Owl survey at Cloudbridge Nature Reserve

Éloïse Roy

Université de Sherbrooke

October 2018

Bare-shanked Screech-Owl (*Megascops clarkii*) - Photo: Éloïse Roy

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1 ABSTRACT

This study on owls, conducted in the cloudforest mountains of Cloudbridge Nature Reserve (Costa Rica) for about two years, had the goal to investigate which owl species were present on the reserve and to compare the diversity and abundance of owl species between different successional habitats. This study used a call-playback method and was conducted by different people over time.

The Mottled Owl was found to be the more abundant species on the reserve and the point counts 12 and 34 had the highest proportion of responses. The habitat had an influence in the proportion of surveys where owls were heard, with the Old Growth Forest having significantly more owls heard, compare to the planted forest, the natural regenerated forest under 30 years and the natural regenerated forest over 30 years. This result could be explained by the fact that the most common species, the Mottled Owl, is mostly found in tall forests. Finally, the illumination, moon phase, and month of the year were factors that did not make a significant difference in the number of owls heard.

2 INTRODUCTION

Birds in general are a group that tend to be more studied than other groups in biology. This is also the case at Cloudbridge Nature Reserve, located on the Pacific slope of the Talamanca mountains in Costa Rica. While birds as a whole are studied more, there is one family that are less known: the owls (*Strigidae*). The fact that they are mostly active at night makes them more difficult to study.

Since the creation of the Cloudbridge reserve in 2002, only one study has been done on these nocturnal birds. Conducted from September 2006 to April 2007, the previous study found that the Mottled Owl (*Strix virgata*) was common on the reserve and that the ambient illumination had an impact on the number of callbacks (Paradis, 2007).

Since Paradis's study, the forest of Cloudbridge has grown and this present research, started in March 2016, was therefore necessary to provide a better understanding of those birds in this new environment.

Therefore, this study was developed with two goals in mind:

- Firstly, to build and maintain a Cloudbridge bird species list. Every owl species confirmed during the night surveys was added at the species list of the reserve.
- Secondly, to compare the diversity and abundance of owl species between different successional habitats (actively planted areas, natural regenerated areas under 30 years, naturally regenerated areas over 30 years, and old growth forest).

The study's questions were to investigate which species were the more common, which point counts had the most responses and if the moon phase, the ambient illumination, or the month of the year had an impact on the proportion of surveys where owls were heard.

3 STUDY LOCATION

3.1 General location

This study took place in the cloudforest of Cloudbridge Nature Reserve, in San Gerardo de Rivas, Perez Zeledon, Costa Rica. Located in the Talamanca mountain range, the reserve recognizes four different forest successional habitats within its limits due to the reforestation of previous farmland. Three of them are secondary forest (actively planted areas, natural regenerated areas under 30 years, naturally regenerated areas over 30 years), and one is primary forest (old growth forest).

3.2 Specific location

The surveys were conducted on five different trails in the reserve, which are all at different elevations between 1625 and 2140 meters (see Table 3-1).

Twenty-four stations were used for owl surveys (Figure 3-1), which are the same as the daytime bird point count stations used in the general bird survey (Powell and Spooner, 2018). Not all the stations on the reserve are used and some have been dropped over the years, meaning that station numbers on a trail are not always sequential. Stations are marked with a fixed metal sign and the GPS coordinates recorded.

A compass marker, located approximately 25 meters from each bird station, was used for triangulation to locate the position of owls. GPS coordinates for the compass markers was also recorded.

Due to bridge damage and landslides from tropical storm Nate that happened October 4th to 6th of 2017, the Don Victor trail (point counts 22 to 25) was not surveyed after this date.

