

# Golden-cheeked Warbler Responses to Road Construction Noise and Activity

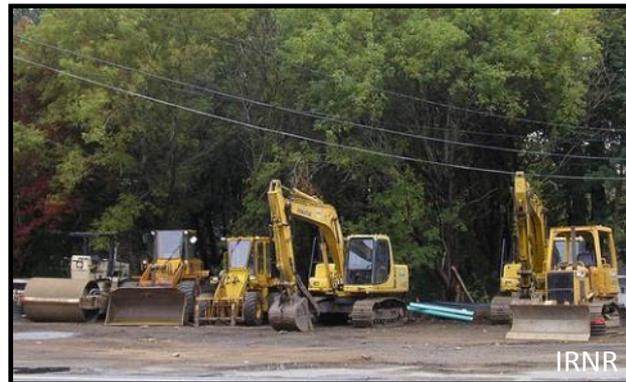
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# Background

- Habitat loss and degradation associated with increased road infrastructure can negatively affect bird populations via:
  - Increased edge effects
  - Decreased dispersal ability
  - Increased mortality
  - Increased human access



# Background

- Noise pollution can also negatively affect bird populations inhabiting vegetation near roadways via:
  - Hearing damage
  - Increased physiological stress
  - Masking communication signals
  - Changes in song characteristics



# Background

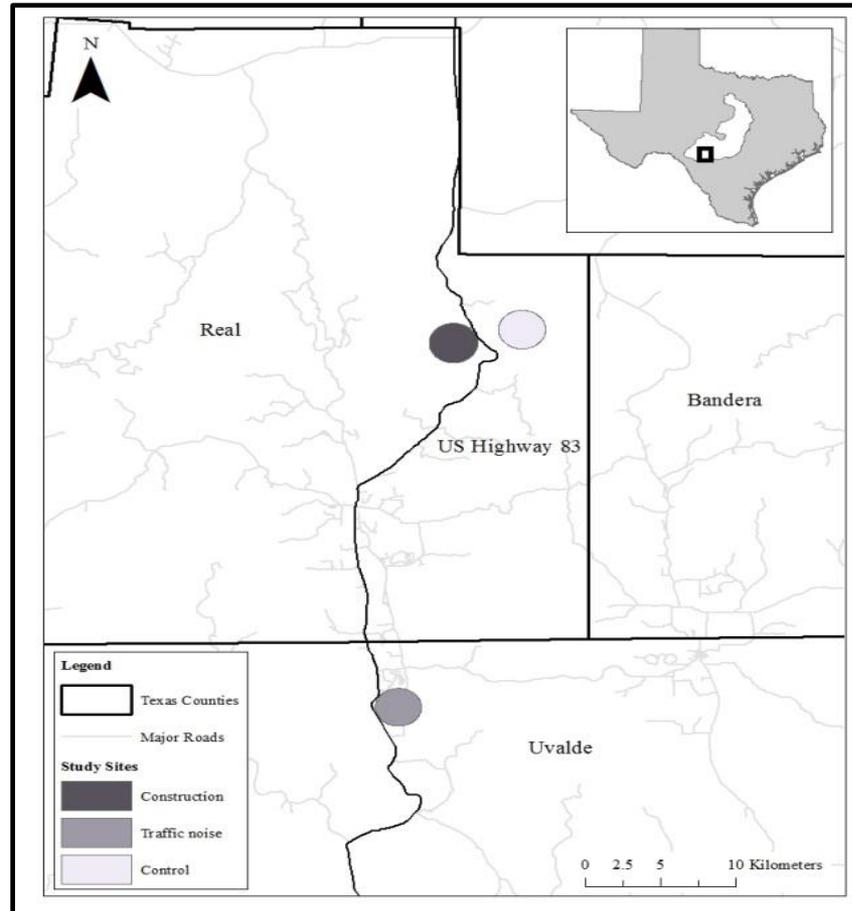
- Important to field-test the potential effects of construction noise and activity on birds because responses are species-specific
- Potential difficulties:
  - Requires several breeding seasons
  - Correlated variables
  - Responses change with distance
  - Need to separate construction from road noise



