NUISANCE BATS: CURRENT TECHNOLOGY IN THEIR MANAGEMENT AND CONTROL

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ABSTRACT: Managing nuisance bat colonies can be accomplished via exclusion (bat-proofing) or in limited cases via the use of repellents. Exclusion is emphasized as the first and most desirable approach providing it is also practical. New products and devices have recently become available which may significantly aid in making exclusion programs more possible and practical. Repellents such as lights, fiberglass batting and various improvised mechanical devices may all have some utilization. Controlling nuisance bats can be accomplished via the use of toxicants and trapping, although there is considerable opposition from many bat researchers towards the use of toxicants. Toxicants that have been used against bats include DDT and Chlorophacinone (Rozol®). Efficacy studies conducted on Rozol tracking powder against nuisance big brown bats have demonstrated mean population reductions of 40% within three days, 88% reduction within two weeks and 98% reductions were obtained within one month following application. It is recommended that toxicants be considered for use only when all attempts at exclusion or repelling the bats have been tried and exhausted. It is contended that professionally supervised and administered toxicant programs are preferable to the various haphazard (and sometimes dangerous) "home remedy" approaches undertaken by a frustrated and a noneducated public. These practices often exacerbate the problem of bat-people contacts as well as subject the bats to excessive inhumane treatments.

INTRODUCTION

Bat management programs are often complicated and sometimes even controversial since there are conflicting aspects to be considered. Bats are, of course, a very unique and interesting part of our wildlife fauna. Thus, we need to direct our efforts towards conserving this wildlife resource. Bat conservation is important for other reasons: 1) "House bats" in the United States are insectivores and thus biologically useful mammals. (The actual economic impact of the insectivorous nature of bats has never been measured. Therefore, it's speculative as to what degree bats impact upon insect pest populations.) 2) A combination of natural and human-related mortality factors have caused substantial regional or rangewide reduction in the numbers of several North American species of bat (Humphrey 1982). Efforts are needed to protect all bats in general. Such efforts, however, must remain reasonable within any particular situation involving nuisance colonies of bats inhabiting occupied buildings.

Nuisance bats in structures are generally not accepted by the building inhabitants despite the uniqueness of bats. As unfortunate and unnecessary as it may be, many people still fear bats and are very quick to kill any and all bats found flying around inside a room or attic. In addition to their fears, people have other valid reasons for not tolerating colonies of bats in their structures. The scratching and squeaking noises the bats create inside walls are annoying. Their droppings and urine not only stain walls and ceilings, but also cause objectionable odors. And, finally, there is the concern of someone contacting a rabid bat, although the bat-rabies threat is usually exaggerated and/or misunderstood by the general public. Nevertheless, as a general rule of health safety, it's best for bats and people that they not associate with one another under the same roof. Nuisance bat colonies in inhabited structures must be managed or controlled.

MANAGEMENT OF NUISANCE BAT COLONIES

The management of a nuisance bat problem should always begin with a thorough inspection of the affected structure by a person knowledgeable in bat biology and management. Such persons might include wildlife damage specialists, public health officials and pest control operators, all of which should be properly trained in house bat management. Bat management and control strategies are highly situational due to multiple types of structures, construction, building age and other factors so that no single method can be recommended to solve all problems. Often a combination of methods (habitat modification, physical means and/or chemical controls) must be employed (Greenhall 1982).

This paper addresses managing nuisance bat colonies via exclusion and repelling programs. Discussion of controlling nuisance bats is directed at the use of toxicants.

Exclusion (Bat-Proofing)

Exclusion is the most effective and appropriate method of managing nuisance bat colonies (Silver 1935). If successful, exclusion offers the only permanent solution to the problem and provides the bats with the opportunity to roost elsewhere. Thus, excluding the bats should always be the first approach in any management program.