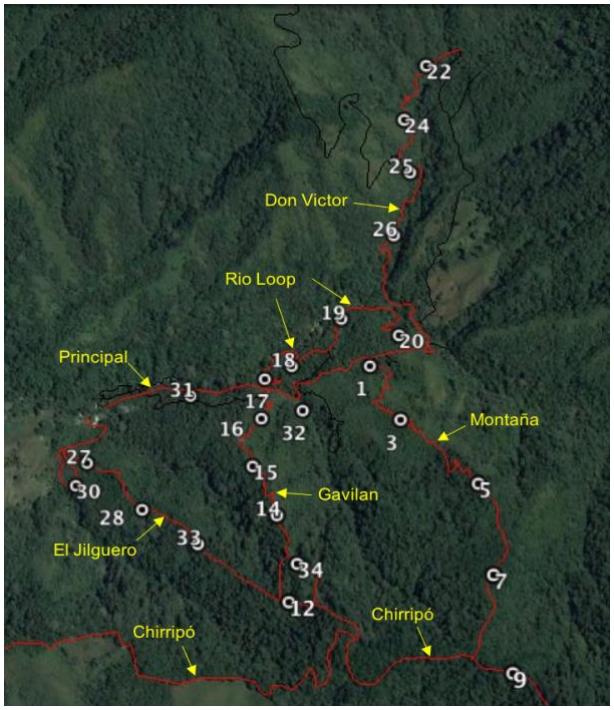

FIGURE 3-1 – Location of Bird Stations

TABLE 3-1 - Summary of Bird Stations

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

* P = Planted, NR = Natural Regeneration, O = Old Growth

4 MATERIALS & METHODS

4.1 Survey Timing

The study was conducted between March 2016 and April 2018. There are periods where no surveys were done during this interval of time due to a lack of observers (March-April, June-July, October-December 2017, and January 2018). The study took place in both the dry and the wet seasons. Methods followed Cloudbridge's Owl Survey Protocol (Powell and Spooner 2016).

Stations were surveyed in groups of 5 per survey day, with one group (Don Victor) only containing 4 stations (Table 3-1). Surveys were usually done over one week a month. If survey nights were cancelled due to rain or high winds, surveys were sometimes extended over several weeks until all stations were surveyed. Every day of the week, a different trail was surveyed.

Surveys were done at night, starting half an hour after sunset (approximately 6:30 pm) or later, and were completed by midnight at the latest. For a matter of safety, the surveys were conducted with a minimum of 2 observers.

4.2 Survey Procedures

For each bird station, general weather information (rain, wind, cloud cover, and illumination class) (see Appendix 1) were recorded at the beginning and end of the survey, as well as minimum and maximum temperatures with an infrared thermometer. The start and end times of the survey were also recorded.

Three minutes of silence were observed at the beginning of each survey to ensure less disturbance caused by the humans' presence, and to record any owls that may have been calling before the start of playback. The survey consisted of a call-playback technique, where calls of the target owl species were played in sequence. The call of a species was played for two minutes, using a portable Bluetooth speaker connected to a smartphone, followed by three minutes of silence. The owl calls were played from the smallest species to the largest to ensure that the small owls would not be scared off by the calls of the larger owls (Braga and Motta-Junior, 2009). Seven species (some added over time) were included in the study (see Table 4-1).

TABLE 4-1 - Order of Call Playback

Owl Common Name	Owl Scientific Name	Average Adult Size (cm)	Call Playback Order	Date Added to Survey	Date Deleted from Survey	Audio File
Costa Rican Pygmy Owl	*Glaucidium costaricanum*	15	1	March 2016		Spencer 2011a,b; Athanas 2005
Unspotted Saw-whet Owl	*Aegolius ridwayi*	18	2	March 2016		Nelson 2014b
Tropical Screech-Owl	*Megascops choliba*	23	3	March 2016		Chave 2015, Noernberg 2011
Bare-shanked Screech-Owl	*Megascops clarkii*	25	4	March 2016		Spencer 2011c, Lane 2001
Mottled Owl	*Ciccaba virgate*	35	5	March 2016		Nelson 2014a, Boesman 2010a
Striped Owl	*Pseudoscops clamator*	38	6	April 2016		Ramírez Alán 2014, Lane 2001a
Spectacled Owl	*Pulsatrix perspicillata*	48	7	December 2016	August 2017	Boesman 2010b, Jahn 1999

*The spectacled Owl was added to the study based on results of old data and was then removed to reduce the length of the surveys after no presence detected.

4.2 Owl Recordings

Owl recordings used for playback were created from sound clips found on the Xeno-Canto website (www.xeno-canto.org). Typically, calls from two different owls were used, except for the Unspotted Saw-whet Owl (*Aegolius ridgwayi*) as only one clear recording could be found. Whenever possible, a standard call would be played for the first minute, followed by an alarm call for the second minute. When a recording of an alarm call could not be found, two standard calls were used and played for a minute each. If the recorded clips were shorter than 1 minute, the frequency between individual hoots was matched when looping the clips.