# Study Design

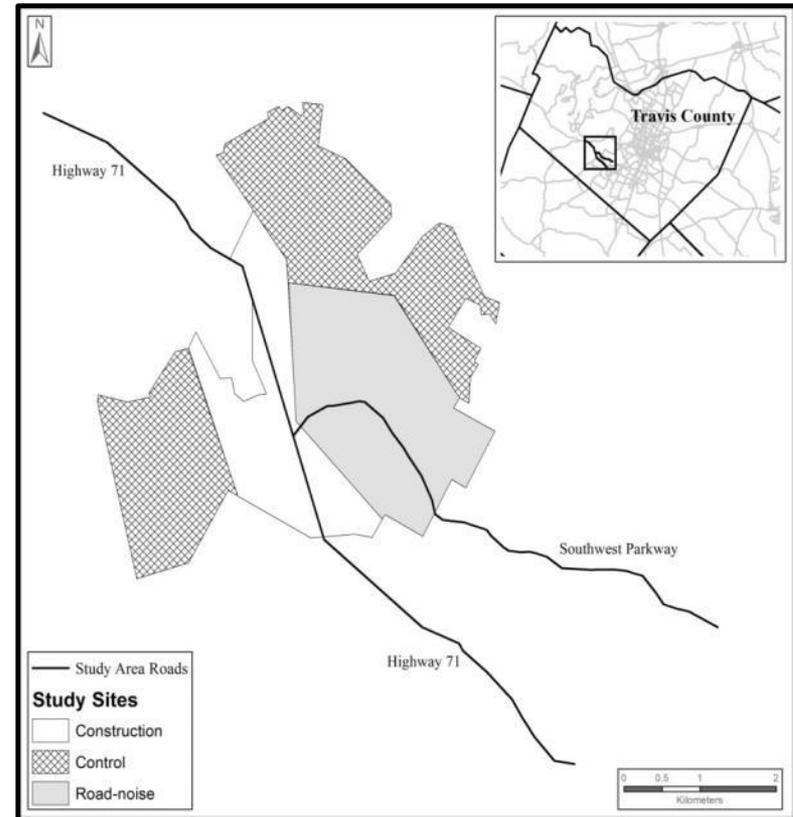
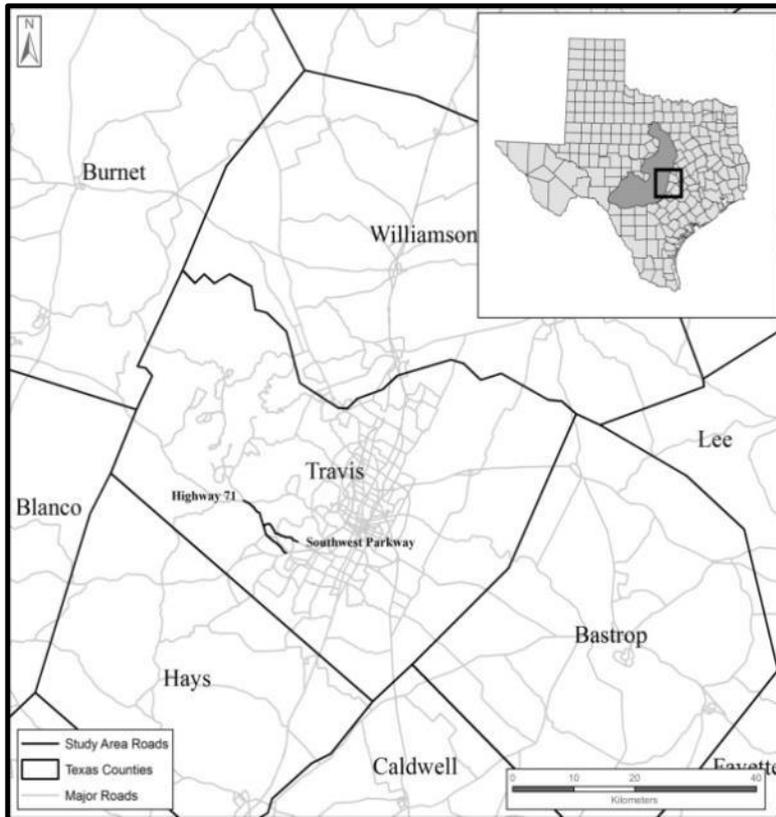
- Goal: Determine the potential impacts of road construction activities and noise on warblers at Highway 83 and Highway 71
- Monitored warblers for several breeding seasons
  - Highway 83 Phases: During and after construction
  - Highway 71 Phases: Before, during, and after construction
- Sites included (1) treatment with construction, (2) control with traffic-noise only, and (3) control with no construction or traffic noise
- Also examined responses in relation to distance from road

