The Effect of Suburbanization on Black-capped Chickadees in the Albany Pine Bush, NY

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Introduction

Suburbanization can have a large impact on the surrounding environment as the area becomes more populated. Suburbanization is the shift of populations from urban to suburban areas (Jargowsky and Yoonhwan). Suburbanization can be detrimental to the environment and the organisms living in an environment. Some examples can be habitat fragmentation and habitat loss (Lookingbill). An example of such organisms are birds. Birds can be very sensitive to changes in the environment and are ecological indicators. Birds are often affected by habitat fragmentation and loss (Lookingbill). Certain birds like black-capped chickadees can be affected differently from other birds due to their generalist species adaptability. Black-capped chickadees respond to suburbanization both positively and negatively due to bird feeders and habitat destruction respectively (All About Birds). Bird feeders provide easy access to food for chickadees and other year round birds during the winter. Destruction of their habitat decreases the amount of habitat they can use to forage and live in.

A gradient is one way to compare the effects of suburbanization on different suburbanization settings (low, medium, and high). A low setting would mean a generally undisturbed habitat area. A medium setting means just outside the border of the low setting and a high setting represents a more urbanized, city-like area. These three settings compared to each other would prove a good way to compare the effects of suburbanization and how it might affect the low setting and similar areas especially since buildings and people continue to encroach upon the preserve. Birds also draw people in and will potentially increase the amount of people that will care about this issue, which is why they are a good species to use as an example of suburbanization effects.

The Albany Pine Bush is an important area for bird conservation and is surrounded by suburbanized areas (Hawver). The Albany Pine Bush is a good low suburbanization setting (base area) to use due to the intact natural habitat interior of the preserve (Hawver). The edges of the preserve also represent habitat fragmentation and habitat loss as the areas right outside the preserve are being more suburbanized and encroached upon (Hawver).

Purpose

The purpose of this study is to compare and contrast the effect of suburbanization on black-capped chickadees in a three level gradient of suburbanization (low, medium, and high).

Hypothesis

There will be higher levels of black-capped chickadees inside the Albany Pine Bush (low suburbanization) compared to the medium, and high, settings.

Null Hypothesis

There will be no significant differences between the three levels of suburbanization (low, medium, high).

Materials and Methods

The data collection was set to start around the beginning of June 2023 and the suburbanization level sites for the gradient were selected around that time. Due to unsafe outdoor conditions such as smoke from the Canadian wildfires, the data collection ended up starting around the end of June. June and the beginning of July were selected for the data collection period because of bird breeding seasons which occurred around that time. This is to decrease any chance I might count a migrating bird as I want to collect data on the birds that live in the area.

To record the data, I used a point count data sheet from the Albany Pine Bush courtesy of my mentor. My mentor also sent me the collection methods for the point count data sheet. I used

this explanation as a basis for how I was going to count the birds. I ended up picking seven point counts for each of the three site types I picked (the Albany Pine Bush, 100-200 meters away from the border of the Pine Bush in a neighborhood, and a busier neighborhood area surrounded by main streets). I planned to collect data in a total of nine days. I chose to do three collection days per site.

Low Suburbanization	Medium Suburbanization	High Suburbanization
Inside the Albany Pine Bush	100-200 meters away from the Albany Pine Bush border	Suburban areas such as neighborhoods
10 meters	10 meters	10 meters
25 meters	25 meters	25 meters
50 meters	50 meters	50 meters

I spent 10 minutes at each point count. I moved from 50 meters to 25 to 10 and then to the center, and then to 10, 25, 50 meters within the 10 minutes spent at the point count in that order. I recorded the minute within the 10 minutes that I saw or heard the bird. I recorded the bird by using four letter bird codes (ex: ‘BCCH’) and used a variety of symbols such as F for flyover or an open circle to represent that a bird was seen. This can be shown in the completed point count data sheet examples.

