Comparing point counts and line transects as an effective bird survey methodology

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Abstract

The aim of this study was to compare the effectiveness of two bird surveying methodologies in a Costa Rican cloud forest, with the goal of determining if one method of data collection yields more results than the other. Ninety point counts and ninety line transect surveys were conducted in three different forest types at Cloudbridge Nature Reserve. Line transects were found to record more individuals and species than point counts. Furthermore, the trail used, and weather also showed to have an influence on the numbers recorded. While results were clear, observer bias, birding skills, and non-randomization of the study, are some aspects to be taken into consideration when discussing the results. Overall, this study gives us more knowledge on the importance of methodology in the field of research.

Introduction

Conservation management plans of tropical montane cloud forests (TMCF) have become essential in today's world (Scatena et al., 2011). Relying on regular low-lying clouds and having a fragmentary nature, they have created a unique environment for many species, making them highly valuable hotspots (Hernández-Baños et al., 1995; Foster, 2001). Making up only 2.5% of all tropical forests, cloud forests host 11.6% of threatened birds species bound to this habitat in the Americas (Bubb et al., 2004). Even though, historically TMCF were less affected by climate change in comparison to other tropical forests, it has become clear they are not only highly susceptible to climate change, but they have already been greatly affected by it (Scatena et al., 2011).

As TMCF are facing so many challenges, ecological restoration techniques such as reforestation could be critical for recovering biodiversity and ecosystem function (Pejchar et al., 2018). However, the effectiveness of "man-designed" restorations, is still a matter of evaluation (Pejchar et al., 2018). One way of evaluating this, is through monitoring of avian species. Birds are great bioindicators when examining the status of an area (Price, 2006). They are not only an essential part of the environment but monitoring them, provides great information about their adaptation to climate change, the species richness in that area and general valuable data that might help determine conservation priorities (Bibby et al., 1998; Gregory et al., 2004).

Monitoring of birds is dependent on surveys, which will help visualize trends occurring (Gregory et al., 2004). Therefore, choosing the right methodology for these surveys can have a great effect on the results. Several methodologies used globally include point counts, line transects, mist-nesting, playback call, etc. (Akçay et al., 2020).

Point counts and line transects are methodologies used widely, mostly because of how flexible their application can be. They are used for surveys of individual species or groups of species, and they can be applied to terrestrial or aquatic systems, making them very adaptable to the objectives of each study (Gregory et al., 2004). While looking at these two methodologies, it is important to define the aims and objectives of the study. They are both useful, but depending on the factors involved one might be more effective than the other (Gregory et al., 2004).

Line transects involve the observer walking a previously defined transect and recording all the birds heard/seen during that time. The length and width of the transect, along with other specifications are all open to be defined according to the study. This methodology suits extensive, open, and uniform habitats. As the observer is continually on the move, it can be effective for mobile and large species. Gregory et al. (2004) claim that not only the number of birds counted is higher with line transects than with point counts, but line transects also reduce the chances of double counting individuals.

Point counts is the most used quantitative method. It involves the observer staying in one single point for a standardized period of time and recording all the birds present (Ralph et al., 1995). Specifications such as the radius used, duration per point count etc., can all be defined individually. This methodology suits dense habitats such as forests and is very efficient with shy and skulking species. Even though the number of individuals might be lower than with line transects, usually it is more species rich (Gregory et al., 2004).

Overall, one would think that it is clear which method is more effective for a specific study. But surprisingly, this is not the case. Gregory et al. (2004) found that line transects were most effective in open and uniform habitats and point counts in dense habitats; however there have been other studies contradicting this. In a previous study they compared line transects and point counts regarding spring migration in forest wetlands. In this case, they concluded that line transect was the most effective method in complex hardwood forests; while point counts were more effective in open plantations (Wilson et al., 2000).

