



Bioacoustic Study of Nocturnal Migration Patterns Over Different Elevations



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Abstract

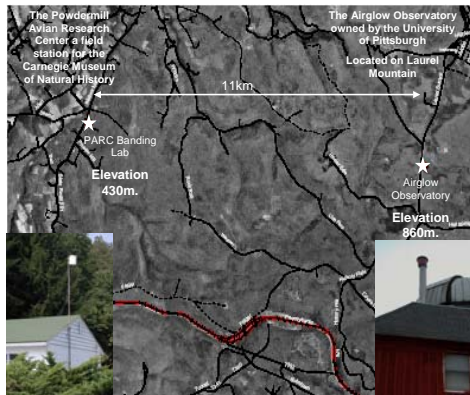
In 2004-2005 a directional microphone setup was to digitally record flight calls emitted by nocturnal migrants. Simultaneous recordings were made at a valley (elev. 1400 ft.) and a nearby ridge-top (elev. 2800ft.) in south-western PA. Flight calls isolated from these recordings were sorted based on morphology of spectrogram pattern and identified by species or species complex. Weather data, including information about precipitation, cloud cover, wind speed/direction, temperature, and barometric pressure was also collected during recording periods. We assessed differences in total number of calls and rough species composition between the sampling sites under a variety of weather conditions, and examined temporal and seasonal migration timing. Preliminary results indicate similarities between sites in species composition but differences in migration patterns, including number or calling behavior of migrants, between the two sites. Differences seem to be linked to weather conditions, a result which suggests migration channeling due to local topography.

Objectives

- Examine differences in migration patterns over two sites of differing elevation including differences in overall number of birds, species composition, and timing of migration
- Explore the idea that differences in elevation could be causing migration channeling under certain weather conditions
- Determine the importance of installing microphones at both high and low elevation sites in a region when using bioacoustics to monitor nocturnal migration

Methods

-Two Recording sites Located in South Western Pennsylvania (~50 miles SE of Pittsburgh)



-Directional microphone mounted on roof records for 11-12 hrs overnight

- Computer programs extract possible calls from overnight recordings

- Calls are sorted into categories and totaled
13, 483 calls from 30 different nights were included in the final data set.

Warbler-like = calls over 4 kHz
Including warblers and sparrows

Thrush-like = calls under 4 kHz
Including thrushes grosbeaks and tanagers

Call Complex:
-Upsleeps
-Downsleeps
-Buzzy
-Zeeps
-Other

Species level:
-Swainson's Thrush
-Gray-cheeked Thrush
-Veery
-Wood Thrush
-Bicknell's Thrush
-Other



Results

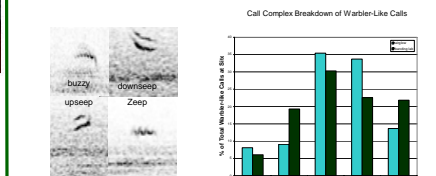
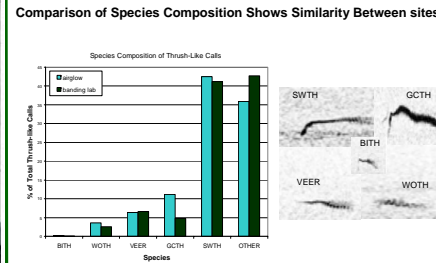
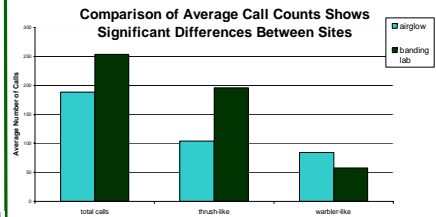
Comparison of Sites

-Significant differences between call count totals of warblers at the Airglow site and the Banding Lab site

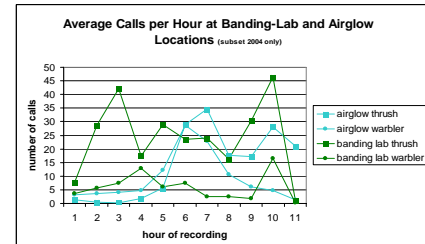
Paired T-test $p=0.90$

-Significant differences between call count totals of thrushes at the Airglow site and the Banding Lab site

Paired T-test $p=.045$



Possible differences in Temporal Migration Patterns



More birds tend to be flying over the Airglow during the middle of the night while at the Banding Lab more calls were recorded early in the night and early the next morning

Correlation with Weather

Overnight Hourly Weather Data from Johnstown, PA was used to calculate average nightly conditions for several variables. These were assigned numerical values and regressed against call count ratios.

