BUREAU OF RECLAMATION

Avian Noise Disturbance Study

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Avian Noise Disturbance Study

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U.S. Army Corps of Engineers
Albuquerque District
4101 Jefferson Plaza NE
Albuquerque, NM 87109

by

Bureau of Reclamation
Technical Service Center
Fisheries and Wildlife Resources Group
Kristen G. Dillon, Biologist
Dave Moore, Wildlife Biologist

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Executive Summary

Noise disturbance due to construction, traffic, and other anthropogenic activity has been found to have detrimental impacts on avian habitat occupancy, pairing success, and reproductive output. However, there is not a particular level of noise disturbance that is known to universally cause an impact. Currently, along the Rio Grande in central New Mexico, U.S. Fish and Wildlife Service guidelines require a one-quarter mile (approximately 400 meter) buffer between construction activities and known nests of two endangered birds - the Southwestern willow flycatcher (*Empidonax traillii extimus*) and Western yellow-billed cuckoo (*Coccyzus americanus*). However, data are lacking on whether this buffer distance is appropriate. Therefore, a noise disturbance study was initiated using non-federally listed proxy species to determine whether the current buffer distance is appropriate. No measurable impact of construction noise broadcasts on nesting birds was documented in the pilot year of the study. Further study is recommended in order to assess the impacts to breeding avian species from long-term and complex heavy equipment operation adjacent to occupied nesting habitat.

Introduction

Noise generated by traffic, construction, power stations, and other anthropogenic disturbances has been found to alter avian behavior and population dynamics. Previous research has documented a reduction in pairing success (Habib et al. 2007), smaller clutch sizes (Halfwerk et al. 2011), and lower population density (Reijnen and Foppen 1994) due to noise disturbance. Noise disturbance may impact bird populations through masking or distortion of male song (Habib et al. 2007), causing changes in habitat selection, or inducing a stress response that negatively impacts fitness (Kleist et al. 2018).

However, some studies have found no avian response to noise disturbance. For example, Lackey et al. (2011) found no relationship between construction activities and territory placement, density, or reproductive success of golden-cheeked warblers (*Dendrioca chrysoparia*). Others have found that while habitat occupancy may be unaffected by noise disturbance in some species (Habib et al. 2007, Bayne et al. 2008), mate attraction and pairing success are negatively influenced (Habib et al. 2007, Gross et al. 2010) and the impact of noise on occupancy differed by species (Bayne et al. 2008). Indeed, there are many, often subtle, ways in which noise disturbance might affect breeding birds making determination of an impact complex.

The U.S. Fish and Wildlife Service (USFWS) may require a buffer between project activities and nests of special status avian species in order to minimize disturbance effects. Currently, within the Middle Rio Grande basin of New Mexico, USFWS guidelines require a quarter mile (approximately 400 meters [m]) buffer between construction activities and the location of active nests of the federally endangered Southwestern willow flycatcher (*Empidonax traillii extimus*) and federally threatened Western yellow-billed cuckoo (*Coccyzus americanus*). However, buffer distances are often based on "best biological opinion," with minimal data available to inform the decision.

A noise disturbance study was initiated on the Rio Grande in 2019, in an effort to determine whether the current 400 m buffer distance around project areas is appropriate. This was the pilot year of the study in which methodology was tested and refined. Non-special status riparian breeding songbirds were used as proxy species in this study in order to prevent disturbance to the endangered species of interest. Although many metrics of disturbance can be used, flight initiation is often used in such studies as it is relatively easy to quantify and is a basic indicator of disturbance regardless of the larger impacts of that disturbance. This study was focused on disturbance to nesting birds specifically, and it was therefore decided to quantify flight initiation from the nest (i.e., flushing) as a measure of disturbance due to noise.

Methods

Trials were conducted in the Escondida reach of the Rio Grande between San Acacia Diversion Dam and the northern boundary of the Bosque del Apache National Wildlife Refuge. Nest searching, focused on non-special status cup-nesting riparian obligate species, was conducted from sunrise to noon in riparian habitat adjacent to the Rio Grande. Sound trials were commenced as soon as a nest reached the incubation stage and ended upon hatching.

