



TRC0501

**Evaluation of Passive Bird Deterrent
Devices to Minimize Nesting on
Bridges and Culverts**

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Final Report

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Project Number TRC-0501

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June 2007

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**Arkansas State Highway and Transportation Department
Planning and Research Division
Environmental Division**

TITLE: TRC-0501 Evaluation of Passive Bird Deterrent Devices to Minimize Nesting on Bridges and Culverts

INTRODUCTION

The Migratory Bird Treaty Act of 1918 (as amended 1989)(hereafter MBTA) implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under the MBTA, taking, killing or possessing migratory birds is unlawful. Specifically, the MBTA provides that it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not.

The MBTA makes it unlawful to destroy migratory bird nests when birds are attempting to build nests, lay eggs, and brood the young. Highway project construction has been impacted when migratory birds, primarily swallows, are present on bridges and in culverts. Modification and/or demolition of structures providing nesting habitat cannot occur if birds and/or nests will be destroyed. Birds are usually present on bridges in Arkansas from approximately April 1 through August 31.

There are three primary species of migratory birds that utilize bridge and culverts for nesting in Arkansas. They are the Barn Swallow, the Cliff Swallow, and the Eastern Phoebe, and a brief description of pertinent details regarding each bird follows. The barn swallow (*Hirundo rustica*) is a small slender bird (15-19cm in length, 29-32 cm wingspan) with a long forked tail. The color pattern is dark iridescent blue on the back and rufus underneath. The barn swallow is native to all biogeographical regions except Australia and Antarctica (Roth and Dewey 2002). The North American population

breeds from southern Alaska to central Mexico and winters in South America. Barn swallows are monogamous, however extra-pair copulations are not uncommon (Dewey and Roth 2002). During the winter months, barn swallows congregate in large colonies but often breed in colonies of various sizes from single pairs to groups of 40 or more pairs (Snapp 1976). Breeding typically occurs from May through August but active nests have been observed as early as 7 April and as late as 15 September in Texas (Martin 1974). Females lay between three and seven eggs that hatch in 13 to 15 days. The chicks fledge in 18-23 days (Ehrlich *et al.* 1988). Two broods are typically raised each summer. Barn swallows originally nested in caves but now nest almost exclusively on man-made structures such as barns, bridges, and culverts (Brown and Brown 1999). Nests are made of mud lined with grass, hair, and/or feathers, are bowl-shaped with successive years often rebuilt on top of the previous year, and are attached to vertical walls underneath overhangs. Barn swallows are insectivores that forage in territories typically within 1.2 km of their nests (Brown and Brown 1999).

The Cliff Swallow (*Petrochelidon pyrrhonota*) is very similar in size and color to the Barn Swallow but differs in having a square tail, a pale orange rump, and a creamy-white forehead patch. The Cliff Swallow breeds from March to September in western and central Alaska eastward to Nova Scotia, southward to southern Mexico, central Arkansas, northern Georgia, and New Jersey. It winters in South America (Brown and Brown 1995). The Cliff Swallow is gregarious during all seasons often nesting in large colonies. Nests are constructed of mud lined with straw, grass, and feathers, are usually gourd-shaped with the nest opening facing downward, and are placed on vertical ledges and overhangs (Grant and Quay 1976). Clutch sizes range 1-6 with four being most common (Brown and Brown 1999). Mating pairs typically raise one clutch but occasionally rear two or three (Ehrlich *et al.* 1988). Eggs hatch in 14 to 16 days and young fledge in 21 to 24 days post hatching (Ehrlich *et al.* 1988). Cliff Swallows are insectivores that specialize in flying insects and often feed at heights of 50m or more above ground (Brown and Brown 1995).

The Eastern Phoebe (*Sayornis phoebe*) is a dark grayish brown bird with dark head and tail and whitish underparts often washed with yellow. The Eastern Phoebe breeds from southeastern Yukon and northeastern British Columbia eastward to Nova Scotia and southern Quebec, southward to central Texas, northern Mississippi, and Central Georgia. It winters from Maryland to southeastern Oklahoma, southward to Florida, the Gulf Coast, and eastern Mexico (Weeks 1994). Nests are constructed of mud mixed with green moss and leaves, are lined with grass and hair, and are affixed to a wall under a bridge, cliff, or eave of a building (Ivory 1999). Females lay between 2-6 eggs, which hatch in about 16 days. Mating pairs often have two broods. Fledging occurs 15 to 18 days post fledging. Eastern Phoebes are monogamous and share in parental care of the young, however only the female incubates the eggs (Weeks 1994). Eastern Phoebes are insectivores but will occasionally eat small fruits and fish (Terres 1980).

Projects in Arkansas that have been involved with migratory birds include the U.S. Highway 412 Bridge crossing Beaver Lake, Washington County, where demolition of the old Beaver Lake crossing was held up for several months to allow for young swallows to fledge and leave the nesting sites. Also, the Interstate 40 Rehabilitation at Spadra Creek Bridge and Little Spadra Creek Bridge, Johnson County included migratory bird

involvement where contractor operations for construction sequencing of the entire project was affected by presence of migratory swallows nesting beneath interstate bridges. The Contractor filed for damages in excess of \$1,000,000.

In 2002, the AHTD let a project to net interstate rehabilitation project bridges that were slated for lettings in February, April, and May in order that birds would be passively excluded from nesting. The preventative netting (passive exclusion) allowed contractors for the rehabilitation projects to proceed with bridge construction if the birds are not nesting at the time of construction work. Cost of the netting project was approximately \$150,000.

Currently, birds must be physically restricted from nesting on bridges by installation of netting that is costly and sometimes ineffective. The Arkansas State Highway and Transportation Department (AHTD) has only one approved method (See Appendix I) for preventing migrating birds, primarily swallows, from nesting on bridges and culverts that need to be removed. This method allows the contractor to install netting before the nesting season and details the appropriate size of netting and installation procedure. The Department's current Special Provision requires netting to be installed with no more open spacing than a ½ inch. Frequently this installation requires lane closures during installation and maintenance. When installed and maintained correctly, netting has proven to be very successful in deterring nesting birds. However, due to its size and required maintenance, netting is a labor-intensive installation that requires close monitoring.

