x		x	
Ochre-bellied Flycatcher	<i>Mionectes oleggineus</i>	LC			x	x
Olive-striped Flycatcher	<i>Mionectes olivaceus</i>	LC	x		x	
Paltry Tyrannulet	<i>Zimmerius vilissimus</i>	LC	x		x	
Slaty-capped Flycatcher	<i>Leptopogon superciliaris</i>	LC			x	x
Torrent Tyrannulet	<i>Serpophaga cinerea</i>	LC			x	x
Yellowish Flycatcher	<i>Empidonax flavescens</i>	LC	x		x	
Tityridae						
Barred Becard	<i>Pachyrhamphus versicolor</i>	LC	x		x	
Masked Tityra	<i>Tityra semifasciata</i>	LC	x		x	
Corvidae						
Brown Jay	<i>Psilorhynchus morio</i>	LC			x	x
Turdidae						
Black-billed Nightingale-Thrush	<i>Catharus gracilirostris</i>	LC	x		x	
Black-faced Solitaire	<i>Myadestes melanops</i>	LC	x		x	
Mountain Thrush	<i>Turdus plebejus</i>	LC	x		x	
Ruddy-capped Nightingale-thrush	<i>Catharus frantzii</i>	LC			x	x
Mimidae						
Tropical Mockingbird	<i>Mimus gilvus</i>	LC			x	x
Ptiligonatidae						
Long-tailed Silky-Flycatcher	<i>Ptiliogonys caudatus</i>	LC	x		x	
Troglodytidae						
Gray-breasted Wood-Wren	<i>Henicorbina leucophrys</i>	LC	x		x	
House Wren	<i>Troglodytes aedon</i>	LC	x		x	
Isthmian Wren	<i>Cantorchilus elutus</i>	LC			x	x
Ochraceous Wren	<i>Troglodytes ochraceus</i>	LC	x		x	
Rufous-breasted Wren	<i>Phengopedius rutilus</i>	LC	x		x	
White-breasted Wood-wren	<i>Henicorbina leucosticta</i>	LC			x	x
Vireonidae						
Brown-capped Vireo	<i>Vireo leucophrys</i>	LC	x		x	
Rufous-browed Peppershrike	<i>Cyclarhis gujanensis</i>	LC	x		x	

English name	Scientific Name	IUCN Status ¹	Point Counts		Walking Surveys	
			IN Visual ²	OUT Only ³	All ⁴	WS Only ⁵
Parulidae						
Blackburnian Warbler	Setophaga fusca	LC	x			
Black-cheeked Warbler	Basileuterus melanogenys	LC			x	x
Collared Redstart	Myioborus torquatus	LC			x	x
Costa Rican Warbler	Basileuterus melanotis	LC	x		x	
Flame-throated Warbler	Oreothlypis gutturalis	LC	x		x	
Golden-crowned Warbler	Basileuterus culicivorus	LC	x		x	
Slate-throated Redstart	Myioborus miniatus	LC	x		x	
Tropical Parula	Setophaga pitiayumi	LC			x	x
Thraupidae						
Bay-headed Tanager	Tangara gyrola	LC	x		x	
Blue-black Grassquit	Volatinia jacarina	LC			x	x
Buff-throated Saltator	Saltator maximus	LC	x		x	
Cherrie's Tanager	Ramphocelus costaricensis	LC			x	x
Golden-hooded Tanager	Tangara larvata	LC	x		x	
Peg-billed Finch	Acanthidops bairdi	LC	x			
Scarlet-thighed Dacnis	Dacnis venusta	LC	x		x	
Silver-throated Tanager	Tangara icterocephala	LC	x		x	
Slaty Flowerpiercer	Diglossa plumbea	LC	x		x	
Spangle-cheeked Tanager	Tangara dowii	LC	x		x	
Speckled Tanager	Tangara guttata	LC	x		x	
Variable Seedeater	Sporophila corvina	LC			x	x
White-collared Seedeater	Sporophila torqueola	LC			x	x
Yellow-faced Grassquit	Tiaris olivacea	LC			x	x
Emberizidae						
Chestnut-capped Brush-Finch	Arremon brunneinucha	LC	x		x	
Common Chlorospingus	Chlorospingus flavopectus	LC	x		x	
Rufous-collared Sparrow	Zonotrichia capensis	LC			x	x
Sooty-capped Chlorospingus	Chlorospingus pileatus	LC			x	x
White-naped Brushfinch	Atlapetes albinucha	LC	x		x	
Yellow-thighed Finch	Pselliophorus tibialis	LC	x		x	
Cardinalidae						
Flame-colored Tanager	Piranga bidentata	LC	x		x	
White-winged Tanager	Piranga leucoptera	LC	x		x	
Icteridae						
Bronzed Cowbird	Molothrus aeneus	LC			x	x
Fringillidae						
Elegant Euphonia	Euphonia elegantissima	LC	x		x	
Golden-browed Chlorophonia	Chlorophonia callophrys	LC	x		x	
	Total Species		74	3	96	29

1, IUCN Redlist List of Threatened Species (www.iucnredlist.org). LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NA = Not Assessed, DD = Data Deficient; 2, Bird species identified visually during point counts inside the survey area; 3, Bird species only identified outside of the survey area during point counts; 4, All bird species identified during walking surveys; 5, Bird species only identified during walking surveys and not during point counts; 6, Magnificent Hummingbird prior to August 2017 (CLO 2017a).

