Final Report on Field Study of Efficacy of Transonic Pro and QB4 Ultrasound Broadcast Units in Reducing Bat Numbers and Droppings in Buildings

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ABSTRACT

The Big Brown Bat, *Eptesicus fuscus*, exists from lower regions of Canada to northern South America. Females form maternity colonies in barns, houses, and churches which can be a vector to rabies and histoplasmosis. Bats are extended legal protection from disturbance or killing in the United States, and must be removed from colony sites humanely. Use of ultrasound and sonic frequency sound generating devices may help to humanely reduce bat use of buildings. Maximum hearing sensitivity for E. fuscus extends 10-45 kHz with a best hearing threshold of 7 dB at 20 kHz, solidly within the frequency and decibel range of sounds produced by the QB 4 (QUADBLASTER) and TRANSONIC PRO sound generating devices (Bird-X Inc. 300 N. Elizabeth St. Chicago, IL 60607). The primary purpose of this study was to test whether these sound producing units would show efficacy at reducing/eliminating bat numbers at four established roosting colonies of the species. Tests ran 19 July – 28 August 2009, using bat dropping counts collected from 3 X 4 m plastic tarps from four sites in farm buildings with histories of summer bat colony occupation. Three periods with sound units off (control) were alternated with two test periods of roughly 8 days each. Droppings were counted individually using a ½ inch artist's brush to sweep them from the tarps for disposal. Average number of droppings per day at each site, per test phase was used to determine efficacy. Reduction in droppings per site per day comparing control cycle versus counter versus final dropping/day count levels after two "on cycles in 24 days were 41.05%, 81.43%, 94.73% and 87.18% for the large shed, small shed, lower and upper barn loft sites, respectively. Efficacy was shown for dispelling colonial bats and should be even better at preventing colony return following hibernation.

Introduction

The Big Brown Bat, *Eptesicus fuscus*, exists as a species all across North America from coast to coast and extending from the lower regions of Canada's southern provinces to extreme northern South America. There are six recognized subspecies with E. f. fuscus being the principle subspecies found in the eastern prairie and deciduous forest biomes of the continental United States (Hall, 1981). In general, bats are slow reproducers with 1-2 young born per year/female and females not reproducing every year (Barclay and Harder 2003). In this E. fuscus subspecies, after hibernation ends, the females form large maternity colonies, often in man-made structures such as barns, houses, and churches (Barber and Davis 1969) with eastern maternity colonies most commonly containing 25-75 adult females. Males are often thought to be solitary in summer but may share a roost with the females, or more commonly have separate smaller all male colony roosts (Davis et. al., 1968). These bats roost during the day and for much of the night as well, with foraging peaking 18 (Kunz, 1973) to 49 (Phillips, 1966) minutes after sundown, and an average of only 100 minutes active feeding flight time during the night. Feeding occurs within 1 - 2 km of the roost (Kurta and Baker 1990). Unlike many other bats, the species shows no preference for foraging habitats and will feed over water, in forests, open grass lands and in urban environments as well as rural ones (Furlonger et. al. 1987). Young are born in Late May to mid-June with 1-3 common per female. Lactation continues as late as early August. Summer colonies may begin to disperse as early as August but generally do not gather in winter roosts in caves, mines, or buildings until November (Mills et. al. 1975), or conversely, are reported to peak in hibernacula in late August and September in Wisconsin (Long and Thiese 1996 unpublished data, reported in Long 2008).