Recently, new products have been touted as effective in deterring nesting and roosting activities of birds. A variety of predator decoys, sonic deterrents, and ultrasonic bird deterrents have been advertised as effective in removing birds from various sites. These products have also been promoted as cost effective, easy to install, and virtually maintenance free.

No Department of Transportation (DOT) has an approved Standard Specification or Special Provision on the use of ultrasonic devices as a deterrent for nesting birds. Other private companies have utilized these devices with success in deterring birds from roosting on billboards or near parking lots. A study of this type, placement of ultrasonic devices on bridges or box culverts, has not been conducted and many other DOT's expressed interest when contacted for preliminary guidance.

The objective of this project was to evaluate ease of installation, effectiveness of deterrence of migratory birds, and cost effectiveness in terms of initial cost and maintenance cost when compared to netting installations. This deterrent system was directly compared to the previous years nesting counts on the same test bridges and culverts with a goal of 100% reduction of nesting birds. The goal of this project was to provide deterrent options that have been tested and approved by the Environmental Division. Presuming the ultrasonic bird deterrent meets the set objectives of this project; there are many potential benefits to the Department that can be gained. A less expensive and readily available product will become an option. The installation process will require less lane closures for installation and smaller manpower. Implementation would consist of producing a Special Provision detailing the appropriate equipment, proper installation

methods, bridge and box culverts, and required maintenance procedures to be used with ultrasonic bird deterrents.

METHODS

During 2004, paired test sites were evaluated and selected to encompass as many different types of structures and sizes as possible giving funding constraints. Initial evaluations reviewed structures statewide, but final selection was narrowed to include test sites near the AHTD Central Office Complex in Little Rock to maximize cost efficiency in installing, maintaining, and monitoring the test sites. Field inspections were conducted during May 2004 to assure that migratory birds were nesting in each of structures under final consideration.

Six paired test/control sites were ultimately selected, and their locations are shown in Figure 1. Table 1 describes the locations, structure types, and other site considerations. Paired sites encompassed a variety of habitat types distributed among three different ecoregions. Photographs of the study sites are shown in Appendix II.

Coordination with the U. S. Fish and Wildlife Service, review of the available literature, and a survey of bird deterrent products resulted in the selection of the Bird X Ultrason X Model USX for evaluation. The standard USX unit includes a control box with four directional speakers, operates on 110v AC electricity, and is programmable for use of high, medium, and low frequencies (range 15-25kHz). The USX is advertised to “target pest birds with unrelenting newest-technology ultrasonic waves. This powerful sound attack forces birds to leave for good, yet it is harmless to the birds and the environment”.

USX units were deployed between *February 9 through March 30, 2005* prior to the arrival of migrants returning from wintering in the tropics. Electrical power was provided by utility lines at 10 of the 12 study sites. Two sites required the use of battery power and the system included deep cycle marine battery supplemented by 34-watt solar panels, a charge controller and required wiring. USX units were deployed such that the coverage or overlap of ultrasonic wave cones of dispersal was well within product specifications so that all nesting surfaces were exposed to the ultrasonic waves. *An ultrasonic detector was utilized in the lab to verify the coverage area as shown in the manufacturer’s specifications. After verification, the devices were then installed per the manufacturers recommended coverage specifications in the field.*

The study sites were inspected weekly to assure that the ultrasonic units were functioning properly and to determine if nesting migratory birds were present. Bird counts were made every two weeks and separate ultrasonic unit inspections were performed during the intervening weeks. Data were recorded as number of active nests and were separated by species. Bird counts began on March 16, 2005 and continued through August 18, 2005. Site monitoring was discontinued when birds were absent from the site for two consecutive visits.

The bird deterrent system was assembled with the solar power unit and tested for its usability in the field. A weekly test method was developed for confirming the unit was broadcasting. In addition, routine solar power maintenance encompassing cleaning the solar panels and replacing or charging the batteries, as per manufacturer recommendations, was performed weekly.

Cost of installation was compared by calculating the total cost (material + labor) for installing bird netting in previous projects versus the installation of USX units for this project. AHTD Job BX0110, let in 2002, was utilized for obtaining costs of netting installation, and it included only bridges as there were no culverts involved with the project.

RESULTS

Cost Effectiveness

AHTD Job BX0110 involved installation of nylon netting to exclude nesting migratory birds from 13 bridges on Interstates 30 and 40. Bridges ranged in length from 52 to 702 feet with widths ranging from 20 to 38.5 feet. Approximately 88,908 square feet of bridge were netted at a total cost of \$142,483 for an average cost of \$1.60 per square foot. Approximately 31,239 square feet of bridge and box culverts were strategically fitted with the USX units at a total cost of \$93,312 for an average cost of \$2.99 per square foot.

Deterrence Effectiveness

Table 2 summarizes the results of active nest counts for each of the 12 study sites. Figures 2-7 graphically display these results. Birds were noted near the Box Culvert 1 control site on March 28, 2005. The first migratory bird nesting activity was recorded during the April 14, 2005 field inspection with nesting activity noted at all test sites, one Box Culvert control site, and all Bridge control sites. Nesting activity was recorded for the remaining two Box Culvert control sites on April 26-27, 2005.

Figures 2-7 show there was no loss of active nest sites during the nesting season indicating no deterrent affect contributed by the ultrasonic units. Nesting birds seemed not affected at all by the ultrasonic emissions as illustrated in Figure 8.

