Spring Nocturnal Migration at Amherst, Nova Scotia, 2014-2015

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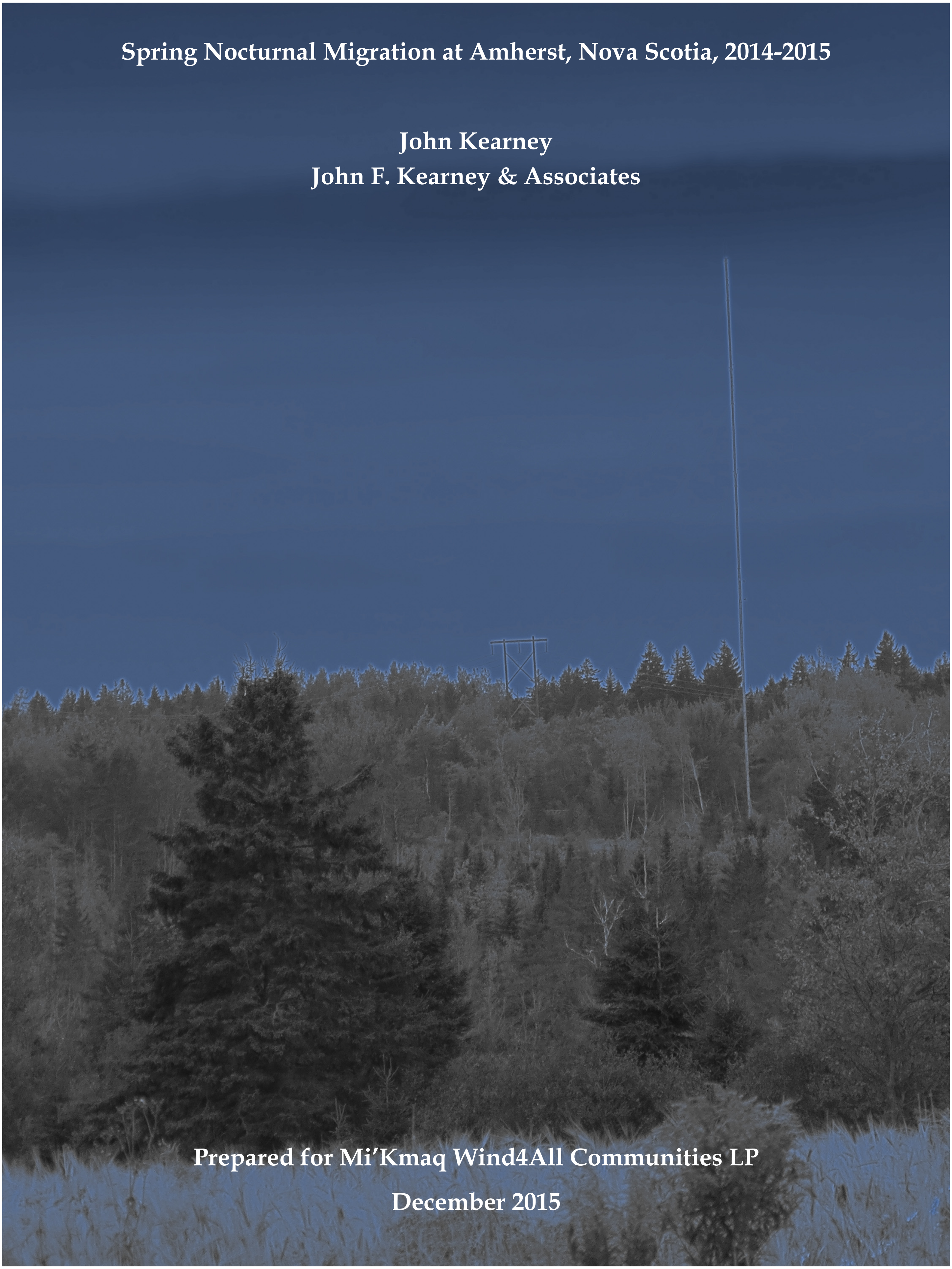

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Abstract

The two years of data show that the intensity of spring nocturnal migration at low altitude is considerably greater in the northwest portion of project area than in the southeast portion. Most of these nocturnal migrants are small passerines. The intensity of migration is highest in the three hours before civil sunrise when birds appear to be descending through the acoustic range of the microphones from higher altitudes to the ground. This intensity may also be greater with very light winds, warmer temperatures, and higher barometric pressure.Two species of conservation concern in the project area that have aerial displays and/or foraging behaviour at blade height are the Wilson's Snipe ("sensitive") and Common Nighthawk ("threatened"). The post-construction monitoring plan should include protocols for monitoring both these species in the project area.The total number of high frequency night flight calls during the spring migration at Stations 5 and 3 are among the highest for various locations in Nova Scotia where the same acoustic monitoring methods have been carried out. Stations 1 and 4 are among the lowest. These data further highlight the difference in the intensity of migration between the southern and northern section of the study area.

