

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

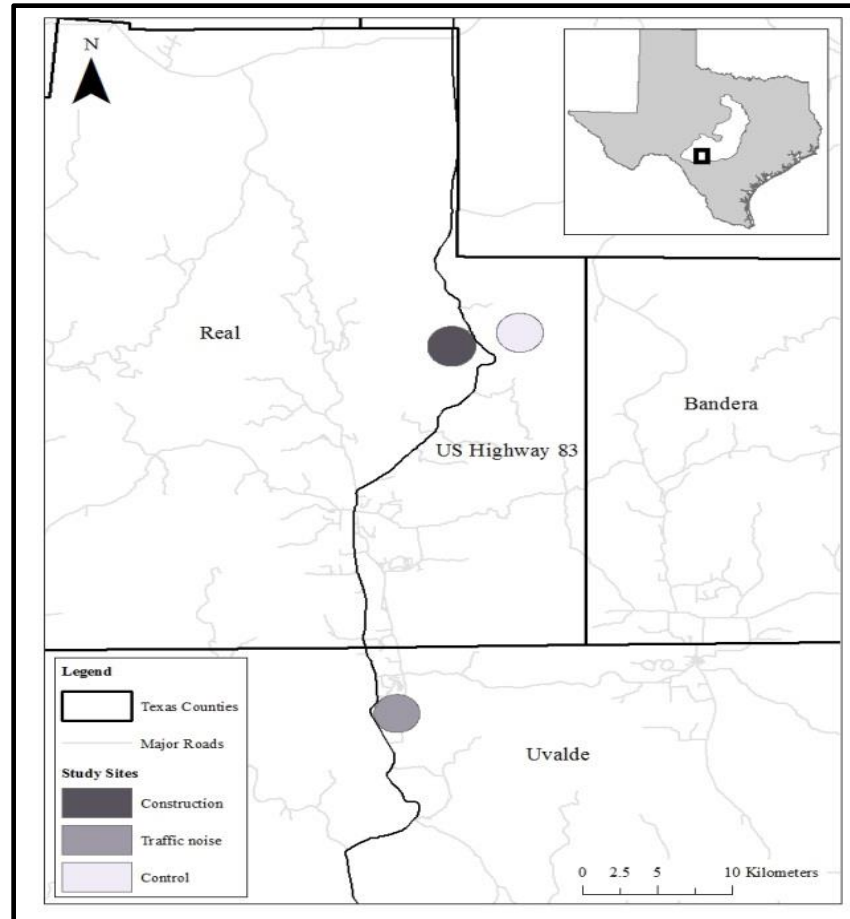
- Important to field-test the potential effects of construction noise and activity on birds because responses are species-specific
- Potential difficulties:
 - Requires several breeding seasons
 - Correlated variables
 - Responses change with distance
 - Need to separate construction from road noise