There are important considerations associated with exclusion programs, however: 1) The recommended programs must be practical and economically feasible for each situation (Corrigan and Bennett 1982b). A low-income family living in an older home may not be able to afford to have the necessary structural deficiencies of their home repaired. 2) Excluded bats may still persist and remain on and around the exterior portions of a building, utilizing areas below eaves, behind window sills, under loose-fitting shingles, nearby trees, or attached garages, and 3) The question remains as

to where will displaced bats disperse to after an exclusion program? According to Greenhall (1982), displaced bat colonies re-establish in alternate roosts. This seems probable, at least for some colonies, and providing there are alternate roosts available to the bats. But to date no research is available to verify what percentage of bat colonies have alternate roosts, or to what extent they are utilized. Additionally, there is the question of mortality rates among excluded bats. When little brown bats are excluded from their nursery roosts, dispersal movements occur; but in studies of marked animals, the bats failed to appear in their traditional sites for hibernation. Presumably most excluded animals die (Humphrey 1982). Extermination and exclusion resulted in the loss of at least 52 percent of the little brown bats in 23 colonies monitored for about a decade (Humphrey and Cope 1976).

Exclusion programs should be initiated either in late fall after the bats depart for hibernacula, or in late winter-early spring before the bats arrive. These time periods are recommended over summer exclusion programs for several reasons: 1) bats would not be excluded suddenly, which may cause stress and mortality resulting from abrupt habitat loss; 2) fewer bats will persist in "hanging around" the roost structure; and 3) the number of visable bats and/or bat-human contacts should be less (if any).

If the exclusion program must be initiated during the summer, it should be done in two phases. First, all but one or two of the principal openings should be sealed. Wait a few days to allow for the bats to adjust to the remaining openings and then seal those openings some evening just after the bats have left for their nightly feeding.

Exclusion programs should never be done from mid-May through mid-August as the young will be trapped within the structure and die, creating odor problems. Mid-August and later is the preferable time for exclusion programs when they must be done during the summer.

Materials such as 1/4-inch hardware cloth, sheet metal, plywood or aluminum flashing can be used to seal openings. All openings 3/8-inch and larger must be sealed. For temporary exclusion, any soft materials (rags, cheese cloth) can be used.

Currently, the greatest disadvantage with the exclusion approach is that it may not be economically feasible, practical, or even possible on buildings that have many openings, or buildings such as barns or large warehouses. But there are some new products that have possibilities for providing practical, economical and permanent exclusion even for buildings such as barns.

One product is a plastic netting called Conwed Bird Netting. Its primary use is to exclude birds from high-value agricultural crops, but it is gaining wider applications for excluding birds from structures and may have some applications in bat control. This netting is very light and supple, but yet relatively tough and resilient. It is easy to work with and inexpensive. Depending on the situation, it can be draped over entire roof areas, or cut and applied as needed to cover only certain sections. The netting can be affixed to building areas permanently by several means (Gorenzel and Salmon 1982) or velcro fabric strips can be stapled to the edges of the netting to allow for temporary attachment and easy removal.

Other products which hold promise are the new foam sealants. Great Stuff and Polycel 100 are two of the more common brands. These products are used to seal cracks and crevices in walls. They are applied from aerosol-type cans, emerging as a soft foam but drying hard. When applied into cracks and crevices, the foam expands to fill the openings. They also can be shaped while drying to fit holes of varying shapes.

"Excluding devices" have been developed recently. Constantine (1982) has developed a one-way valve-like device which is installed during the day in the last exit(s) used by bats in a summer roost. This device permits the bats to leave after dark but prevents their re-entry. After all bats have been excluded the device can be removed and the holes sealed.

Another device called the EX-100 Hanks Bat Excluder has been developed by a Wisconsin company.* This excluder is similar in principle to the Constantine device. It allows bats to leave through a one-way passageway, but their re-entry is blocked by a doorway that only opens outward. Complete instructions come with a kit containing five excluders. The manufacturer has been using this excluder for four years and claims it to be extremely effective, easy to use, and very economical (Hanks, pers. communication 1984). Development of these new excluding devices may be of tremendous value in bat management programs (especially for homeowners who cannot afford major structural repairs).