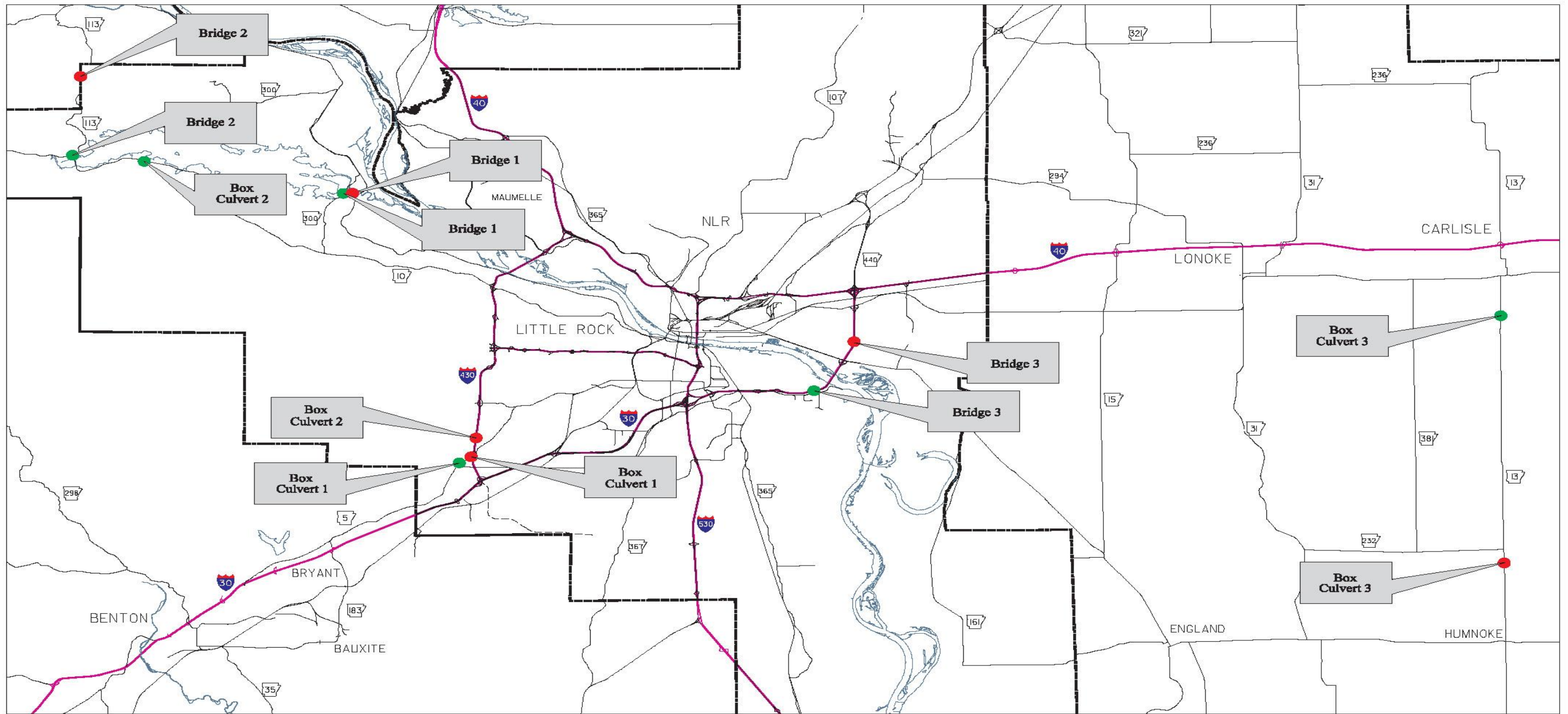


Figure 1. Locations of Six Paired Sites for Testing Bird Deterrent Devices
 Arkansas State Highway and Transportation Department

- Test Site
- Control Site



Structure Type	Treatment	Location	Dimensions	Birds	Bird X Units	Power	Ecoregion
Box Culvert 1 C	Control Site	Hwy. 5 (Sec 9 LM 3.5) Stagecoach/Hwy 5 Exit from SB I-430 (Rock Creek Baptist Church).	3 barrel (6' X 4' X 110')	Barn Swallows (10)		Line	South Central Plains
Box Culvert 1 T	Test Site	Hwy 5. (Sec 9 LM 2.66) between Baseline Rd and I-430 (Bill Fitts Auto).	4 barrel (12' X 10' X 103')	Barn Swallows (ND)	4	Line	South Central Plains
Box Culvert 2 C	Control Site	I-430 (Sec 21 LM 1.99) at McHenry Creek	4 barrel (12' X 10' X 200')	Barn Swallows (13)		Line	Arkansas Valley
Box Culvert 2 T	Test Site	AR Hwy. 10 (Sec 7 LM 9.39) at Twin Creek (outflow for AGFC Nursery Pond).	2 barrel (10' X 12' X 96')	Barn Swallows (36) Phoebe (1)	2	Solar	Arkansas Valley
Box Culvert 3 C	Control Site	AR Hwy. 13 (Sec 9 LM 7.97) - last box culvert before Humnoke/Hwy. 232 intersection.	3 barrel (10' X 6' X 54')	Barn Swallows (11)		Line	Delta
Box Culvert 3 T	Test Site	AR Hwy. 13 (Sec 9 LM 19.09)- first box culvert south of Carlisle.	3 barrel (10' X 8' X 62')	Barn Swallows (21)	3	Solar	Delta
Bridge 1 C	Control Site	AR Hwy. 300 (Sec 2 LM 17.27) old bridge at Big Maumelle River.	Steel Truss span with end abutments (16' X 171')	Barn (3) and Cliff (5) Swallows		Line	Arkansas Valley
Bridge 1 T	Test Site	AR Hwy. 300 (Sec 2 LM 17.27) at Big Maumelle River.	5-span, 3 interior bents (35' X 277')	Barn (3) and Cliff (39) Swallows Phoebe (1)	9	Line	Arkansas Valley
Bridge 2 C	Control Site	AR Hwy. 113 (Sec 3 LM 1.44) at Reece Creek.	Single span, 4 cells	Barn Swallows (17)		Line	Arkansas Valley
Bridge 2 T	Test Site	AR Hwy. 113 (Sec 2 LM 0.11) at Lamb Creek.	Single span, 4 cells (20 X 40')	Barn swallows (42)	3	Line	Arkansas Valley
Bridge 3 C	Control Site	I-440 (Sec 1 LM 7.91) overpass of Faulkner Lake Rd.	Twin Bridges, 3 spans, 2 interior bents (59' X 262')	Cliff (140) and Barn (69) Swallows		Line	Delta
Bridge 3 T	Test Site	I-440 (Sec 1 LM 5.16) overpass of Fourche Dam Pike.	Twin Bridges, 3 spans, 2 interior bents (59' X 224')	Cliff (77) and Barn (95) Swallows	27	Line	Delta