In my analysis, I excluded flyovers because it didn’t necessarily mean that those birds were using the resources in that particular point count. Some groups of birds were too large to count fast enough so groups were counted as 5 birds each. For my analysis, I calculated an ANOVA test for the overall 3 site types and for black-capped chickadees (BCCH) only. Results of the ANOVA test led me to calculate the Shannon Diversity Index for the overall 3 site types and also each point count of each site type over all nine days. Lastly, I calculated densities. I did

this by taking the average of each point count (dividing it by 3 because of the 3 different site types). After calculating the ANOVA tests and Shannon Diversity Indices, I went back through my raw data and cross referenced with my point count data sheets to delete any birds counted outside of the 50 meter mark in order to calculate the densities as I only could count birds within the 50m. The densities were calculated to add onto my raw data graphs and to also see what densities my sites had and how that compared to the numbers shown in my raw data. When I counted in June-July, I estimated that certain birds would be outside the 50 meters, but I did not have a measuring tape to measure exactly if the bird was inside or outside of the 50 meter mark which accounts for why some of the birds were outside the circle line. The densities calculated would be composed of only birds counted inside the 50 meter mark as compared to the ANOVA tests and Shannon Diversity Indices. The results for both density and Shannon Diversity Index should tell around the same results as only a few birds were subtracted–or even none at all in the raw data. I averaged both Shannon Diversity Index, ANOVA test, and density results separately to create graphs.

Results

I created a master spreadsheet for all of my raw data, analysis, and calculations. I transferred all my data written on the point count sheets into a raw data spreadsheet. I made graphs off of the raw data in the spreadsheet.

I compiled my results for the Shannon Diversity Index into a bar chart to more easily see my results and to compare my sites. The higher the number is, the more diversity there is. Overall, the Albany Pine Bush had the highest number, continued with Colonie and then Albany. I also looked at the number of species represented in each point count or site type (species richness). Albany had a lower biodiversity than Colonie and APB but had the highest species

richness compared to the other two. The lower biodiversity number is due to unevenness of the data (species evenness). This means that I counted a lot of one or two birds but very few of one or two other species (for example: I counted a lot of mourning doves and maybe saw a turkey or hawk once or twice).

I calculated ANOVA for each overall site type. The null hypothesis was rejected. My F score was: $F(2, 18) = 9.974289585$, $p < 0.05$ and the critical value was 3.55. The p value is 0.0012. The F score 9.974289585 is past 3.55 in a F distribution curve graph which means that the null hypothesis is rejected and that the means between the three sites are significantly different. For the ANOVA calculated on BCCH, the null hypothesis was proven true aka accepted. My F score was: $F(2,18) = 1.336283186$, $p < 0.05$. The p value was 0.29. The alpha value ($a = 0.05$) for the F distribution table is the cutoff that I used to determine statistical significance. It means that I'm allowed to be wrong 5/100 times and it is commonly used in ecological or biological studies. If the F score was over the critical value of 3.55 (which was determined by the degrees of freedom numerator (2), degrees of freedom denominator (18) and the alpha value of 0.05), then the null hypothesis was rejected. If it was less than 3.55 then the null hypothesis was accepted. BCCH was not statistically different from each other in each of the three site types but overall, the three site types were statistically significant.

I calculated population densities by taking the average birds of each point and then dividing the average by .005 hectares. I converted 50 meters to hectares which is .005 hectares. I used the formula (individual/hectares). I compiled my averaged calculated densities into a bar chart.

Albany seems to have the highest population densities based on the chart. The Albany Pine Bush has the lowest and Colonie falls in between.

I also calculated densities for only black-capped chickadees using the same method as my overall densities.

Similar to the overall densities, Albany has the highest population densities of black-capped chickadees. Unlike the overall densities, the Albany Pine Bush has higher densities than the Colonie site.

Discussion

I found that the three sites were statistically different from each other and that the three levels of suburbanization were statistically different which rejects the null hypothesis. The Albany Pine Bush had the highest level of diversity which is then followed by Colonie and then Albany. Albany had the highest level of black-capped chickadees and the Albany Pine Bush had the second highest level of black-capped chickadees. This may be due to any hidden bird feeders in the backyards. I noted that the backyards were larger in Albany and I couldn't access the backyards. I also recorded 6 bird feeders in total at the Colonie site. Point count 5 (PC5), point count 4 (PC4), and point count 6 (PC6) each had 2 bird feeders.

From my findings, I can conclude that black-capped chickadees were found most in the Albany/medium site of suburbanization. My calculated densities support this conclusion. Albany has the highest population densities of the three site types. Albany also has the highest black-capped chickadee population densities as well. The trends are supported. Albany (highest) and the Albany Pine Bush (second highest) have the highest black-capped chickadee population densities while, overall, Albany (highest) and Colonie (second highest) have the highest population densities compared to the Albany Pine Bush.