Introduction

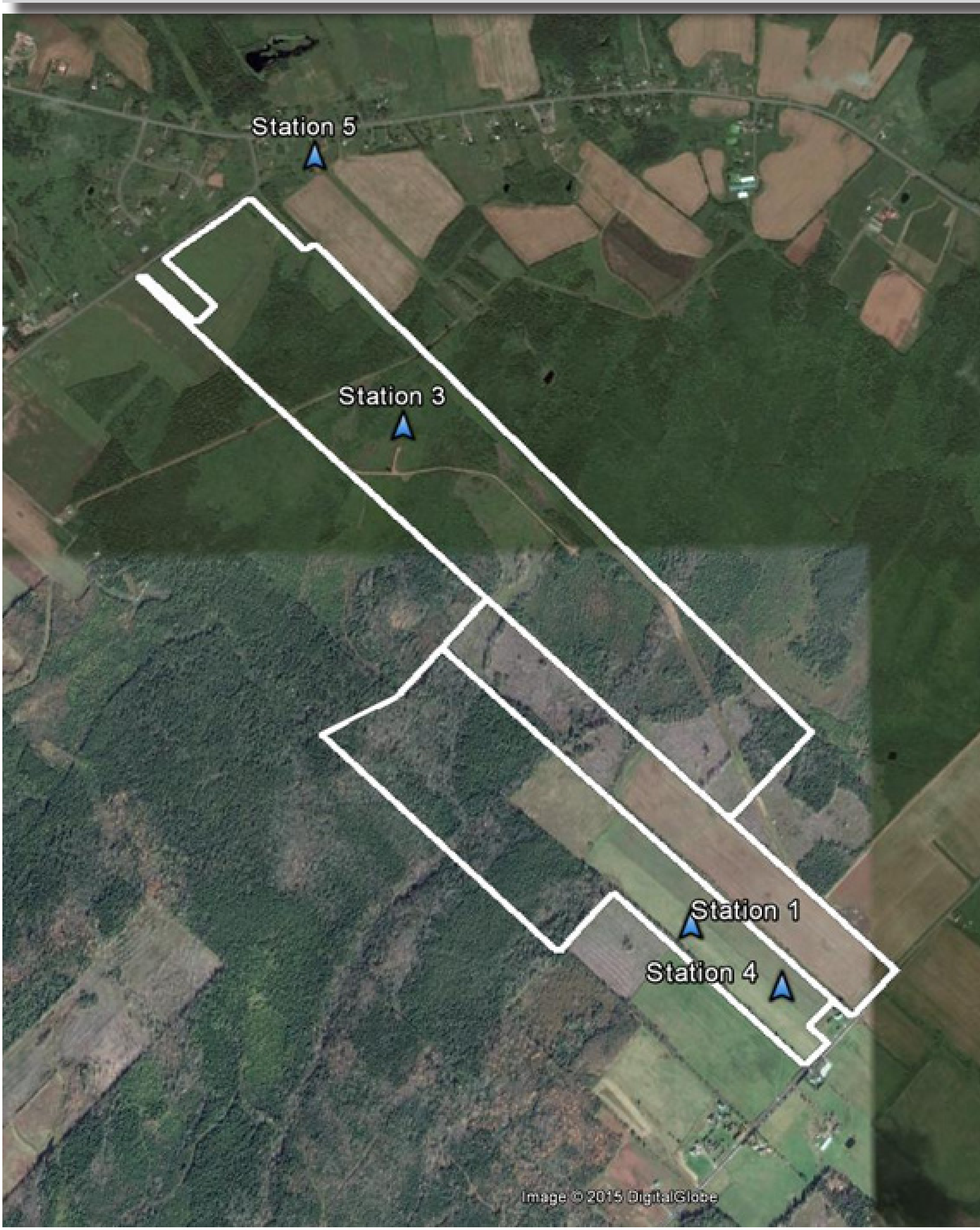
Acoustic and radar studies of bird migration were carried out in the spring of 2015 as a supplement to the baseline, pre-construction study for the Amherst Community Wind Farm that was completed in 2014. Studies in 2014 included a full complement of field surveys and acoustic monitoring including studies of stop-over, diurnal passage, nocturnal passage, breeding birds, and wintering birds. A radar study was carried out during the autumn migration of 2014 with the intention of doing a spring radar study in 2015 along with a repeat of the spring acoustic work. The report presents the results of the acoustic work in 2015 as well as an aggregated analysis of the spring acoustic work over two years.

Figure 1: Location of Amherst in the Canadian Maritime Provinces

Location

The project area is located on the Chignecto Isthmus, a narrow bridge of land only 17 kilometers in width at its

Figure 2: Location of Acoustic Monitoring Stations



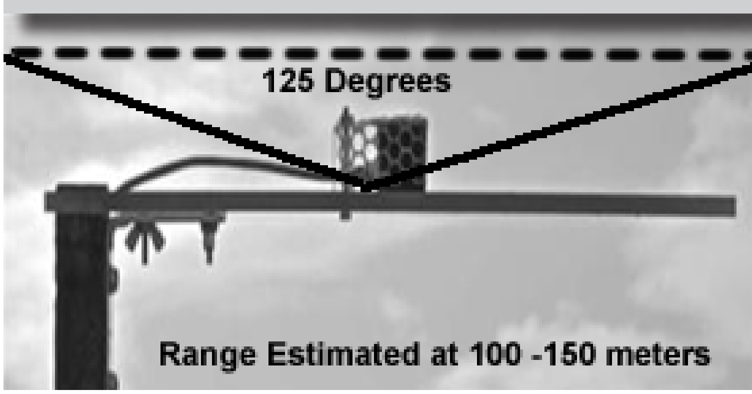
narrowest point (see Figure 1). The Isthmus is the only land connection between Nova Scotia and the mainland of North America and separates two major marine bodies; the Bay of Fundy and the Gulf of St. Lawrence. The region is recognized as an important breeding and migration stop-over area for birds. More details on the ecological and avian significance of the area is given in Kearney (2015).

A total of four acoustic monitoring stations were deployed; two in each of the two years of the study. As shown in Figure 2, three of the stations were located within the project area and one outside. Stations 1, 4, and 5 were located in or near the edge of agricultural fields (hay and corn), and Station 3 was in a forestry clearcut. Stations 1 and 3 were deployed in 2014, and Stations 4 and 5 in 2015. The latter two stations were located within approximately 20-50 meters of a marine radar installation simultaneously monitoring nocturnal migration.

Acoustic Methods

Figure 3: Acoustic Monitoring Setup at Station 1

Figure 4: SMX-NFC Microphone



Acoustic monitoring of nocturnal passage provides data on the species of birds migrating through an area, their relative abundance, and migration timing. Recording took place every night from civil sunset to civil sunrise from mid-April to early June. At all sites, a Song Meter SM2, made by Wildlife Acoustics, was used as a recording device. The Song Meter is powered by 2 AA and 4 D alkaline batteries. Settings were as follows:

- Sampling format: 16 bit
- Sampling rate: 24,000 Hz
- High pass filter: 1,000 Hz
- Pre-amp: 60 dB gain
- Storage: 2-32GB SD cards

Wildlife Acoustics also produces a night flight call microphone, the SMX-NFC, to be used with the Song Meter (see Figure 3). This weather-resistant microphone rests on a flat horizontal plate creating a pressure zone resulting in a 3-6 dB gain within a beam angle of 125 degrees (see Figure 4). Based on experience in Nova Scotia, the range is estimated at 100-150 meters in altitude.

The Song Meter and SMX-NFC

Table 1: Detection Parameters

	High Frequency	Low Frequency
Minimum Frequency	6,000 Hz	2,250 Hz
Maximum Frequency	11,000 Hz	3,750 Hz
Minimum Duration	29 ms	29 ms
Maximum Duration	400 ms	330 ms
Minimum Separation	104 ms	52 ms
Signal to Noise Ratio Parameters		
-- Minimum Occupancy	25.0%	20.0%
-- Threshold	3.5 dB	4.0 dB
Noise Power Estimation Parameters		
-- Block Size	5,000 ms	1,000 ms
-- Hop Size	250 ms	250 ms
-- Percentile	50.0%	50.0%

microphone were chosen for use in this study since they were also employed by the author at seven other existing or proposed wind energy facilities from 2011 to 2015 in Nova Scotia.

The detection of night flight calls was conducted using the Raven Pro sound analysis software produced by the Cornell Lab of Ornithology. The detection parameters for high frequency calls (sparrows and warblers) and low frequency calls (thrushes and shorebirds) are shown in Table 1. The review panel of Raven Pro allows for a standardized process to classify, identify, and store night flight calls.

During periods of wind and/or rain, detection software can produce tens of thousands of false positives. This effect is more severe in the low frequency range. To overcome this problem, a number of bandwidth filters were employed when normal detector runs produced more than 5,000 detections. For the high frequency detector, a bandwidth filter with a minimum of 100 Hz, a maximum of 1000 Hz, and an energy percentile of 40% (the fraction of total energy in the specified bandwidth) proved to be the most effective. For the low frequency detector, a filter with a minimum bandwidth of 100 Hz, a maximum of 500 Hz, and an energy percentile of 40% or more was used. Past studies showed that the high frequency filter captured up to 98% of the true positives detected without the filter. For the low frequency detector, the bandwidth filter is less efficient but still captures the majority of night flight calls during the night. The use of the filters can be supplemented by a systematic search of those times of a given night where most of the night flight calls were detected.