Study Design

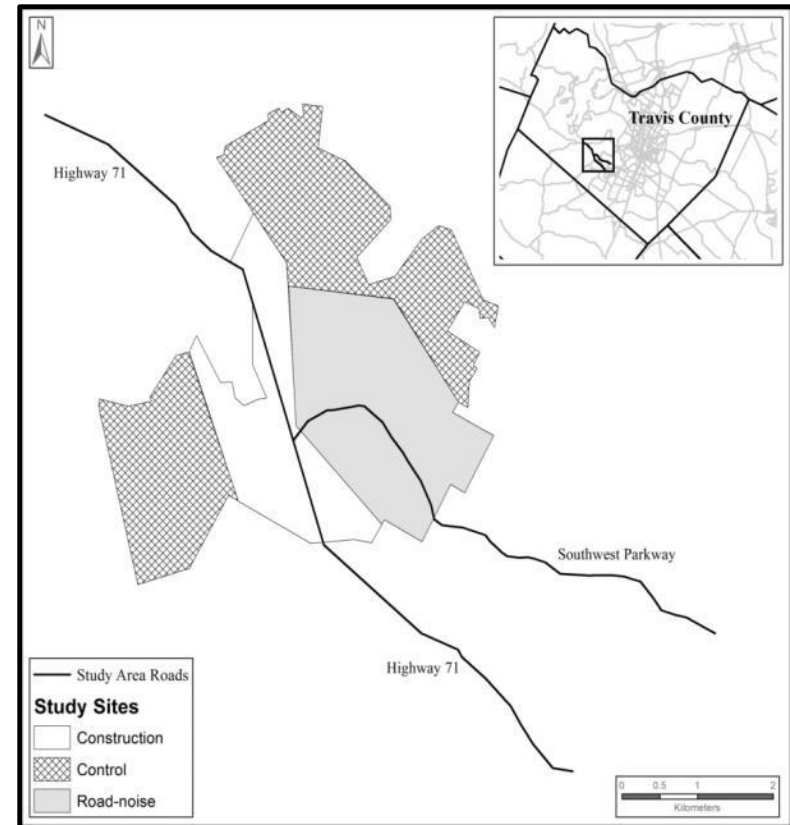
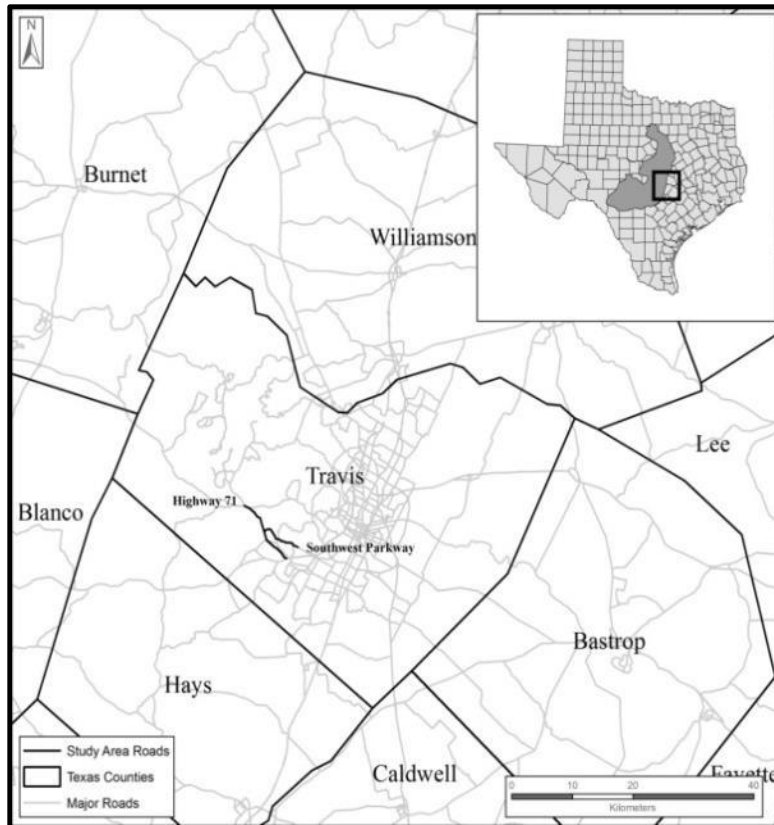
- Goal: Determine the potential impacts of road construction activities and noise on warblers at Highway 83 and Highway 71
- Monitored warblers for several breeding seasons
 - Highway 83 Phases: During and after construction
 - Highway 71 Phases: Before, during, and after construction
- Sites included (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