My hypothesis was not supported. I hypothesized that there would be a higher amount of black-capped chickadees in the lowest suburbanization setting rather than the medium and high

settings. I hypothesized this because most would think the most preserved area would have the highest amount of wildlife. I reasoned that my hypothesis was rejected due to their generalist nature of the species and that they are affected positively and negatively by suburbanization (birds feeders and habitat destruction). This theme of higher concentrations of birds in the medium and high settings reoccurs as the total number of birds and total number of birds excluding black-capped chickadees (graphs) were found in the medium and high settings more so than the low setting.

Most of the species recorded were generalist species and common backyard birds. However, there may be fewer birds recorded in the Albany Pine Bush because of a collection error. I heard way more birds in the Albany Pine Bush which made it difficult to pinpoint the sounds which led to less recordings of birds on the collection data sheet. I also only recognize a certain number of birds in the wide scheme of things, even with help from the Merlin bird app. In general, I also noticed that there were more birds that I heard in the Albany Pine Bush and Albany areas compared to the Colonie area. However, I saw more birds in the Colonie and Albany areas compared to the Albany Pine Bush area. This is due to the high amount of undergrowth and trees in the Albany Pine Bush preserve as compared to the Albany and Colonie sites which had way more buildings than undergrowth or trees.

I conferred with my mentor and he noted that the ‘high’ suburbanization might just be medium or medium-high suburbanization due to its similarities to the Albany area and that a true high suburbanization level would be located in downtown Albany. I originally thought that downtown Albany would be too loud to hear any birds and so this skewed my results a little. He also noted that perhaps I would have found more pigeons and house sparrows in the high suburbanization level if I had truly collected data from a high suburbanization level. From my

own understanding and observations, I reasonably believe that there are more house sparrows and pigeons in city-like areas even if it is not shown in my data. I often see these two species in any of the cities I have visited. However, this is something for me to correct in future studies.

Because my data and collection design is evenly distributed, using ANOVA tests sufficed instead of using non-parametric tests such as Kruskal-Wallis tests.

Conclusion

My hypothesis was not supported and the Albany site had the highest amount of black-capped chickadees found. My null hypothesis was also rejected, meaning that my data was found to be statistically different between the three sites.

More data collection is needed to differentiate high from medium suburbanization. I think that this will change the results and future research is needed for better results and analysis of said results for this project. I hope to do this in the future in the upcoming breeding season (June-July 2024). I also want to look into Environmental DNA as it might be more accurate to use to collect data

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References

"Albany Pine Bush Bird Checklist." Albany Pine Bush Preserve Commission, 2022, https://albanypinebush.org/fckimages/uploads/1518447225_2017apbp-bird-checklist.pdf.

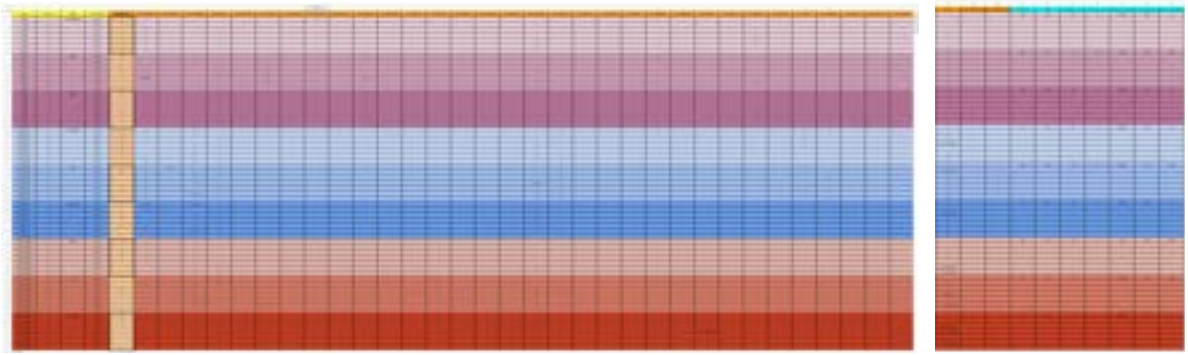
"Black-Capped Chickadee Life History, All About Birds, Cornell Lab of Ornithology," All About Birds, Cornell Lab of Ornithology, https://www.allaboutbirds.org/guide/Black-capped_Chickadee/lifehistory.

Hawver, Christopher "2017 Management Plan for the Albany Pine Bush Preserve."

Jargowsky, Paul A., and Yoonhwan Park. "Cause or consequence?" Crime & Delinquency, vol. 55, no. 1, 2008, pp. 28–50, https://doi.org/10.1177/0011128708323630.

Lookingbill, Todd R., et al. "Evaluation of Albany Pine Bush." 15 Mar. 2013, pp. 1–105.

