The Effects of Temperature and Moon-Phase on the Migration of the Northern Saw-whet Owl (*Aegolius acadicus*) at Beaverhill Bird Observatory in Autumn 2016

January, 2018

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Introduction

The Northern Saw-whet Owl (*Aegolius acadicus*), at 20 centimeters in length, is the second smallest species of raptor in Alberta and despite being fairly common in the forested areas of the Rocky Mountains and boreal forests, it is rarely seen due to its nocturnal and secretive nature (Alberta Environment and Parks 2017). Northern Saw-whet Owls are secondary-cavity nesters and rely on areas that contain older trees or snags for suitable nesting sites. These owls nest in naturally formed tree cavities or cavities excavated by other avian species (Groce and Morrison 2010). Northern Saw-whet Owls are a migratory species that migrates from northerly breeding locations in the Canadian boreal forest to as far south as Alabama, Louisiana, and northern Florida (Beckett, & Proudfoot, 2011). Northern Saw-whet Owls are banded at various locations across North America giving scientists crucial information regarding their population numbers, migratory routes, and overwintering locations. Banding efforts have revealed that Northern Saw-whet Owl populations have cyclical population migration irruptions about every four years. This could be due to prey abundance and scarcity (Beckett, & Proudfoot 2011).

While some Northern Saw-whet Owls are residents and overwinter in Canada, the majority undergo a southern migration during fall and fly through the Beaverhill Natural Area located near Tofield, Alberta. Since 1997, biologists at the Beaverhill Bird Observatory (BBO) have been running a monitoring program in order to record information on this migration, as well as collect much needed, long-term data on the population trends of the Northern Saw-whet Owl in Western Canada (Beaverhill Bird Observatory 2017).

This report will examine the effects of temperature and moon phases on Northern Saw-whet Owl movements during their fall migration. More precisely, the mean daily temperature will be used in the data analysis, since different thermal exposure can affect metabolic rate during active hours, as well as during resting time (Krystal et al. 2013); which could in turn initiate migration movement for Northern Saw-whet Owls. We will also look at moon phase and how light availability could affect owl movement and capture rate.

Methods

From September 1st, 2016 until November 11th, 2016, four nylon mist nets which measured 3m tall, and 12m long, were placed in deciduous forest near the BBO laboratory and were opened half an hour after sunset and stayed open for six hours. Mist nets were closed if weather became unsafe for banding, such as winds above 20 km/hr at the net level, any rain, medium to heavy snow, or if temperatures dropped below -15 ° C. Three mist nets were placed in a ‘U’ shape, with an audio lure playing the territorial call of the Northern Saw-whet Owl, while the fourth net was placed a short distance away (see Appendix, Figure 7). The mist nets were checked every 30 minutes and owls were extracted from the mist nets and carried back to the lab for banding. A lightweight aluminum band with a 9-digit serial number was placed on their right tarsus for individual identification. For each bird, the data recorded included the time of capture, the weather (temperature, wind, cloud coverage, precipitation, and visibility of the moon), the net caught in, band number, wing length, tail length, weight, sex, age and molt pattern (if older than hatch year). Each bird was released after banding and all the data recorded was then entered into a bird banding database called “Bandit”.

Results

In the season of 2016, a total of 564 Northern Saw-whet Owls were caught, the majority of which were new-bands, except for the 23 recapture owls. Hatch year birds were the most commonly caught age with 401 captures, followed by second year birds with 93 captures, after second year birds with 37 captures, and after hatch year birds with 10 captures (Table 1).

Table 1. - Ages of captured Northern Saw-whet Owls during the 2016 monitoring program