4.2 ABUNDANCE

Overall, 649 birds were identified visually, inside the survey area during point counts between July 3rd and August 18th, 2017 at an overall rate of 3.9 birds per point count (Table 13). The stations with the highest overall abundance were 5 (6.6 birds/point count), 17 (6.4 birds/point count), and 15 (6.3 birds/point count). The stations with the lowest abundance were 22 and 32 (1.9 birds/point count), 24 (2.0 birds/point count), and 30 (2.1 bird/point count). The habitat type with the highest overall abundance was NR<30 at 4.2 birds per point count, while the lowest was NR±30 at 3.3 birds per point count (Table 14). August had a higher overall abundance than July (4.2 and 3.7 birds/point count, respectively) (Tables 13 and 14).

Hummingbirds (*Trochilidae spp.*) were the most abundant family (6.67 birds/10 point counts) with New World Warblers (*Parulidae spp.*) a close second at 6.61 birds/10 point counts (Table 16). The most abundant families at each station are highlighted in Table 16, with the most abundant family in red text and the 2nd most abundant in blue text. New World Warblers were the most abundant family in all the habitats except P and OG (Table 17). Hummingbirds were the most abundant family in P and Toucans (*Ramphastidae spp.*) the most abundant in OG. The second most abundant family varied between the habitats, with New World Warblers in P, Hummingbirds in P/NR<30 and OG, New World Sparrows and Allies (*Emberizidae spp.*) in NR<30, Tyrant Flycatchers (*Tyrannidae spp.*) in NR>30, and Wrens (*Troglodytidae spp.*) in NR±30.

Overall, the five most abundant species between July 3rd and August 18th, 2017 were: Slate-throated Redstart (*Myioborus miniatus*) (4.70 birds/10 point counts), Common Chlorospingus (*Chlorospingus flavopectus*) (3.45 birds/10 point counts), Silver-throated Tanager (*Tangara icterocephala*) (2.20 birds/10 point counts), Brown Capped-Vireo (*Vireo leucophrys*) (1.73 birds/10 point counts), and White-throated Mountain-gem (*Lampornis castaneiventris*) (1.49 birds/10 point counts) (Table 15). The two most abundant species at each station are highlighted in Table 15, with the most abundant species highlighted in red and the 2nd most abundant highlighted in blue.

Generally, Slate-throated Redstart was the most abundant species in each habitat type with a few exceptions (Table 17). In P/NR<30, Slate-throated Redstart shared the most abundant slot with Common Chlorospingus, and in NR±30 it shared it with Gray-breasted Wood-wren (*Henicorbina leucophrys*). In OG, Northern Emerald-Toucanet (*Aulacorhynchus prasinus*) was most abundant. The 2nd most abundant species varied between habitat types, with Purple-crowned Fairy (*Heliothryx barroti*) in P, Lesser Violetear (*Colibri cyanotus*) and Golden-bellied Flycatcher (*Myiodynastes hemichrysus*) in P/NR<30, Common Chlorospingus in NR<30 and NR>30, Flame-colored Tanager (*Piranga bidentata*) and Golden-crowned Warbler (*Basileuterus culicivorus*) in NR±30, and Sulphur-winged Parakeet (*Pyrrhura hoffmanni*) and Spotted Wood-Quail (*Odontophorus guttatus*) in OG.

TABLE 13: Bird Abundance By Station – July 3rd – August 18th, 2017

Station	July		August		Total		# Point Counts
	Count	Birds/PC	Count	Birds/PC	Count	Birds/PC	
1	18	3.6	11	5.5	29	4.1	7
3	21	4.2	5	2.5	26	3.7	7
5	29	5.8	17	8.5	46	6.6	7
7	17	3.4	9	4.5	26	3.7	7
9	28	5.6	9	4.5	37	5.3	7
12	6	1.5	18	6.0	24	3.4	7
14	12	3.0	12	4.0	24	3.4	7
15	27	6.8	17	5.7	44	6.3	7
16	14	3.5	13	4.3	27	3.9	7
17	26	6.5	19	6.3	45	6.4	7
18	10	2.5	8	2.7	18	2.6	7
19	20	5.0	17	5.7	37	5.3	7
20	16	4.0	15	5.0	31	4.4	7
22	4	1.0	9	3.0	13	1.9	7
24	5	1.3	9	3.0	14	2.0	7
25	6	1.5	10	3.3	16	2.3	7
26	19	4.8	21	7.0	40	5.7	7
27	11	2.8	7	2.3	18	2.6	7
28	22	5.5	14	4.7	36	5.1	7
30	9	2.3	6	2.0	15	2.1	7
31	19	4.8	3	1.0	22	3.1	7
32	12	3.0	1	0.3	13	1.9	7
33	10	2.5	13	4.3	23	3.3	7
34	16	4.0	9	3.0	25	3.6	7
Total	377	3.7	272	4.1	649	3.9	168
# Point Counts	101		67		168		

