PROGRESS REPORT #1 (Nov. 20, 2010).

Project title: Understanding sources of variation in detectability among sites and across the breeding season in golden-cheeked warblers (Dendroica chrysoparia).

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In fall 2008, Drs. J. Ott and F. Weckerly were funded by COA (PA# MA2200 NI070000006) to conduct research aimed at measuring detectability of GCWA's as a function of warbler density using six 1km sq. grids centered on the COA's 100-ac long-term study plots. The overall goal of the research has been to determine whether there exist a correlation between average GCWA density/grid and detectability/grid. An intermediate report detailing progress for this project was filed 4 Dec. 2009 and is on record with COA. The current report provides a summary of progress achieved from 4 Dec. 2009 to the present. Included herein is A) a general summary of progress, B) a timeline for completion of the project, and C) a brief presentation of results to date for the project's four stated objectives.

A. General summary of progress

1. In total, Automatic Recording Units (ARU's) yielded 20,765 five-minute recording across all 6 sites. Total recordings summed to 1,730 hours across all study sites. The process of reviewing 1,730 hours of recording to extract the data of interest spanned the interval from April 2009 through mid-October of 2010. Thus data collection is now complete and all data needed to address objectives have now been extracted from the sound files. The data extracted from the 5-minute sound recordings was a) number of songs per 5-min. interval, and b) the proportion of 5-minute recording intervals with ≥1 GCWA song.

2. Intermediate analyses of data were performed by C. Warren, F., Weckerly and J. Ott for selected study sites from Fall 2009 through summer 2010 and intermediate results addressing each of the four objectives have been presented at the following scientific meetings.

Warren, C. C., Ott, J. R., Weckerly, F. W. Density-dependent singing behavior and the reliability of population estimates for passerine birds. Ecological Society of America -Annual Meeting. August, 2010.

Warren, C. C., Ott, J. R., Weckerly, F. W. Did you hear something? The effect of singing behavior on probability of detection: Implications for population estimation for the Golden-cheeked Warbler, *Dendroica chrysoparia.* Texas State University Biology Department Colloquium. April, 2010.

Warren, C. C., Ott, J. R., Weckerly, F. W. Did you hear something? The effect of singing behavior on probability of detection: Implications for population estimation for the Golden-cheeked Warbler, *Dendroica chrysoparia.* Southwestern Association of Naturalists Society – Annual Meeting. April, 2010.

Warren, C. C., Ott, J. R., Weckerly, F. W. The effect of singing behavior on probability of detection: Implications for population estimation for the Golden-cheeked Warbler, *Dendroica chrysoparia.* Balcones Canyonlands Preserve Golden-cheeked Warbler Monitoring Workshop – City of Austin/Texas State University. February, 2010.

Warren, C. C., Ott, J. R., Weckerly, F. W. The effect of singing behavior on probability of detection: Implications for population estimation for the Golden-cheeked Warbler, *Dendroica chrysoparia.* Golden-cheeked Warbler Symposium – EDF/Texas A&M University, January, 2010.

Warren, C. C., Ott, J. R., Weckerly, F. W. Population density and probability of detection: Implications for population estimation for the Golden-cheeked Warbler, *Dendroica chrysoparia.* International Research Conference for Graduate Students – Texas State University-San Marcos, TX. November, 2009.

B. <u>TIMELINE for project completion.</u> The research forms the basis of the Master of Science Degree for Mr. Christopher Warren —the student supported by the funds provided by COA. Mr. Warren has been meeting regularly with Dr.'s Weckerly and Ott to review, verify, interpret, and extend results for all aspects of the project. Mr. Warren is currently on track to complete all aspects of analysis and interpretation of results and produce a thesis by the target deadline of May 2011. The thesis now exists in draft form and will be finalized and defended in May of 2011. The thesis will constitute the basis for the final report for project PA# MA2200 NI070000006. Thus a final report can be provided to COA by May 2011.

C. Results to date for the project's four stated objectives

The research addressed four specific questions

1) Does the rate of male singing correlate with variation in density of GCW among the six grids

2) Does the rate of male singing vary temporally during the season?

3) How does seasonal variation interact with density?

4) How do rates of singing vary during the day?

Results: Upon completing data collection in Oct. of 2011 we have now been able to address the four objectives of the project through analyses that have included the data from all six-study sites. Results follow.