Table 2: Total Spring Night Flight Calls, 2014 & 2015

Year	Location	Total Calls
2014	Station 1	320
	Station 3	428
	Total	748
2015	Station 4	487
	Station 5	672
	Total	1,159
2014-2015	Total	1,907

Results

The total of all night flight calls recorded at the four stations in 2014 and 2015 is summarized in Table 2. There 748 calls detected in 2014 and 1,159 in 2015. Thus, 411 more calls were recorded, or about 50% more, in 2015 than in 2014. This was largely the result of the higher number of calls at

Table 3: Total Spring High and Low Frequency Night Flight Calls by Station, 2014 & 2015

Year	Location	Frequency	Total Calls
	Station 1		
		High	300
2014		Low	20
	Station 3		
		High	428
	Station 4		
		High	276
2015		Low	211
	Station 5		
		High	672
2014-2015	Total		1,907

Station 5, the station just outside the project area.

The high frequency calls (warblers and sparrows) were analyzed at all four stations. However, due to the much longer time involved in processing low frequency calls (thrushes and other medium sized birds), low frequency analysis was conducted at only 1 station in each of the two years.

As shown in Table 3, the most high frequency calls were recorded at Station 5 in 2015 with 672 calls. The number of calls increases from south to north with the lowest number of calls at Station 4. While Station 1 and 4 are relatively close to each other, Station 4 had a considerably higher number of low frequency calls in 2015 than did Station 1 in 2014. No analysis of low frequency flight calls were conducted for Stations 3 and 5.

Figure 5: Total High Frequency Calls by Date in the Spring for Two Years, 2014 & 2015

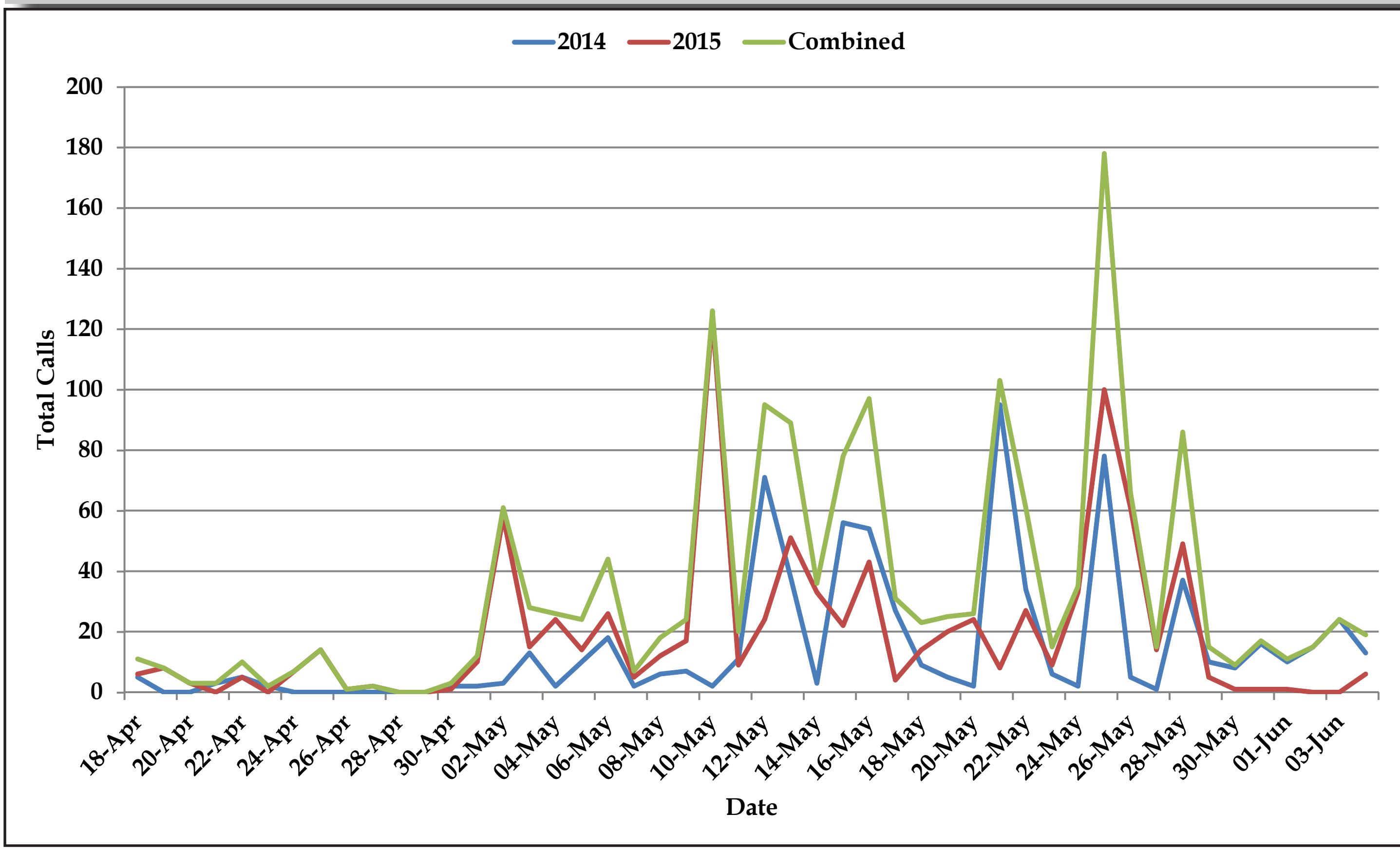


Figure 5 shows the total high frequency calls by date for each of the two years of monitoring along with a combined total of calls for both spring surveys. As can be seen in Figure 5, the chronology of nocturnal migration is similar in the two years. There are two peaks; the first from 10 to 16 May and the second from 21 to 28 May.