The lack of uniformity regarding previous results of these two methodologies, makes it even more desirable to study them in a specific environment such as a tropical montane cloud forest. To do that, it is necessary to take into consideration all the other factors that might affect the bird counts during a survey. Having different forest ages could influence the results. For instance, a secondary-growth forest might be more attractive to a larger number of birds in comparison to old-growth, due to the food availability (Blake & Loiselle, 2001). Also factors such as weather are known to influence bird surveys. Fog might reduce the visibility of birds, while at the same time improving sound identification, because of the sound amplification it produces (Robbins, 1981). Rain, depending on the severity, could also cause a decrease in the number of individuals seen. But also, weather changes could be the reason for a drastic increase in the number of birds recorded. This could be because of the effect weather change has on the species' prey. The sky condition not only affects the presence of certain species, but it also affects the observer. A heavy overcast delays the dawn chorus, causes early cessation of evening activity, reduces presence of soaring birds, and can also heavily affect the visibility of the observer, making identification less accurate (Robbins, 1981). Furthermore, it is widely believed that the sun's presence influences bird activity. It can be for sun-bathing or other reasons, but it has been previously found that birds are more likely to be on crests of trees that get the first rays of sun in the morning (Hauser, 1957)

The aim of this study is to get more insight into the two methodologies applied in the three forest types found in Cloudbridge Nature Reserve. Hopefully, we will not only find out which methodology is more effective to estimate abundance, but we will also further our knowledge on the current state of bird populations in the study area. The results of this study could be of great help for future researchers regarding the effectiveness of these two methodologies in the unique environment of TMCF.

Methods

Study Area

The data for this study was collected in the terrain of Cloudbridge Nature Reserve. Located on the pacific side of the Talamanca Mountains, this Tropical Montane Cloud Forest neighbors the Chirripó National Park. The four forest types at Cloudbridge Nature Reserve include primary, old growth, young and planted. For this study, old growth and primary are going to be compressed into one. Therefore, the three forest types being taken include primary/old, young, and planted. Primary and old growth forests are at least 77 years old and are found at elevations ranging between 1550 to 2600 m. Naturally regenerated forest and the planted areas are currently around 21 years old (Cloudbridge Nature Reserve, n.d.).

Data Collection

The main aspect of this study was alternating between point counts and line transects when collecting data. This was divided into 5 rounds. Each round took place on a different trail and took six days to be completed. Originally it was intended to have three point counts and three line transects spread so that there would be one in each forest type (figure 1 & figure 2). As certain trails did not have all forest types, it was regulated as well as possible, making up for it during the next round.

The data for this study was collected between February 21st,2023 and June 12th,2023. The exact coordinates and elevation for the point counts and line transects are to be found in appendix A.

Each day of survey started at 6:00 a.m. and concluded at 11:15 a.m. Six time blocks of 40 minutes were defined, with 15 minutes between each time block (see appendix B). Each day three point count surveys, and three line transect surveys were conducted, with 15 minutes between them to get to the next point count or line transect. The two methods rotated with the time blocks throughout the six days of each round (see appendix B).

The fifteen point counts and fifteen line transects were not chosen randomly. They were chosen according to their likelihood of being active spots for birds. As this is affected by previous knowledge on the matter, assumptions have been made.

Obtained from the bird protocol used at Cloudbridge Nature Reserve, when surveying a 50-meter radius was implemented. This meant that whenever a bird was spotted inside that radius it was noted as “inside”, and all birds spotted outside that radius as “outside”. No precise measurements were made for this radius. Furthermore, other control variables were noted. This included date, time, weather, sun presence, and if the bird was heard or seen. Sun presence was noted as “yes” when at least one third, starting at the crest of the trees, was hit by sunlight.

In a point count all the individuals seen or heard during the survey time were noted. If the identification of the individual was not possible, it was added to the unidentified column for that specific time block. Movement during point counts was allowed to get a better view of birds.

Line transects were walked at a slow pace, stopping every few steps to hear more. If the transect was finished before the 40 minutes were up, the transect was repeated in the other direction. If the transect was not finished in the 40 minutes, the remaining transect was not to be finished.