Table 1. Test site summary information. (Numbers in parenthesis are estimated active nests in June 2004)

Date	Box 1			Box 2		Box 3		Bridge 1				Bridge 2			Bridge 3			
	Test		Control	Test	Control	Test	Control	Test		Control		Test	Control		Test		Control	
	Barn	Cliff	Barn					Barn	Cliff	Barn	Cliff		Barn	Barn	Cliff	Barn	Cliff	Barn
Mar-16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mar-31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Apr-14	1	1	2	12	0	17	0	2	12	3	4	10	5	0	3	58	50	48
Apr-27	3	0	6	16	5	17	8	0	12	0	2	7	7	0	2	68	11	0
May-11	2	0	7	23	8	20	10	3	2	0	12	13	12	0	15	44	20	14
May-25	2	0	7	29	11	22	11	0	19	2	2	8	11	0	21	68	24	106
Jun-8	2	0	7	30	11	24	8	0	19	2	5	13	10	1	17	90	21	142
Jun-23	2	0	7	36	12	25	12	0	21	2	5	10	13	1	23	111	30	138
Jul-6	2	0	8	31	7	25	8	0	20	6	0	11	11	1	16	83	29	133
Jul-20	1	0	4	30	3	18	11	0	16	0	0	10	8	0	19	60	26	81
Aug-4	0	0	2	3	0	12	4	0	0	0	0	9	1	0	5	0	4	0
Aug-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. Survey results of active nests at test and control sites. Barn = Barn Swallow. Cliff = Cliff Swallow.

Box Culverts 1 (Hwy 5)

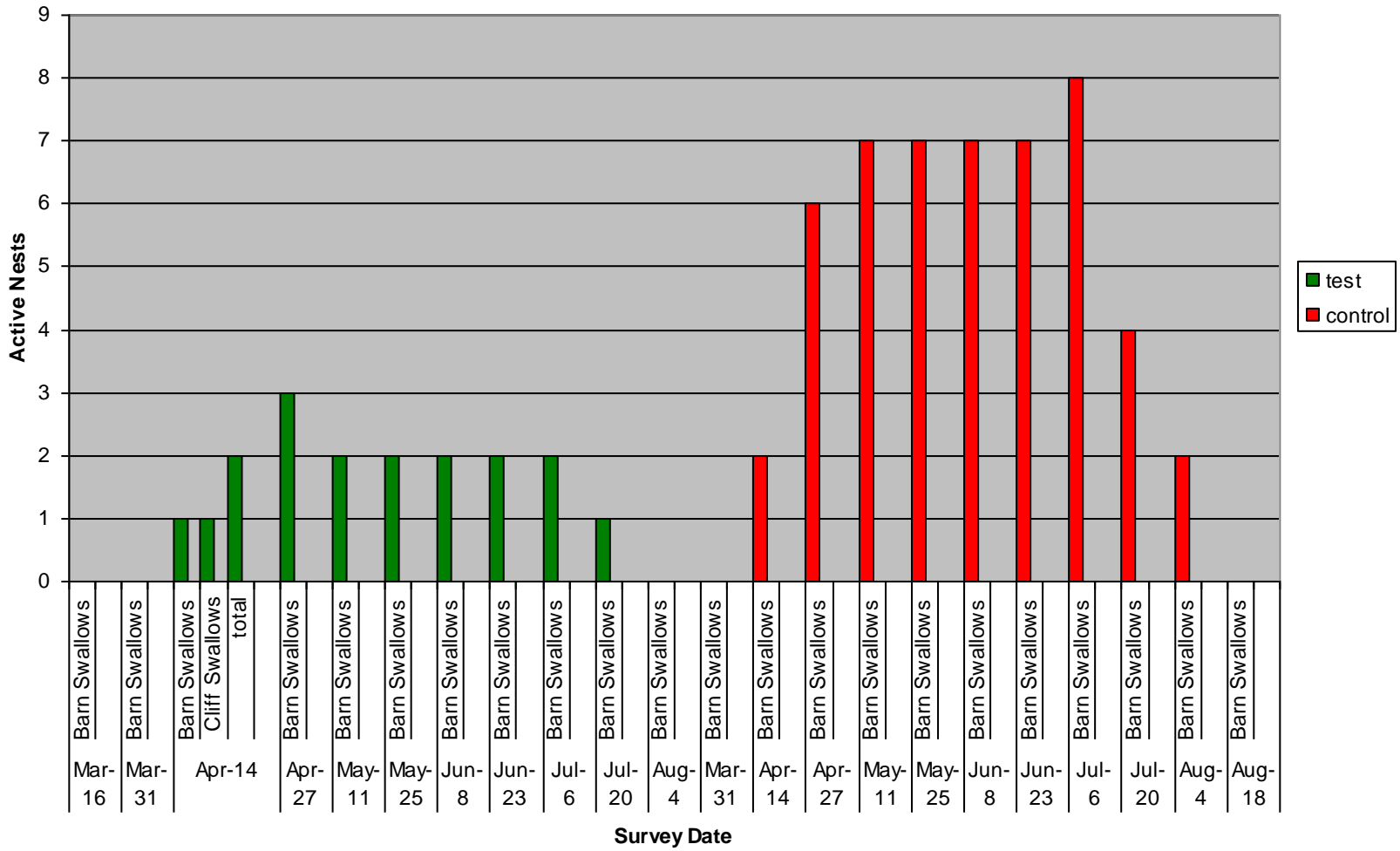


Figure 2. Survey results for Box Culvert 1 test and control sites.