TABLE 14: Bird Abundance By Habitat – July 3rd – August 18th, 2017

Habitat	July		August		Total		# of Point Counts
	Count	Birds/PC	Count	Birds/PC	Count	Birds/PC	
P	98	3.8	47	2.9	145	3.5	42
P/NR<30	40	3.3	36	4.0	76	3.6	21
NR <30	167	4.0	128	4.6	295	4.2	70
NR >30	12	3.0	12	4.0	24	3.4	7
NR±30	10	2.5	13	4.3	23	3.3	7
OG	50	3.8	36	4.5	86	4.1	21
Total	377	3.7	272	4.1	649	3.9	168
# Point Counts	101		67		168		

P = Planted, NR<30 = Natural Regeneration Under 30 Years, NR>30 = Natural Regeneration Over 30 Years, NR±30 = Natural Regeneration Over and Under 30 Years, P/NR<30 = Planted and Natural Regeneration Under 30 Years, OG = Old Growth.

TABLE 15: Raw Bird Species Abundance by Station – July 3rd – August 18th, 2017

Stations	1	3	5	7	9	12	14	15	16	17	18	19	20	22	24	25	26	27	28	30	31	32	33	34	Total
Cracidae												3								1					4
Black Guan												3								1					4
Odontophoridae				2	4	3																			9
Spotted Wood-Quail				2	4	3																			9
Accipitridae																								1	1
Ornate Hawk-Eagle																								1	1
Trochilidae	9	9	4	2	3	5	4	6	6	6	2	8	3	2	3	4	7	1	1	11	3	5	4	4	112
Bronzy Hermit										1															1
Green Hermit			1					1	1							1		1					1		6
Green-crowned Brilliant												3				1								1	5
Lesser Violetear	7	5																		2	2			1	17
Purple-crowned Fairy								1			2						1			1		1			6
Rivoli's Hummingbird ¹										1												1			2
Scintillant Hummingbird		1			1		1		1											1					5
Snowy-bellied Hummingbird															1										1
Stripe-tailed Hummingbird	1		1			1		1	1							1	1				1				8
Violet Sabrewing								1				1													2
White-tailed Emerald												1							1	1					3
White-throated Mountain-gem		1	1	2	2	1	2	2				2	1	1	2		2			2		1	3		25
Hummingbird sp.	1	2	1			3	1	1	3	3		1	2	1		1	3			4		2		2	31
Columbidae	1				2										1										4
Buff-fronted Quail-Dove															1										1
Ruddy Pigeon	1				2																				3
Psittacidae						7																			7
Sulphur-winged Parakeet						7																			7
Cuculidae									1	3															4
Squirrel Cuckoo									1	3															4
Trogonidae				5	3											1	1								10
Collared Trogon				1	2											1	1								5
Resplendent Quetzal				4	1																				5
Momotidae									1			1													2
Lesson's Motmot									1			1													2
Capitonidae			1			1		3		2									1					1	9
Red-headed Barbet			1			1		3		2									1					1	9

Stations	1	3	5	7	9	12	14	15	16	17	18	19	20	22	24	25	26	27	28	30	31	32	33	34	Total
Ramphastidae	2			2	5	2	1		1									2	1					9	25
Northern Emerald-Toucanet	2			2	5	2	1		1									2	1					9	25
Picidae							2												1						3
Acorn Woodpecker							1												1						2
Hairy Woodpecker							1																		1
Furnariidae			3	2		2		2	1	1		1	3		1	2	2	2		1	1				24
Buff-throated Foliage-gleaner				2					1												1				4
Lineated Foliage-gleaner																		1							1
Red-faced Spinetail			1																						1
Spot-crowned Woodcreeper			2			1		1					2		1	1	1								9
Spotted Barbtail													1				1			1					3
Woodcreeper sp.						1		1		1		1				1		1							6
Tyrannidae		3	6	1	4	1	5	2	3	1	2	2	4	2		1	4	3	3		2	1	2	1	53
Boat-billed Flycatcher											1														1
Dark Pewee							1																	1	2
Dusky-capped Flycatcher																		1			1	1			3
Eye-ringed Flatbill									1														1		2
Golden-bellied Flycatcher									1			2	4				1		1						9
Mountain Elaenia			4		1		2											1					1		9
Olive-striped Flycatcher										1											1				2
Paltry Tyrannulet			2		1		1				1					1	3		2						11
Yellowish Flycatcher		3		1	2	1	1	2	1					2				1							14
Tityridae	1									1	2	2									1				7
Barred Becard	1										1														2
Masked Tityra										1	1	2									1				5
Turdidae				3	1				1			2	1					2	2			1			13
Black-billed Nightingale-Thrush					1													1							2
Black-faced Solitaire				3								2	1					1				1			8
Mountain Thrush									1										2						3
Ptilonotidae		1		8	3																				12
Long-tailed Silky-flycatcher		1		8	3																				12
Troglodytidae	2							1		2			4	3			7		1			1	6		27
Gray-breasted Wood-Wren	2							1		2			3	3			2					1	5		19
House Wren													1												1
Ochraceous Wren																	4								4
Rufous-breasted Wren																	1								1
Wren sp.																			1				1		2