Obj. 1) Does the rate of singing correlate with variation in density of GCW?

Answer: Yes (See figure 1, figure 2)

Figure 1. Observed and expected song rates (mean number of songs per 5-min.) (± SE) at six sites. Standard error calculated per site. Observed values are the mean number of Golden-cheeked Warbler (GCWA) songs per five-minute recording per site. Expected values calculated using the lowest abundance value [JT song rate * (*x* site abund./JT abund.)]. Expected values represent a 1:1 song rate to abundance relationship. Abundance estimated by Hunt et al. (*submitted*) concurrent with recordings.

Figure 2. Observed and expected song rates (proportion of five-minute recordings with ≥ 1 GCWA song) (± SE) at six sites. Standard error calculated per station per site. Expected values calculated using the lowest abundance value [JT song rate * (*x* site abund./JT abund.)]. Abundance estimated by Hunt et al. (*submitted*) concurrent with recordings.

Interpretation Figs 1 and 2. Observed song rate is higher/lower than expected based on abundance. Song rate at higher densities is higher than expected based on predictions from observed song rates at lower densities and vice versa. In other words, one cannot predict song rate based on abundance alone. This may indicate that song rate is a density-dependant behavior.

Obj. 2) Does the rate of male singing vary temporally during the season?

Answer: No (See figure 3)

Figure 3. Song rate (number of songs per 5-minute recording) by day of season (15 March = 1; 3 May = 51). Each station was recorded from sunrise to sunset for two days. No overall date effect on song rate blocked by site ($t = -1.5967$, $P = 0.1104$).

Obj. 3) Does seasonal variation in song rate interact with density?

Answer: data analysis for this objective is incomplete.

Obj. 4) Do rates of singing vary during the day?

Answer: Yes, but weak relationship (See figure 4)

Figure 4. Song rate (number of songs per 5-minute recording) by time of day (minutes after sunrise). Negative x-axis values indicate recordings before sunrise. Values represent mean song rate per hour per station. Each station was recorded from sunrise to sunset for two days. Quadratic time of day effect on song rate blocked by site ($t = -4.176$, $P < 0.0001$). Dotted lines indicate sunrise (0 min.). Average sunrise throughout season = 07:00. Recordings taken from 06:00 to 19:00. Sample size refers to the number (out of 14) of successfully recorded stations.

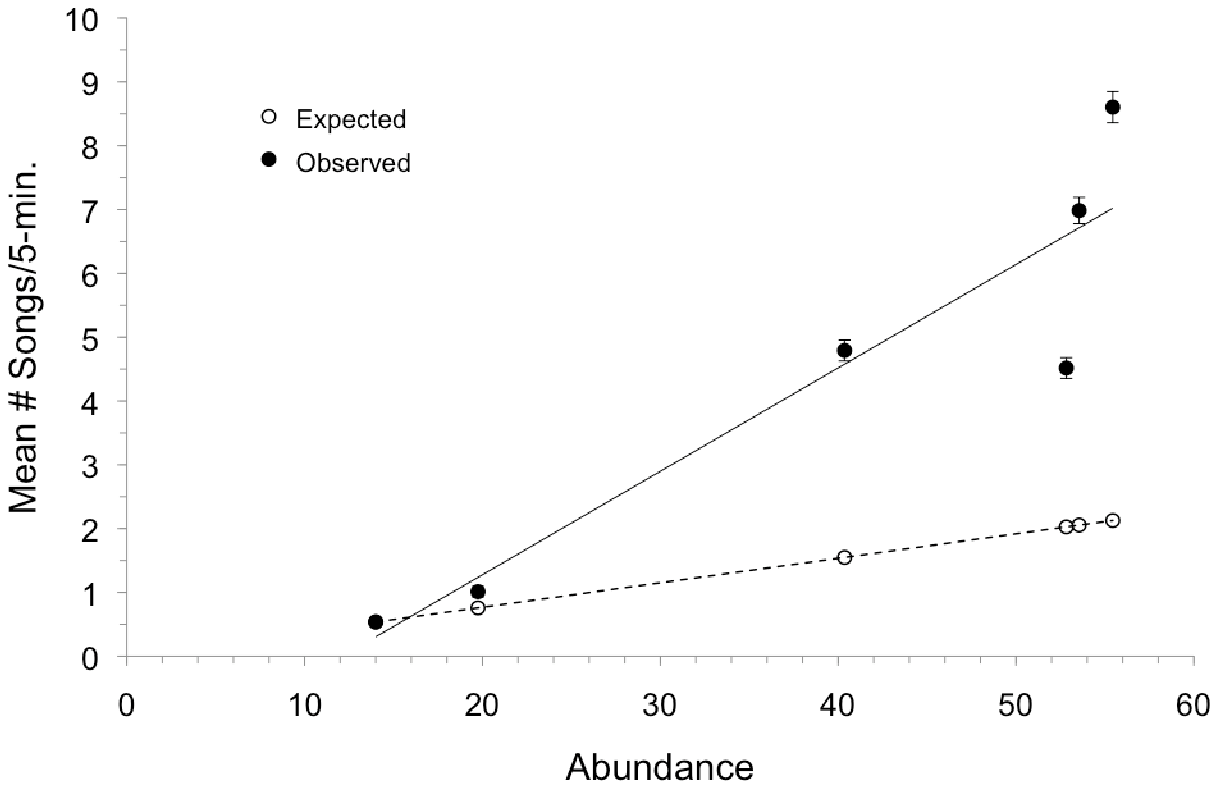
Mean # Songs/5-min.
Abundance
Expected
Observed
0
1
2
3
4
5
6
7
8
9
10
0
10
20
30
40
50
60