# Study Area and Sites



During: 2007–2010 and After: 2011–2013  
Study Sites: 32–61 ha; Control Site >1 km from the road

# Study Area and Sites



Before: 2009–2011, During: 2012–2013, and After: 2014  
Study Sites: 301–682 ha; Control Sites >800 m from the road

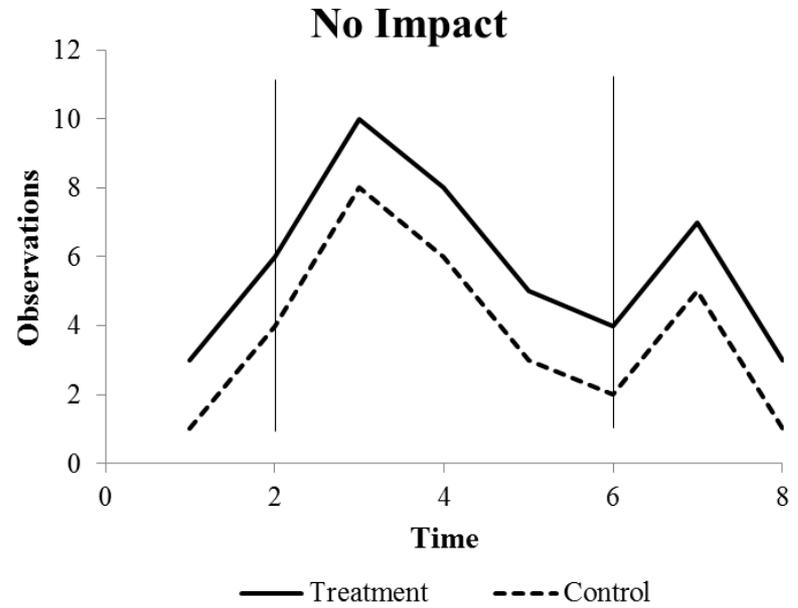
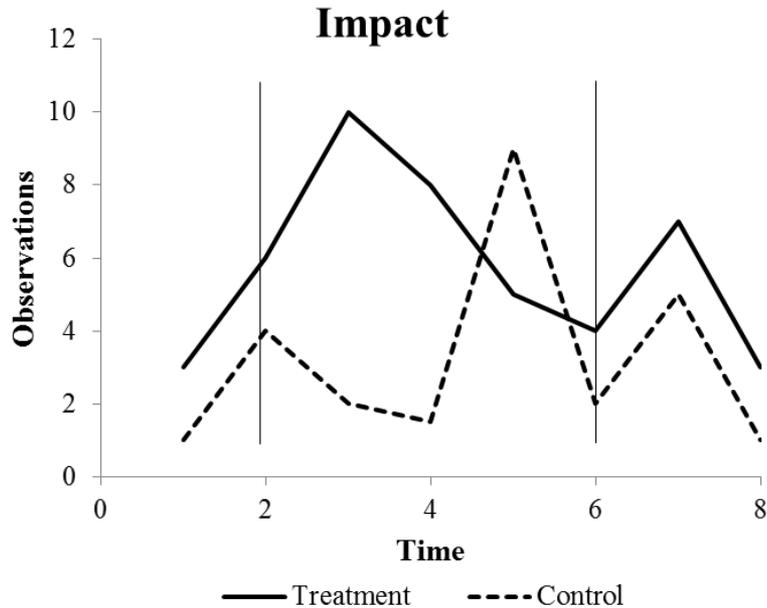
# Objectives

- Quantify sound with increasing distance from roadway
- Habitat selection and reproductive success
  - Territory density
  - Territory size
  - Territory placement
  - Pairing success
  - Fledging success
- Behavioral responses
  - Playback surveys
  - Song characteristics



G. Lasley

# BACI Study Design



A change in warbler responses at the construction sites relative to the control sites—as represented by a statistically significant interaction—would suggest that construction activities had affected warblers

# Methods

- Used sound meters to record ambient noise from 06:00–12:00
  - Highway 83: 50 m, 200 m, 350 m, and 500 m from road
  - Highway 71: 16 m, 32 m, 64 m, 128 m, 256 m, and 512 m from roads
  - Calculated mean and maximum noise for each sound meter
  - Used ANOVA to test the interactive effects of site, treatment phase, and distance from the road