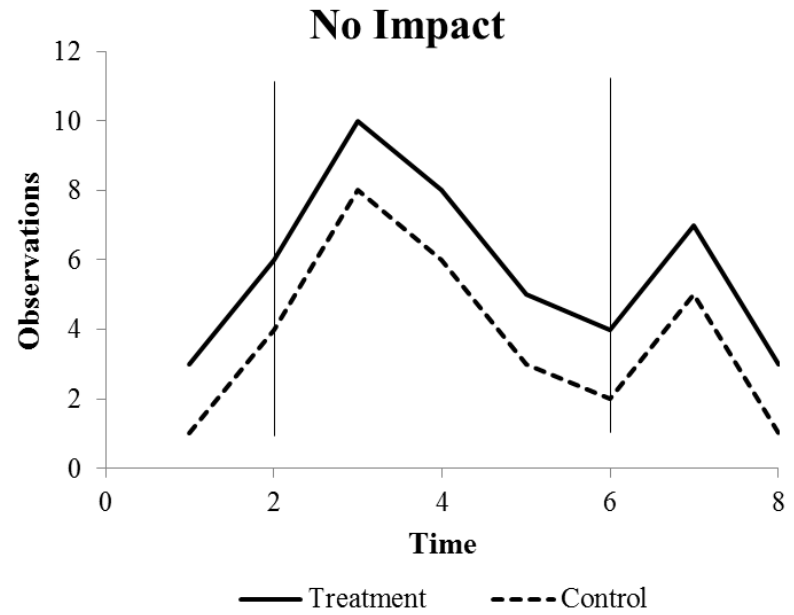
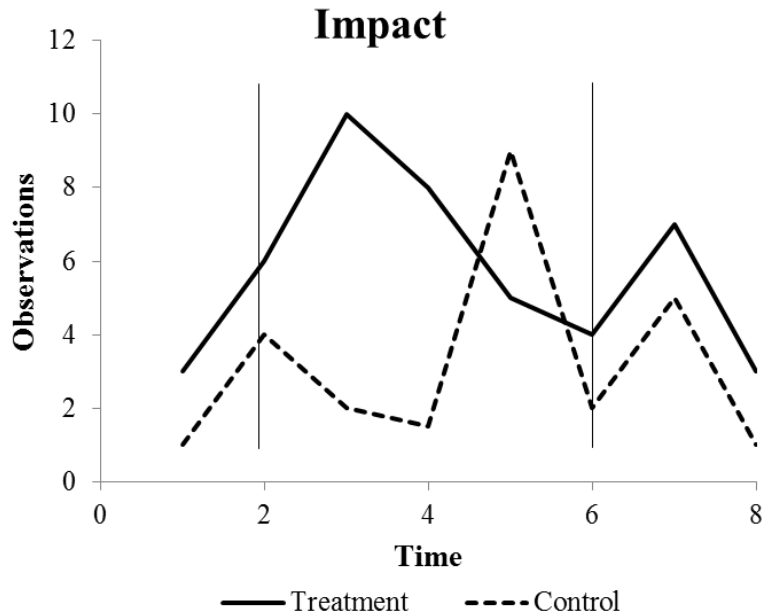
Before: 2009–2011, During: 2012–2013, and After: 2014
Study Sites: 301–682 ha; Control Sites >800 m from the road

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



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

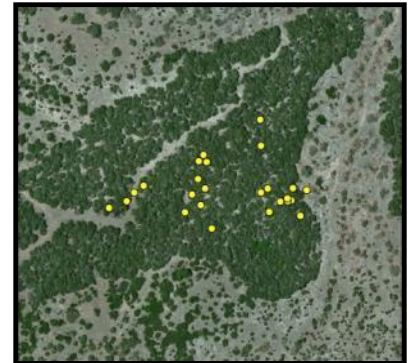
Methods

- 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 ≥ 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 ≥ 4 weeks
2	Female present ≥ 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 ≤ 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

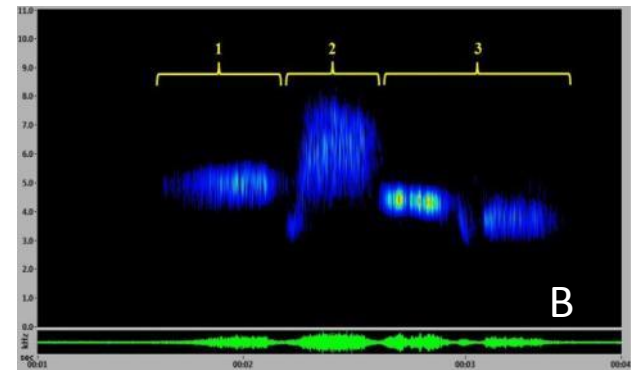
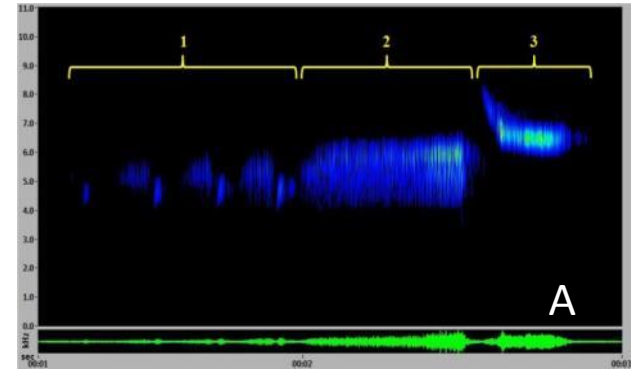
Methods