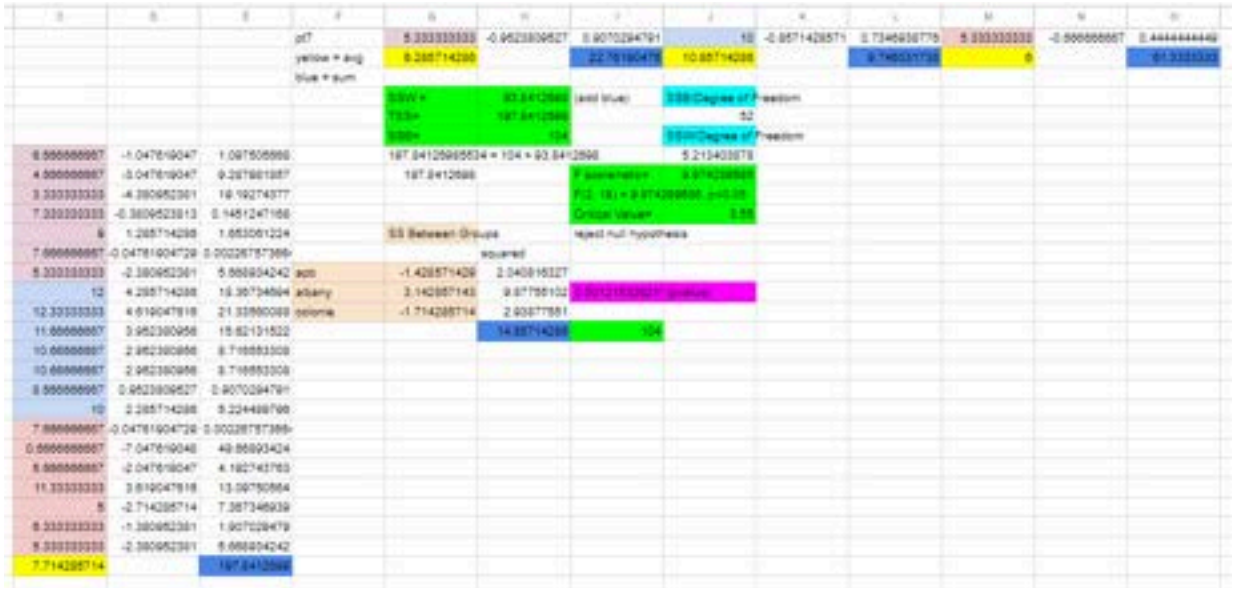
Appendices



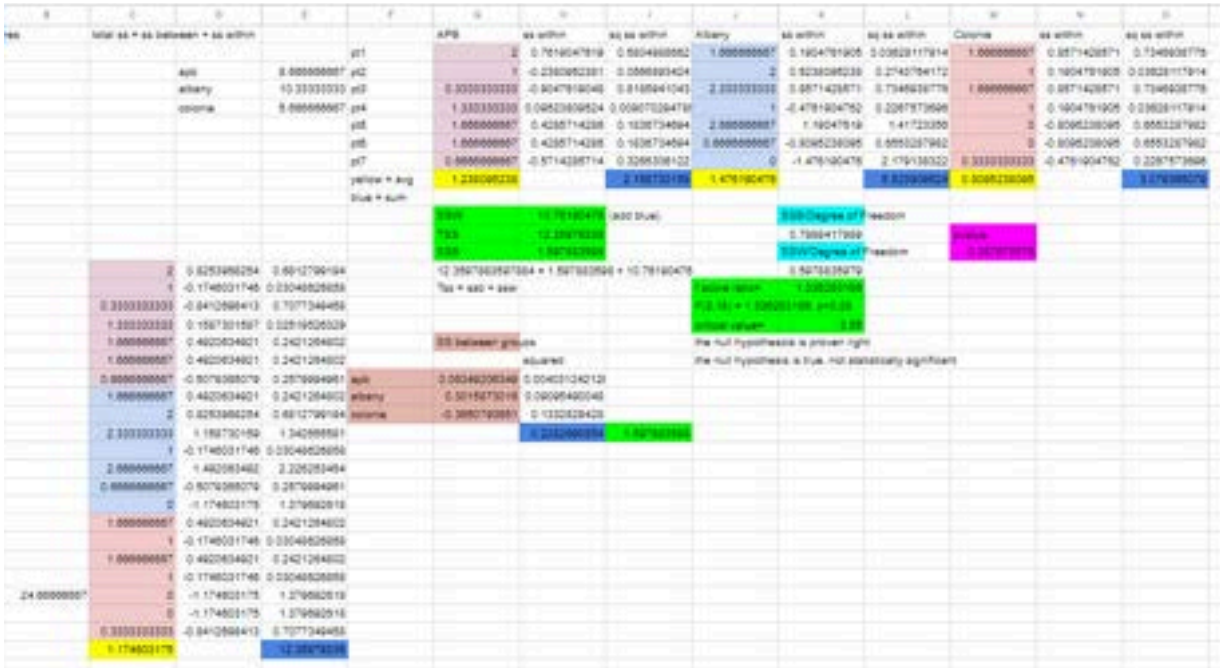
Appendix A - Unsummarized Data

1	Overall	Results		
2	APB	2.414419536	17 species	132 birds in total
3	Albany	2.331813952	24 species	228 birds in total
4	Colonie	2.400829643	18 species	145 birds in total
5	APB1	1.765057252	7 species	20 birds in total
6	APB2	2.111772711	8 species	14 birds in total
7	APB3	1.609437912	6 species	10 birds in total
8	APB4	2.071343303	9 species	22 birds in total
9	APB5	2.150723378	9 species	23 birds in total
10	APB6	2.039582475	9 species	23 birds in total
11	APB7	2.079441542	9 species	16 birds in total
12	Albany1	2.480066497	15 species	37 birds in total
13	Albany2	2.228549201	11 species	37 birds in total