Age	Count
After hatch year	10
Hatch year	401
Second year	93
After second year	37

During every evening of owl banding, the cloud cover, moon phase, temperature, wind speed/direction, and precipitation were recorded, but the weather-related data used in this report will be from the Agriculture and Forestry department of the Government of Alberta database, from September to November 2016 collected at Shonts AGCM station, (Government of Alberta, 2017), which is the closest governmental weather station from the BBO. This database provides the temperature of the entire day instead of being restricted to the night temperature only. Figure 1 shows the average daily temperature versus the number of owls captured every night. The first increase in the migration can be observed on September 19 after the temperature dropped from 15.6 to 10.5 ° C on September 18. The number of owls captured fluctuated daily, going from 18 captures on October 2, down to one on October 14-15, until another major peak between October 18 until October 22, when 34 owls were caught in one night; the highest number for the season. From October 26 until the end of the banding program on November 11, only three nights had 10 captures or more. The distribution of the captures over the 58 days of banding shows a more pronounced difference, since half the captures occurred in the middle of the migration from October 2 to October 22 (270 owls), while the first and last third of the migration accounted for 29 % and 21% of the captures respectively. A simple regression analysis of the daily mean temperature versus the number of owl captures (Figure 2) shows a poor relationship with an R^2 value of 0.0036. The ANOVA (Table 2) also shows the regression to be non-significant with a P value higher than 0.05 (P=0.6564).

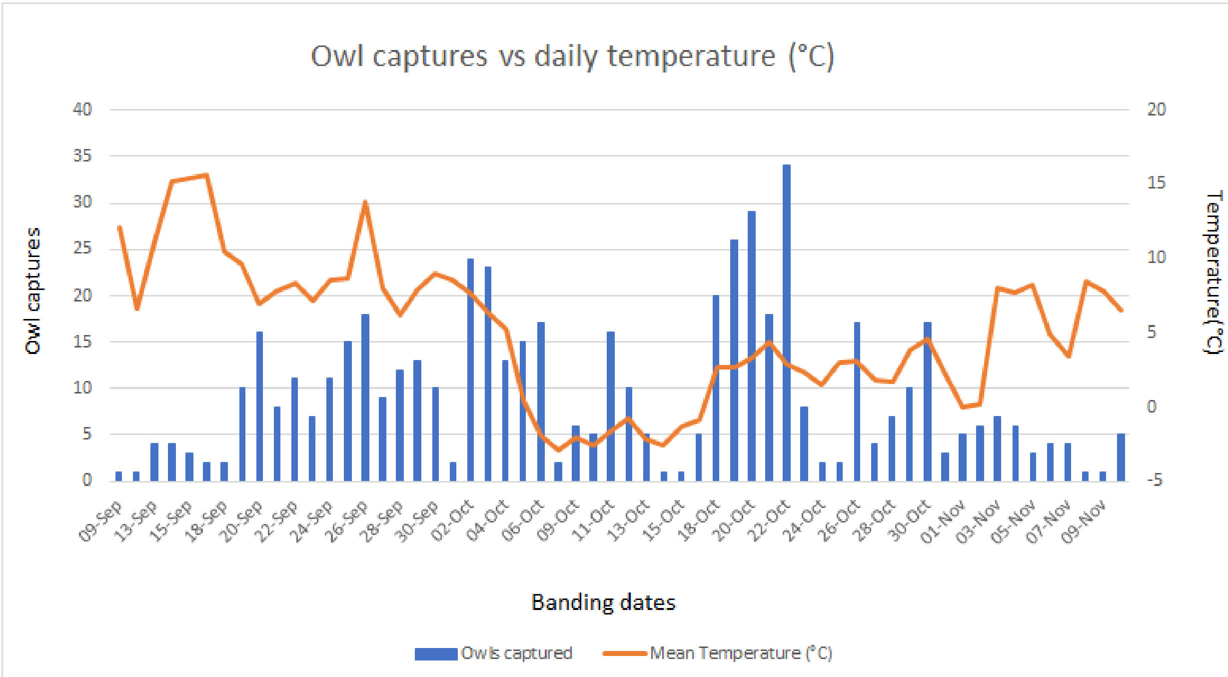

Figure 1. The number of owls captured (vertical blue bars) versus the mean daily temperature (orange line)