Figure 6: Total Spring High Frequency Calls Recorded over Two Years by 10-Day Period, 2014 & 2015

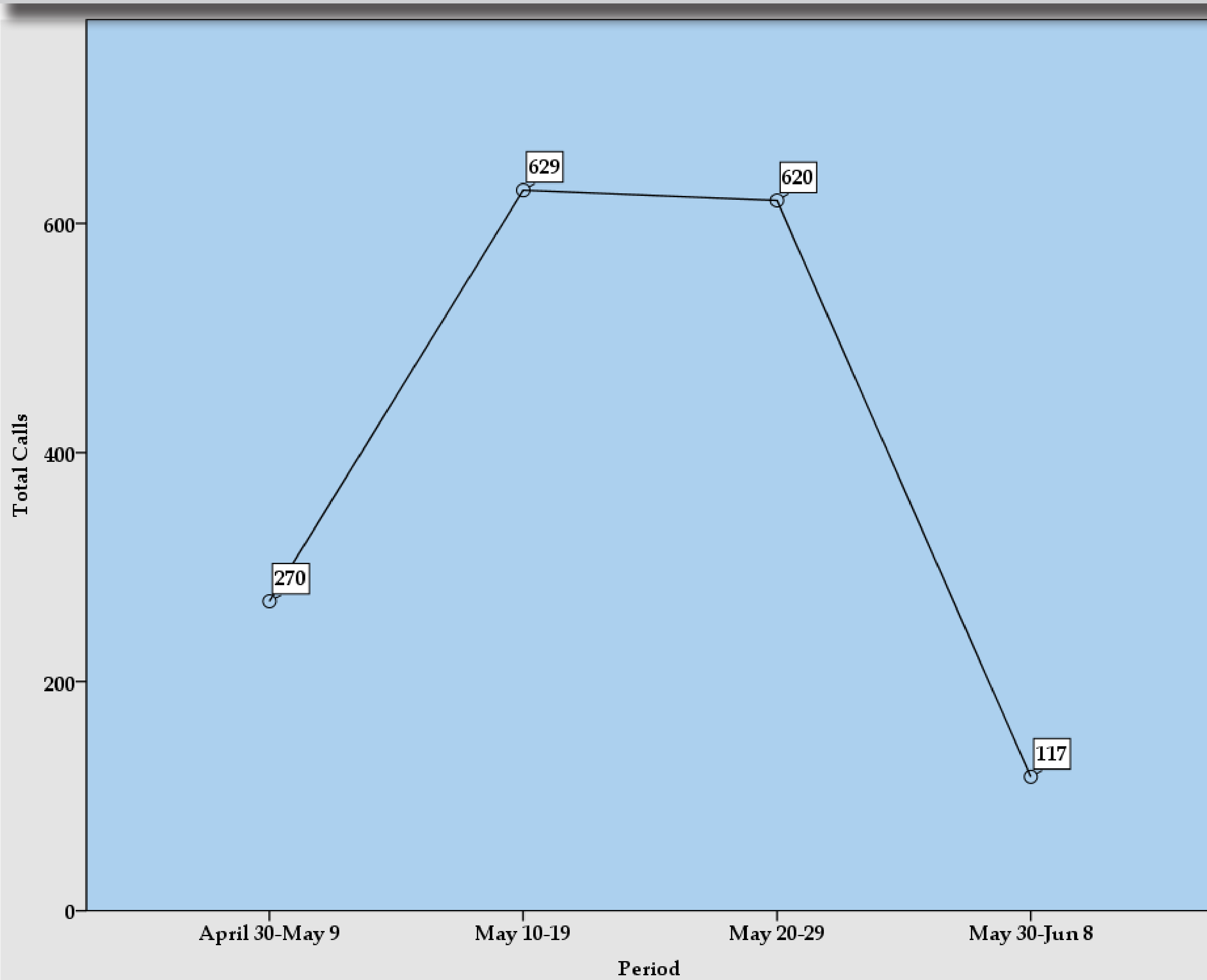


Figure 7: Total Sparrow and Warbler Spring Night Flights Calls by Date for Two Years, 2014 & 2015

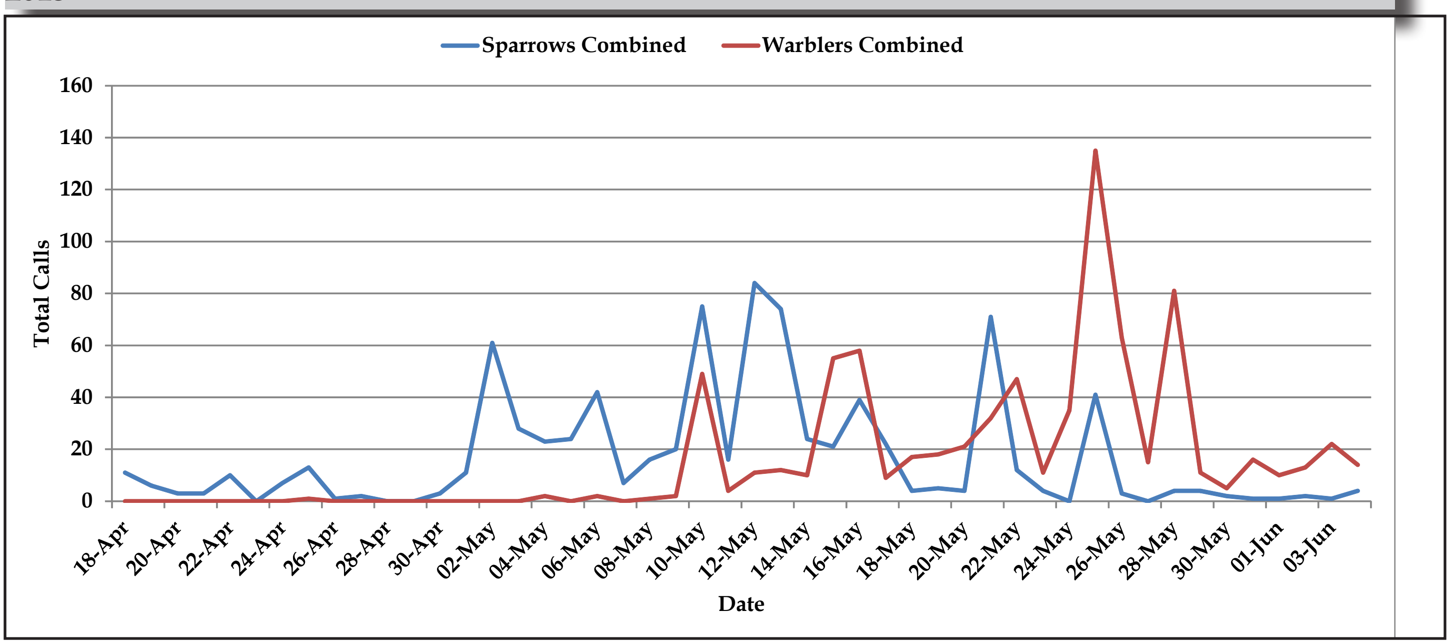


Figure 6 presents the total night flight calls for the two years by 10-day period. This analysis by period rather than by individual days may help to account for weather and other seasonal variations that occur from one year to the next. The graph also incorporates only those dates in the two years

Figure 8: Total Spring Night Flight Calls of Most Common Sparrow and Warbler Species by Date, 2014 & 2015