Fig. 1.

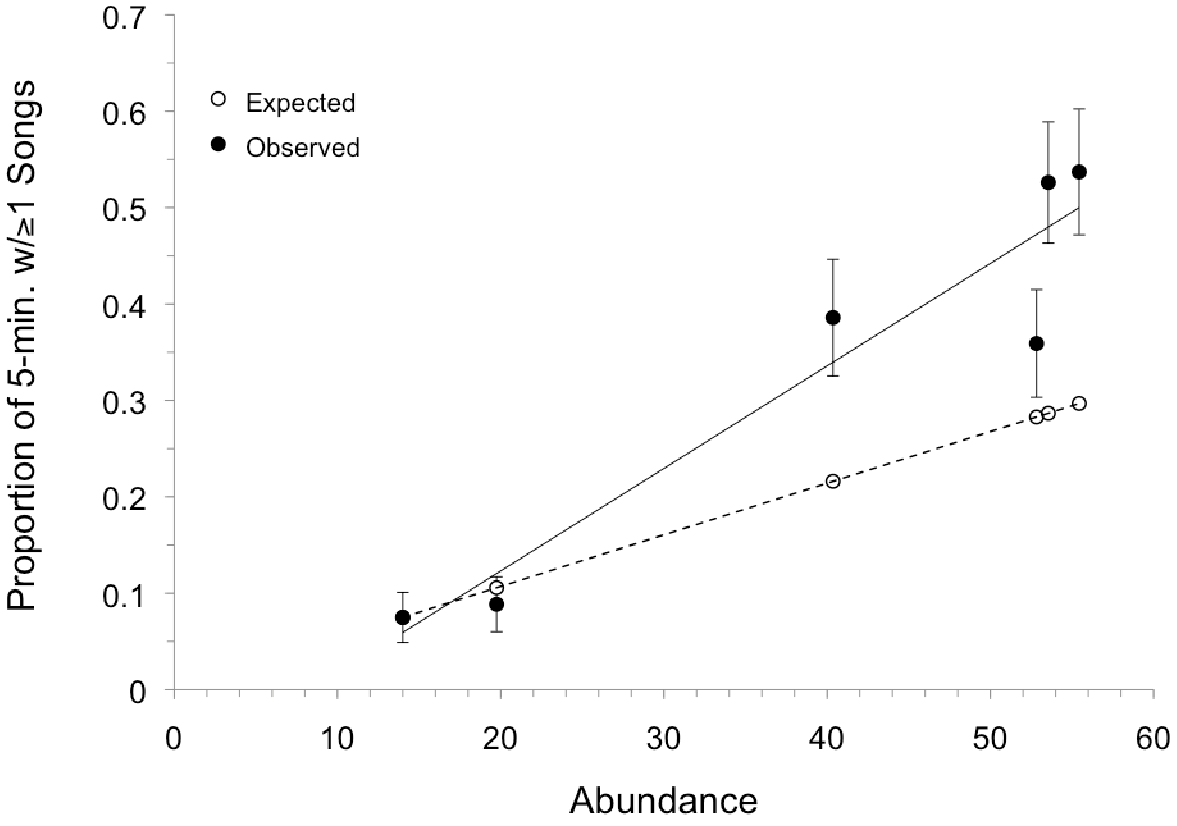
Proportion of 5-min. w/≥1 Songs
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Expected
Observed
0
10
20
30
40
50
60
Abundance

Fig. 2.