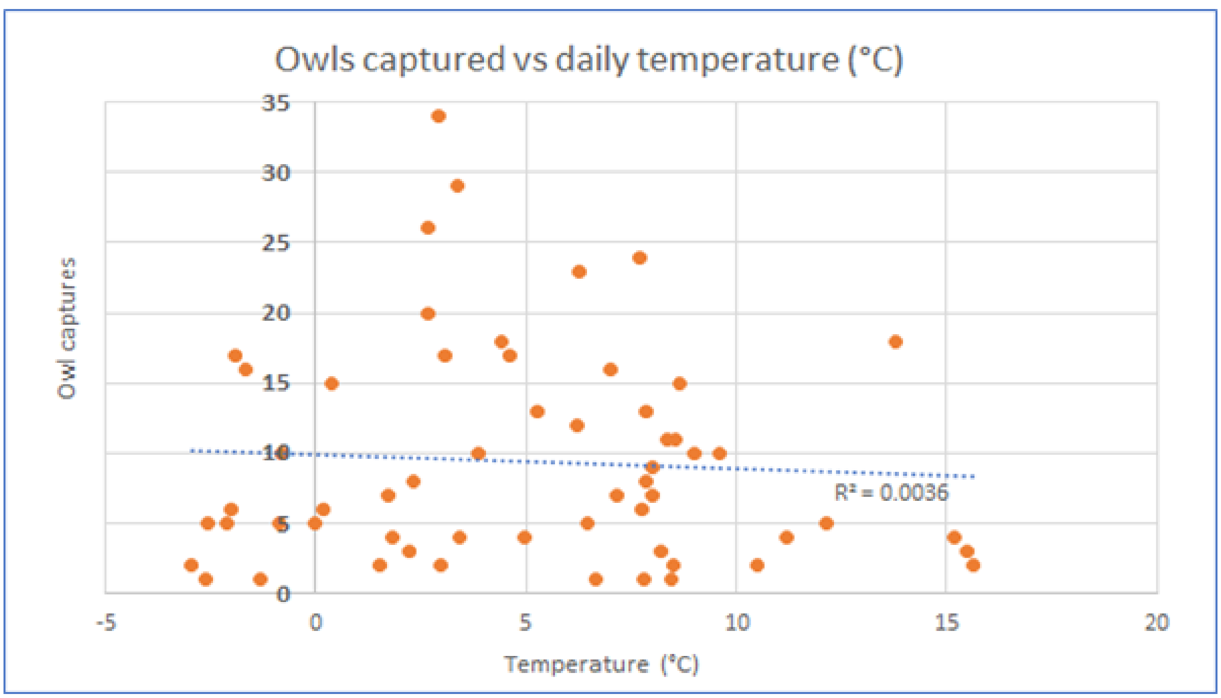

Figure 2. Linear regression analysis of the number of owls captured vs the mean daily temperature

Table 2. Results of the ANOVA for the regression analysis of temperature versus owl captures

ANOVA						
	df	SS	MS	F	Sign. F	
Regression	1	12.1291	12.1291	0.2000	0.6564	
Residual	56	3395.7502	60.6384			
Total	57	3407.8793				
	Coef-ficients	SE	t Stat	P-value	Lower 95%	Upper 95%
Intercept	9.8804	1.4885	6.6377	1.37E-08	6.8985	12.8622
Mean Temp. (°C)	-0.0955	0.2136	-0.4472	0.6564	-0.5234	0.3323

The moon phases depicted in this report are from The Old Farmer's Almanac website for the moon and lunar phases for Tofield, Alberta (The Old Farmer's Almanac, 2017). Figure 3 illustrates the number of owls caught during the different phases of the moon, from 0% being a new moon to 100% being a full moon. Regression analyses conducted on the number of owls caught versus the moon phase (Table 3) shows a P-value = 0.2166 (which is greater than 0.005) and therefore is non-significant. Along with the P-value though, the R^2-value is 0.0276 (Figure 4) which indicates a correlation within the data. Examining the graphical data in Figure 3, we see a higher number of owls being caught when the moon phase is at a lower percent. This could be either due to the owls not flying during a full moon, or they are flying but the nets are more visible during this time. This assumption is based on the number of owls being caught per night. Figure 3 however does not take into account cloud cover for the respective dates.