# Methods

- Conducted transect surveys to identify initial warbler locations
- Mapped territories  $\geq 1$  time per week for one hour or until no longer visible
- Used recorded locations of males to create MCPs for each territorial male
  - Territory density = # of MCPs/ha; Friedman's test
  - Territory size = area of MCP (ha); ANOVA
  - Territory placement = distance from MCP centroid to roadway (m); ANOVA



# Methods

- Recorded behavioral observations to predict the reproductive stage of territorial males

Rank	Observation
1	Male present $\geq 4$ weeks
2	Female present $\geq 4$ weeks
3	Evidence of nest building
4	Evidence of nestlings
5	Fledglings sighted

# Methods

- Recorded behavioral observations to predict the reproductive stage of territorial males

- Repeated visits by trained observers
- Rotated observers across territories
- Deployed multiple observers
- Observers shared information
- Assigned dependent fledglings  $\leq 2$  weeks of age to territories
- Assumes similar error for all sites and in all years of our long-term studies

- Limits disruption of breeding pairs
- Used when nests are difficult to find and monitor
- Avoids biases from non-randomly collected nest data
- Provides conservative estimate of reproductive success
- Can sample larger geographic area in a shorter period of time

# Methods

- Recorded behavioral observations to predict the reproductive stage of territorial males
  - Calculated pairing success as the number of territories with a consistently observed female relative to the number of territorial males
  - Calculated fledging success as the number of males that successfully fledged young relative to the number of paired males
  - May underestimate actual reproductive success due to differences in sampling intensity
- Compared relative estimates across sites and phases using ANOVAs and distance from road using logistic regression

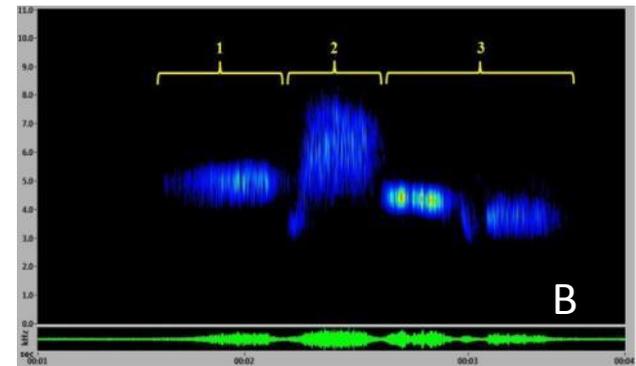
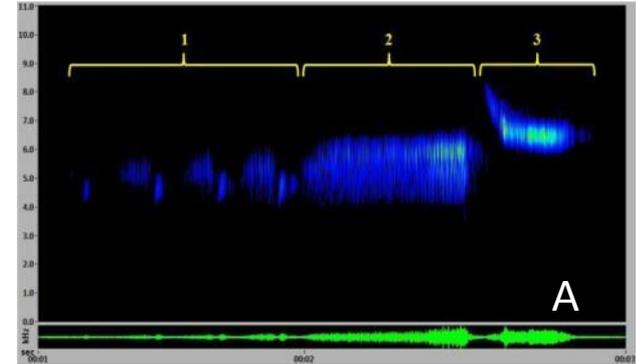
# Methods

- Conducted playback experiment to examine acute responses
  - Played construction noise at ~80 dB to individual male warblers using a hand-held speaker for <5 seconds
  - Noises included (1) backup warning beepers, (2) diesel engine noise, and (3) loading dump trucks
  - Also conducted control surveys with no noises
  - Recorded presence or absence of behavioral response for 10 minutes post-playback or until we could not relocate
- Used logistic regression to examine responses in relation to survey type, site, and distance from the road