Recordings from Costa Rica or western Panama were preferentially selected, to avoid possible significant dialect differences in conspecifics from a different country. However, recordings from the same close geographical area were avoided if possible, to capitalize on possible neighbour-stranger discrimination. Neighbour-stranger discrimination is when "territorial animals display lower levels of aggression toward familiar neighbors than towards unfamiliar strangers" (Lovell and Lein 2004) and has been shown to occur in owls (Galeotti and Pavan 1993). If no recordings from Costa Rica or western Panama were available, recordings from the nearest geographical area were used.

To maximise sound transmission, the volume of both the phone and the speaker was set to maximum, the speaker was pointed for 30 seconds in each of the 4 cardinal directions, and the speaker held at a 45° angle from the ground.

When an owl responded to a playback, a compass bearing was taken facing the calling owl and standing next to the station marker. Another compass bearing was taken facing the calling owl, but this time standing next to the compass marker, around 25 meters away from the station marker. The exact position of the owl was then located later using triangulation (see Figure 4-1).

To ensure variability of the moon phase during surveys and the time each station was surveyed, the week that the surveys occurred each month and the order of stations surveyed varied.

Surveys were not conducted at a wind or rain class of 4 or greater (see Appendix A), because it reduced the ability to hear, as well as the broadcast area of the speaker.

Owls heard between the call-playback surveys (not at a bird station) were recorded, but were not considered in data analysis, as they were heard outside of the survey time and their location could not be pinpointed.

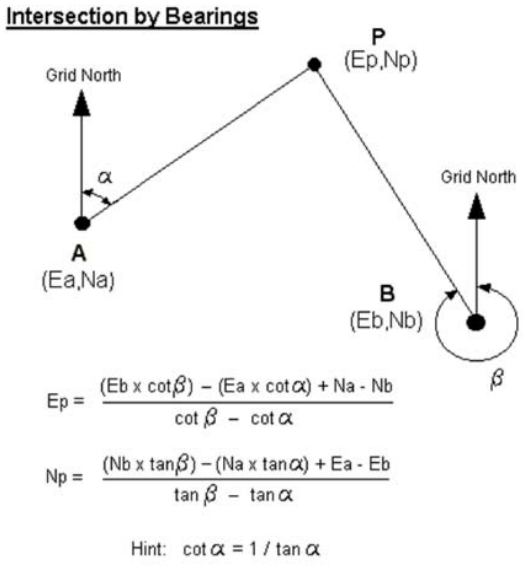

FIGURE 4-1 – Calculation of the owl's location using the triangulation

4.3 Data analysis

Microsoft Excel was used for visualisation of data and its pivot tables for summary analysis. Google Earth was used to map the locations of the owls.

Kruskal-Wallis non-parametric statistical test from Minitab Express was used for the analyses of the habitat type, the moon phase, the illumination and the month of the year. This test was used because the data had a skewed distribution (large number of zeros) with a short tail and was composed of more than three samples. This test can compare at least three samples by their median to determine if they come from the same distribution or from distributions of equal medians. The null hypothesis is that all the samples have the same median and the alternative hypothesis is that at least one median is different from the others.

Then, if a result of the Kruskal-Wallis test was significant, a post hoc test with Mann-Whitney was done to test which comparisons were significantly different.

4.3.1 Owl species

The most abundant species were determined by calculating the number of surveys where each owl species was heard per 100 surveys. Each species' detection rate per survey was calculated in relation to the number of surveys where the species' call was played. The number of surveys conducted for each species was not the same because some species were added after the beginning of the study. Playbacks for the Costa Rican Pygmy Owl (*Glaucidium costaricanum*), Unspotted Saw-whet Owl, Tropical Screech-Owl (*Megascops choliba*), Bare-shanked Screech-Owl (*Megascops clarkii*), and Mottled Owl were included during all 335 surveys done, while the Striped Owl (*Pseudoscops clamator*) was only included in 312 of them, and the Spectacled Owl (*Pulsatrix perspicillata*), 207. The rate was calculated by dividing the number of surveys where a least one owl of the species was heard, by the number of surveys that included that species. The number was then converted into a rate per 100 surveys.