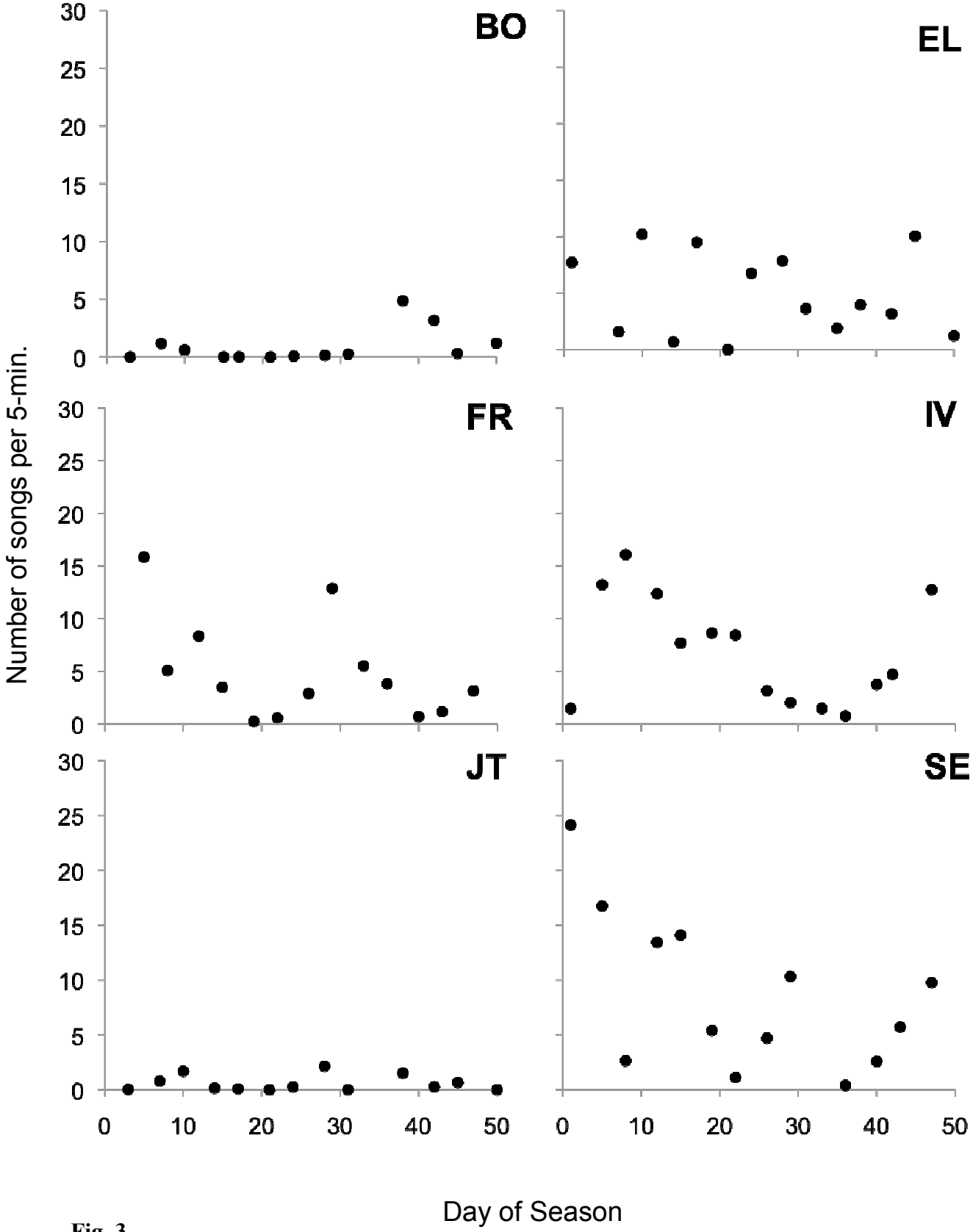
BO
EL
FR
IV
JT
SE
Number of songs per 5-min.
Day of Season
0
5
10
15
20
25
30
40
50

Fig. 3.