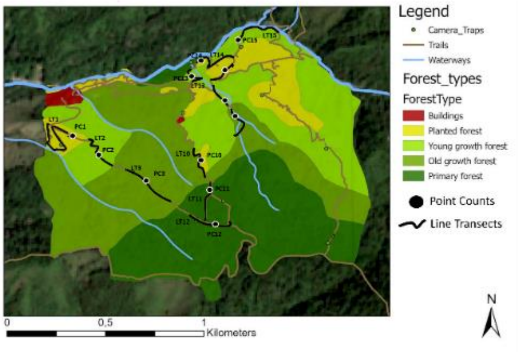

Figure 1: Point counts and line transects for first four rounds.

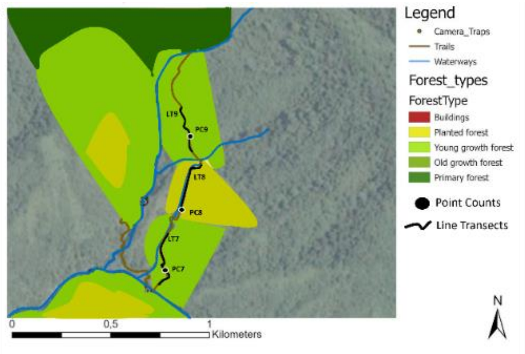

Figure 2: Point counts and line transects for fifth round.

Data Analysis

Two Mann-Whitney U tests were conducted. One to find out if the number of individuals recorded with point counts was significantly different from line transects. The second, to find out if the average number of species recorded during one line transect was significantly different from a point count.

A general linear model (GLM) was conducted to assess which variables (weather, time block, trail, forest type) had the most influence on the number of individuals recorded.

Results

A Mann-Whitney U test was performed to evaluate whether the average number of species identified each survey differed by the method used.

The results indicated that line transects had a significantly higher average number of species per survey than point counts ($U = 2704$, $p = < .001$). This is visualised in figure 3, where line transects are shown to have recorded in average 7.5 species, while point counts 5.7 during a survey.

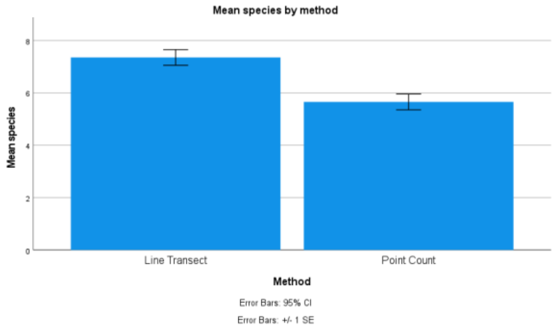

Figure 3: Bar graph of mean species recorded each survey in relation to methodology.

A second Mann-Whitney U test was performed to evaluate whether the number of individuals differed with the methods used. The results indicated that line transects had a significantly higher number of individuals recorded than point counts ($U = 280581,5$, $p = .003$). This can be observed in figure 4, where it is noticeable that on average with line transects around 17 individuals were recorded, while with point counts around 12 individuals.

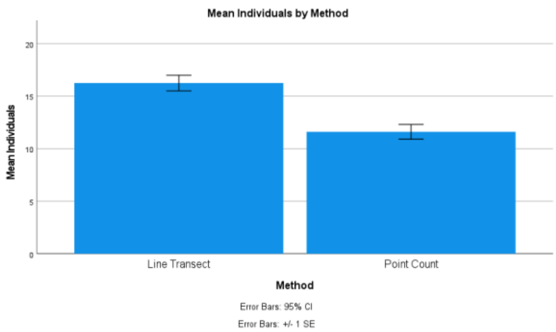

Figure 4: Mean individuals recorded each survey per methodology.

The GLM conducted, showed that three of the variables getting tested had a significant influence on the number of individuals recorded. The methodology used was found to have a significant influence on the average number of individuals recorded in a survey (GLM, $F(1,1559)=5.956$, $p=<.015$). The trail a survey was conducted on was found to have a significant influence on the average number of individuals recorded during said survey (GLM, $F(4,1559)=6.403$, $p=<.001$). Furthermore, weather conditions were also found to have a significant influence on the average number of individuals recorded in a survey (GLM, $F(7,1559)=27.730$, $p=<.001$).

In terms of methodology, it can be seen in a previous graph (see figure 4), how the two methods had an influence on the individuals recorded.

