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Title of Study:
Flight-calling in Wood-Warblers (Parulidae): Does Species-Specific Behavior Drive Evolution of Calls**?**

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RESEARCH SIGNFICANCE: For the past five years, I have documented large diurnal flights of warblers and other Neotropical passerines moving from the tip of the Keweenaw Peninsula region down the south shore of the Keweenaw Peninsula during migration. Data from 2013—2016 have lead me to believe that this diurnal flyway is the result of unfavorable winds for migration redirecting birds caught over Lake Superior to the Keweenaw Peninsula. Diurnal flights along a concentrated coastal pathway are relatively rare and especially understudied in the Great Lakes region. The Keweenaw pathway therefore offers an intriguing opportunity to assess the importance of this region to migrant birds, and the size of the flights. Beyond a purely descriptive study however, the concentrated flight characteristics and even spacing of passing flocks have lead me to believe that this site would be an ideal location to start studying the evolutionary behavioral ecology of communication between flocks using short flight calls. Studying the evolutionary incentives of flight calling behavior during diurnal migration offers a tremendous opportunity for elucidating the roles calls play in maintaining migratory flocks and the differences in this behavior among species. Traditional studies of songbird migration make use of nocturnal flight call recordings, as opposed to rarer diurnal flights. Farnsworth and Lovette) 2005 reviewed the effect of atmospheric conditions on migration, but little research has been conducted on species-specific patterns of flight calling behavior. The advantage of using diurnal flights as opposed to the traditional study of nocturnal migration is that patterns of flight calls recorded aurally can be confirmed visually.

BACKGROUND: The evolutionary pressures shaping the migratory behaviors of songbirds (Passeriformes) remain poorly studied. Most attention has been directed to the study of nocturnal migration of songbirds when migration normally occurs. Little attention has been given to the study of diurnal migration, which is at odds with the conventional research on why songbirds migrate at night. I propose to study wood-warbler behavior using flight calls, short species-specific vocalizations that are poorly understood, but thought to maintain flock unity. Little research has been conducted on flight calling behavior and in particular this research represents an outstanding opportunity to investigate the evolution of aural communication during migration that is mutually intelligible across multiple species.

RESEARCH PROPOSAL AND METHODS: We will focus on the function of flight calls. I propose that flight calls among wood-warblers during migration have evolved to be transmissible according to species-specific differences in flocking behavior. To test this, I will collect audio recordings and visual counts of migrating warblers at a massive migration site in the Keweenaw Peninsula during spring 2017 and future years. As this project will likely require multiple years to adequately investigate, 2017 will be focused on data collection. From this I will look for patterns in flock composition, abundance, and acoustic properties of each species to determine if call rates vary with the number of individuals per species within flocks. I will test if more calls are uttered as the proportion of conspecifics in flocks increases and how this applies to single species vs. multi-species flocks. I will compare trends in a phylogenetic context.

Methods: To investigate these hypotheses, we will conduct fieldwork at two study sites along the diurnal migration of warblers in Michigan's Keweenaw Peninsula. At both the west end of Manitou Island and Bete Grise, we will conduct stationary counts of all westbound warblers flying over these locations. Preliminary data have shown that migrant flights are very concentrated at these two locations making it possible to tally the majority of individuals from a single location (Weidner 1992). We will use observer-tallied counts to assess the magnitude of migration at both locales.

To more directly analyze the behavior and composition of warbler flocks we will use audio recording of flight calls during morning flights at both study sites. We will record flight calls by placing SMM-A2 cabled acoustic microphones at each study site, each of which will be attached to a remote, passive SongMeter SM4 recorder at a sampling rate of 24 kHz (Smith et al. 2014). Recording will be programmed to start at sunrise and continue to 1300 hrs., which preliminary data have shown to be a time when cessation of diurnal flights occur. Audio recording will be collected from a 30-day window capturing peak migration periods in both spring and fall 2017-2019. Recordings will be downloaded and all species identities and individuals will be assigned using the SPCC algorithm to assign similarity values (Keen et al. 2016) to flight calls in RavenPro software. We will use linear mixed models to explore the influence of flock position, number of adjacent conspecific individuals, and distance to flock individuals on flight call emission and calling rate. This will allow us to address whether flight-calling behavior varies with distance and position within migrant flocks and whether such calls function primarily in interspecific or intraspecific communication. From these data we will also look directly at species-specific biases in calling behavior and reliance on flight calls for flock unity.

Literature Cited:

Farnsworth, A., and I. J. Lovette. 2005. Evolution of nocturnal flight calls in migrating wood-warblers: apparent lack of morphological constraints. J Avian Biology 1–11.

Keen, S., J. C. Ross, E. T. Griffiths, M. Lanzone, and A. Farnsworth. 2016. Ecological Informatics. Ecological Informatics 1–9. Elsevier B.V.

Smith, A. D., P. W. C. Paton, and S. R. McWilliams. 2014. Using nocturnal flight calls to assess the fall migration of warblers and sparrows along a coastal ecological barrier. PLoS ONE 9:e92218–e92218.

Budget for Spring 2017

A prior award of $3,419 dollars from the Experiment crowdfunding was budgeted to include costs only for audio monitoring equipment for this project. No funds for personal expenses or data recording were included in this original award. These funds would greatly increase the ease of conducting this project.

Additional Expenses for Spring 2017 not included in Experiment Budget

Item	Costs
Samsung tablet using Dunkadoo software for data recording	$340
Personal stipend to compensate grocery expenses @ $40/week X 4 weeks	$160
Total Requested	$500.00

*Start Date: 10 May 2017
*End Date: 10 June 2017