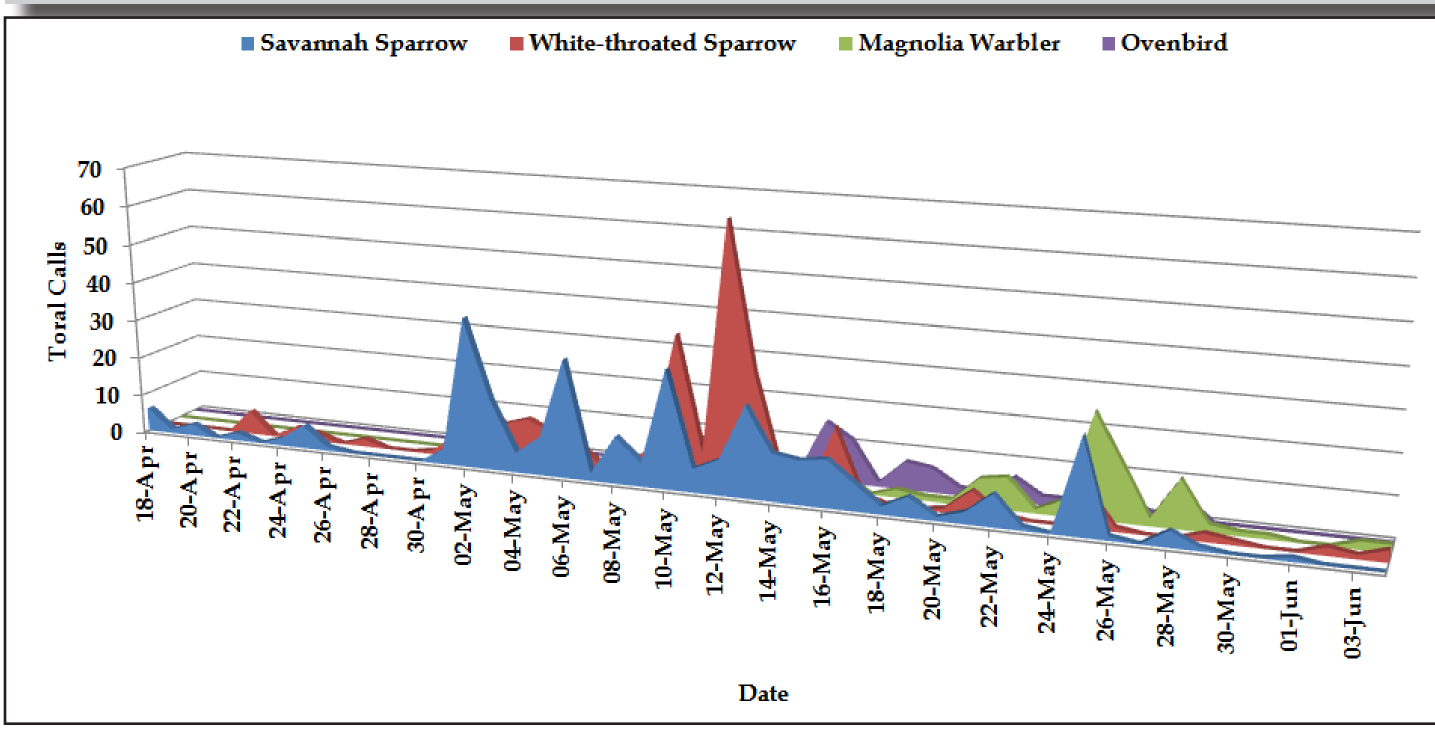
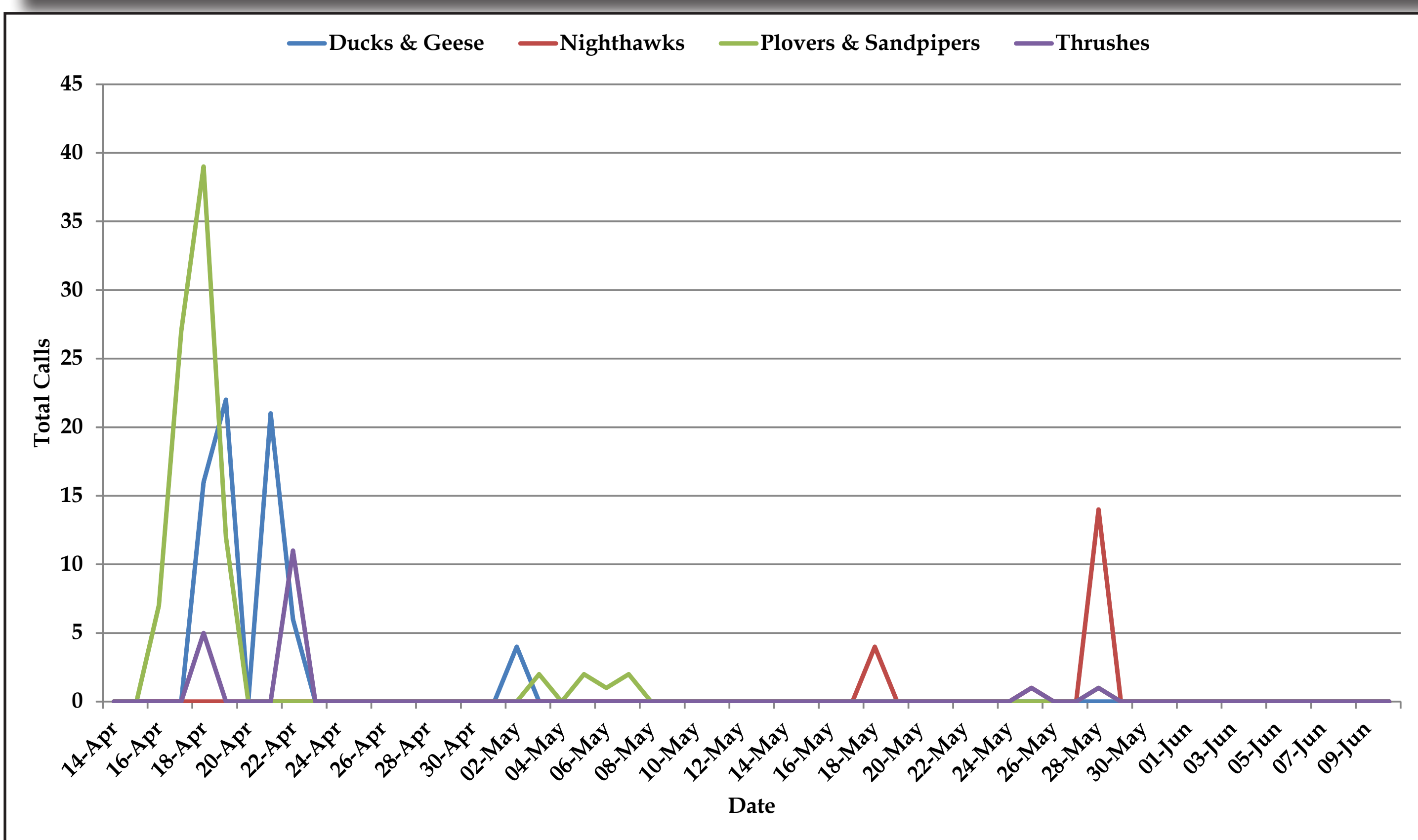


Figure 9: Total Spring Low Frequency Night Flight Calls for Two Years, 2014 & 2015



when all four acoustic monitoring stations were operating.

Thus Figure 6 confirms the two peak nature of nocturnal migration during the spring season of 2014 and 2015. These peaks correspond with those in Figure 5; in this case, the first peak is from 10-19 May (629 total calls), and the second from 20-29 May (620) calls.