14	Albany3	2.036939165	9 species	35 birds in total
15	Albany4	1.744418082	8 species	31 birds in total
16	Albany5	1.914610265	9 species	32 birds in total
17	Albany6	1.73598604	6 species	25 birds in total
18	Albany7	0.2986265782	9 species	30 birds in total
19	Colonie1	2.19464393	11 species	23 birds in total
20	Colonie2	1.917215519	8 species	20 birds in total
21	Colonie3	1.870568889	8 species	17 birds in total
22	Colonie4	2.092717709	10 species	34 birds in total
23	Colonie5	1.522699926	6 species	15 birds in total
24	Colonie6	1.530605242	6 species	19 birds im total
25	Colonie7	1.714087541	6 species	15 birds in total

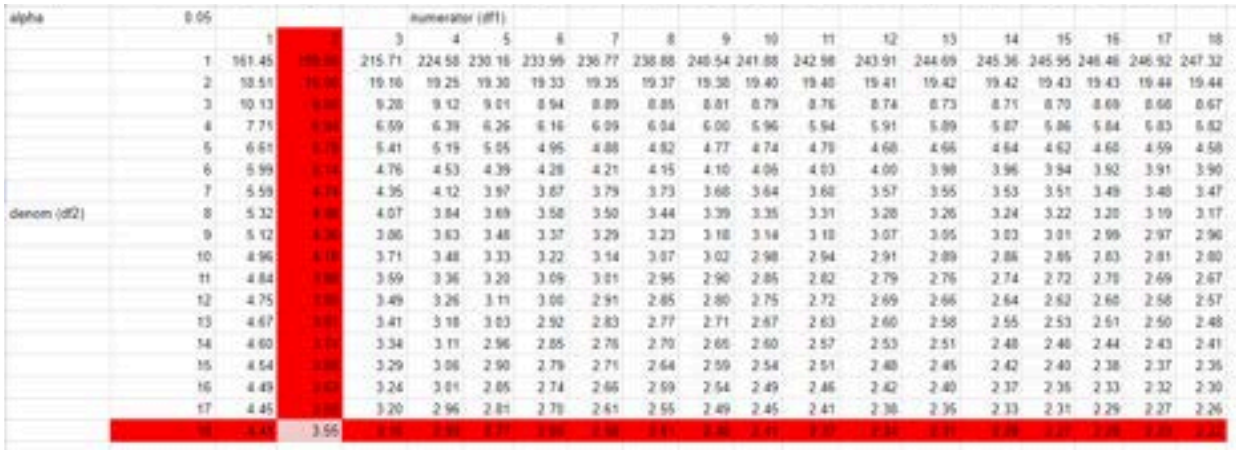
Appendix B - Shannon Diversity Index Results