4.3.2 Point counts

The more abundant owl locations were determined by calculating the percentage of surveys where owls were heard at each point count. This rate was calculated for each point count used in the study by dividing the number of surveys where at least one owl was heard at the point count by the total number of surveys done at the point count and then converting into a percentage.

4.3.3 Habitat types

A Kruskal-Wallis Test was used to see if there was a difference between the proportion of surveys where owls were heard between the different habitat types.

The different habitats used in this study were:

- Old Growth (OG)
- Natural Regeneration over 30 years (NR>30)
- Natural Regeneration around 30 years (NR><30)
- Natural Regeneration under 30 years (NR<30)
- Planted/Natural Regeneration (P/NR)
- Planted (P)

The Natural Regeneration over 30 years and Natural Regeneration over and under 30 years did not have enough point counts each so they were excluded from the analysis. Also, the point counts located on the Don Victor trail were not used in this analysis because this trail was sampled less times than all the other trails.

4.3.4 Moon phase

A Kruskal-Wallis Test was used to compare the effect of the moon phase on the proportion of surveys where owls were heard.

Because the different moon phases result in different illumination, and the amount of illumination is heavily influenced by the forest type, three point counts of each habitat were selected randomly and used for the test to standardize the results. The Natural Regeneration over 30 years and Natural Regeneration over and under 30 years did not have three point counts each so they were excluded from this analysis.

The point counts located on the Don Victor trail were not used in this analysis because this trail was sampled less times than all the other trails.

4.3.5 Illumination classes

A Kruskal-Wallis Test was used to compare the effect of the different illumination classes on the proportion of surveys where owls were heard.

Because the amount of illumination is heavily influenced by the forest type, three point counts of each habitat were selected randomly and used for the test. The Natural Regeneration over 30 years and Natural Regeneration over and under 30 years did not have three point counts each so they were excluded from this analysis.

The point counts located on the Don Victor trail were not used in this analysis because this trail was sampled less times than all the other trails.

4.3.6 Months

A Kruskal-Wallis Test was used to compare the effect of the different months of the year on the proportion of surveys where owls were heard.

The point counts located on the Don Victor trail were not used in this analysis because this trail was sampled less times than all the other trails.

5 RESULTS

5.1 General results

335 surveys were conducted in total during this study and 117 owls were heard. Eight owls were not identified to species and 18 had an unknown location, leaving 91 owls with a known location (see Figure 5-1).

5.2 Species abundance

Each species was heard a different number of times and has a different detection rate (see Figure 5-2). The Mottled Owl was the most abundant with 21.19 surveys where at least one owl was heard per 100 surveys. The Bare-shanked Screech-Owl was second with almost 6 surveys per 100 surveys. The Spectacled Owl was never heard.

5.3 Point counts

The point count that had the highest percentage of surveys where owls were heard was number 34 (86.67%), followed by number 12 (81.25%) and number 28 (56.25%). No owls were ever heard on the Don Victor trail (stations 22, 24, 25, 26), the same for point count stations 17, 20, 31 and 32.