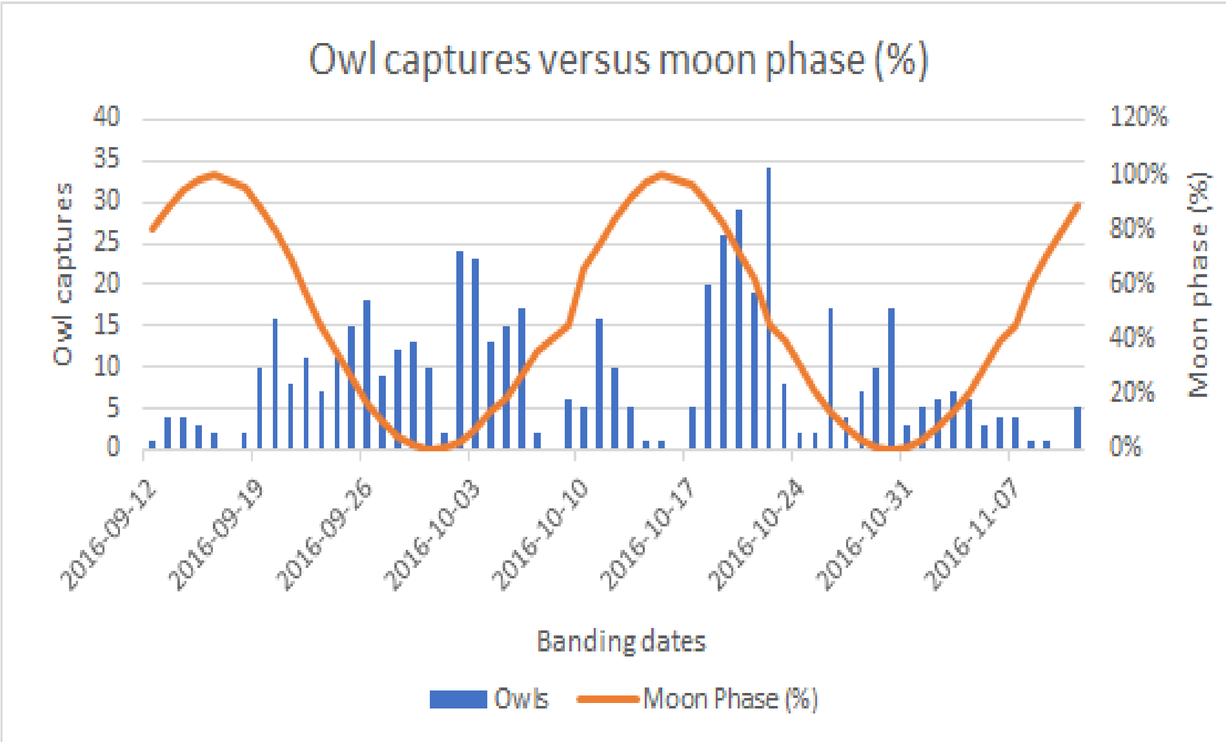

Figure 3. Number of owls (vertical blue bars) captured versus the % moon phase (orange line)

Table 3. Results of the ANOVA for the regression analysis of owl captures vs moon phases (%)

ANOVA						
	df	SS	MS	F	Sign. F	
Regression	1	94.0950	94.0950	1.5624	0.21659	
Residual	55	3312.15	60.220			
Total	56	3406.24				
	Coeffic-ients	SE	t-stat	P-value	Lower 95%	Upper 95%
Intercept	11.181	1.6983	6.5836	1.8105E-08	7.7776	14.5846
Moon Phase (%)	-3.6977	2.95821	-1.25	0.216592	-9.6261	2.2306