Box Culverts 2 (Hwy 10 and I-430)

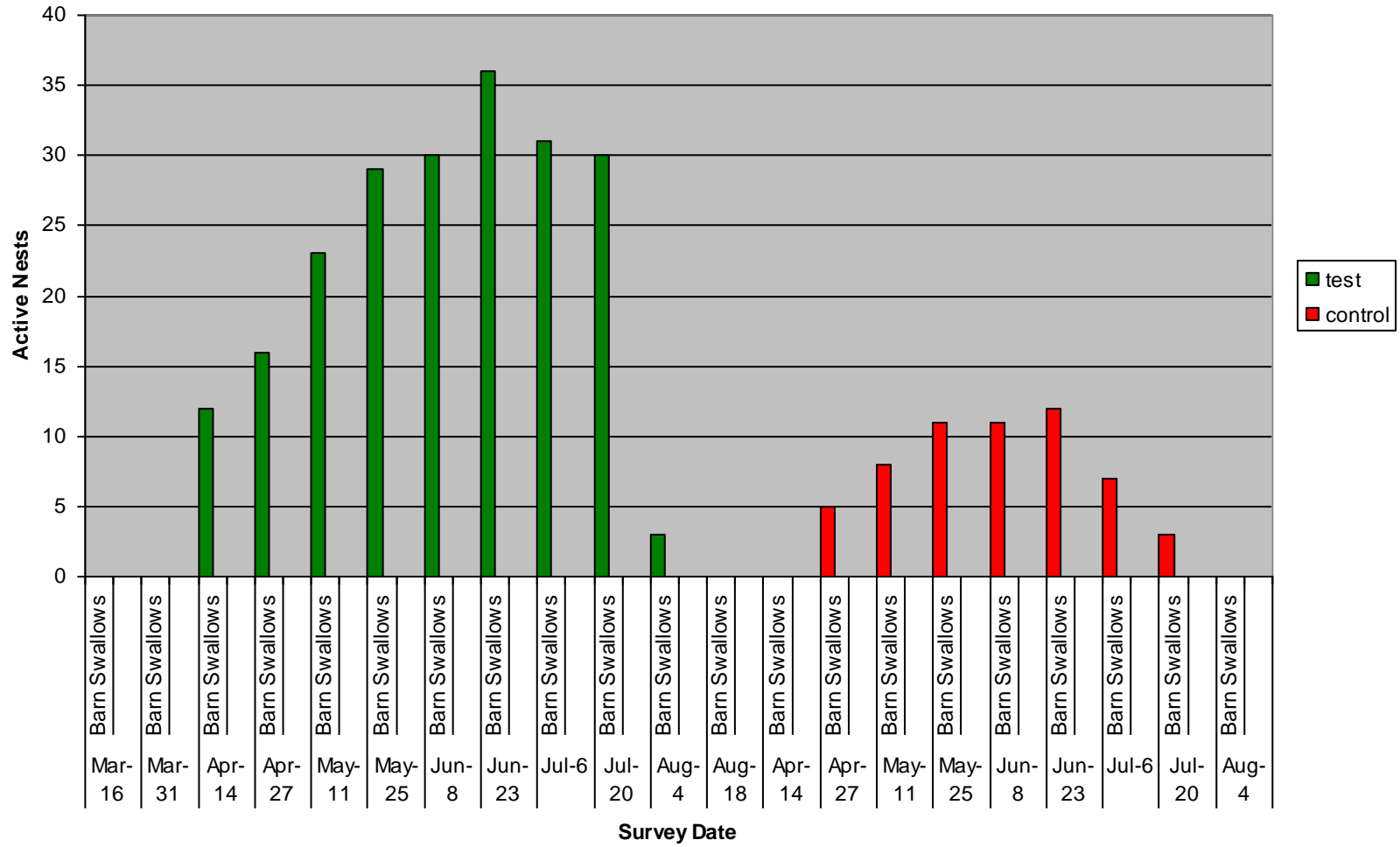


Figure 3. Survey results for Box Culvert 2 test and control sites.

Box Culverts 3 (Hwy 13)