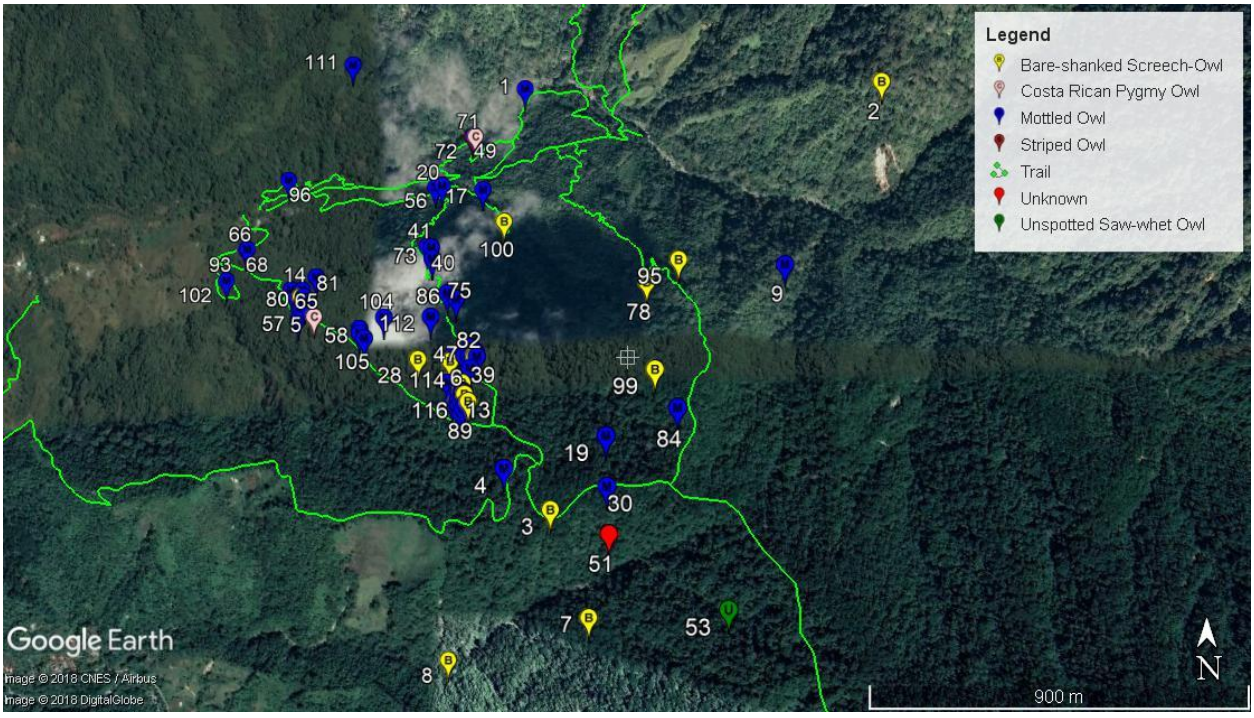

FIGURE 5-1 – Locations of owls with coordinates that called back during surveys

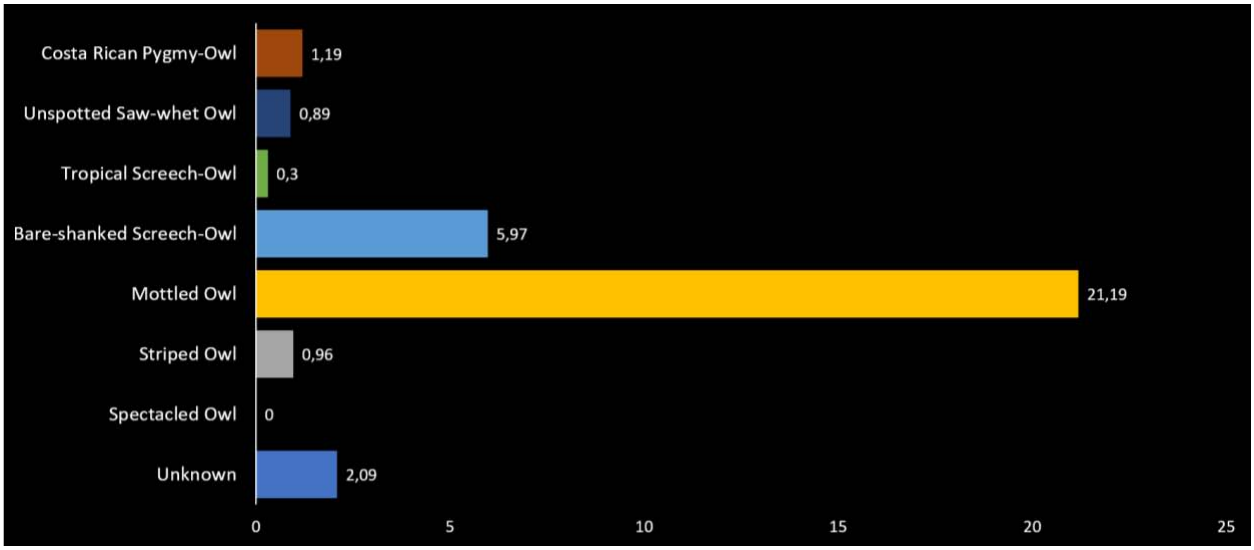

FIGURE 5-2 – The number of surveys where owls were heard per 100 surveys.