As the model showed, trail had a significant influence on the results. This can be seen in figure 5, where it is very clear that the trail Los Quetzales had on average a much higher number of individuals recorded each survey in comparison to the other trails. Furthermore, the two trails with the lowest numbers are Sentinel and Jilguero. Gavilán and Rio had very similar numbers in terms of individuals.

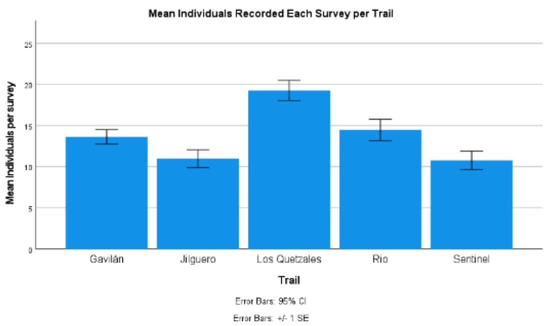

Figure 5: Mean individuals recorded each survey per trail.

In addition, weather also had a significant influence on the average number of individuals recorded each survey. As figure 6 shows, it was in a clear sky that the most individuals were recorded, and when foggy the least. With a clear sky on average around 12 individuals were recorded, when it was cloudy around 10 individuals, and when it was foggy just under 9 individuals.

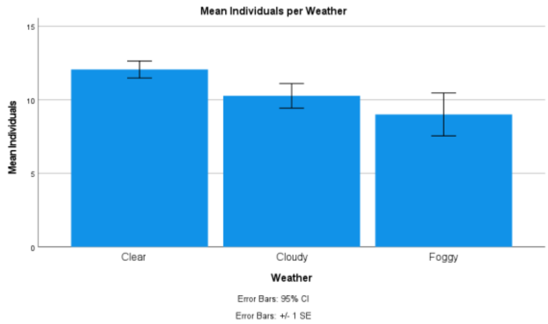

Figure 6: Mean individuals seen per survey in different weather conditions.

Discussion

Gregory et al. (2004) suggest that line transects are more effective in terms of abundance, but when looking at species, point counts take the lead. They also stated that point counts are more effective than line transects in dense forests. Even though my data does concur with the fact that line transects are more effective than point counts in terms of individuals, my results differ in the other aspects. In disagreement with two of the previous statements, my data shows that line transects was the methodology that recorded not only more individuals, but also more species in all three different forest types (see results). Supporting these results, Wilson et al. (2000) noted that line transects were more effective, especially in dense forests. This can be explained by the lack of visibility in dense forests when conducting point counts. Also being constantly on the move and covering more ground during line transects increases the chances of coming in contact with birds (Wilson et al., 2000; Gregory et al., 2004).

Even though my results show clear significance between the two methodologies, there are some aspects that might have influenced my results.

The first one is bias. The point counts and line transects were chosen by me. For line transects

I don't think it would have that much of an influence on the results, as they covered more ground. But especially with point counts, it can be argued that my judgment while choosing may give an inaccurate representation of this method.

Furthermore, observer bias might have had an influence on the results in terms of family representation. I was accompanied by volunteers, researchers, and staff members of Cloudbridge frequently. As different people had different birding skills, it also meant that with certain people more individuals and species would be recorded.

On another note, my identification skills have improved greatly during the data collection time. As a high level of observer skill and experience is required for reliable data (Gregory et al., 2004), if I were to do a repetition of all rounds, I would expect to see a difference in the results. This applies especially to the first rounds.

Referring to the GLM results, it was interesting to see that the trail had a significant influence on the number of individuals recorded. During data collection I did notice that certain trails were on average much more active than others. Analysing this, possible explanations could include the trails' openness and sun orientation. For example, Sentinel trail showed to have one of the lowest average of individuals recorded (see figure 5). This trail is not only tunnel-like, with branches leaning into the trail, but because of its position in the reserve it does not get as much sunlight as the other trails. This could influence the presence of birds, as many of them like to sunbathe on the crests of trees that are hit by sunlight (Hauser, 1957). Supporting these GLM results, the trail Los Quetzales, which had the highest numbers (see figure 5), is known to be high on bird activity. It is hard to define what makes this trail so liked by birds, but the fact it has a lot of sun, due to its openness, in combination with the tunnels it has, might offer a great environment for many different birds.