Because E. fuscus tends to establish fair sized to large colonies in manmade structures, and can be a host vector to rabies (Kurta 1979) and histoplasmosis (Bartlett et. al. 1982) and other diseases transmissible to humans (Kurta and Baker, 1990), it has often been subjected in the past to control measures designed to eliminate the colony and/or kill the bats. Bat species are generally extended protection from such activities and from inadvertent killing (Smallwood and Karas 2009) in the United States these days and must be removed from colony sites humanely. Removal is permissible only following fledging of the young, which occurs in late July to early August (Kurta and Baker 1990). Once evicted, the bats generally move to alternate roost sites very near the original (Brigham and Fenton 1986). Since removal options are limited, it is best if one can prevent the bats from establishing a roost within a building or prevent them from return to established roosts in future years, but the means of doing this reliably are few. Use of ultrasound and lower frequency sound generating devices that may produce sounds that bats find intolerable, or, at the least, disturbing, offers hope of being able to discourage bats from use of buildings where their presence may conflict with human health, sanitary standards, or uses of the structure.

It is common knowledge that most bats are insectivorous and utilize ultrasonic calls for obstacle avoidance and to locate and capture prey while on the wing (Kurta and Baker, 1990). Thus, it is reasonable to expect that they can hear and respond to ultrasound generating units that are designed to rid buildings of rodent pests and other species as long as the sound broadcast by the unit is within the specific frequency sensitivity range of the bat species in question. Maximum hearing sensitivity for E. fuscus extends over a broad range from 10-45 kHz (Dalland et. al. 1967), with a best hearing threshold of 7 dB at 20 kHz and a distinct decrease in sensitivity at 45 kHz, but extends to 120 kHz at 83 dB and down to 0.850 kHz (Koay et. al. 1996). Thus, the known best hearing range of this bat is solidly within the frequency and decibel range of sounds produced by the Bird-X QB 4 ultrasound and lower frequency sound generating device. The primary purpose of this study was to test whether Quadblaster QB-4 and/or Transonic Pro Ultrasound Producing Units (Bird-X Inc. 300 N. Elizabeth St. Chicago, IL 60607) produced proper sounds at sufficient dB that they would demonstrate efficacy at reducing or eliminating bat numbers at summer roosting sites in areas with established colonies of the species.

Methods

Three Transonic Pro Ultrasonic expeller units and one Quadblaster QB-4 ultrasonic unit were chosen to test whether bats could be reduced or removed from summer colony roosts by sound disturbance alone. The QB- produces either steady 22 kHz sound or warbled sounds rising and falling in frequency from 22 - 30 kHz and 112 bD output strength at 1m, and may be used with fast or slow rotation of selected speakers broadcasting the sound. The first test of this unit, Jul 28 – Aug 7, 2009, used varied frequency, medium warble, and slow rotation settings. From 15-23 August, for the second test series, it was set for alternating frequency, fast warble, and fast rotation. Transonic Pro units produce sounds from 3-40 kHz and at 96 dB at 0.5 m, and were set to “C” setting (a human audible frequency), and loudest volume for both first and final test series. All sound units were turned off 5-14 August to see if bat numbers returned to original levels once the units were off, or whether there was evidence they remained lower. This test also served to prove that the bats had not left for early departure for hibernation sites as sometimes has been reported to happen (Barbour and Davis, 1969). Final tests done 15-23 August were to serve as a repeat test to determine whether bats would respond to the ultrasound as effectively the second time it was used as they did when it was a novel stimulus in the first test series. All conclusions on efficacy of the units at reducing bat numbers were based on daily average number of droppings collected on plastic tarps and comparing pre-test and test dropping count, and inter-test counts.