When conducting sound trials, one observer set up a PCE Instruments sound level meter within one meter of the nest by suspending it from a branch. The sound meter automatically recorded decibel levels (dBa) every second until stopped. This observer then concealed themselves in vegetation in a location from which they could observe the nest without disturbing the bird. The bird often flushed from the nest during the initial sound meter setup and thus there was typically a short waiting period to allow normal behavior to resume after the initial disturbance. Once the bird returned to incubation, the concealed observer alerted a second biologist by text message to begin the sound trial.

Typical construction sounds are in the 85 to 95 dBa range, although equipment such as hammer drills can reach 120 dBa (Seixas et al. 2001; Sinclair et al. 2011). The Occupational Safety and Health Administration (OSHA) requires ear protection for extended exposure above 85 dBa. Construction noise was broadcasted at 85 dBa from a FoxPro Fusion game caller in 50 m intervals, starting at 400 m from the nest and ending at 50 m from the nest. The construction noise was played for 5 minutes at each 50 m interval. The biologist conducting the sound trial recorded the UTM coordinates of the first (400 m) broadcast location, as well as the start and stop time of each 5-minute broadcast. During this time, the biologist observing the nest recorded the times at which the bird flushed from and returned to the nest. If the bird flushed from the nest and had not returned by the end of the final construction noise broadcast, the nest observer continued observation for another 10 minutes to determine whether the bird returned in that time. Upon conclusion of observation, the nest observer removed the decibel meter and transcribed their behavioral observations onto the noise trial datasheet so that the timing of flushing could be compared to the time and distance of sound trials.

Two sound trials were conducted at each nest whenever possible, with the second trial conducted at least two days after the first. In some instances, the eggs had hatched or the nest was predated by the second visit, preventing a second sound trial. Nest monitoring was not conducted past sound trial completion. Additionally, control observations were conducted at some nests in which the sound meter was set up and an observer recorded the timing and frequency of the nesting bird leaving and returning to the nest, but no sound trial was conducted. Control observations lasted as long as a typical sound trial (30 minutes minimum). These control observations were intended to document baseline noise levels and frequency of flushing behavior. All sound trials and control observations were conducted before 11 a.m., in an effort to control for time of day and the potential for warmer temperatures later in the day to increase the likelihood of a bird staying off the nest for extended periods of time.

Results

Thirty-nine sound trials and 6 control observations were conducted at 26 individual nests. Of those, two sound trials were conducted at 15 nests, and one trial was conducted at 9 nests. The nests included in the study belonged to yellow-breasted chats (*Icteria virens*; n=14), gray catbirds (*Dumatella carolinensis*; n=7), black-headed grosbeaks (*Pheucticus melanocephalus*; n=4), and Bell's vireos (*Vireo bellii*; n=1).

The incubating bird flushed at least once in 62 percent of sound trials (n=24) and flushed more than once in 31 percent of sound trials (n=12). In 21 percent of sound trials, the bird flushed from the nest and did not return during the observation period. During control nests, two thirds of birds (n=4) flushed more than once and flushed without returning during the observation period.

The average maximum decibel level recorded at a nest during a sound trial was 56.6 dBA (range= 42.9 to 76.9). The average maximum decibel level recorded at nests during control observations was similar (53.6), but the maximum decibel level recorded during control observations was only 59.5 dBA. For reference, decibel levels of approximately 60 dBA were recorded at the nest in association with the bird vocalizing loudly near the nest or a train passing in the distance. The average decibel level at the nest was approximately 4 dBA higher (range= -4.1 to 11.4) during the 50 m noise broadcast than during the 400 m noise broadcast, and the maximum decibel level was approximately 2.5 dBa higher (range= -29.3 to 19.3).