Stations	1	3	5	7	9	12	14	15	16	17	18	19	20	22	24	25	26	27	28	30	31	32	33	34	Total
<i>Vireonidae</i>		1				1	1	5	3	3		3	1		1		3		4		2		1	1	30
Brown-capped Vireo		1				1	1	5	3	3		3	1		1		3		3		2		1	1	29
Rufous-browed Peppershrike																			1						1
<i>Parulidae</i>	5	7	7		1	2	8	7	6	9		8	9	3	3	4	4	3	9	2	3		7	4	111
Blackburnian Warbler																					1				1
Costa Rican Warbler									3	1				2		1									7
Flame-throated Warbler		1	1		1	1																			4
Golden-crowned Warbler							1	4	1	1		1	3			3	2				1		2	1	20
Slate-throated Redstart	5	6	6			1	7	3	2	7		7	6	1	3		2	3	9	2	1		5	3	79
<i>Thraupidae</i>	1	2	5		5			3		5	8	5	2				4	1	6		6	2		1	56
Bay-headed Tanager											2								1						3
Buff-throated Saltator								1																	1
Golden-hooded Tanager					1																				1
Peg-billed Finch		1																							1
Scarlet-thighed Dacnis										1	3		1						2						7
Silver-throated Tanager	1		5		2			2		4	2	5	1				4	1	2		5	2		1	37
Slaty Flowerpiercer		1																							1
Spangle-cheeked Tanager					2																				2
Speckled Tanager											1								1		1				3
<i>Emberizidae</i>	8	2	15		4		3	5	4	6	3	1	3	3	5	3	8	1	2		2			2	80
Chestnut-capped Brush-Finch									2					1				1	1					1	6
Common Chlorospingus	8	2	15		2		3	3	2	3	3	1	3	1	2	1	6				2			1	58
White-naped Brushfinch								1		1									1						3
Yellow-thighed Finch					2			1		2				1	3	2	2								13
<i>Cardinalidae</i>			1					7		2								1	3		1	1	3		19
Flame-colored Tanager			1					3		2								1	3			1	2		13
White-winged Tanager								4													1		1		6
<i>Fringillidae</i>			1					1		1			1												4
Elegant Euphonia										1			1												2
Golden-browed Chlorophonia			1					1																	2
<i>Uncertain Family</i>		1	3	1	2			2		3	1	1				1		2	2		1	2		1	23
Flycatcher sp.																					1				1
Passerine sp.		1	3	1	2			2		3	1	1				1		2	2			2		1	22

1, Magnificent Hummingbird prior to August 2017 (CLO 2017a).

TABLE 16: Bird Species Abundance Per 10 Point Counts by Station – July 3rd – August 18th, 2017

Stations	1	3	5	7	9	12	14	15	16	17	18	19	20	22	24	25	26	27	28	30	31	32	33	34	Total
# Point Counts	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Cracidae												4.3								1.4					0.24
Black Guan												4.3								1.4					0.24
Odontophoridae				2.9	5.7	4.3																			0.54
Spotted Wood-Quail				2.9	5.7	4.3																			0.54
Accipitridae																								1.4	0.06
Ornate Hawk-Eagle																								1.4	0.06
Trochilidae	12.9	12.9	5.7	2.9	4.3	7.1	5.7	8.6	8.6	8.6	2.9	11.4	4.3	2.9	4.3	5.7	10.0	1.4	1.4	15.7	4.3	7.1	5.7	5.7	6.67
Bronzy Hermit										1.4															0.06
Green Hermit			1.4						1.4	1.4						1.4		1.4					1.4		0.36
Green-crowned Brilliant												4.3				1.4								1.4	0.30
Lesser Violetear	10.0	7.1																		2.9	2.9			1.4	1.01
Purple-crowned Fairy								1.4			2.9						1.4			1.4		1.4			0.36
Rivoli's Hummingbird ¹										1.4												1.4			0.12
Scintillant Hummingbird		1.4			1.4		1.4		1.4											1.4					0.30
Snowy-bellied Hummingbird															1.4										0.06
Stripe-tailed Hummingbird	1.4		1.4			1.4		1.4	1.4							1.4	1.4				1.4				0.48
Violet Sabrewing								1.4				1.4													0.12
White-tailed Emerald												1.4						1.4		1.4					0.18
White-throated Mountain-gem		1.4	1.4	2.9	2.9	1.4	2.9	2.9				2.9	1.4	1.4	2.9		2.9			2.9		1.4	4.3		1.49
Hummingbird sp.	1.4	2.9	1.4			4.3	1.4	1.4	4.3	4.3		1.4	2.9	1.4		1.4	4.3			5.7		2.9		2.9	1.85
Columbidae	1.4				2.9										1.4										0.24
Buff-fronted Quail-Dove															1.4										0.06
Ruddy Pigeon	1.4				2.9																				0.18
Psittacidae						10.0																			0.42
Sulphur-winged Parakeet						10.0																			0.42
Cuculidae									1.4	4.3															0.24
Squirrel Cuckoo									1.4	4.3															0.24
Trogonidae				7.1	4.3											1.4	1.4								0.60
Collared Trogon				1.4	2.9											1.4	1.4								0.30
Resplendent Quetzal				5.7	1.4																				0.30
Momotidae									1.4			1.4													0.12
Lesson's Motmot									1.4			1.4													0.12
Capitonidae			1.4			1.4		4.3		2.9								1.4						1.4	0.54
Red-headed Barbet			1.4			1.4		4.3		2.9								1.4						1.4	0.54