Appendix C - ANOVA Overall

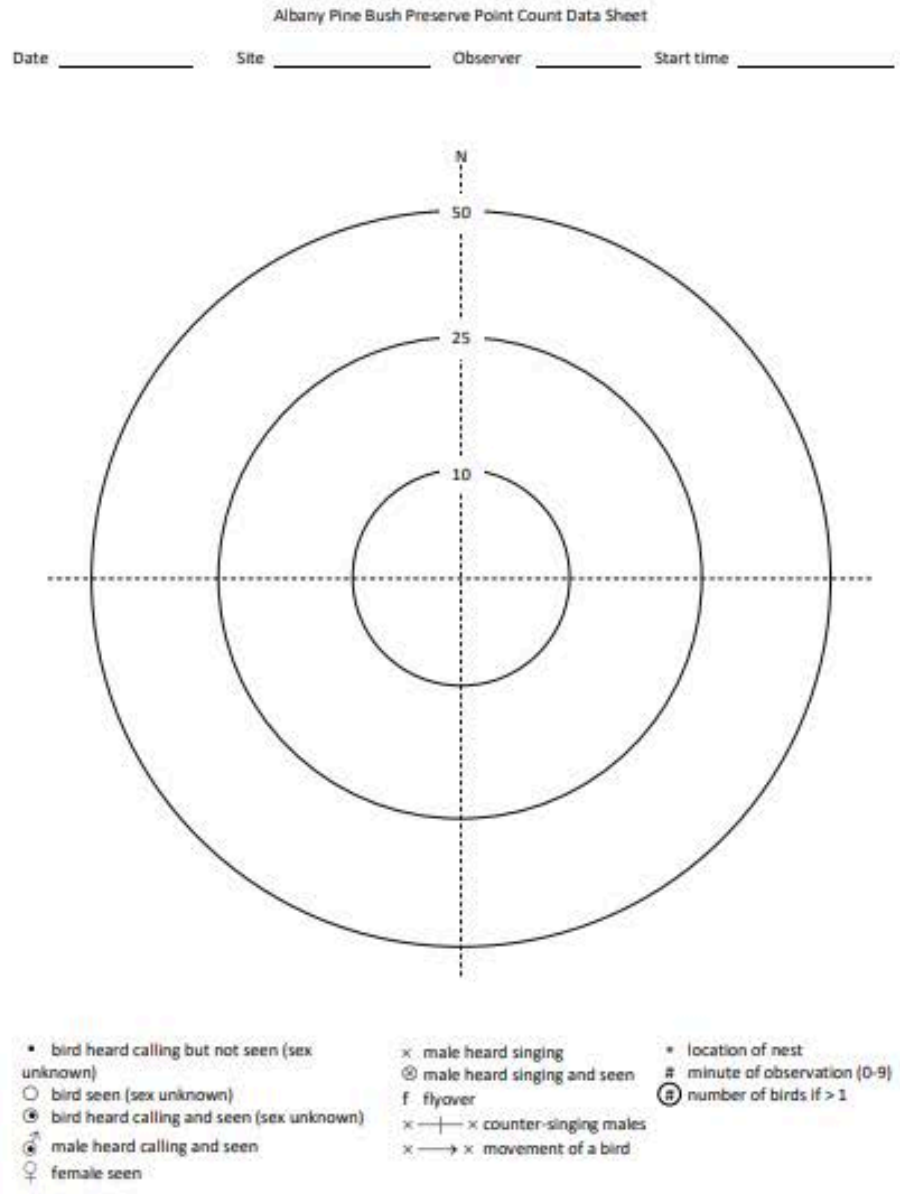


Appendix D - ANOVA BCCH



alpha	0.05			numerator (df1)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88	242.98	243.91	244.69	245.36	245.95	246.46	246.92	247.32
	2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.40	19.41	19.42	19.42	19.43	19.43	19.44	19.44
	3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.76	8.74	8.73	8.71	8.70	8.69	8.68	8.67
	4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.94	5.91	5.89	5.87	5.86	5.84	5.83	5.82
	5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.70	4.68	4.66	4.64	4.62	4.60	4.59	4.58
	6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.03	4.00	3.98	3.96	3.94	3.92	3.91	3.90
	7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.60	3.57	3.55	3.53	3.51	3.49	3.48	3.47
denom (df2)	8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.31	3.28	3.26	3.24	3.22	3.20	3.19	3.17
	9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.10	3.07	3.05	3.03	3.01	2.99	2.97	2.96
	10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.94	2.91	2.89	2.86	2.85	2.83	2.81	2.80
	11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.82	2.79	2.76	2.74	2.72	2.70	2.69	2.67
	12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.72	2.69	2.66	2.64	2.62	2.60	2.58	2.57
	13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.63	2.60	2.58	2.55	2.53	2.51	2.50	2.48
	14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.57	2.53	2.51	2.48	2.46	2.44	2.43	2.41
	15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.51	2.48	2.45	2.42	2.40	2.38	2.37	2.35
	16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.46	2.42	2.40	2.37	2.35	2.33	2.32	2.30
	17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.41	2.38	2.35	2.33	2.31	2.29	2.27	2.26
	18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.37	2.34	2.31	2.29	2.27	2.25	2.23	2.22