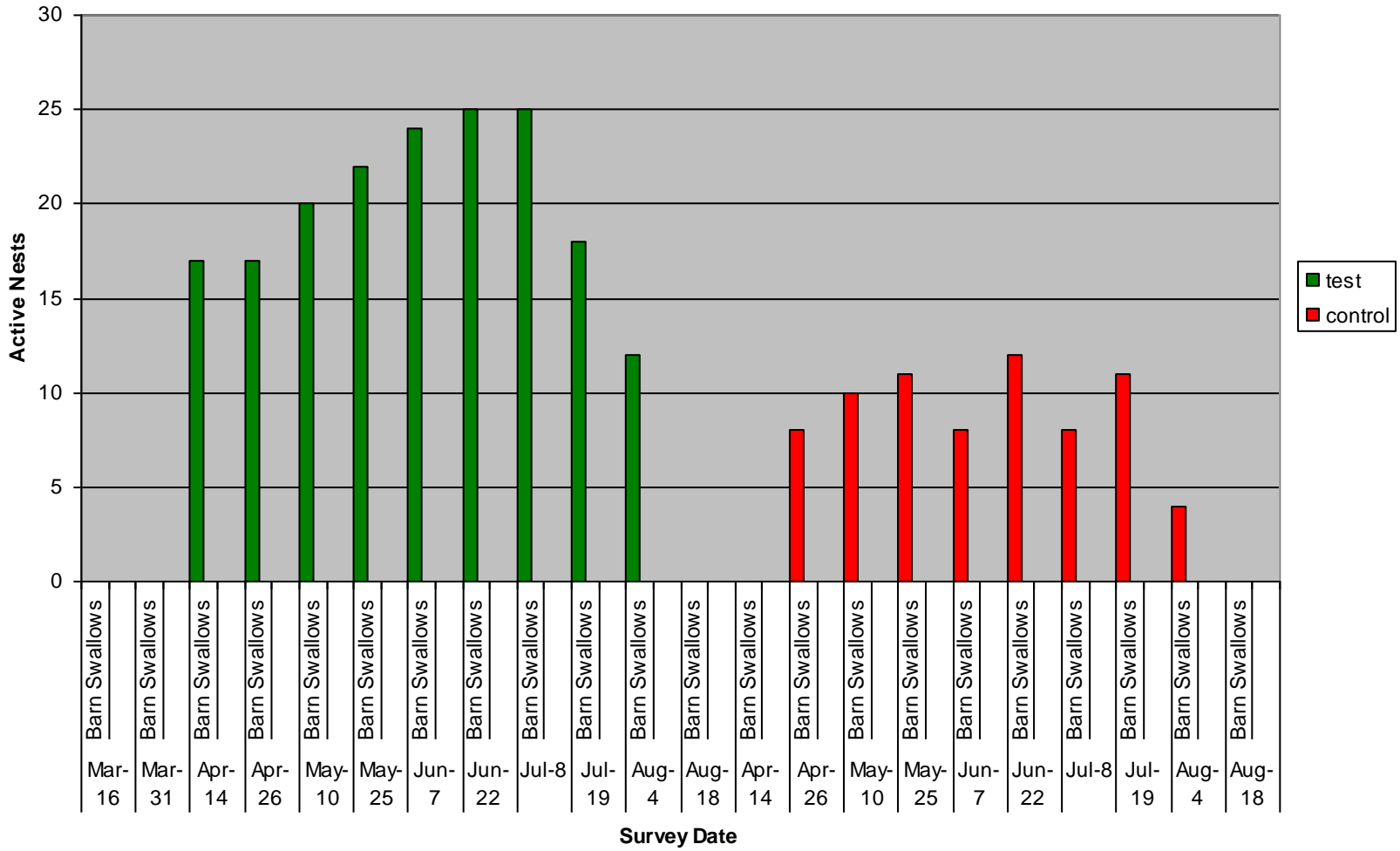


Figure 4. Survey results for Box Culvert 3 test and control sites.

Bridges 1 (Hwy 300)

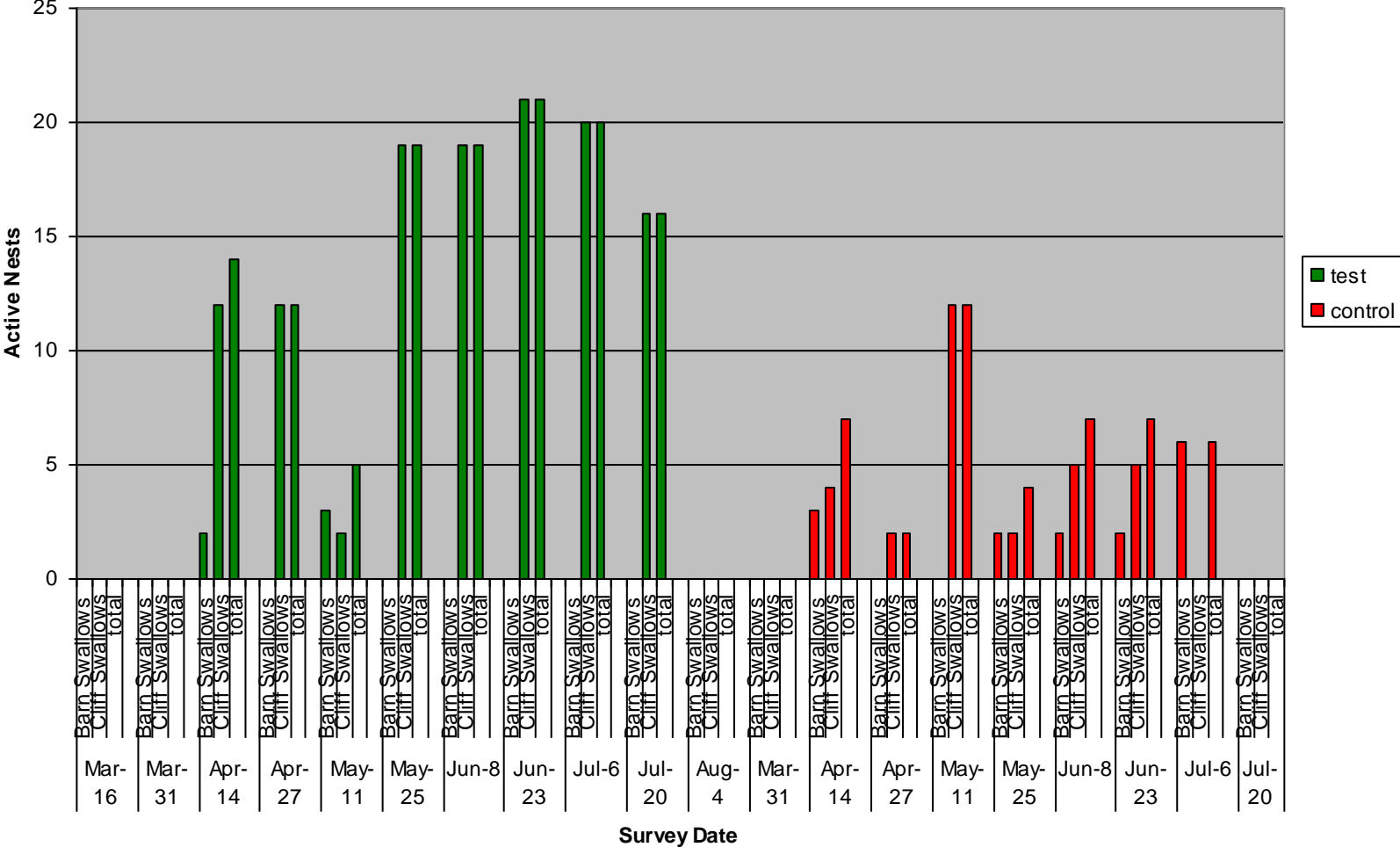


Figure 5. Survey results for Bridge 1 test and control sites.