Stations	1	3	5	7	9	12	14	15	16	17	18	19	20	22	24	25	26	27	28	30	31	32	33	34	Total
Ramphastidae	2.9			2.9	7.1	2.9	1.4		1.4									2.9	1.4					12.9	1.49
Northern Emerald-Toucanet	2.9			2.9	7.1	2.9	1.4		1.4									2.9	1.4					12.9	1.49
Picidae							2.9												1.4						0.18
Acorn Woodpecker							1.4												1.4						0.12
Hairy Woodpecker							1.4																		0.06
Furnariidae			4.3	2.9		2.9		2.9	1.4	1.4		1.4	4.3		1.4	2.9	2.9	2.9		1.4	1.4				1.43
Buff-throated Foliage-gleaner				2.9					1.4												1.4				0.24
Lineated Foliage-gleaner																		1.4							0.06
Red-faced Spinetail			1.4																						0.06
Spot-crowned Woodcreeper			2.9			1.4		1.4					2.9		1.4	1.4	1.4								0.54
Spotted Barbtail													1.4				1.4			1.4					0.18
Woodcreeper sp.						1.4		1.4		1.4		1.4				1.4		1.4							0.36
Tyrannidae		4.3	8.6	1.4	5.7	1.4	7.1	2.9	4.3	1.4	2.9	2.9	5.7	2.9		1.4	5.7	4.3	4.3		2.9	1.4	2.9	1.4	3.15
Boat-billed Flycatcher											1.4														0.06
Dark Pewee							1.4																	1.4	0.12
Dusky-capped Flycatcher																		1.4			1.4	1.4			0.18
Eye-ringed Flatbill									1.4														1.4		0.12
Golden-bellied Flycatcher									1.4			2.9	5.7				1.4		1.4						0.54
Mountain Elaenia			5.7		1.4		2.9											1.4					1.4		0.54
Olive-striped Flycatcher										1.4											1.4				0.12
Paltry Tyrannulet			2.9		1.4		1.4				1.4					1.4	4.3		2.9						0.65
Yellowish Flycatcher		4.3		1.4	2.9	1.4	1.4	2.9	1.4					2.9				1.4							0.83
Tityridae	1.4									1.4	2.9	2.9									1.4				0.42
Barred Becard	1.4										1.4														0.12
Masked Tityra										1.4	1.4	2.9									1.4				0.30
Turdidae				4.3	1.4				1.4			2.9	1.4					2.9	2.9			1.4			0.77
Black-billed Nightingale-Thrush					1.4													1.4							0.12
Black-faced Solitaire				4.3								2.9	1.4					1.4				1.4			0.48
Mountain Thrush									1.4										2.9						0.18
Ptilonotidae		1.4		11.4	4.3																				0.71
Long-tailed Silky-flycatcher		1.4		11.4	4.3																				0.71
Troglodytidae	2.9							1.4		2.9			5.7	4.3			10.0		1.4			1.4	8.6		1.61
Gray-breasted Wood-Wren	2.9							1.4		2.9			4.3	4.3			2.9					1.4	7.1		1.13
House Wren													1.4												0.06
Ochraceous Wren																	5.7								0.24
Rufous-breasted Wren																	1.4								0.06
Wren sp.																			1.4				1.4		0.12