Appendix E - F Distribution Table



Appendix F - blank point count data sheet


(appendix G)

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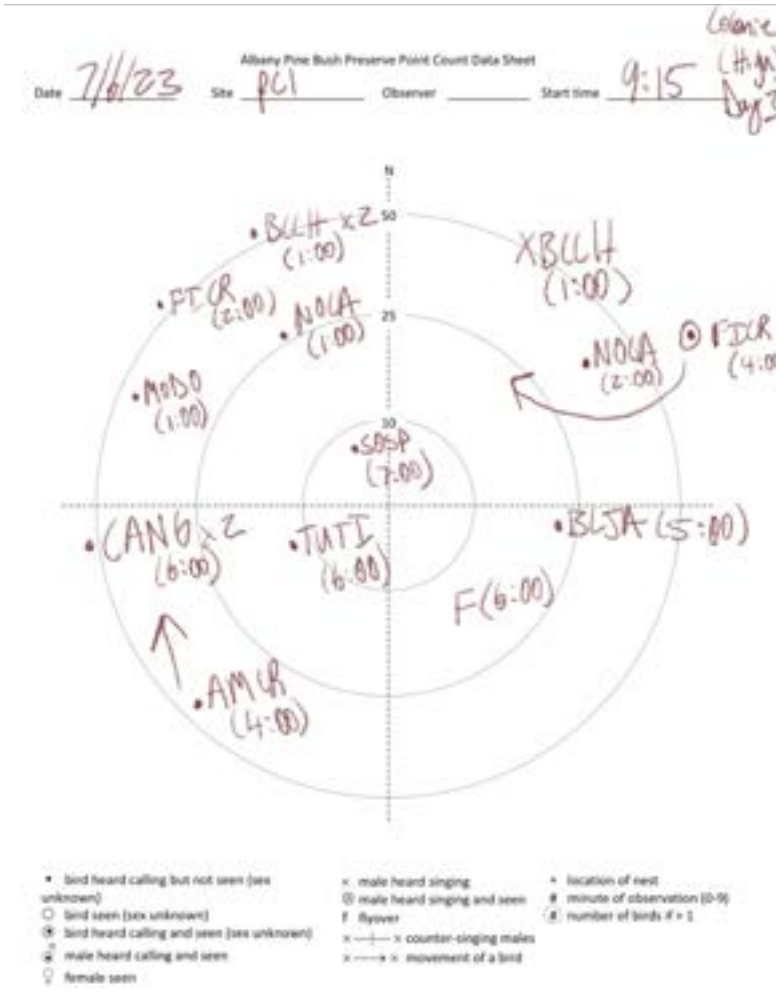
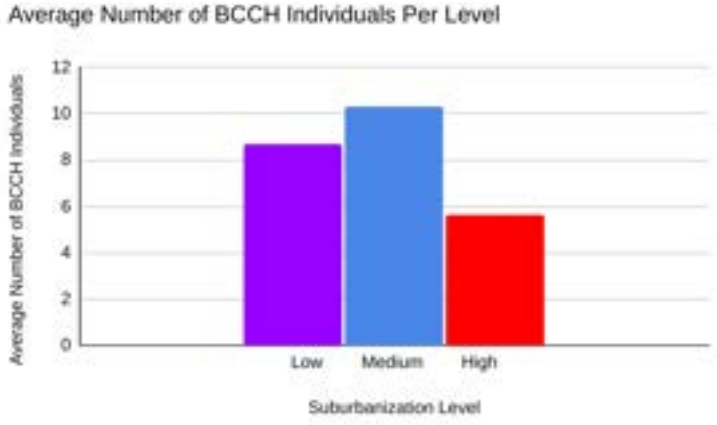
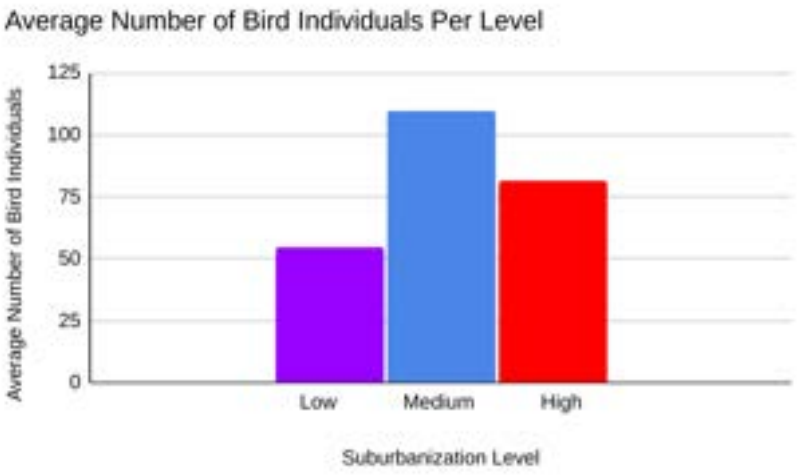
(appendix M)