- 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



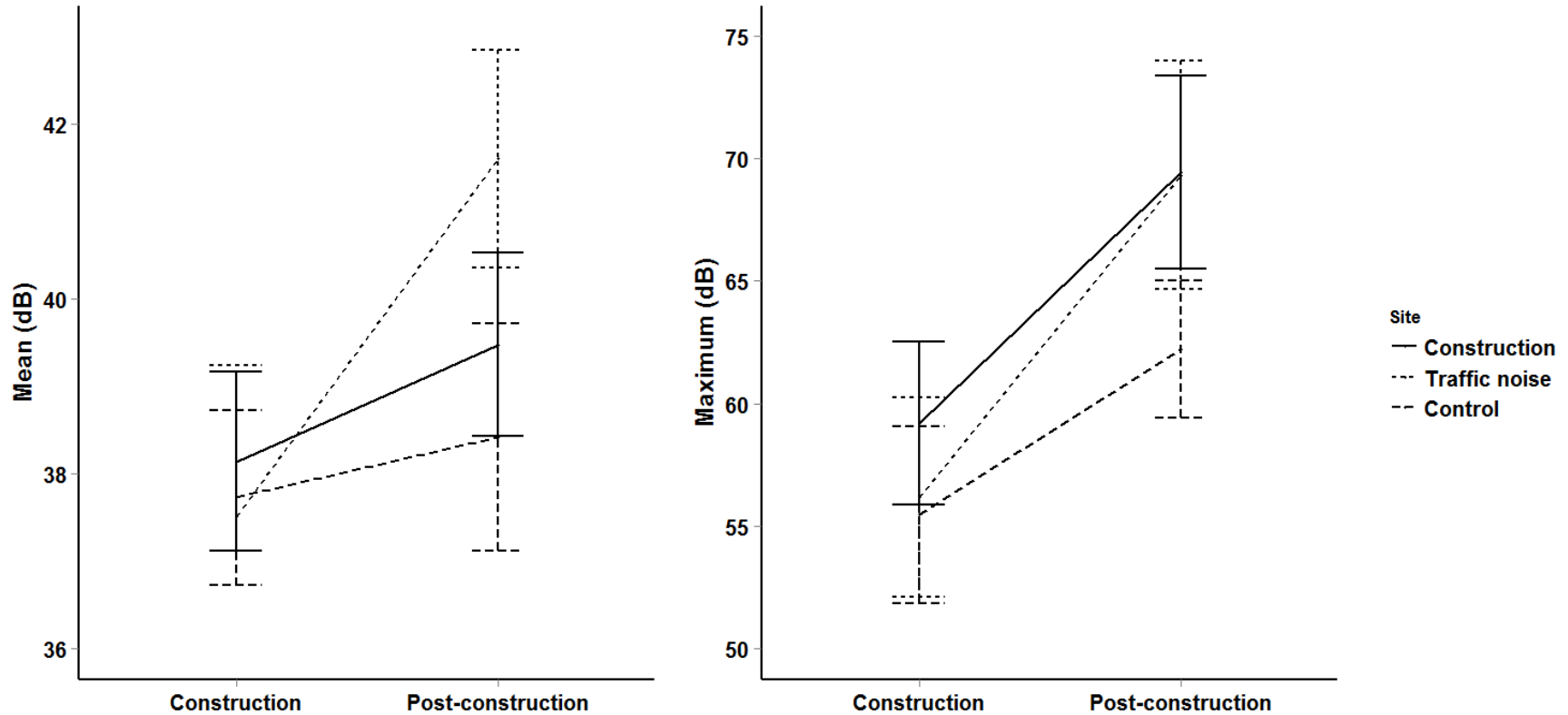
Methods

- 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



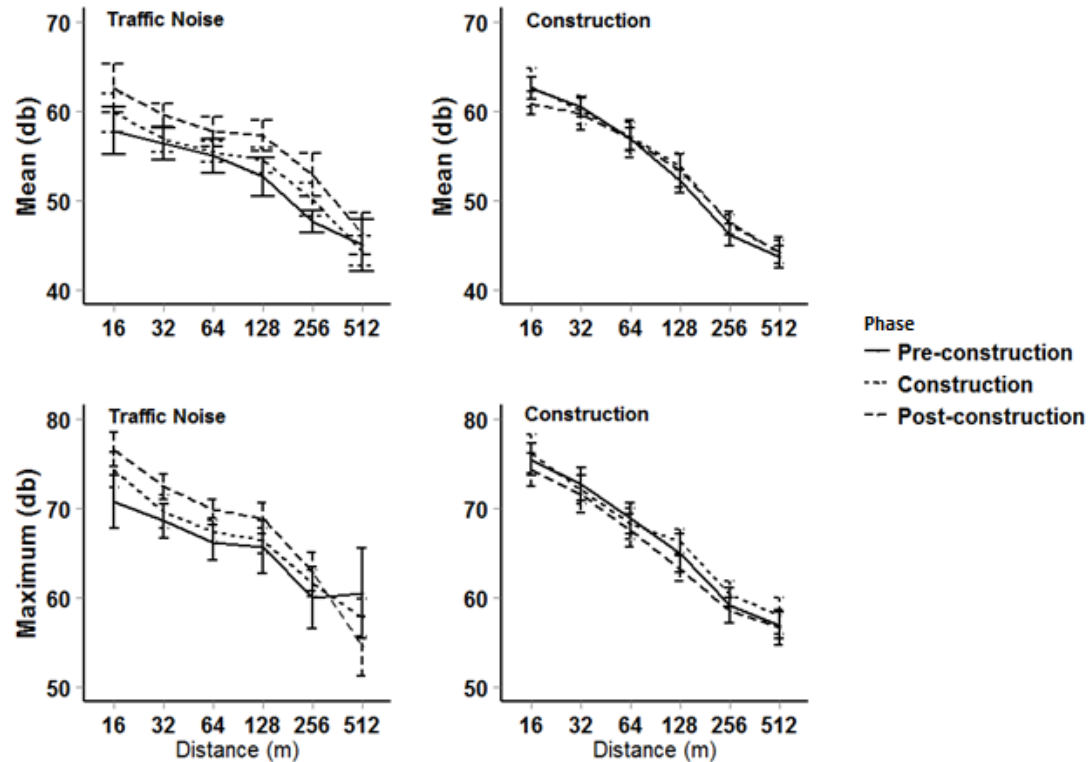
Typical golden-cheeked warbler songs