Stations	1	3	5	7	9	12	14	15	16	17	18	19	20	22	24	25	26	27	28	30	31	32	33	34	Total
Vireonidae		1.4				1.4	1.4	7.1	4.3	4.3		4.3	1.4		1.4		4.3		5.7		2.9		1.4	1.4	1.79
Brown-capped Vireo		1.4				1.4	1.4	7.1	4.3	4.3		4.3	1.4		1.4		4.3		4.3		2.9		1.4	1.4	1.73
Rufous-browed Peppershrike																			1.4						0.06
Parulidae	7.1	10.0	10.0		1.4	2.9	11.4	10.0	8.6	12.9		11.4	12.9	4.3	4.3	5.7	5.7	4.3	12.9	2.9	4.3		10.0	5.7	6.61
Blackburnian Warbler																					1.4				0.06
Costa Rican Warbler									4.3	1.4				2.9		1.4									0.42
Flame-throated Warbler		1.4	1.4		1.4	1.4																			0.24
Golden-crowned Warbler							1.4	5.7	1.4	1.4		1.4	4.3			4.3	2.9				1.4		2.9	1.4	1.19
Slate-throated Redstart	7.1	8.6	8.6			1.4	10.0	4.3	2.9	10.0		10.0	8.6	1.4	4.3		2.9	4.3	12.9	2.9	1.4		7.1	4.3	4.70
Thraupidae	1.4	2.9	7.1		7.1			4.3		7.1	11.4	7.1	2.9				5.7	1.4	8.6		8.6	2.9		1.4	3.33
Bay-headed Tanager											2.9								1.4						0.18
Buff-throated Saltator								1.4																	0.06
Golden-hooded Tanager					1.4																				0.06
Peg-billed Finch		1.4																							0.06
Scarlet-thighed Dacnis										1.4	4.3		1.4						2.9						0.42
Silver-throated Tanager	1.4		7.1		2.9			2.9		5.7	2.9	7.1	1.4				5.7	1.4	2.9		7.1	2.9		1.4	2.20
Slaty Flowerpiercer		1.4																							0.06
Spangle-checked Tanager					2.9																				0.12
Speckled Tanager											1.4								1.4		1.4				0.18
Emberizidae	11.4	2.9	21.4		5.7		4.3	7.1	5.7	8.6	4.3	1.4	4.3	4.3	7.1	4.3	11.4	1.4	2.9		2.9			2.9	4.76
Chestnut-capped Brush-Finch									2.9					1.4				1.4	1.4					1.4	0.36
Common Chlorospingus	11.4	2.9	21.4		2.9		4.3	4.3	2.9	4.3	4.3	1.4	4.3	1.4	2.9	1.4	8.6				2.9			1.4	3.45
White-naped Brushfinch								1.4		1.4									1.4						0.18
Yellow-thighed Finch					2.9			1.4		2.9				1.4	4.3	2.9	2.9								0.77
Cardinalidae			1.4					10.0		2.9								1.4	4.3		1.4	1.4	4.3		1.13
Flame-colored Tanager			1.4					4.3		2.9								1.4	4.3			1.4	2.9		0.77
White-winged Tanager								5.7													1.4		1.4		0.36
Fringillidae			1.4					1.4		1.4			1.4												0.24
Elegant Euphonia										1.4			1.4												0.12
Golden-browed Chlorophonia			1.4					1.4																	0.12
Uncertain Family		1.4	4.3	1.4	2.9			2.9		4.3	1.4	1.4				1.4		2.9	2.9		1.4	2.9		1.4	1.37
Flycatcher sp.																					1.4				0.06
Passerine sp.		1.4	4.3	1.4	2.9			2.9		4.3	1.4	1.4				1.4		2.9	2.9			2.9		1.4	1.31

Red = Most abundant taxa at that station; **Blue** = 2nd most abundant taxa at that station. **Red** = Most abundant family at that station; **Blue** = 2nd most abundant family at that station. 1, Magnificent Hummingbird prior to August 2017 (CLO 2017a).

TABLE 17: Bird Species Abundance Per 10 Point Counts by Habitat – July 3rd – August 18th, 2017

Habitat	P	P/NR<30	NR<30	NR>30	NR±30	OG	Total
# Point Counts	42	21	70	7	7	21	168
<i>Cracidae</i>	0.2		0.4				0.24
Black Guan	0.2		0.4				0.24
<i>Odontophoridae</i>			0.3			3.3	0.54
Spotted Wood-Quail			0.3			3.3	0.54
<i>Accipitridae</i>						0.5	0.06
Ornate Hawk-Eagle						0.5	0.06
<i>Trochilidae</i>	9.8	5.2	5.7	5.7	5.7	5.7	6.67
Bronzy Hermit			0.1				0.06
Green Hermit	0.2	0.5	0.4		1.4		0.36
Green-crowned Brilliant			0.6			0.5	0.30
Lesser Violetear	2.4	2.4	1.4	1.4		2.4	1.85
Purple-crowned Fairy	3.3		0.3			0.5	1.01
Rivoli's Hummingbird ¹	0.7	1.0	0.1				0.36
Scintillant Hummingbird	0.2		0.1				0.12
Snowy-bellied Hummingbird	0.5	0.5		1.4		0.5	0.30
Stripe-tailed Hummingbird			0.1				0.06
Violet Sabrewing	0.5	0.5	0.6			0.5	0.48
White-tailed Emerald	0.2		0.1				0.12
White-throated Mountain-gem	0.2		0.3				0.18
Hummingbird sp.	1.4	0.5	1.4	2.9	4.3	1.4	1.49
<i>Columbidae</i>	0.2		0.1			1.0	0.24
Buff-fronted Quail-Dove			0.1				0.06
Ruddy Pigeon	0.2					1.0	0.18
<i>Psittacidae</i>						3.3	0.42
Sulphur-winged Parakeet						3.3	0.42
<i>Cuculidae</i>		0.5	0.4				0.24
Squirrel Cuckoo		0.5	0.4				0.24
<i>Trogonidae</i>			1.0			1.4	0.60
Collared Trogon			0.4			1.0	0.30
Resplendent Quetzal			0.6			0.5	0.30
<i>Momotidae</i>		0.5	0.1				0.12
Lesson's Motmot		0.5	0.1				0.12
<i>Capitonidae</i>	0.7		0.6			1.0	0.54
Red-headed Barbet	0.7		0.6			1.0	0.54
<i>Ramphastidae</i>	1.0	0.5	0.4	1.4		7.6	1.49
Northern Emerald-Toucanet	1.0	0.5	0.4	1.4		7.6	1.49
<i>Picidae</i>			0.1	2.9			0.18
Acorn Woodpecker			0.1	1.4			0.12
Hairy Woodpecker				1.4			0.06
<i>Furnariidae</i>	1.2	1.9	1.9			1.0	1.43
Buff-throated Foliage-gleaner		0.5	0.4				0.24
Lineated Foliage-gleaner	0.2						0.06
Red-faced Spinetail			0.1				0.06
Spot-crowned Woodcreeper	0.2	1.0	0.7			0.5	0.54
Spotted Barbtail	0.2	0.5	0.1				0.18
Woodcreeper sp.	0.5		0.4			0.5	0.36
<i>Tyrannidae</i>	2.1	4.3	3.1	7.1	2.9	2.9	3.15
Boat-billed Flycatcher		0.5					0.06
Dark Pewee				1.4		0.5	0.12