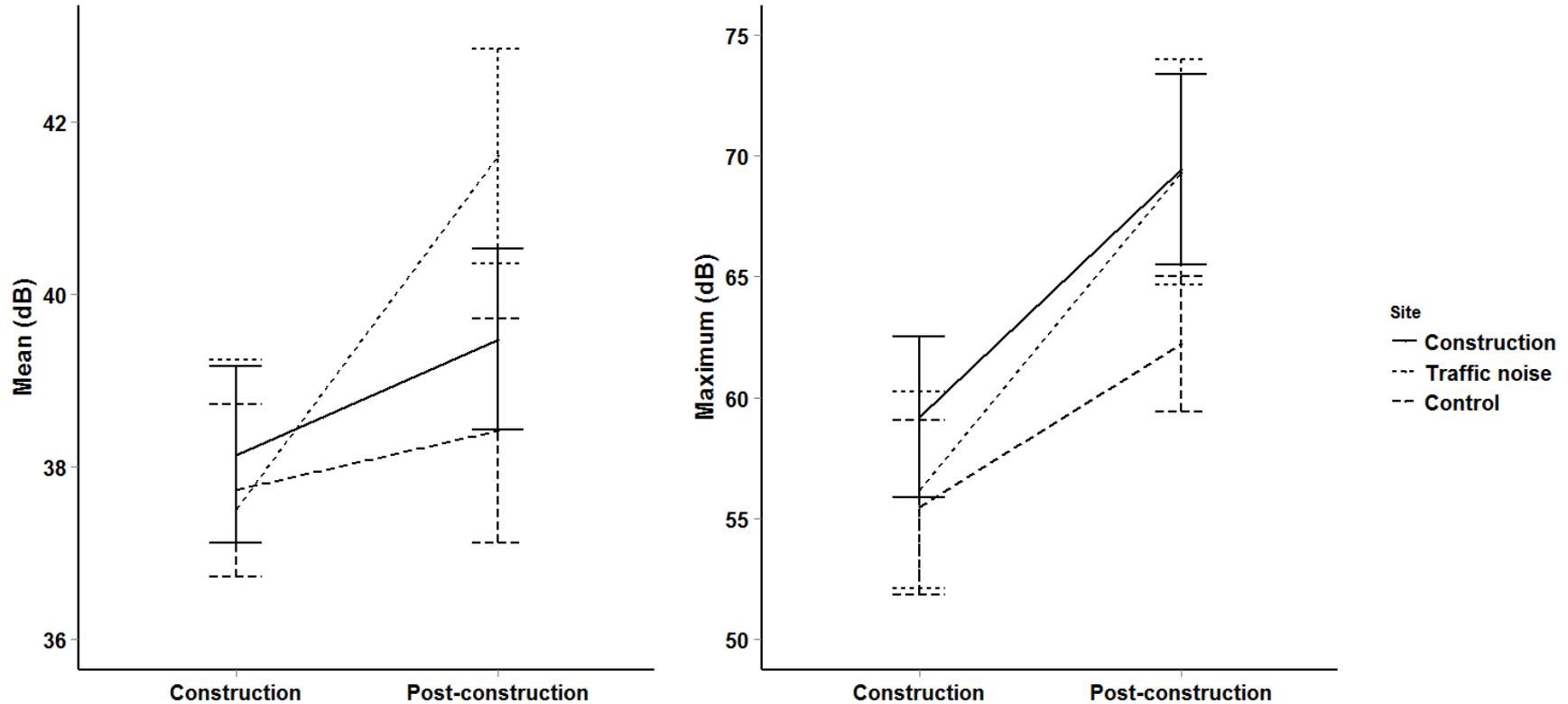
# Methods

- Recorded songs using ARUs placed within randomly selected territories
- Used SonoBird™ to identify and analyze songs
- For each phrase of each song type we recorded:
  - Lower frequency
  - Upper frequency
  - Bandwidth
- Compared metrics using ANOVAs