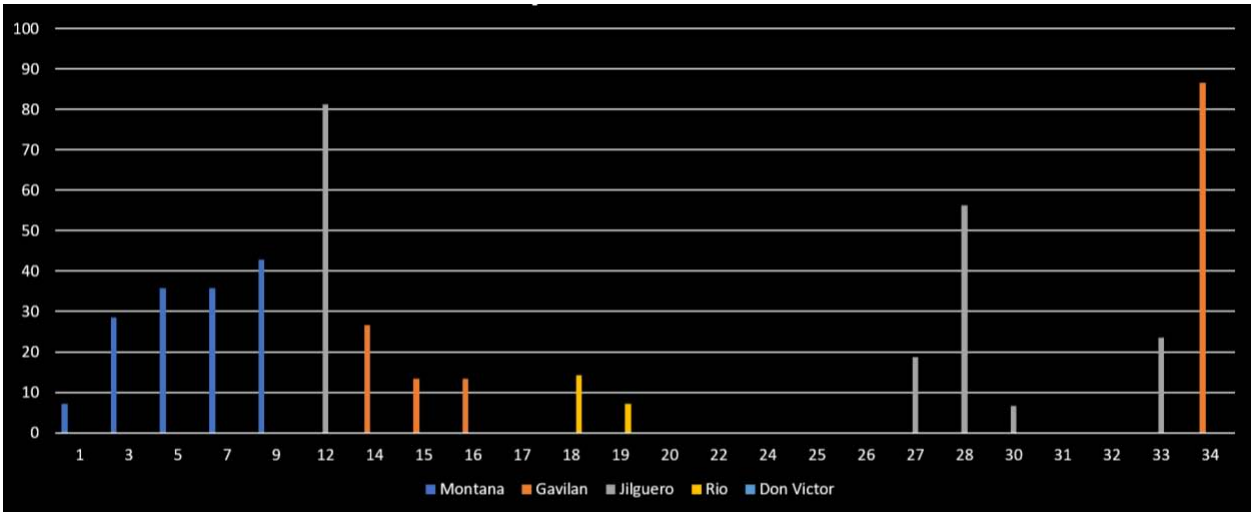

FIGURE 5-3 – Percentage of surveys where owls were heard for each point count station.

5.4 Habitat types

The Kruskal-Wallis test was used to analyse if the habitat type was having an impact on the number of surveys where at least one owl was heard. The result of this test was significant, with a p-value adjusted for ties of <0.0001 (see Table 5-1).

Because the Kruskal-Wallis Test was significant, a post hoc test was done with Mann-Whitney between each pair of habitats to determine which ones were different from the others. Only the Old Growth habitat was different from the other habitats (see Table 5-2) with a p-value adjusted for ties of <0.0001 for each of its tests.

TABLE 5-1 - Results of the Kruskal-Wallis test comparing the number of surveys where an owl was heard across habitats (Natural Regeneration under 30 years (NR<30), Old Growth (OG), Planted and Natural Regeneration under 30 years (P/NR<30), and Planted forest (P)). P-value of the test adjusted for ties is <0.0001.

Sample	N	Median	Mean Rank	Z-Value
NR<30	87	0	126.9	-0.70
OG	45	1	192.9	5.97
P/NR<30	43	0	110.3	-2.00
P	87	0	114.8	-2.51
Overall	262		131.5	

TABLE 5-2 - Results of the post-hoc Mann-Whitney tests between the different pairs of habitats tested in the Kruskal-Wallis test (Natural Regeneration under 30 years (NR<30), Old Growth (OG), Planted and Natural Regeneration under 30 years (P/NR<30), and Planted forest (P)).

Test	Samples	N	Median	Difference	Achieved Confidence	P-Value adjusted for ties
1	NR<30	87	0	-1	95.04%	<0.0001
	OG	45	1			
2	NR<30	87	0	0	95.03%	0.0916
	P	87	0			
3	NR<30	87	0	0	95.05%	0.0663
	P/NR<30	43	0			
4	OG	45	1	1	95.04%	<0.0001
	P	87	0			
5	OG	45	1	1	95.02%	<0.0001
	P/NR<30	43	0			
6	P/NR<30	43	0	0	95.05%	0.5738
	P	87	0			

5.5 Moon phase

The Kruskal-Wallis test was used to analyse if the moon phase was having an impact on the number of surveys where at least one owl was heard. The results of this test were not significant, with a p-value adjusted for ties of 0.7997, which means no median was different from the others (see Table 5-3).