Figure 1 is an example of decibel levels at a nest before and during a sound trial. The construction noise broadcast can be clearly seen in the decibel level pattern at the nest when it was played at the 150 m, 100 m, and 50 m broadcast locations. Prior to that, only small fluctuations in decibel level are recorded, perhaps picking up the loudest parts of the broadcast. Additionally, dogs began barking nearby during this trial, raising the decibel level at the nest more than 20 dBa higher than the loudest decibels associated with the noise broadcast. Red arrows on the graph indicate a bird leaving the nest, and green arrows indicate a bird returning. Although there was an apparent response to the loudest disturbance from dogs, there was no apparent response to the loudest disturbance from the noise broadcast. Figure 2 is an example of decibel levels at a nest during control observations, in which no sound trial was conducted. Decibel levels at the control nest repeatedly reached levels at or above those induced by the sound trial (Figure 1) due to other disturbances. Birds singing, traffic noise, and the sound of the river were all commonly, and often loudly, heard during nest observations.

Results

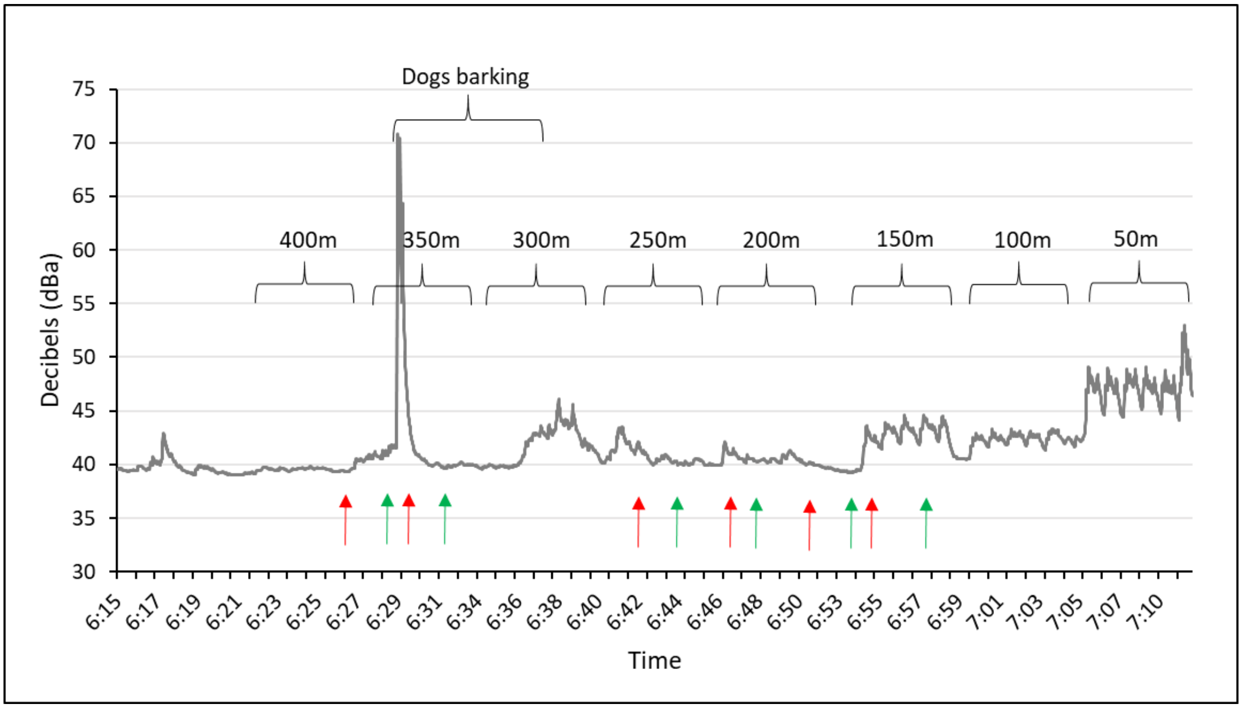

Figure 1. Decibel levels at a nest during a sound trial.