Habitat	P	P/NR<30	NR<30	NR>30	NR±30	OG	Total
Dusky-capped Flycatcher	0.5		0.1				0.18
<i>Tyrannidae (cont'd)</i>							
Eye-ringed Flatbill		0.5			1.4		0.12
Golden-bellied Flycatcher		2.4	0.6				0.54
Mountain Elaenia	0.2		0.6	2.9	1.4	0.5	0.54
Olive-striped Flycatcher			0.3				0.12
Paltry Tyrannulet		0.5	1.1	1.4		0.5	0.65
Yellowish Flycatcher	1.4	0.5	0.4	1.4		1.4	0.83
<i>Tityridae</i>	0.2	1.0	0.6				0.42
Barred Becard	0.2	0.5					0.12
Masked Tityra		0.5	0.6				0.30
<i>Turdidae</i>	0.7	1.0	1.0			0.5	0.77
Black-billed Nightingale-Thrush	0.2					0.5	0.12
Black-faced Solitaire	0.5	0.5	0.7				0.48
Mountain Thrush		0.5	0.3				0.18
<i>Ptilogonatidae</i>	0.2		1.1			1.4	0.71
Long-tailed Silky-flycatcher	0.2		1.1			1.4	0.71
<i>Troglodytidae</i>	1.0	1.9	1.9		8.6		1.61
Gray-breasted Wood-Wren	1.0	1.4	1.0		7.1		1.13
House Wren		0.5					0.06
Ochraceous Wren			0.6				0.24
Rufous-breasted Wren			0.1				0.06
Wren sp.			0.1		1.4		0.12
<i>Vireonidae</i>	1.4	1.9	2.3	1.4	1.4	1.0	1.79
Brown-capped Vireo	1.4	1.9	2.1	1.4	1.4	1.0	1.73
Rufous-browed Peppershrike			0.1				0.06
<i>Parulidae</i>	5.7	7.1	7.1	11.4	10.0	3.3	6.61
Blackburnian Warbler			0.1				0.06
Costa Rican Warbler		1.4	0.6				0.42
Flame-throated Warbler	0.2		0.1			1.0	0.24
Golden-crowned Warbler	1.0	1.9	1.1	1.4	2.9	0.5	1.19
Slate-throated Redstart	4.5	3.8	5.1	10.0	7.1	1.9	4.70
<i>Thraupidae</i>	2.1	4.8	4.4			2.9	3.33
Bay-headed Tanager		1.0	0.1				0.18
Buff-throated Saltator	0.2						0.06
Golden-hooded Tanager						0.5	0.06
Peg-billed Finch	0.2						0.06
Scarlet-thighed Dacnis		1.9	0.4				0.42
Silver-throated Tanager	1.4	1.4	3.6			1.4	2.20
Slaty Flowerpiercer	0.2						0.06
Spangle-cheeked Tanager						1.0	0.12
Speckled Tanager		0.5	0.3				0.18
<i>Emberizidae</i>	3.8	4.8	6.4	4.3		2.9	4.76
Chestnut-capped Brush-Finch	0.2	1.0	0.3			0.5	0.36
Common Chlorospingus	3.1	3.8	4.4	4.3		1.4	3.45
White-naped Brushfinch	0.2		0.3				0.18
Yellow-thighed Finch	0.2		1.4			1.0	0.77
<i>Cardinalidae</i>	2.1		1.0		4.3		1.13
Flame-colored Tanager	1.2		0.9		2.9		0.77
White-winged Tanager	1.0		0.1		1.4		0.36
<i>Fringillidae</i>	0.2	0.5	0.3				0.24
Elegant Euphonia		0.5	0.1				0.12

Habitat	P	P/NR<30	NR<30	NR>30	NR±30	OG	Total
Golden-browed Chlorophonia	0.2		0.1				0.12
Uncertain Family	1.7	0.5	1.7			1.4	1.37
Flycatcher sp.			0.1				0.06
Passerine sp.	1.7	0.5	1.6			1.4	1.31

P = Planted, NR<30 = Natural Regeneration Under 30 Years, NR>30 = Natural Regeneration Over 30 Years, NR±30 = Natural Regeneration Over and Under 30 Years, P/NR<30 = Planted and Natural Regeneration Under 30 Years, OG = Old Growth. **Red** = Most abundant taxa at that station; **Blue** = 2nd most abundant taxa at that station. **Red** = Most abundant family at that station; **Blue** = 2nd most abundant family at that station.