The Moon phase classes were then regrouped by the size of the moon, ignoring if the moon was waxing or waning, to see if it would have more of an effect and a Kruskal-Wallis test was then made with the new classes (see Table 5-4). The new groups were: New Moon (class 0), First and Fourth Quarters (classes 1 and 7), Half Moon (classes 2 and 6), Second and Third Quarters (classes 3 and 5) and Full Moon (class 4). This test was no more significant than the first one, with a p-value adjusted for ties of 0.6060.

TABLE 5-3 - Results of the Kruskal-Wallis test comparing the number of surveys where an owl was heard across moon phases.

Sample	N	Median	Mean Rank	Z-Value
0-New Moon	19	0.0	79.7	-0.36
1-Waxing Crescent	47	0.0	82.2	-0.21
2-First Quarter	6	0.0	73.3	-0.53
3-Waxing Gibbous	16	0.0	91.9	0.74
4-Full Moon	10	0.5	100.8	1.17
5-Waning Gibbous	18	0.0	80.1	-0.32
6-Third Quarter	29	0.0	81.9	-0.20
7-Waning Crescent	21	0.0	83.1	-0.04
Overall	166		83.5	

TABLE 5-4 - Results of the Kruskal-Wallis test comparing the number of surveys where an owl was heard across moon sizes.

Sample	N	Median	Mean Rank	Z-Value
New Moon	19	0.0	79.7	-0.36
First and Fourth Quarters	68	0.0	82.5	-0.22
Half Moon	35	0.0	80.4	-0.43
Second and Third Quarters	34	0.0	85.7	0.29
Full Moon	10	0.5	100.8	1.17
Overall	166		83.5	

5.6 Ambient illumination

The Kruskal-Wallis test did not end up significant for the effect of ambient illumination on the proportion of surveys where owls were heard. The p-value adjusted for ties was 0.2288, which means all the medians were equals (see Table 5-5). The classes were: Dark (class 0), Between Dark and Very Faint (class 0.5), Very Faint (class 1), Between Very Faint and Faint (class 1.5) and Faint (class 2). The class 3 (Moderately light) was not included in the test, because there were not enough data points to run it in the test accurately.

TABLE 5-5 - Results of the Kruskal-Wallis test comparing the number of surveys where an owl was heard across ambient illumination classes.

Sample	N	Median	Mean Rank	Z-Value
Dark	51	0	85.5	0.74
Between Dark and Very Faint	21	0	76.4	-0.54
Very Faint	68	0	83.7	0.51
Between Very Faint and Faint	10	0	83.1	0.11
Faint	12	0	59.5	-1.69
Overall	162		81.5	

5.7 Months

The months of the year did not have a significant impact on the proportion of surveys were owls were heard as the p-value of the Kruskal-Wallis test was 0.6383. This means that the medians of each months were similar (see Table 5-6).

TABLE 5-6 - Results of the Kruskal-Wallis test comparing the number of surveys where an owl was heard between months.

Sample	N	Median	Mean Rank	Z-Value
January	15	0	150.9	0.51
February	22	0	161.9	1.29
March	40	0	144.6	0.35
April	34	0	137.4	-0.24
May	20	0	160.1	1.12
June	22	0	134.2	-0.38
July	17	0	145.3	0.25
August	20	0	132.3	-0.47
September	30	0	131.8	-0.63
October	20	0	126.6	-0.80
November	20	0	125.9	-0.84
December	20	0	139.3	-0.07
Overall	280		140.5	

6 DISCUSSION

Out of the seven species studied, the most abundant was the Mottled Owl, which was heard during 21.19 surveys per 100. The study done on the same territory in 2007 by Paradis had the same outcome, even if the methods were different (0.59 owls per kilometer transected for Paradis). This indicates that the Mottled Owl is still the most abundant species, more than 10 years later. However, the densities of the studied species from then and now are not known, so further research should be done to better understand the owl populations in the reserve.

Also, out of the four analyzes done with the Kruskal-Wallis test, the only significant result was the influence of the habitat type on owl presence with significantly more owls heard in the Old Growth forest compared to the other habitats. The taller trees found in that area could explain this result, as a study done in California linked a high canopy cover of tall trees to a better habitat for an owl species (*Strix occidentalis*) instead of a high total canopy cover from all strata (North and all, 2017). Furthermore, another study conducted in a reserve in Brazil also concluded that the vegetation structure has an impact on the occurrence of owls, plus that the Mottled Owl use mostly a habitat with higher canopies, which was a characteristic of mature forests (Menq and Anjos, 2015). As the Mottled Owl is the most abundance species in the reserve, this could indicate why the Old Growth forest is the place where more owls were heard.