Results



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

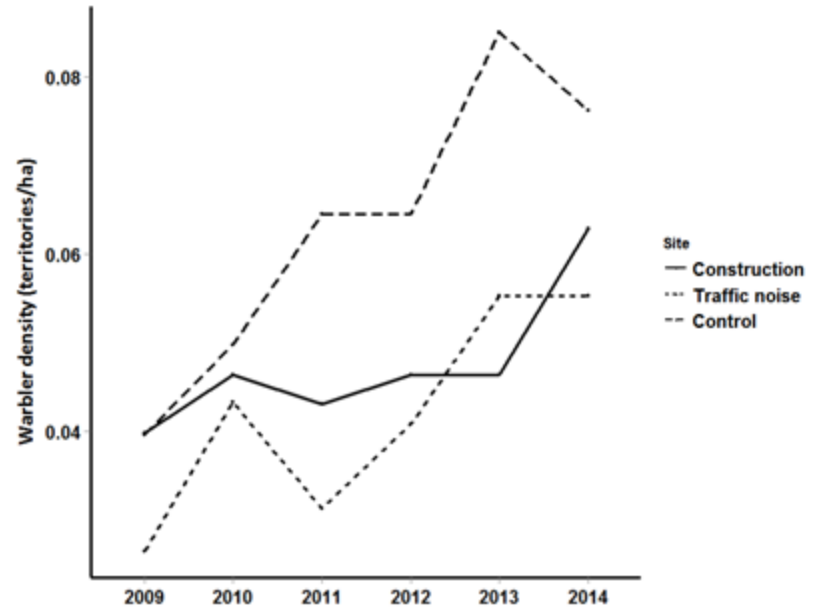
Results



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

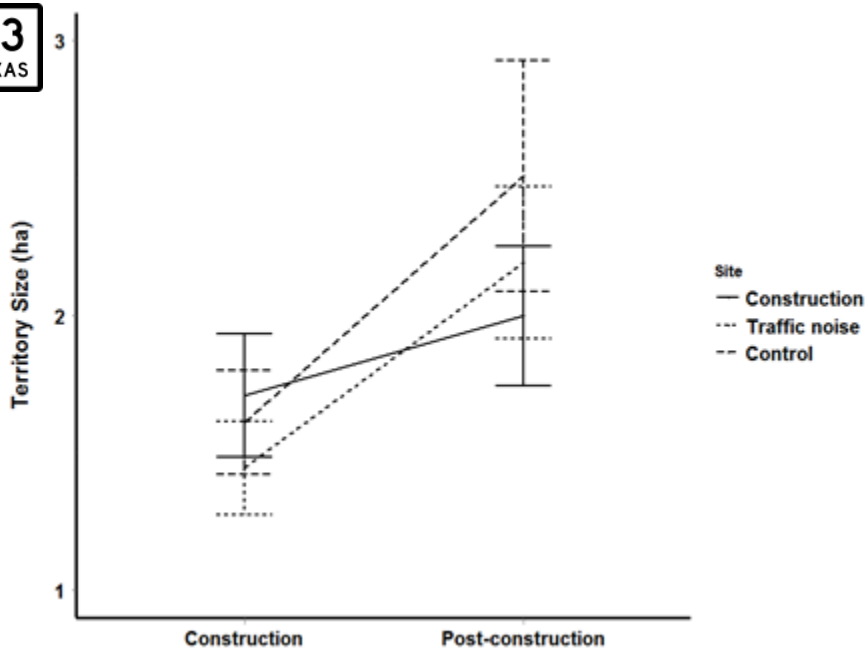