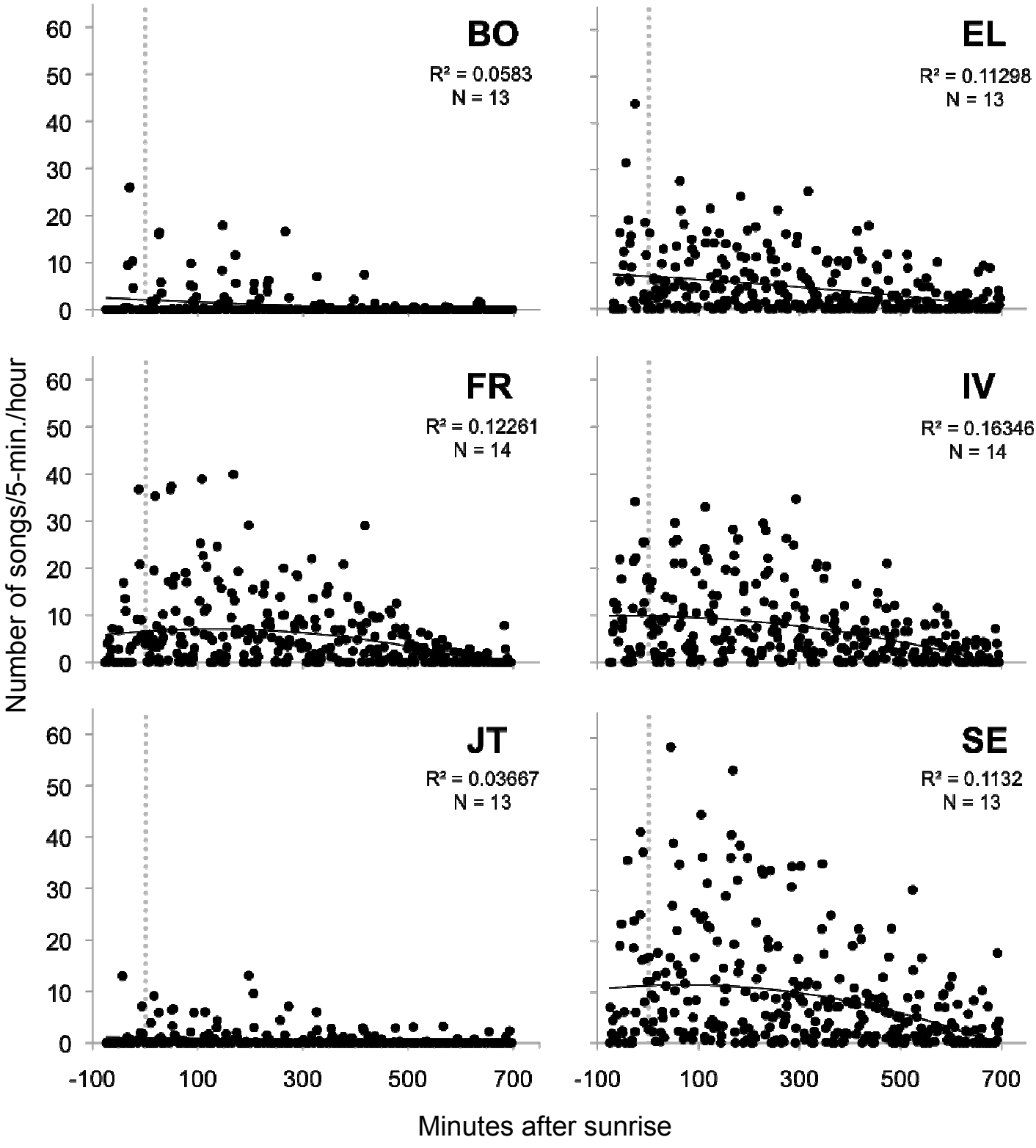
BO
R² = 0.0583
N = 13
EL
R² = 0.11298
N = 13
FR
R² = 0.12261
N = 14
IV
R² = 0.16346
N = 14
JT
R² = 0.03667
N = 13
SE
R² = 0.1132
N = 13
Number of songs/5-min./hour
Minutes after sunrise
0
10
20
30
40
50
60
-100
100
300
500
700

Fig. 4.