The other analyses, about the influence of the moon phase, the illumination and the month, did not have any significant results. This can be due to the high number of data that was equal to zero (no response). Those results are similar of those from a study conducted in Illinois (USA) in 2013 and 2014 that was looking to improve the survey protocols for the detection of the Barn Owls (*Tyto alba*). Those researchers studied different parameters, including the moon phase, the day of the year and the cloud cover, and concluded that they did not have an influence on the detection rates (Wingert and Benson, 2018).

There are possible sources of errors in this study. Many factors (the habitat around the point count, the wind intensity, ambient noise from the river, etc.) changed between the point count stations and the survey' nights. That could influence the broadcast area and the intensity of the sound, which could not be standardized between the point counts.

Additionally, some problems appeared during the study. Data was collected by a number of different volunteers, which means the data could have been collected differently depending on the observers and that could have influenced the results. Some data sheets also got lost, which means some data could not be verified afterwards. The exact locations of the owls were not precise as well, because it was only determined by hearing, and some owls could not be located at all due to the impossibility of taking a bearing (the owl stopped calling, it moved, or it was heard between the point counts).

7 CONCLUSION (& RECOMMENDATIONS)

This study found that the Mottled Owl was the most abundant species in the reserve and that point count stations 12 and 34 had the highest proportion of responses. Also, the habitat had an influence in the proportion of surveys where owls were heard, with significantly higher numbers of owls heard in the Old Growth forest. This result could be explained by the fact that the Mottled Owl is mostly found in tall forests. Finally, the illumination, moon phase, and month of the year were factors that did not make a significant difference in the number of owls heard. It would be interesting to go further into assessing what environmental and habitat factors affect owl populations in tropical climates and to see if the regeneration of the forest is having a positive impact on these birds.

An improvement to this study could be to add mist nests during the surveys, but it would cover far less distance and demand more human resources as it takes a lot more time to conduct the surveys. However, mist netting would allow greater surety in species identification, and it would allow the measurement of individual characteristics like the wing length or weight. Depending on the future of this study, mist netting could be used to better understand the owl populations on the reserve's land, but would be costlier. It would also be interesting to study other variables like the impact of the seasons (wet vs. dry), the difference between the years and the impact of the breeding season to improve our understanding of the owls species of Costa Rica, as there are not a lot known about them.

8 ACKNOWLEDGEMENTS

I would like to thank the people who helped me conduct the surveys at night and the people who had done it before me. A special thanks to the scientific coordinator, Jennifer Powell, who helped me during all the process at Cloudbridge Reserve from the beginning and for the support in the writing of the report. Thank you also to Linda Moskalyk and Tom Gode for allowing this project by directing the reserve.

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Appendix A: Weather Classification Tables

TABLE A-1 – 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 A-2 - 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 A-3 – 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 A-4 - ILLUMINATION CLASS

Illumination Class		Conditions
0	Dark	Complete darkness.
1	Very Faint	Can see faint outlines of objects at close range (<1m).
2	Faint	Can see clear outlines of objects at close range (<1m).
3	Moderate	Can see clear outlines of objects 1-5 meters away.
4	Bright	Can see clear outlines of objects 5-20 meters away.
5	Very Bright	Can see clear outlines of objects over 20 meters away.

TABLE A-5 – MOON PHASE CLASS

Moon Class		Conditions
0	New	New moon. Includes day before and after.
1	Waxing Crescent	Crescent moon illuminated on the right side, getting larger.
2	1st Quarter	Half moon illuminated on the right side, getting larger. Includes day before and after.
3	Waxing Gibbous	Gibbous moon illuminated on the right side, getting larger.
4	Full	Full moon. Includes day before and after.
5	Waning Gibbous	Gibbous moon illuminated on the left side, getting smaller.
6	3rd Quarter	Half moon illuminated on the left side, getting smaller. Includes day before and after.
7	Waning Crescent	Crescent moon illuminated on the left side, getting smaller.

Check the current moon phase here: http://www.timeanddate.com/moon/phases/