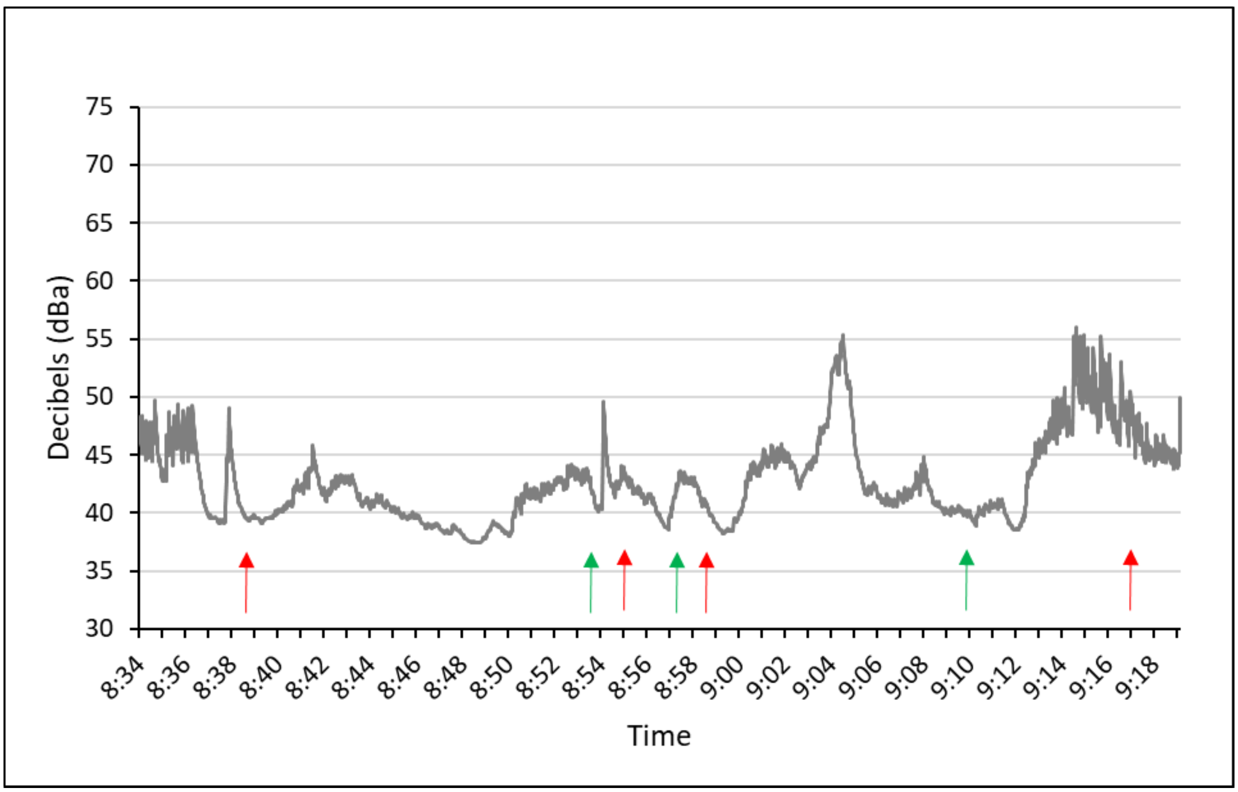

Figure 2. Decibel levels at a nest during control observations.

There was no observed difference in the maximum or average decibel level at nests between the groups of birds that flushed from the nest during the sound trial and those that did not (Figure 3). This was true when comparing groups of birds that flushed at least once with those that did not (Figure 3), as well as when comparing groups of birds that flushed more than once with those that did not.