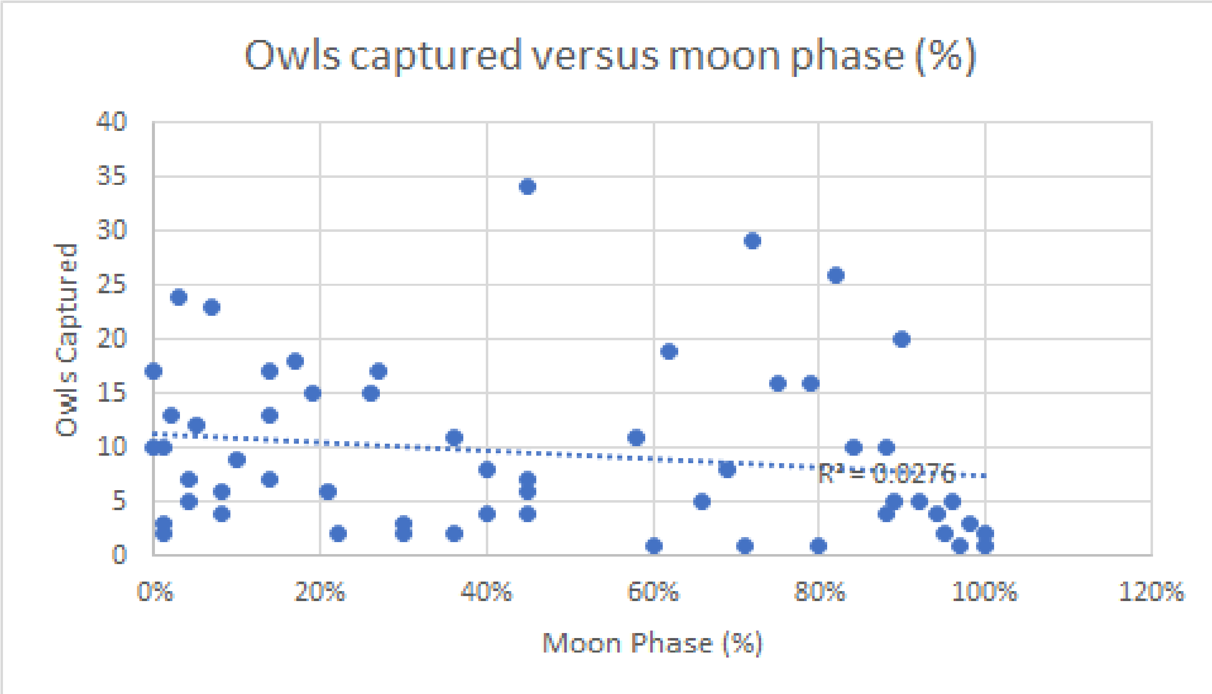

Figure 4. Regression analysis of owls captured versus the moon phases (%)

When the cloud coverage in percent versus the owl captures is evaluated with a regression analysis (Figure 5 and Table 4), there is a significant (P-value= 0.0016), but weak correlation (R^2= 0.16) showing a lower owl captures when the cloud coverage is higher. On the other hand, the graph representation of both the cloud cover per night of owl banding compared to the number of owls captured during the respective moon phase (Figure 6) shows a different correlation. The number of owls caught on heavy cloud cover nights is higher than the number of owls caught on reduced cloud cover nights, but only when the moon is on a new moon phase. On full moon, high cloud coverage doesn't seem to promote flight in the Northern Saw-whet Owls. This can be observed during the middle of the migration; when the moon is over 60% full, the number of owls captured were low even with high cloud coverage.

