



BIRD BANDING AND BIOACOUSTICS: A USEFUL COMBINATION FOR MIGRATION MONITORING?

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Introduction

Bird banding provides information about spatial, temporal, and demographic patterns of bird migration. Migration banding has biases, however, that may limit its usefulness, reliability, and sensitivity for population monitoring. Integration and calibration of banding and bioacoustical data may give more precise and accurate patterns of migration at a range of spatial scales (Lanzone and Farnsworth, in review), thereby increasing the likelihood that populations of birds poorly monitored during the breeding season could be accurately monitored during migration. Powdermill Avian Research Center (PARC), located in southwestern Pennsylvania, operates a year-round banding station and a bioacoustics laboratory, which collect data concurrently during spring and fall migration. We tested the null hypothesis of no statistical correspondence in relative abundance among various subsamples of banding capture data and acoustic recordings.

Objectives

The primary objectives for the study were to:

- 1) Determine if banding totals 1 day, 3 days, and 5 days prior to a given nightly recording were correlated with call counts for species during the first half of the night's recording.
- 2) Determine if banding totals 1 day, 3 days, and 5 days after a given nightly recording were correlated with call counts for species during the second half of the night's recording.

Methods

We erected a directional microphone (see Evans and Mellinger 1999) outside the bird banding laboratory at PARC (1300 feet elevation) and attached it to a computer in order to digitally record flight calls emitted by nocturnal migrants for 10-12 hours each night during the fall 2005 migration season. From a random selection of four nights, each flight call was isolated (see Farnsworth et al 2004), identified to morphology and, when possible, to species, using the spectrograms of flight calls of known species (Evans and O'Brien 2002), then sorted by timestamp into the first and second half of the night. Call counts for each nightly subset of acoustical data were compared with banding data collected five, three, and one day prior and subsequent to the recording to test the hypothesis that 1) birds that fly over the microphone just after dusk are most likely those that had stopped over in the vicinity of PARC during previous days and just have restarted their migration, and 2) the birds that fly over the microphone just before dawn are most likely those that will stopover in the vicinity of PARC and be subject to capture for banding over the course of the following days. The acoustic data for each night during the fall 2005 migration season, August 28 – October 13, was sorted into thrush-like calls (below 4kHz) and warbler-like calls (above 4kHz, includes sparrows) (figure 1) and compared, using correlation analysis, to the banding data for each of the corresponding days.

The banding data was collected daily: 35-70 mist nets were opened at approximately dawn and operated for 5-10 hours, weather dependent. Each bird captured was brought back to the banding lab where a serially numbered aluminum band was placed on its leg and measurements were taken, a process of less than a minute, before being released outside the lab.

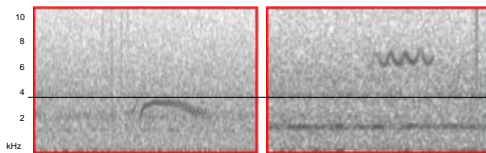


Figure 1. Spectrograms of a thrush (Gray-cheeked Thrush *Catharus minimus*) and an unknown warbler species of the "zeep" flight call morphology type, showing typical frequencies – thrush at less than 4 kHz and warbler at greater than 4 kHz.

Results

During the fall 2005 migration season, we collected data from 40 nights and recorded 8692 flight calls. The nightly recordings ranged from 2 to 1890 calls per night.

We found correlation between banding capture data and acoustic recordings for the data subsets of 5 days prior and subsequent to recording and 3 days prior and subsequent to recording (table 1).

We found no correlation between the number of thrushes ($r = -.106$ at $p < 0.05$) or warblers ($r = .182$ at $p < 0.05$) banded and recorded for each day and corresponding night, indicating that banding capture data and acoustic recordings complement each other in determining migration patterns. However, correlation analyses of acoustic recordings and the banding capture data show significant correlation between thrush and warbler calls ($r = .362$ at $p < 0.05$) and between thrush and warbler banding totals ($r = .414$ at $p < 0.05$) during fall 2005 (figure 3).

Table 1. Correlations (r -values) between various subsets of banding and acoustic data for four randomly selected nights in the fall 2005 migration season.

Data Subset	First half of night	Second half of night
5 days before recording	.335**	-
3 days before recording	.305**	-
1 day before recording	.043	-
1 day after recording	-	.270*
3 days after recording	-	.248*
5 days after recording	-	.167

* $0.1 < p < 0.05$
** $p < 0.05$

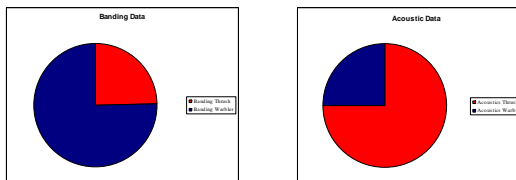


Figure 2. The percent composition of banding and acoustic datasets by bird and call-type.

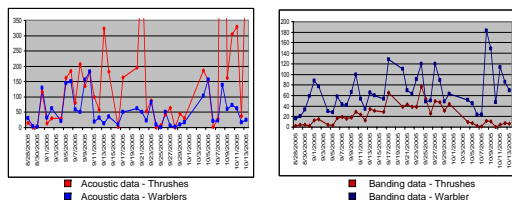


Figure 3. Daily banding totals and acoustic counts sorted into "thrushes" and "warblers," showing corresponding peaks of activity.

Discussion

The species composition of the birds migrating over PARC is not represented by the banding capture data alone and other migration monitoring techniques must be used in conjunction with banding data in order for the patterns of migration over PARC to be understood. According to correlation analyses, there is correlation between some of the subsets of data – 5 days of banding data prior to recording and the first half of the recorded night, 5 days of banding after recording and the second half of the recorded night, 3 days of banding data prior to recording and the first half of the recorded night, and 3 days of banding data after recording and the second half of the recorded night. There are many species common to both monitoring methods, but some species are represented in the acoustic data that are not present in the banding data. Bicknell's Thrush (*Catharus bicknelli*), for example, is frequently recorded acoustically, but has been captured at PARC only 3 times in 50 years. Williams et al (1981) had similar results in comparing radar and ceilometer data with mist-netting data.

The nightly acoustic data indicate that, in general, the majority of flight calls recorded are those of thrushes, whereas warblers represented only approximately a quarter of total calls recorded. However, three quarters more warblers than thrushes were detected by bird banding (figure 2). These discrepancies may be explained by differences in the call rate of migrants, the habitat in which PARC's mist nets are placed, and biases associated with the banding procedure at PARC. The rate at which migrants emit flight calls is largely unknown, but Ball (1952) indicates that thrushes are relatively easy to detect and call more frequently than do other passerines, including warblers, and preliminary examination of the timestamps on the spectrograms of the flight calls recorded at PARC suggests that individual thrushes tend to call frequently, sometimes 5-10 times over the microphone, but warblers call less frequently. The habitat in which the mist nets are set at PARC tends to be favorable to most warbler species' foraging habits, but less so to thrushes' foraging needs. In addition, differences in capture efficiency related to mist net mesh size (Heimerdinger and Leberman 1966) likely favors the capture of warblers over thrushes at PARC, because many more 30mm than 36mm nets are used at the banding station. This may partly explain the relatively low detectability of thrushes at PARC in the banding sample compared to the acoustic data. Although the species composition detected by each of the methods do not fully correspond, banding capture data and acoustic recordings complement each other for a more accurate picture of migration over PARC.

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