Results

- 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



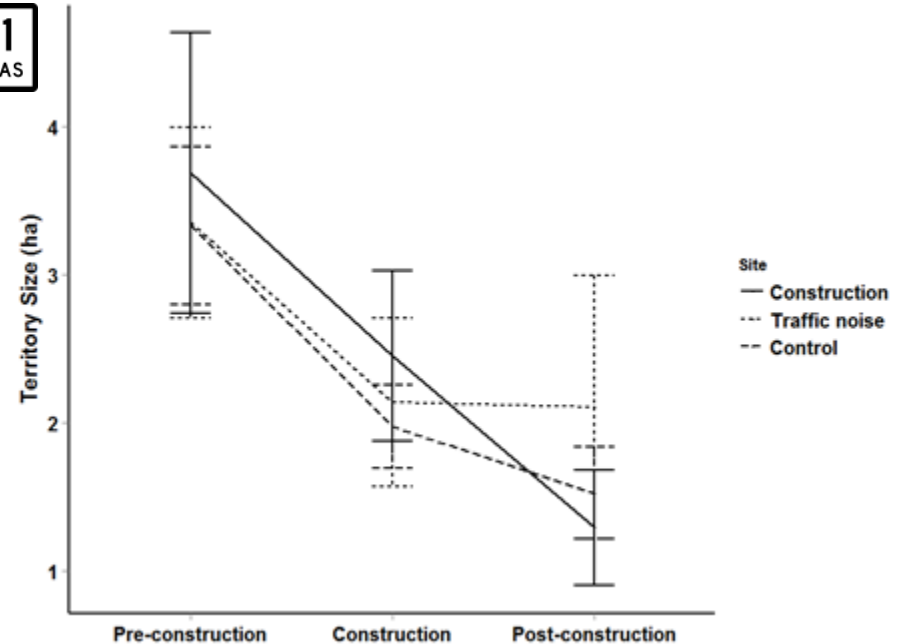
Results

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)

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