Bridges 2 (Hwy 113)

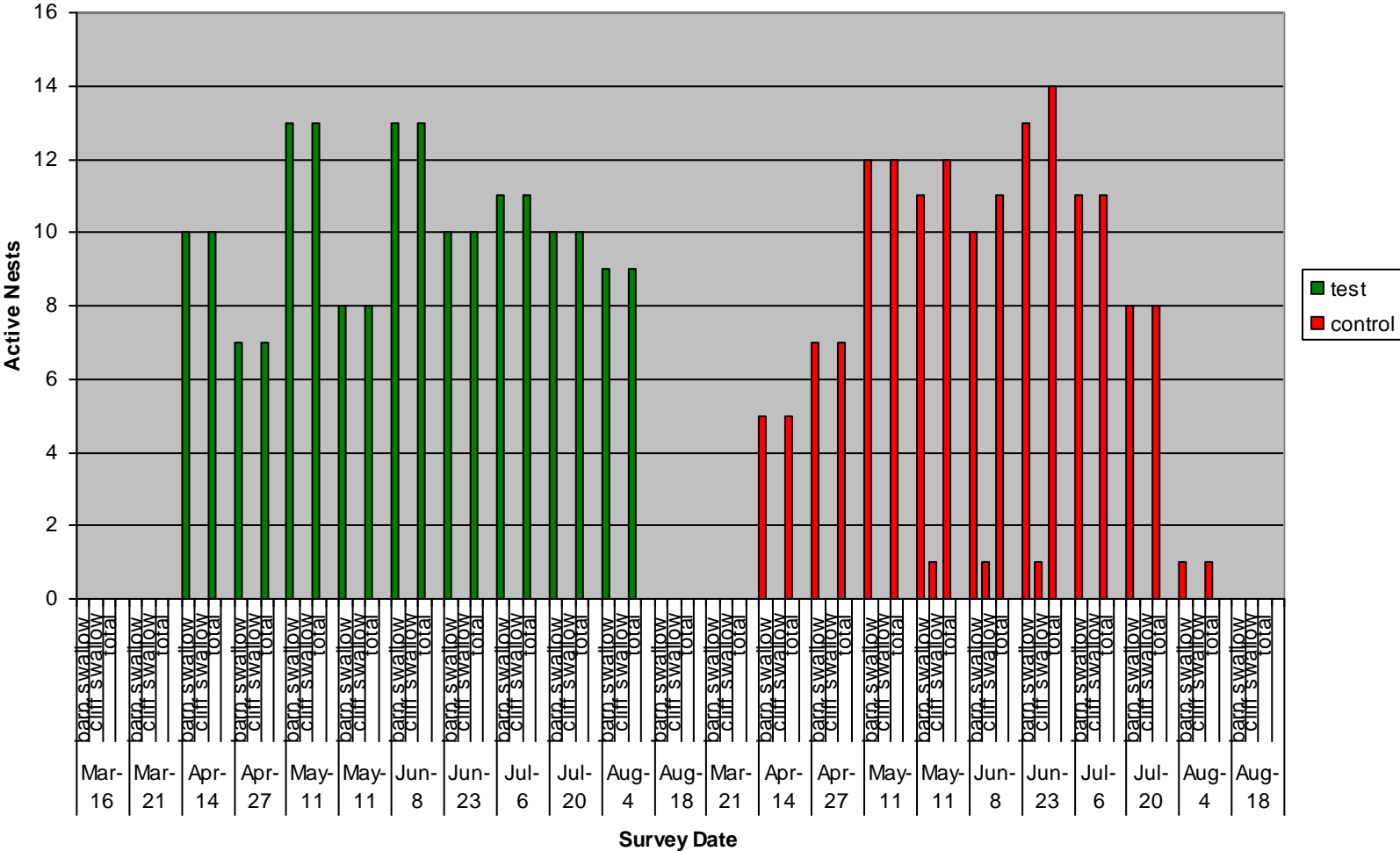


Figure 6. Survey results for Bridge 2 test and control sites.

Bridges 3 (I-440)