In can be seen in Figure 7 that these two peaks are the result of the passage of sparrows in mid-May and the passage of warblers in the late portion of that month. Total calls for the two most common sparrow species (Savannah Sparrow and White-throated Sparrow) and the two most common warbler species (Magnolia Warbler and Ovenbird) are graphed in Figure 8. This graph indicates that sparrows peak in the first half of May while the warblers peak in the second half of May.

Low frequency night flight calls were analyzed at only one station each year and the number of calls was quite low compared to high frequency calls. Most low frequency calls could be classified into four taxonomic groups; ducks and geese, plovers and sandpipers, nighthawks, and thrushes. As seen in Figure 9, ducks and geese, plovers and sandpipers, and thrushes were in passage primarily during the last half of April while the Common Nighthawk, an aerial insectivore, arrived in late May.

A complete listing of all species and taxonomic groups identified in the recordings is presented in Table 4. The table also provides the peak call count on a given date for each taxon and the peak date on which it occurred. Table 4 also indicates the status of those species that are of conservation concern as determinded by the Nova Scotia Government, the Species at Risk Act (SARA), and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

For species listed as “Sensitive” or “May be at Risk” by the Nova Scotia Government, peak numbers were small (1-12 calls). Total calls for the two years for these species were as follows; Rose-breasted Grosbeak (1), Killdeer (17), Wilson’s Warbler (4), Blackpoll Warbler (34), Tree Swallow (2), Blackburnian Warbler (8), Tennessee Warbler (1), Spotted Sandpiper (1), Cape May Warbler (3), and Vesper Sparrow (1). On the other hand, numbers were relatively high for Wilson’s Snipe (55 calls).

Among SARA and COSEWIC listed species, total calls were 11 for Canada Warbler, 1 for Wood Thrush, and 19 for Common Nighthawk.

Some of the rare birds detected during the study included White-crowned Sparrow, Clay-colored Sparrow, Indigo Bunting, Vesper Sparrow, Wood Thrush, and Upland Sandpiper.

An analysis of the distribution of flight calls throughout the night is illustrated in Figure 10. During the two spring migration periods, calls peak at three points; 2-3 hours, 4-5 hours, and 7-8 hours after civil sunset. Understanding these peaks can be furthered by a separate graphing of sparrow and warbler calls as seen in Figure 11. The number of warbler and sparrow calls are similar during the first three hours of the night. This is most likely a period of ascent. Warbler calls then peak from four to six hours after civil sunset. This is likely the period of descent for warblers. Sparrow calls, however, peak later, seven to eight hours after civil sunset. This is likely the descent period for sparrows.

Table 4: Peak Call Counts and Peak Dates during Spring Nocturnal Migration, 2014-2015

Taxon	Peak Call Count	Peak Date (earliest to latest)	Conservation Status: Nova Scotia	SARA	COSEWIC
Song Sparrow	8	14-Apr			
American Tree Sparrow	8	15-Apr			
Fox Sparrow	2	16-Apr			
Sandpipers unidentifed	14	17-Apr			
Rose-breasted Grosbeak	1	18-Apr	Sensitive		
Wilson's Snipe	35	18-Apr	Sensitive		
Ducks unidentified	22	19-Apr			
Killdeer	12	19-Apr	Sensitive		
Green-winged Teal	21	21-Apr			
American Robin	4	22-Apr			
Hermit Thrush	7	22-Apr			
Songbirds unidentified	2	23-Apr			
Canada Goose	4	02-May			
Gulls unidentified	4	02-May			
Savannah Sparrow	38	02-May			
Birds unidentified	8	04-May			
Upland Sandpiper	2	07-May			
Brown Creeper	1	09-May			
Black-and-White Warbler	6	10-May			
Chipping Sparrow	3	10-May			
Northern Parula	7	10-May			
Yellow-rumped Warbler	4	10-May			
White-throated Sparrow	56	12-May			
Sparrows unidentified	7	13-May			
Lincoln's/Swamp Sparrow	8	13-May			
Ovenbird	14	15-May			
Palm Warbler	2	15-May			
White-crowned Sparrow	1	15-May			
Black-throated Blue Warbler	1	15-May			
Nashville Warbler	4	16-May			
Warblers of Genus Oreothlypis unidentified	1	18-May			
Dark-eyed Junco	58	21-May			
Clay-colored Sparrow	1	22-May			
Warblers of Genus Setophaga unidentified	7	22-May			
Canada Warbler	4	24-May	Endangered	Threatened	Threatened
Yellow Warbler	8	24-May			
Chestnut-sided Warbler	2	25-May			
Indigo Bunting	1	25-May			
Norther Waterthrush	7	25-May			
Wilson's Warbler	1	25-May	Sensitive		
American Redstart	13	25-May			
Blackpoll Warbler	7	25-May	Sensitive		
Black-throated Green Warbler	5	25-May			
Common Yellowthroat	18	25-May			
Magnolia Warbler	21	25-May			
Tree Swallow	2	25-May	Sensitive		
Vesper Sparrow	1	25-May	May be at Risk		
Wood Thrush	1	25-May			Threatened
Blackburnian Warbler	3	26-May	Sensitive		
Warblers unidenitified	7	26-May			
Tennessee Warbler	1	26-May	Sensitive		
Common Nighthawk	14	28-May	Threatened	Threatened	Threatened
Spotted Sandpiper	1	28-May	Sensitive		
Swainson's Thrush	1	28-May			
Bay-breasted Warbler	2	31-May			
Cape May Warbler	1	01-Jun	Sensitive		
Mourning Warbler	4	07-Jun			
Nelson's Sparrow	1	07-Jun			
Total	124	10-May			