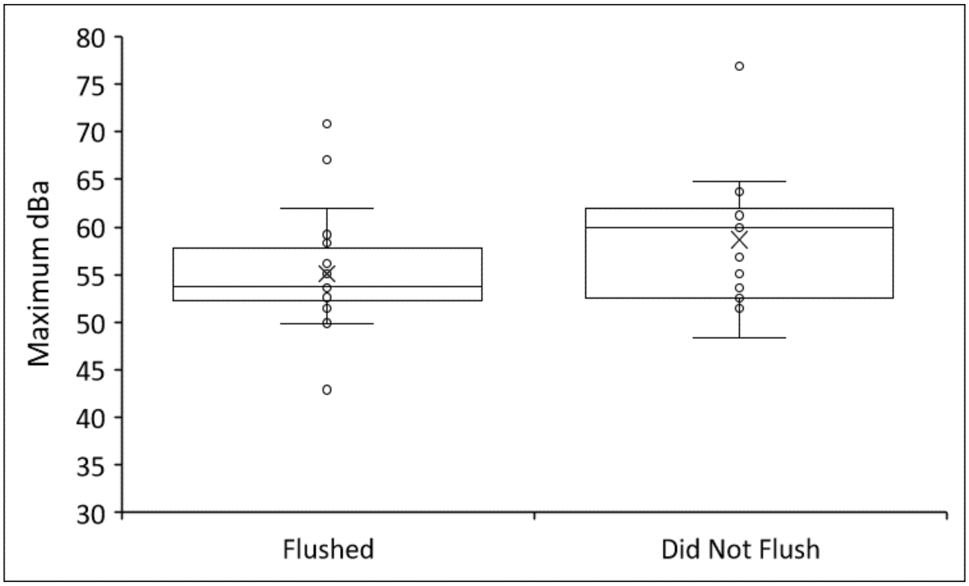

Figure 3. Maximum decibel level during sound trials at nests of birds that flushed vs. those that did not.

Moreover, there was little variation in the number of birds that flushed per noise broadcast distance interval. It would be expected that if the noise broadcast was causing disturbance to nesting birds, the number of nests at which a bird flushed would increase as the broadcast location moved closer to the nest. However, the number of nests at which a bird flushed was fairly evenly distributed across broadcast distances (Figure 4). If anything, the opposite response was observed such that the largest number of birds flushed when the broadcast was played at the furthest distances (400 m) and no birds flushed when the broadcast was played at the closest distance (50 m). This may reflect the fact that in the earliest stage of observation some birds were still restless due to the initial disturbance of the sound meter setup and more likely to leave the nest. The even distribution of instances of flushing after that time suggests that birds' movements on and off the nest reflected normal breeding behavior and were not influenced by the construction noise broadcast. Alternatively, this behavior pattern may suggest that birds became accustomed to the noise broadcast the longer it was played. However, the sound trials did not appear to increase decibel levels at the nest when played at the furthest distances from the nest (Figure 1).

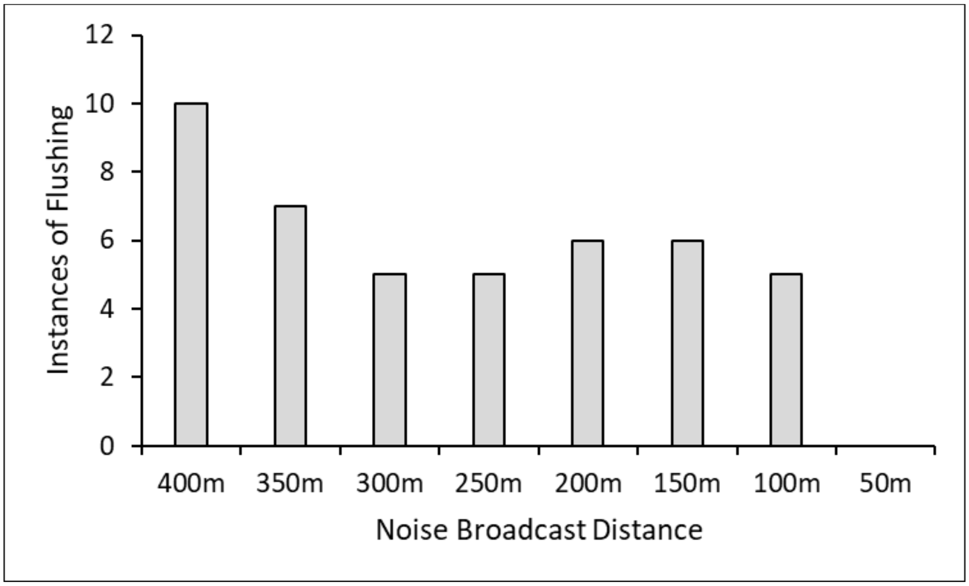

Figure 4. Distribution of number of birds that flushed from the nest by coinciding noise broadcast distance.