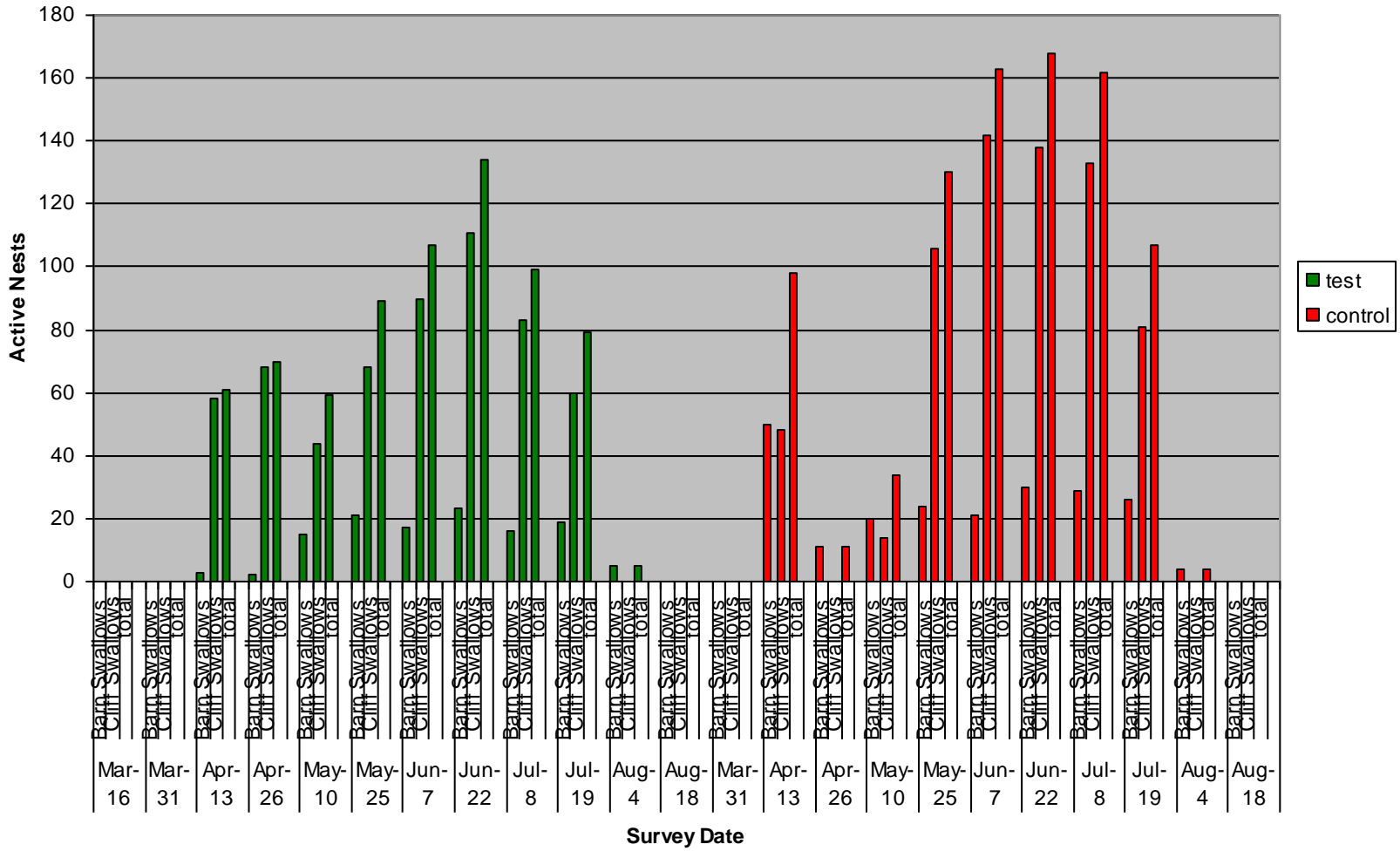


Figure 7. Survey results for Bridge 3 test and control sites.



Figure 8A. Eastern Phoebe nest on speaker at Box 2 test site.



Figure 8B. Active Cliff Swallow nests in close proximity to speaker at Bridge 3 test site.

CONCLUSIONS

The Bird-X Ultrason X Model USX ultrasonic bird deterrent device utilized during this research did not deter Barn or Cliff Swallows from nesting or rearing young in box culverts or on bridge structures. The ultrasonic devices were relatively simple to install and maintain compared to bird netting that is currently utilized as a deterrent device, however the lack of deterrence renders the devices useless for the species encountered on bridges and in culverts in Arkansas.

As a result of this research, netting to exclude nesting birds will remain the approved method to prevent migratory birds from nesting in structures that may need to be demolished or rehabilitated. Additional deterrent devices that appear easy to use and cost effective should be tested as they are developed or become commercially available.

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APPENDIX I

Special Provision for Nesting Sites of Migratory Birds

**ARKANSAS HIGHWAY AND TRANSPORTATION DEPARTMENT
SPECIAL PROVISION
NESTING SITES OF MIGRATORY BIRDS**

DESCRIPTION: All new and/or temporary and/or existing bridge and/or culvert structures on this project may be the nesting sites of migratory birds. These birds include, but are not limited to, swallows and phoebes. The birds and their habitat are protected under the Migratory Bird treaty Act. Nest building and brood rearing sometimes occur on or in bridges and culverts. Demolition of bridge and culvert structures or construction activities that might disrupt nesting activities shall not occur when nesting migratory birds are present. If construction is planned on bridges or culverts that are in place when nesting migratory birds are present, activities shall be limited to construction that will not disrupt nesting activities.

CONSTRUCTION METHODS. Restrictions to the Contractor's activities shall include, but are not limited to, the following:

- 1) Demolition of temporary or existing bridge or culvert structures or bridges or structures built during the project will not be permitted when nesting migratory birds are present.
- 2) Construction activities on new bridges (i.e. sand blasting, painting, etc. that would disrupt nesting activities shall not occur when nesting migratory birds are present. The Contractor shall submit to the Engineer details for all work to be done on the structure between March 1 and September 30. A determination will be made by the Engineer within 10 business days concerning the possible impacts of the work and will then accept or reject the Contractor's proposal.
- 3) Efforts by the Contractor to remove the birds or their nests are prohibited between March 1 and September 30.
- 4) The Contractor may attempt to prevent birds from nesting by erecting netting before nest building begins. Net openings shall be ½ inch or smaller after installation. No other method of deterrence will be permitted without written approval of the Engineer. Birds that nest despite prevention efforts shall not be removed or disturbed. All efforts by the Contractor to deter birds from nesting shall be at the Contractor's expense. Netting shall be installed securely and in such a manner that it will not pose a safety hazard.
- 5) If no birds are nesting on or in the bridge or culvert structures between March 1 and September 30, a request may be made to the Engineer to allow demolition or construction to proceed. The Engineer will make the final determination concerning the presence or absence of nesting migratory birds within ten business days and will accept or reject the Contractor's proposal concerning the demolition or construction.

CONTRACTOR NEGLIGENCE. The Contractor will be assessed the amount of any and all fines and penalties assessed against and costs incurred by the Department which are the result of the Contractor's failure to comply with this Special Provision. The Department will not be responsible for any delays or costs due to the Contractor's failure to comply with this special provision. The Contractor will not be granted additional compensation or contract time due to noncompliance.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT. All costs incurred in complying with this special provision will not be measured or paid for separately, but will be considered included in the contract unit prices bid for other items of the contract.

APPENDIX II
Photographs of Study Sites



Box 1 Control



Box 1 Test



Box 2 Control



Box 2 Test



Box 3 Control



Box 3 Test



Bridge 1 Test



Bridge 1 Control



Bridge 2 Test



Bridge 2 Control



Bridge 3 Test



Bridge 3 Control