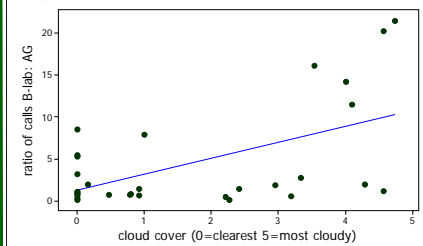
Regression Analysis: ratio of call totals at two sites regressed against weather variables (temperature, barometric pressure, visibility, wind direction, wind speed, precipitation and cloud cover)

| Predictor | Coef | SE Coef | T | P |
|----------------------|---------|---------|-------|-------|
| Constant | -540.0 | 349.2 | -1.55 | 0.136 |
| temp. @ | 0.0840 | 0.3243 | 0.26 | 0.798 |
| pressure (hPa) | 0.5213 | 0.3394 | 1.54 | 0.139 |
| visibility (km) | 0.1559 | 0.4262 | 0.37 | 0.718 |
| wind dir. | 0.02665 | 0.01799 | 1.48 | 0.153 |
| wind speed (km/h) | -0.1637 | 0.3159 | -0.52 | 0.610 |
| precip (cm) | -3.358 | 3.452 | -0.97 | 0.393 |
| cloud cov.(rank 0-5) | 3.149 | 1.170 | 2.69 | 0.013 |

S = 5.34769 R-Sq = 42.7% R-Sq(adj) = 24.5%

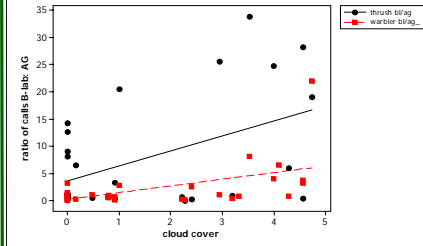
Regression of call count ratios against weather variables show that the relationship between cloud cover and call count is significant. Relationships between wind direction and barometric pressure are also nearly significant.

Significant Relationship between Call Ratio and Cloud Cover

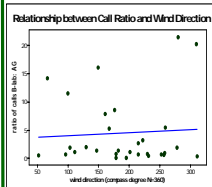


As cloud cover increases, call count ratio (Banding Lab/ Airglow) increases. Thus during cloudy weather, call count is more likely to be higher at the low elevation Banding Lab site than at the high elevation Airglow site.

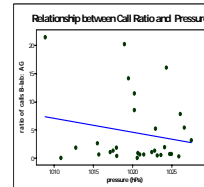
Call Ratios of "Thrushes" and "Warblers" are Related to Cloud Cover



The relationship between cloud cover and call ratio holds true for thrush-like and warbler-like calls when considered separately as well as for the total call count ratios.



Wind blowing from the north is most likely to result in a high ratio of calls at the Banding Lab site, followed by wind from the west and the south. Wind blowing from the east is the least likely to result in a high ratio at the lab.



As barometric pressure drops, call count ratio (Banding Lab/Airglow) increases. On nights with low pressure call counts are more likely to be higher at the low elevation Banding Lab site than at the high elevation Airglow site

Conclusions/ Discussion



Call totals were generally higher at the lower elevation site. This agrees with previous studies which suggest that birds tend not to fly over sudden rises in terrain. It also ties into the theory that on nights with low cloud ceiling birds are channeled into lower elevation areas (Evans 2005).



The total thrush calls were higher at the low elevation site however the total warbler calls were higher at the high elevation site. Our data shows the opposite trend. While studies have shown that small warbler-like passerines generally call at lower elevations than thrush-like birds, there are a variety of factors, including effects of weather, elevation, temporal timing and individual variation, that have not yet been fully investigated (Evans 2000)(Farnsworth 2005).



Within the warbler-like and thrush-like call groups, there was no significant difference in species/ call complex composition between sites.



Preliminary results indicate some possible differences in temporal migration patterns at the high and low elevation sites. The peaks in calling at the lower elevation site could be due to low flying birds taking off or preparing to land. If birds migrating in the middle of the night fly higher at a more uniform elevation, calls at this time would be more likely to register at the higher site creating the middle of the night peak seen at the Airglow.



The disproportionate decrease of calls at the higher elevation site in relation to the lower elevation site on cloudy nights supports the theory that low cloud ceiling and heavy cloud cover may cause migrating birds to channel through areas of lower elevation. This corroborates previous studies that have suggested a relationship between low cloud ceiling and migration channeling. On nights with low cloud ceiling higher elevation areas may have greatly reduced visibility resulting in a preference for migration over lower terrain. (Evans 2005)(Farnsworth 2005) Our data examines cloud cover but not specifically ceiling, so with improved weather data, we may see an even stronger relationship. More detailed weather data and larger sample sizes would allow us to further examine relationships with other weather conditions.



The evidence collected in this study indicates differences in migration patterns over high and low elevation areas, especially under certain weather conditions, most notably heavy cloud cover. Such differences suggest the importance of operating microphones at different elevations and terrains when using bioacoustic monitoring to study nocturnal migration.

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www.oldbird.org (call comparison CD, extraction software, literature)

www.underground.com (Johnstown hourly weather data)

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