When considering only the nests at which two sound trials were conducted during the incubation period, 14 of 15 birds (93 percent) flushed from the nest at least once during the first trial, and only 40 percent flushed during the second trial. However, a third of birds in both trials flushed more than once. Given this, it is likely that the observed difference in the percentage of birds that flushed at least once may simply reflect an increased likelihood of the bird staying on the nest for long periods later in the incubation period, and that leaving the nest periodically during incubation is a normal avian breeding behavior. There was no difference in average or maximum decibel levels at nests between the groups of birds that flushed and those that did not.

Discussion

Current guidelines require a 400 m (one-quarter mile) buffer between construction activities and active nests of Southwestern willow flycatchers or Western yellow-billed cuckoos. This study was the pilot year of an effort to determine whether that buffer is appropriate and at what distance nesting birds respond to noise disturbance.

There was no measurable impact of the construction noise broadcast on nesting birds observed in this first year of data collection. Although birds were observed to leave the nest during the construction noise broadcast, the data suggest that this was normal avian breeding behavior and not a response to disturbance caused by the broadcast. Instances of birds flushing from the nest did not increase as the construction noise was played in closer proximity to the nest. The maximum and average noise levels at the nest did not differ between groups of birds that flushed during the sound trial and those that did not.

Overall, the average maximum decibel level was only slightly higher at sound trial nests than at control nests (57 dBa vs. 54 dBa). However, the maximum decibel level observed at a control nest was 60 dBa, compared to 77 dBa at sound trial nests. Therefore, the construction noise broadcast did increase noise levels at the nest as intended. Given that construction noise was being broadcast at 85 dBa from only 50 m away at the closest broadcast point, this does suggest that the dense vegetation characteristic of riparian habitat on the Rio Grande serves to buffer some of that noise. For reference, the volume of a normal conversation is approximately 60 dBa, a vacuum cleaner is approximately 70 dBa, and a blender is approximately 90 dBa (Federal Aviation Administration).

However, it is important to note that this study did not perfectly replicate the potential disturbance to nesting birds caused by construction activities. For example, construction noise was broadcast for 5 minutes at a time at 8 distance intervals, equating to approximately 40 minutes of sound broadcast starting at the furthest distance from the nest. Although this is an effective way to look for and document a discrete response to noise disturbance, it is possible that habituation may have occurred during the trial or that the impacts are cumulative and the disturbance may be greater when the noise continues for 8 to 10 hours and for multiple consecutive days, as would be observed in a typical construction site. Additionally, the potential disturbance caused by construction activities is not limited to noise alone. Construction sites typically have heavy machinery which cause ground vibrations that can be felt at a distance. The combined effect of noise and vibrational movement may cause considerably more disturbance than sound alone, particularly over an extended period of time. Conversely, it is possible that birds are able to habituate to construction noise after extended exposure and the resulting disturbance is minimal. For instance, birds often nest in relatively close proximity to railroad tracks and roads.

Conclusions

Although this pilot study found no apparent impact of broadcasted construction noise on riparian nesting birds, additional research is recommended prior to drawing conclusions regarding the level of disturbance caused by construction activities. Further study should attempt to assess the broader impacts of construction activity on breeding birds, including physical disturbance and duration of disturbance compounded with discrete noise levels. Sound reproduction broadcasts have a limited ability to reproduce the full frequency spectrum and physical stimulus of an actual construction site. A comparison of nest success and parental behavior of birds nesting in close proximity to a construction site versus those nesting in an undisturbed area may be one approach to assessing these more complex impacts. However, locating an appropriate experimental study area may prove challenging.

Recommendations

- Expansion of the study to assess the more complex impacts of construction activity, beyond noise alone, on nesting birds. One approach to this may be to quantify the impacts of an active construction site on nesting birds.
- The construction noise in this pilot study was broadcasted at the low end of the decibel levels typically heard in a construction site. Further study might include increasing this noise level to assess whether a disturbance effect is observed at higher volumes.
- Rather than a broadcast transect, broadcast multiple times from a fixed location, increasing the volume of the broadcast each time.
- Compare responses in fixed location and volume tests to the transect results from the same volume and distance to investigate habituation.
- Increase the control sample, in which decibel levels and behavior is recorded at the nest in absence of a sound trial.

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