1, Magnificent Hummingbird prior to August 2017 (CLO 2017a).

4.2.1 THREATENED SPECIES ABUNDANCE

4.2.1.1 BLACK GUAN

Black Guan was identified during both point count and walking surveys (Table 12). During point counts, the overall abundance of the Black Guan was 0.24 birds per 10 point counts (Table 17). They were found at 2 stations: 19 (NR<30) and 30 (P), and were more abundant at Station 19 (4.3 birds/10 point counts) than at station 30 (1.4 birds/10 point counts) (Table 17).

4.2.1.2 ORNATE HAWK-EAGLE

Ornate Hawk-Eagle was identified during both point count and walking surveys (Table 12). During point counts, the overall abundance of the Ornate Hawk-Eagle was 0.06 birds per 10 point counts (Table 17). It was found once at 2 stations: 34 (NR<30) and 14 (P) (Table 17). Only juvenile individuals were identified during both point count and walking surveys.

4.2.1.3 RESPLENDENT QUETZAL

Resplendent Quetzal was identified during both point count and walking surveys (Table 12). During point counts, the overall abundance of the Resplendent Quetzal was 0.30 birds per 10 point counts (Table 17). They were found at 2 stations: 7 (NR<30) and 9 (OG), and were more abundant at station 7 (5.7 birds per 10 point counts) than at station 9 (1.4 birds per 10 point counts) (Table 17).

4.2.1.4 RUDDY PIGEON

Ruddy Pigeon was identified during both point count and walking surveys (Table 12). During point counts, the overall abundance of the Ruddy Pigeon was 0.18 birds per 10 point counts (Table 17). They were found at 2 stations: 1 (P) and 9 (OG), and were more abundant at Station 9 (2.9 birds per 10 point counts), than at station 1 (1.4 birds per 10 point counts) (Figure 17).

4.3 RICHNESS & DIVERSITY

Overall, 74 bird species from 24 families were identified during point count surveys with, in total, 0.4 species identified per point count. (Table 18). The highest species richness was found at stations 15 and 17 (19 species); 9 (18 species); and 16, 26 and 28 (17 species). The lowest number of species found at a station was 8, which was found at 6 stations (22, 24, 30, and 32). Looking at habitats, the highest

species richness per point count was found in NR>30 (1.9 species/point count), and the lowest in NR<30 (0.8 species/point count) (Table 19).

Overall, SID was 0.955 (Table 18). The highest SIDs were found at stations 32 (0.972), 16 (0.967), and 27 (0.962), while the lowest were found at stations 34 (0.831), 1 (0.839), and 5 (0.840). Looking at habitats, the highest SID was found in P/NR<30 (0.960) and the lowest in NR±30 (0.892) (Table 19).

TABLE 18: Richness and Diversity By Station – July 3rd – August 18th, 2017

Station	# Point Counts	Family Richness	Species Richness	Species Richness/ Point Count	SID ¹
1	7	8	9	1.3	0.839
3	7	7	11	1.6	0.885
5	7	9	14	2.0	0.840
7	7	8	9	1.3	0.863
9	7	11	18	2.6	0.955
12	7	9	11	1.6	0.868
14	7	7	13	1.9	0.897
15	7	11	19	2.7	0.953
16	7	10	17	2.4	0.967
17	7	13	19	2.7	0.943
18	7	5	10	1.4	0.934
19	7	11	14	2.0	0.922
20	7	10	14	2.0	0.924
22	7	5	8	1.1	0.924
24	7	6	8	1.1	0.912
25	7	6	10	1.4	0.949
26	7	9	17	2.4	0.943
27	7	9	12	1.7	0.962
28	7	12	17	2.4	0.913
30	7	4	8	1.1	0.945
31	7	9	14	2.0	0.938
32	7	6	8	1.1	0.972
33	7	6	10	1.4	0.892
34	7	9	12	1.7	0.831
Overall	168	24	74	0.4	0.955

1, Simpson's Index of Diversity.

TABLE 19: Richness and Diversity By Habitat – July 3rd – August 18th, 2017

Habitat Type	# Point Counts	Family Richness	Species Richness	Species Richness/ Point Count	SID ¹
P	42	17	39	0.9	0.944
P/NR<30	21	14	33	1.6	0.960
NR<30	70	22	57	0.8	0.950
NR>30	7	7	13	1.9	0.897
NR±30	7	6	9	1.3	0.892
OG	21	16	30	1.4	0.935
Overall	168	24	74	0.4	0.955

1, Simpson's Index of Diversity.

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