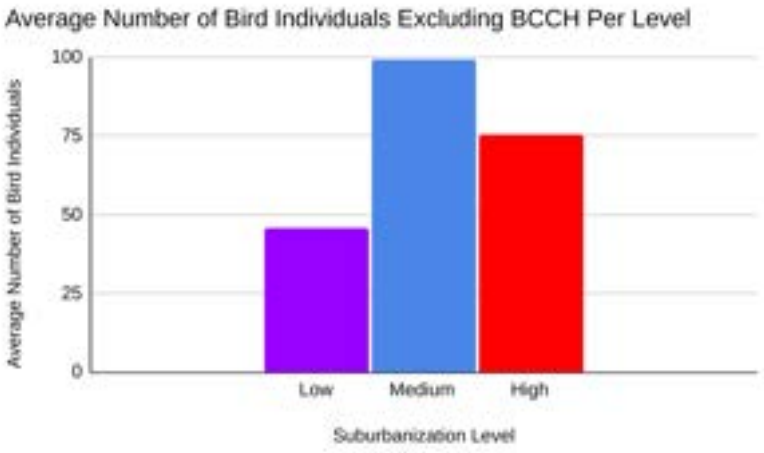
Appendix N - completed point count data sheet



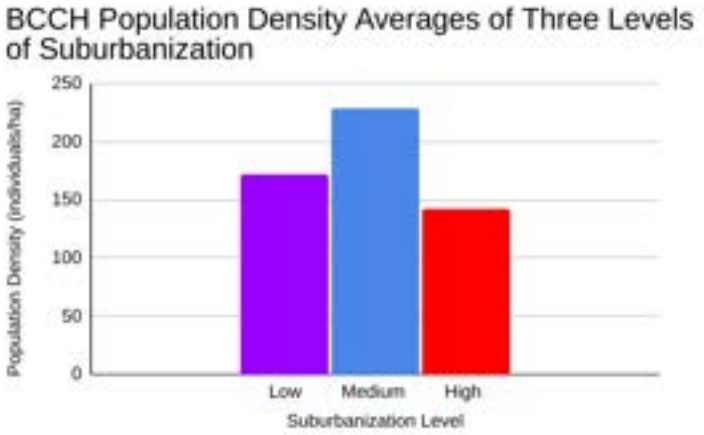
Appendix O - raw data graph of only BCCH



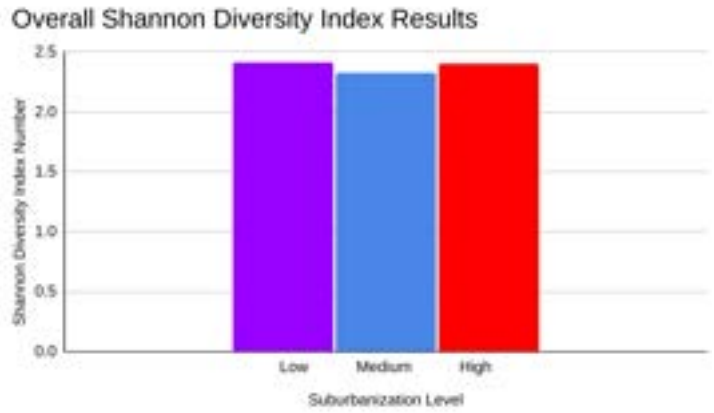
Appendix P - raw data graph of total birds



Appendix Q - raw data graph of total birds excluding BCCH



Appendix R - population densities graph



Appendix S - shannon diversity index graph