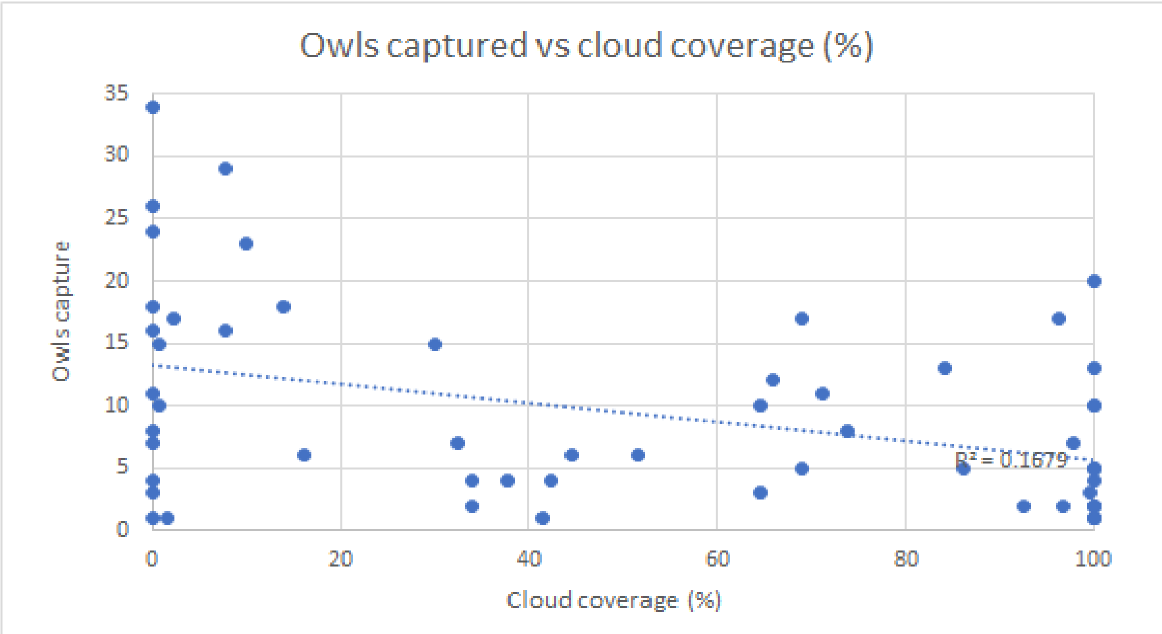

Figure 5. Regression analysis of the number of owls captured vs the cloud coverage

Table 4. Results of the ANOVA for the regression analysis of cloud coverage versus owl captures

ANOVA						
	df	SS	MS	F	Sign. F	
Regression	1	580.5915	580.5915	11.0951	0.0016	
Residual	55	2878.0752	52.3286			
Total	56	3458.6667				
	Coef-ficients	SE	t Stat	P-value	Lower 95%	Upper 95%
Intercept	13.3281	1.5350	8.6826	0.0000	10.2518	16.4044
Cloud coverage	-0.0775	0.0233	-3.3309	0.0016	-0.1241	-0.0309

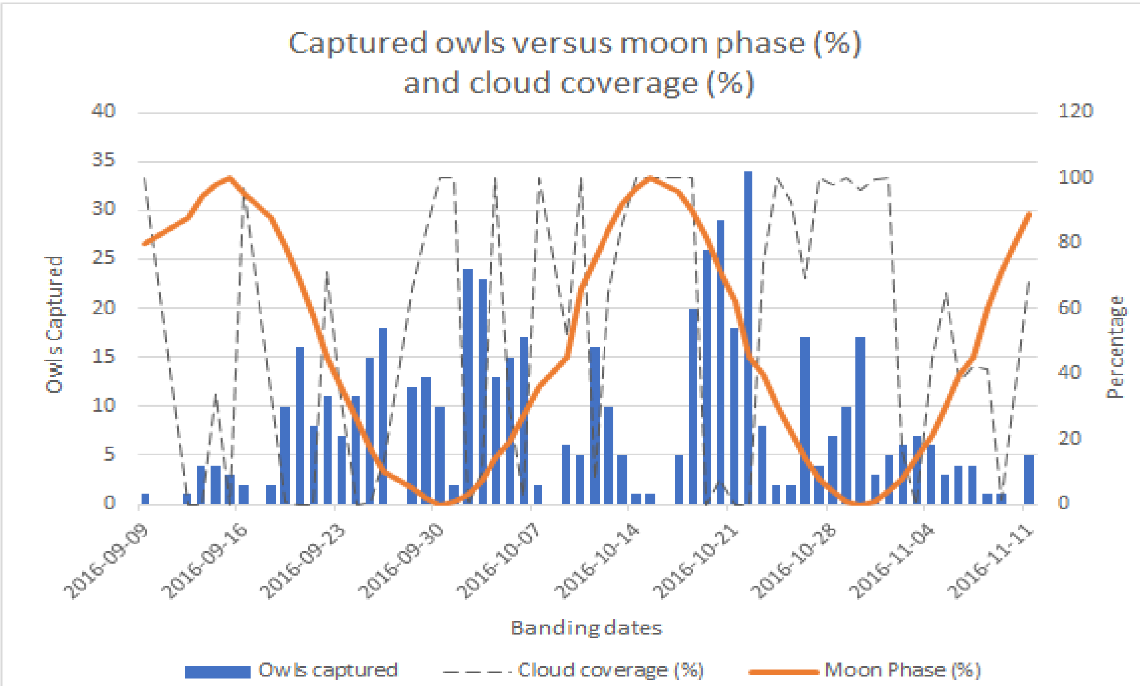

Figure 6. Owls captured versus the moon phase and the cloud coverage (%)

Discussion

In 2016, temperature did not show strong correlation with the number of owls captured, except for the first increase in migration seen on September 19th. Despite the temperature increasing in November and having fewer captures, the low numbers were most likely linked to the end of the migration and the fact that most owls had already flown south.