The GLM also showed that weather conditions had a significant impact on the number of individuals recorded. The highest recordings, on average were in a clear sky, while misty had the lowest (see figure 6). Misty weather had a big influence on my data, mainly because of the constrained view I had. Clouds were also very influential. This can be explained by the fact that heavy clouds reduce the dawn chorus, cause early cessation of evening activity, reduce presence of soaring birds, and can also heavily affect the visibility of the observer (Robbins, 1981).

I was surprised that forest type did not have a significant influence on the number of individuals recorded. I thought that because of feeding options and nesting areas, there would be differences. And while that is the case generally (Blake & Loiselle, 2001), I think Cloudbridge, especially because of its size might be different. The different forest types are in close proximity to each other. And as forest types are a highly enclosed mosaic, it is hard to differentiate the abundance in the different forest types, and when birds could be moving between them (Blake & Loiselle, 2001).

In conclusion, it is safe to say, that even though there were some limitations influencing the results, this study shows that line transects are more effective than point counts for effective bird surveys at Cloudbridge Nature Reserve.

Appendix A

Table 1: Point counts details.

Site	Latitude	Longitude	Elevation (m)	Trail	Forest type
PC1	09°28,210'N	083°34,656'W	1692	Jilguero	Planted
PC2	09°28,142'N	083°34,571'W	1776	Jilguero	Naturally regenerated
PC3	09°28,075'N	083°34,448'W	1874	Jilguero	Old/Primary
PC4	09°28,392'N	083°34,265'W	1710	Rio	Planted
PC5	09°28,295'N	083°34,230'W	1742	Sentinel	Naturally regenerated
PC6	09°28,269'N	083°34,216'W	1771	Sentinel	Old/Primary
PC7	09°28,491'N	083°34,035'W	1720	Los Quetzales	Naturally regenerated
PC8	09°28,575'N	083°34,037'W	1767	Los Quetzales	Planted
PC9	09°28,722'N	083°33,988'W	1819	Los Quetzales	Naturally regenerated
PC10	09°28,124'N	083°34295'W	1909	Gavilán	Planted
PC11	09°28,050'N	083°34,287'W	1929	Gavilán	Old/Primary
PC12	09°27,978'N	083°34,280'W	1967	Gavilán	Old
PC13	09°28,372'N	083°34,325'W	1679	Rio	Naturally regenerated
PC14	09°28'431'N	083°34,292'W	1693	Rio	Planted
PC15	09°28,484'N	083°34,189'W	1690	Rio	Naturally regenerated

Table 2: Line Transects details.

Line Transect	Latitude-Longitude Start	Latitude-Longitude End	Range Elevation (m)	Trail	Forest Type
LT1	09°28,306'N 083°34,660'W	09°28,200'N 083°34,602'W	1610 - 1716	Jilguero	Planted
LT2	09°28,200'N 083°34,602'W	09°28,136'N 083°34,553'W	1716 - 1810	Jilguero	Naturally regenerated
LT3	09°28,136'N 083°34,553'W	09°28,053'N 083°34,415'W	1810 - 1887	Jilguero	Old/Primary
LT4	09°28,425'N 083°34,223'W	09°28,345'N 083°34,280'W	1695 - 1709	Rio	Planted
LT5	09°28,345'N 083°34,280'W	09°28,279'N 083°34,212'W	1709 - 1766	Sentinel	Naturally regenerated
LT6	09°28,271'N 083°34,211'W	09°28,351'N 083°34,279'W	1713 - 1785	Sentinel	Old/Primary
LT7	09°28,481'N 083°34,041'W	09°28,543'N 083°34,036'W	1714 - 1749	Los Quetzales	Naturally regenerated
LT8	09°28,549'N 083°34,040'W	09°28,624'N 083°34,020'W	1755 - 1780	Los Quetzales	Planted
LT9	09°28,690'N 083°33,993'W	09°28,740'N 083°33,961'W	1803 - 1833	Los Quetzales	Naturally regenerated
LT10	09°28,143'N	09°28,087'N	1895 - 1934	Gavilán	Planted