Study sites

Four sites with known day roosting summer populations of E. fuscus were found in Central Wisconsin, at an old farm in sec 6 of Shields Township, Marquette County, Wisconsin. All sites had known records of repeated use extending back over more than thirty years under the authors' ownership. The largest site was an old barn dating to 1904 for the construction of the wooden frame building that later became the upper section of the barn and is a 9.3 m X 15 X 5m hay mow now. That portion was jacked up and a stone foundation built beneath it in 1911, according to records that came with purchase of the farm by my parents in 1954. The original roof of the barn was cedar shakes over rough sawn, hand cut planking. It was later covered with tin roofing in the 1930s. The old cedar over plank under tin offers a warm dry area full of crevices for Big Brown Bats to occupy during the day, but not the more open structure preferred by maternal colonies of lactating females with young. As such, the majority of residents in this structure appear to be males based on a small sampling from those captured/found over the past 25 years, thus indicating that historically these 3 sites have been all male summer colonies as reported for the species by Davis et. al. (1968). The next largest area for study was the lower floor of the same barn. There is another roost area there where the bats use spaces between the axe-hewn cross timbers that provide structural support and the floor boards of the barn loft above. The original floor boards are again hand sawn and irregular in shape, most taken from a single large cottonwood tree. These were overlaid with ¾ inch plywood in 1996 to prevent people and hay from falling through the old floor. The spaces between the plywood and old boards are also used by the bats as day roost sites, as are gaps beneath vertical barn siding boards that have formed by warping of the old boards over the years.

Two other near by sites also showed signs of regular bat summer use. There is a roughly 4 m X 7 m wooden shed which is the principle tool storage area for the farm. The roof is asphalt shingle over cedar shakes and rough planks like those of the barn. The next is a small pump shed roughly 2.5 m X 3.5 m with a roof of similar construction to that of the larger shed, and ancient asphalt roll siding over rough planks which bats frequently crawl under for sleeping. The Transonic pro units were used for tests in both upper and lower levels of the barn and in the small shed. The QB-4 unit was tested in the large shed only.

Within the barn, both upper and lower floors, sample sites were chosen based on visual presence of the greatest abundance of recent bat droppings within the spaces available. In each of these sites, a 9' x 12' transparent plastic painter's tarp was spread to serve to catch droppings of bats roosting overhead during the day and/or during the night. Within the larger shed, a similar tarp was spread across the most accessible central region of the shed, while in the small shed the tarp was opened to its greatest possible dimensions and extended over a flat cardboard surface above all items on the floor. Once the tarps were in place, every effort was made to not disturb the study sites by unnecessary entry.

The plastic tarps were placed in all four sites at 4 pm, 19 July 2009 and left undisturbed for 8 days to collect reference level bat droppings in all sites. This was done at a time just before any young would be fledging and well before bats were expected to leave for winter hibernation sites, based on literature review (Barbour and Davis, 1969). On July 27, eight days later, the first count of all droppings on the traps was conducted. All droppings on the tarps at each site other than the upper barn were calculated by counting every single unit of bat guano on the tarp using a ½ inch artist's brush to remove each individual dropping, once counted, by sweeping it into a dust pan for disposal. The tarp in the upper barn had so much guano that I only counted droppings on the western one half of the tarp and marked the midline of the tarp to assure the same area was counted for each sampling thereafter. After this baseline dropping level was established and converted to average number of droppings per day at each site, the actual test phase began. Average number of droppings per day at each site was used rather than total droppings for each phase of the test, for other commitments prevented consistent sampling using a fixed number of days between counts schedule. This method automatically corrected for differences of 1 or 2 days in sampling length for each test phase. Tarps were completely swept clean of all droppings after each test count before beginning the next phase of the tests.

Results

Table 1. Bat dropping reductions using Transonic Pro and or QB4 in bat occupied farm outbuildings

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Bat data total droppings per sample and droppings per day for each count and site, control and two test cycles of units on. Plastic tarps placed out 7/21 4:30 pm to begin control data dropping collections

	Control 7 days July 19-27		First test cycle 8 days July 28- Aug 4		Off cycle 9 days Aug 5 – 14		2 nd test cycle 9 days Aug 15-23		% reduction week 1	4week total
L shed	95	13.57/day	67	8.37/day	132	14.66/day	72	8.00/day	*38.32%	41.05%**
S shed	127	18.14/day	55	6.87/day	138	15.35/day	32	3.55/day	*62.13%	81.43%**
L barn	235	33.57/day	75	9.37/day	136	15.11/day	16	1.77/day	*72.09%	94.73%**
U barn	697	99.57/day	315	39.57/day	258	28.66/day	115	12.77/day	*59.74%	87.43%**