When looking at moon phase, we could see a trend relating to the number of owls that were migrating through the Beaverhill Natural Area. The number of owls active during the new moon phases were high while the number of owls flying during the full moon phases were quite low. When the moon is full, it emits more light which can greatly affect predation because the owls are more visibile to predators (Penteriani et al. 2009). Northern Saw-whet Owls are a prey species for many larger raptors because of their relative small size. They are a nocturnal species which rely heavily on the light of the moon to hunt, but they also need to avoid being hunted themselves. The potential for predation from larger owls and the increased visibility of the nets are both possibilities that can affect the efficiency of owl capture during different moon phases. A high cloud coverage would reduce the chances of the owls being seen and the captures could potentially be higher during those nights. However, the opposite reaction is observed when only the cloud coverage is compared to owl captures in a regression analysis. When the moon is taken into consideration along with the cloud coverage, it shows the Northern Saw-whet Owls avoided flying on nights of high cloud coverage when the moon was full (or near full), which possibly indicates a stronger influence from the moon on the migration.

Conclusion

Despite not always being completely understood, environmental factors have strong influences on animal behaviour and will continue to play a role in migration patterns. As observed in this report, the temperature and cloud coverage had weak correlation while the moon phase had a strong correlation with the number of owls captured for the 2016 season. Further monitoring effort and study is needed to understand such factors, as well as the journey undertaken every fall by Northern Saw-whet Owls in Canada and the United States.

Appendix

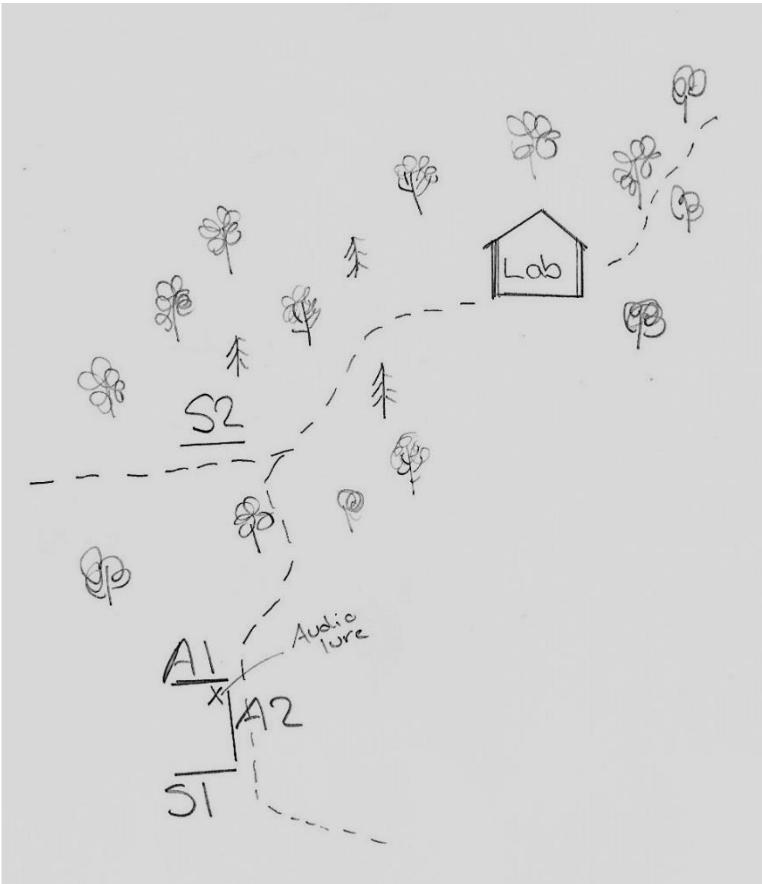

Figure 7. Location of the nets relative to the BBO lab.
The nets are label A1, A2, S1, and S2

References

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