Figure 10: Total Night Flight Calls by Hour after Civil Sunset, 2014 & 2015

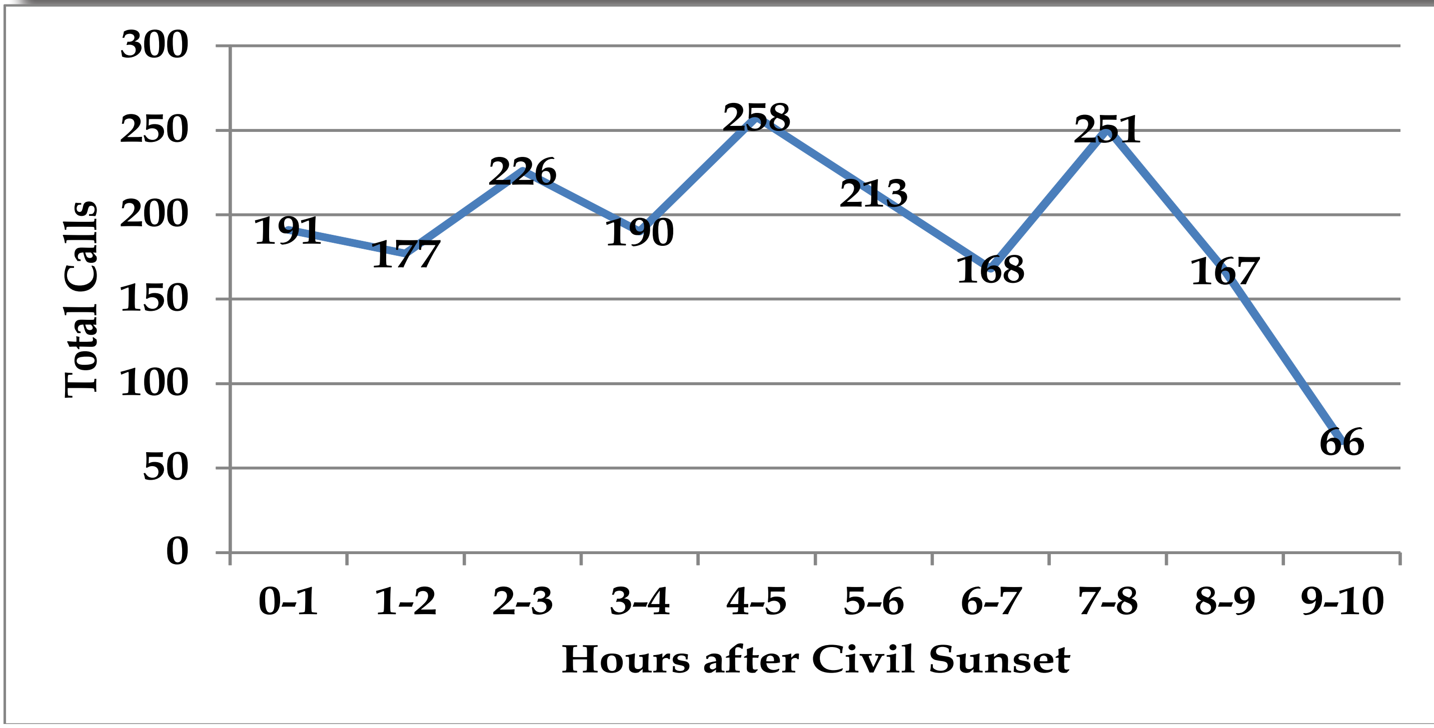
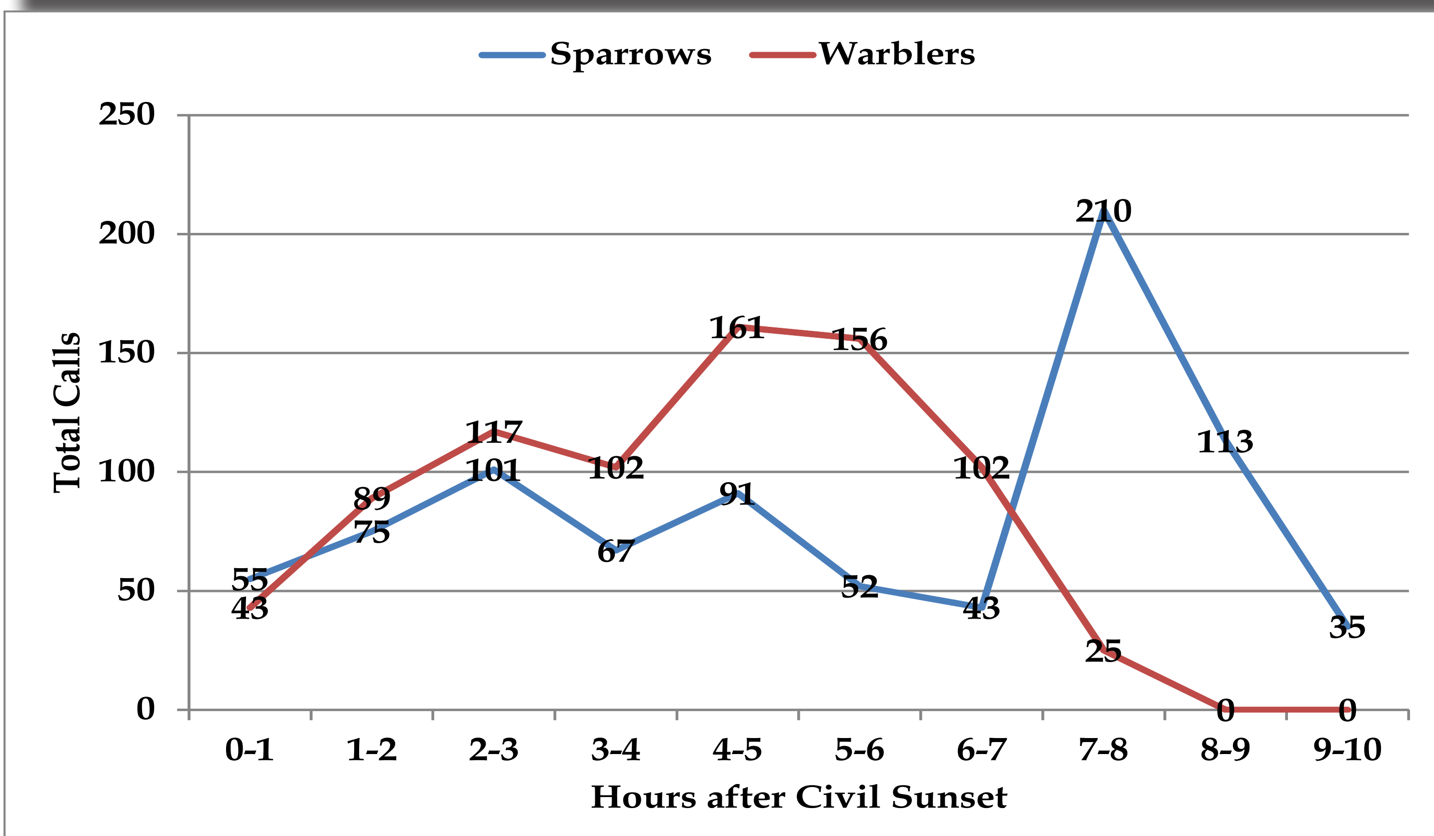
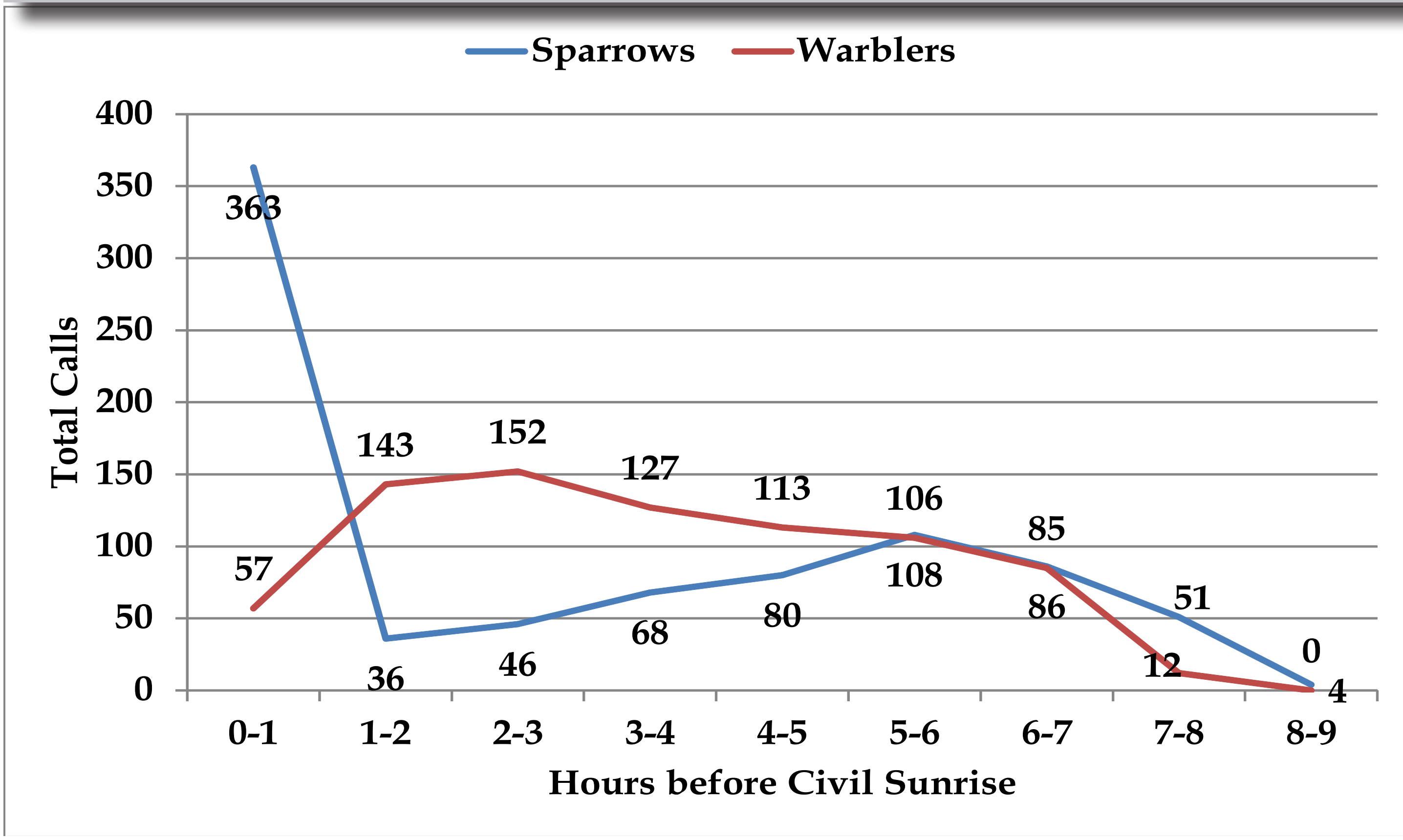