* reduction control versus first test cycle   first test week overall average reduction 58.07 %
** reduction for full 2 test cycles   final overall average dropping reduction 76.16%

Discussion

The most obvious result was that all four sites showed major reductions in droppings/day once the sound units were activated, three of them approaching or above 60% decline after the first week and three exceeding 81 % reductions by completion of the second "on" cycle. That clearly indicates that Big Brown Bats can hear and do respond to the range of sounds produced by the Transonic Pro and QB-4 sound generating, and as proof, the numbers of bats present fell quickly. This probably also reflects that large numbers of bats using those roosts found other sites to roost during the time the machines were on. All sound units were turned off 5-14 August to see if bat numbers/droppings returned to original levels once the units were turned off, or, whether there was evidence they remained at the lower level, which would indicate no return to traditional roosts following a week of ultrasound treatment. This test also served to demonstrate that the bats had not left for early departure for hibernation sites as occasionally has been reported to happen (Barbour and Davis, 1969). During the time the units were turned off following the first test sequence, numbers of droppings and bats using the sites returned to nearly original levels in the two sheds, but remained much below original numbers in both sites within the barn. I suspect this reflects movement of a goodly number of bats from the larger colonies of the barn into the sheds as they returned from temporary roosts nearby used during the first test phase, and as such explains why the total decline in droppings for the large shed was well below that seen for the other three sites tested. This evidence indicates they followed the pattern of movement to nearby alternate roosts following eviction, as reported by Brigham and Fenton (1986), and could further reflect unwillingness to go back into the barn where they had been subjected to the Transonic Pro sounds before, a strong indication of long term effectiveness at moving the bats out, if true.

Numbers of droppings declined further at all sites during the second round of sound tests and those numbers probably reflect a combined effect of decline in numbers of bats due to the sound units being on again and also loss of total numbers of bats from the four building sites as some began early movement to/toward the winter hibernation sites, as reported for the species by Barbour and Davis (1969). The largest shed had the lowest overall rate for dropping reductions during the tests, possibly indicating the QB-4 was less effective at getting bats to leave in that 70 m^3 environment than the Transonic Pro units used in all other sites, or that some aspect of the site reduced effectiveness of the unit. Alternatively, it is very possible that movement of bats from barn to the large shed during and/or between tests masked effectiveness of the unit as smaller sample sizes of droppings showed lesser change as a result. Within the other three test sites, data indicate the greatest decrease in droppings, 72.09% and 94.73%, occurred in the lower part of the barn for first week results and full test reductions, respectively. This site is roughly 348 m^3 volume, and has stone and mortar walls that, unlike all other test sites, would tend to reflect the sound rather than absorb it, as wood does. The small shed, roughly 17.5 m^3, and the hay mow of the upper barn, roughly 657 m^3 in volume, both have similar wooden construction and differ only in final roofing materials. There was effectively no difference in the efficacy of the Transonic Pro units used in these spaces, being 59.74% and 87.18% versus 62.13 % and 81.43% reduction for the loft and small shed, respectively for first week and total test results.

Conclusions

The final conclusion of this study is that use of either the Transonic Pro or the Quadblaster QB-4 ultrasound broadcast units has unquestionably and repeatedly demonstrated efficacy in reducing bat numbers in traditional roost sites in buildings, and hence, reduced bat droppings and potential disease transmission to humans, occupying or working in those structures. Data indicate strong enough aversion to the sounds of the QUADBLASTER and TRANSONIC PRO that bats will abandon historical communal roost sites when these units are used there according to instructions. Further, this implies that they would be highly effective at preventing colonization of human structures, even those with a history of prior use, if placed within those structures before bats return from winter hibernacula and become comfortable in past roost sites.

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