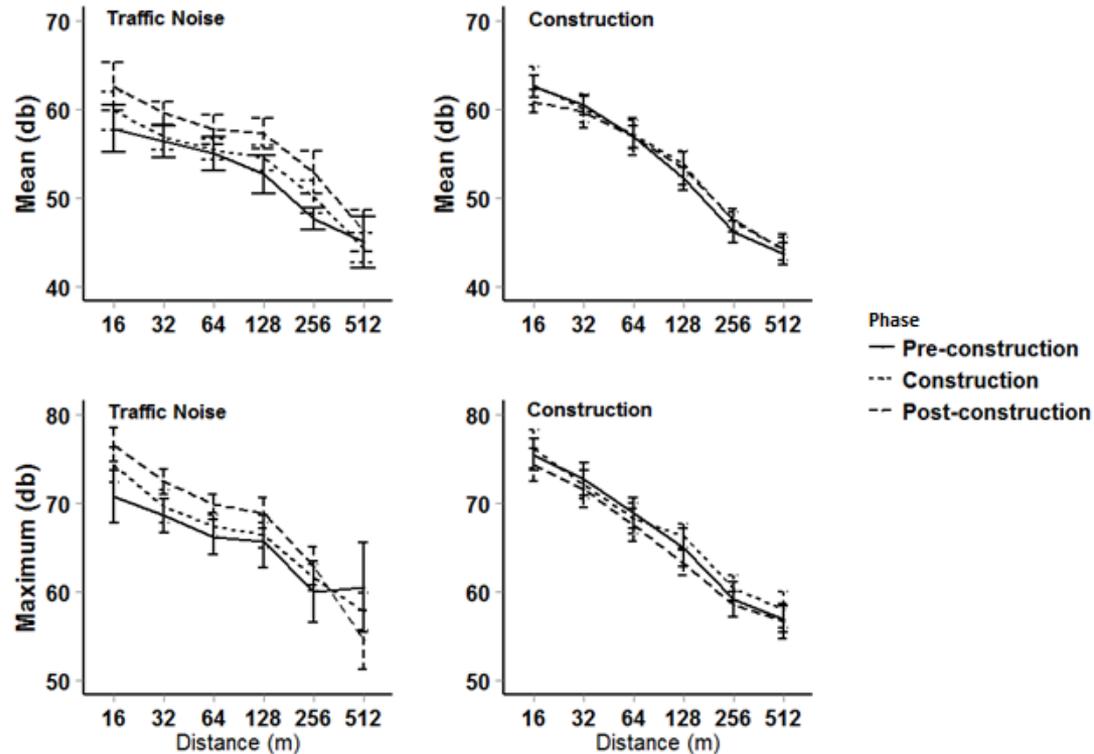
Typical golden-cheeked warbler songs

# Results



Mean and maximum noise did not vary in relation to distance from the road or in relation to construction

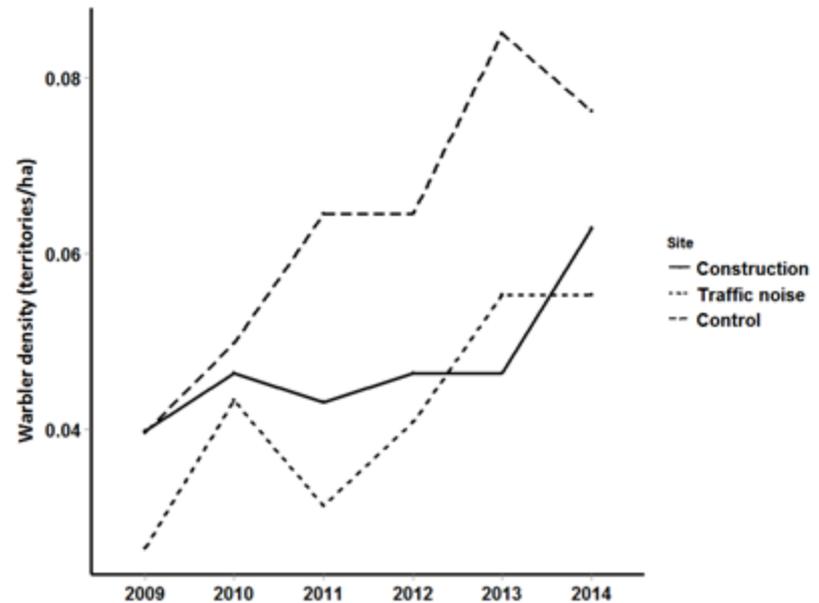
# Results



Mean and maximum noise decreased with increasing distance from roadway, but did not vary in relation to site or phase