Figure 11: Total Night Flight Calls of Sparrows and Warblers by Hour after Civil Sunset, 2014 & 2015



Due to the shortening of the duration of darkness as the spring advances, it is also fruitful to examine the nightly distribution of calls from the perspective of civil sunrise. As seen in Figure 12, there is an intense period of descent of sparrows during the last hour before civil sunrise. Warblers, on the other hand, appear to have a more prolonged period of descent during the period lasting from one to six hours before civil sunrise.

Figure 12: Total Night Flight Calls of Sparrows and Warblers by Hour before Civil Sunrise, 2014 & 2015



A forward stepping, automatic linear model, using the Statistical Package for the Social Sciences (SPSS), shows some correlation of nocturnal migration with wind speed, temperature, and barometric pressure during the night (adjusted R^2=0.158). Nocturnal migration tended to be more intense when wind speed was less than 7 kilometers per hour, the temperature was above 10 degrees Celsius, and the barometric pressure was greater than 101.00 kilopascals.

Discussion

The acoustic monitoring equipment used in this study provides an index of the intensity of migration at an altitude of approximately 0 to 150 meters. This altitude falls within the range of heights for current wind turbines. The two years of data show that the intensity of migration at this altitude is considerably greater in the northwest portion of project area than in the southeast portion. This means that nocturnal migration is more intense from the ridge crossing the project area to the John Black Road in the northwest than it is from the ridge to the Pumping Station Road in the southeast. Most of these nocturnal migrants are small passerines (sparrows and warblers). The intensity of migration is highest in the three hours before civil sunrise when birds appear to be descending through the acoustic range of the microphones from higher altitudes to the ground. This intensity may also be greater with very light winds, warmer temperatures, and higher barometric pressure.

Two species of conservation concern in the project area that have aerial displays and/or foraging behaviour at blade height are the Wilson's Snipe ("sensitive") and Common Nighthawk ("threatened"). Both these species were recorded during their migration period and breed in the project area. Wilson's Snipe were primarily at Stations 1 and 4 in the agricultural lands near the Pumping Station Road and thus are not close to the proposed turbines. Common Nighthawks were only recorded at Station 4 but are known to range widely over the study area (Kearney 2015). No data can be found on the impact of wind turbines on the Common Nighthawk. However extensive studies at communications towers report very low mortality for Common Nighthawk (Stevenson and Anderson 1994). Nonetheless, given their aerial displays, the post-construction monitoring plan should include protocols for monitoring both Wilson's Snipe and Common Nighthawk in the project area.

Table 5: Total High Frequency Night Flight Calls during the Spring at Various Locations in Nova Scotia

Location	Year	Total
Amherst Station 5, Cumberland Co.	2015	672
Glasgow Head, Guysborough Co.	2013	596
Amherst Station 3, Cumberland Co.	2014	428
Brown's Mountain, Antigonish Co.	2012	404
Spinney Gully, Guysborough Co.	2013	361
Loganville, Pictou Co.	2012	355
Weaver Mountain, Pictou County	2012	352
Digby Neck, Digby Co.	2012	321
Amherst Station 1, Cumberland Co.	2014	300
Amherst Station 4, Cumberland Co.	2015	276
Nuttby Mountain, Colchester Co.	2012	263
Winter Creek, Guysborough Co.	2015	255
Glasgow Head, Guysborough Co.	2015	195
Total		4,778
Average		368

Table 5 compares the total number of high frequency night flight calls during the spring migration at various locations in Nova Scotia where the same acoustic monitoring methods have been carried out. Stations 5 and 3 in Amherst are among the highest in the province, while Stations 1 and 4 are among the lowest. These data further highlight the difference in the intensity of migration between the southern and northern section of the study area.

Table 5 also shows how the total number of night flight calls can vary considerably from one year to the next. For example, Glasgow Head in Guysborough County had only about a third of the number of calls in 2015 compared to 2013.

Finally this study contributes to the study of nocturnal migration in showing how low altitude migrants, especially in the hours closest to dawn, are seeking suitable stop-over habitat. The large number of Savannah Sparrows near monitoring stations located near agricultural fields and the large number of White-throated Sparrows in cut-over and shrubby areas support this thesis.

References

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Florida.

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