	083°34,310’W	083°34,276’W			
LT11	09°28,087’N 083°34,276’W	09°28,043’N 083°34,401’W	1901 - 1934	Gavilán	Old/Primary
LT12	09°27,989’N 083°34,312’W	09°27,961’N 083°34,201’W	1943 - 2968	Gavilán	Old
LT13	09°28,371’N 083°34,326’W	09°28,431’N 083°34,298’W	1650 - 1691	Rio	Naturally regenerated
LT14	09°28,444’N 083°34,291W	09°28,490’N 083°34,197’W	1680 - 1707	Rio	Planted
LT15	09°28,490’N 083°34,197’W	09°28,492’N 083°34,106’W	1706 - 1752	Rio	Naturally regenerated

Appendix B

Schedules for rounds of data collection

Table 3: Schedule first round of data collection.

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
06:00 – 06:40	PC 1	LT 1	PC 2	LT 2	PC 3	LT 3
06:55 – 07:35	PC 2	LT 2	PC 3	LT 3	PC 1	LT 1
07:50 – 08:30	PC 3	LT 3	PC 1	LT 1	PC 2	LT 2
08:45 – 09:25	LT3	PC 3	LT 1	PC 2	LT 2	PC 1
09:40 – 10:20	LT2	PC 2	LT 3	PC 1	LT 1	PC 3
10:35 – 11:15	LT1	PC 1	LT 2	PC 3	LT 3	PC 2

Table 4:Schedule second round of data collection.

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
06:00 – 06:40	PC 4	LT 4	PC 5	LT 5	PC 6	LT 6
06:55 – 07:35	PC 5	LT 5	PC 6	LT 6	PC 4	LT 4
07:50 – 08:30	PC 6	LT 6	PC 4	LT 4	PC 5	LT 5
08:45 – 09:25	LT 6	PC 6	LT 4	PC 5	LT 5	PC 4
09:40 – 10:20	LT 5	PC 5	LT 6	PC 4	LT 4	PC 6
10:35 – 11:15	LT 4	PC 4	LT 5	PC 6	LT 6	PC 5

Table 5:Schedule third round of data collection.

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
06:00 – 06:40	PC 7	LT 7	PC 8	LT 8	PC 9	LT 9
06:55 – 07:35	PC 8	LT 8	PC 9	LT 9	PC 7	LT 7
07:50 – 08:30	PC 9	LT 9	PC 7	LT 7	PC 8	LT 8
08:45 – 09:25	LT 9	PC 9	LT 7	PC 8	LT 8	PC 7
09:40 – 10:20	LT 8	PC 8	LT 9	PC 7	LT 7	PC 9
10:35 – 11:15	LT 7	PC 7	LT 8	PC 9	LT 9	PC 8

Table 6: Schedule fourth round of data collection.

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
06:00 – 06:40	PC 10	LT 10	PC 11	LT 11	PC 12	LT 12
06:55 – 07:35	PC 11	LT 11	PC 12	LT 12	PC 10	LT 10

07:50 – 08:30	PC 12	LT 12	PC 10	LT 10	PC 11	LT 11
08:45 – 09:25	LT 12	PC 12	LT 10	PC 11	LT 11	PC 10
09:40 – 10:20	LT 11	PC 11	LT 12	PC 10	LT 10	PC 12
10:35 – 11:15	LT 10	PC 10	LT 11	PC 12	LT 12	PC 11

Table 7: Schedule fifth round of data collection.

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
06:00 – 06:40	PC 13	LT 13	PC 14	LT 14	PC 15	LT 15
06:55 – 07:35	PC 14	LT 14	PC 15	LT 15	PC 13	LT 13
07:50 – 08:30	PC 15	LT 15	PC 13	LT 13	PC 14	LT 14
08:45 – 09:25	LT 15	PC 15	LT 13	PC 14	LT 14	PC 13
09:40 – 10:20	LT 14	PC 14	LT 15	PC 13	LT 13	PC 15
10:35 – 11:15	LT 13	PC 13	LT 14	PC 15	LT 15	PC 14

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