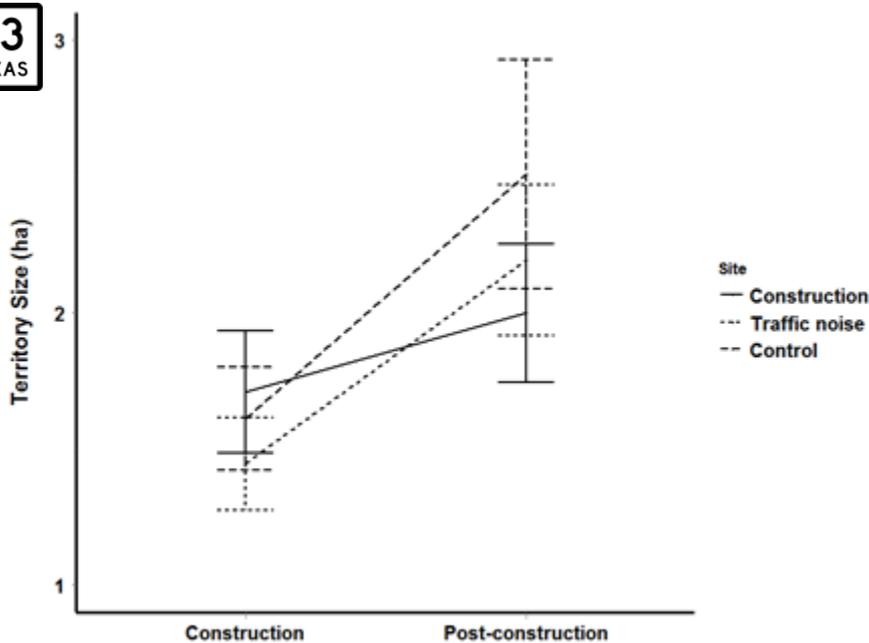
# Results

- Sample sizes:
  - 370 warbler territories at Highway 83
  - 450 warbler territories at Highway 71
- Territory densities remained the same or increased over time
- No difference in territory distance from the roadways across sites



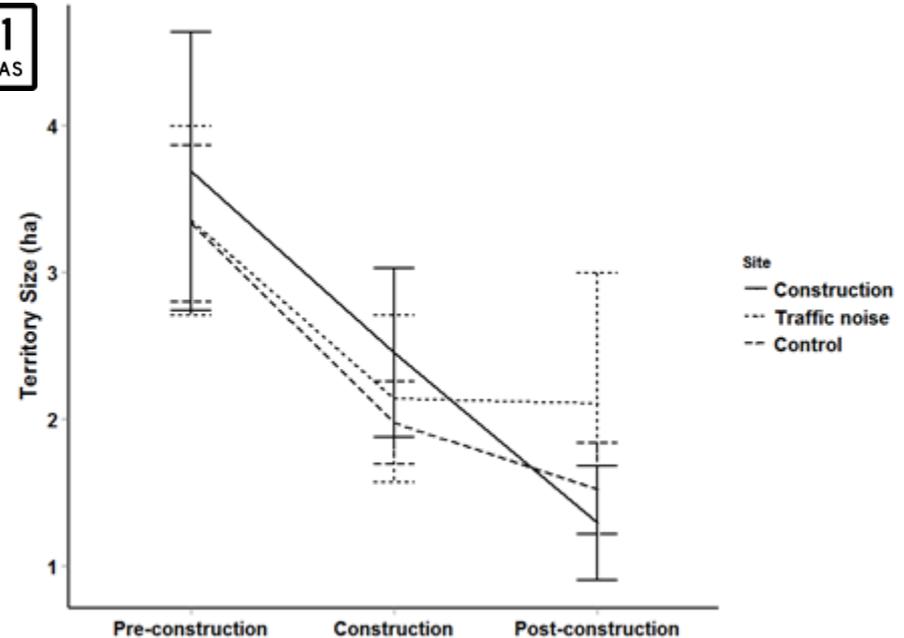
# Results

83  
TEXAS



Significant interaction between site and phase for territory size, but difference unrelated to construction

71  
TEXAS



No significant interaction between site and phase on territory size

# Results



Test	Metric	P-value
Site X Phase	Pairing	0.31
	Fledging	0.29
Distance	Pairing	0.01
	Fledging	0.07



Test	Metric	P-value
Site X Phase	Pairing	0.13
	Fledging	0.13
Distance	Pairing	0.38
	Fledging	0.66

Highway 83: Pairing and fledging success increased with increasing distance from the road, but no difference in ambient noise with increasing distance from the road

# Results

- Playback experiments elicited few responses (<10%) regardless of site, phase, or distance to the roadway
- Some difference in song characteristics. However, they were unrelated to phase and likely reflected individual variation



# Conclusion

- We found no evidence to suggest that warblers respond negatively to road construction noise and activity
  - Noise didn't vary across treatment sites as predicted
  - No evidence of chronic disturbance
  - Examined across existing roadway
  - Noise may not be loud enough
  - Frequency may be more important than amplitude
- Warblers may be more sensitive to other explanatory variables (e.g., patch size, tree species composition)

# Acknowledgments

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