For a more detailed and further discussion concerning bat exclusion the reader is referred to Greenhall (1982).

Repelling Bats

Sometimes exclusion of bats from a structure will be very impractical, if not impossible. Or bats may need to be forced out of a building before an exclusion program is begun. In these situations a repelling program should be attempted.

*The EX-100 Hanks Bat Excluder is manufactured by the Bay Area Bat Protection Company, P. O. Box 374, Station A, Sturgeon Bay, Wisconsin 54235.

Naphthalene is currently the only registered bat repellent which can be used in structures. The material usually is applied at the rate of three to five pounds for an average attic. It is most effective when used in areas where bats are roosting in confined air locations such as tight attic spaces, double walls, between the roof and ceilings, or other boxed-in areas. It is less effective in large attics and in more open situations such as porches and beneath eaves (Marsh and Howard 1982).

Positive results with naphthalene may be only temporary and treatments must be repeated every few weeks. Also, naphthalene should not be used if constant inhalation of the odors will occur. Some individuals are sensitive to naphthalene odors and should avoid contact with the material (Morgan 1977).

Various other materials and tools have been used as repellents with varying degrees of success. Fiberglass insulation may discourage bats from using temporary outside roosts (Greenhall 1982). Coarse fiberglass batting tacked to the surfaces where bats hang might discourage them (Constantine 1979).

Using floodlights to illuminate roost areas was reported 90% successful in attics of nine Canadian houses (Laidlow and Fenton 1971). Attics can be illuminated using four or more 150-watt bulbs directed so all darkened areas are illuminated. Other repellents which have been tried include dog whistles (Hill 1970), ultrasonics (Hurley and Fenton 1980) and sticky bird repellents (Marsh and Howard 1982, Barclay et al. 1980).

Various types of physical repellents can be improvised and utilized according to specific situations when bats are roosting in small, confined areas. For example, carpet tacking boards or prickly-type bird repellents (porcupine wire) can be nailed to small areas (such as the sides of rafters) to discourage bat activity.

BAT CONTROL

Controlling nuisance bats via population reduction can be accomplished using toxicants or by trapping and physically removing the bats. This paper will only address the use of toxicants. Trapping bats out of structures is discussed by Greenhall and Paradiso (1968).

Bat Toxicants

There is considerable opposition from many bat researchers towards the use of any toxicants against nuisance bats. Constantine (1979) provides four reasons why killing bats (via toxicants) is contraindicated: (1) It is a waste of time, because the animals usually are replaced promptly by other bats. (2) Killing the bats has the effect of displacing the only permanent solution, which is physical exclusion. (3) Killing the bats is hard to justify because the incidence of rabies infection is extremely low, and the animals are of value in insect control, and (4) The killing of bats is contraindicated primarily because the toxins likely to be used, such as DDT, scatter sick bats over wide geographic areas (Greenhall and Stell 1960) where persons and pets can be bitten as they investigate them.

Although these statements all have some validity, some of the points raised require further research before any factual conclusions can be drawn concerning their accuracy. For example: (1) No studies have been conducted as of yet that measure the rate and/or the severity of bat re-infestation once a bat colony has been exterminated. Replenishment of a vacated bat roost by new bats would presumably be highly dependent upon bat population densities and distribution factors. Thus, re-infestation is likely to vary considerably from one situation to another. It is probable that in some cases, re-infestation will occur and in others it might not. (2) The argument that "toxins scatter bats over wide areas where persons and pets can be bitten as they investigate them" has been defended by several researchers (Barclay et al. 1980, Hurly and Fenton 1980, Kunz et al. 1977). But formal quantitative studies (which include statistical treatment of the data) measuring the incidence of bat-people contacts following pesticide applications have not been provided. Furthermore, the important aspect of this particular argument lies within a comparative study which would document whether pesticide applications would cause an increase in bat-human contacts as compared to the number of contacts which normally occur periodically in and around nursery roosts during the time the bats are present, e.g., newly volant bats, lost and disoriented bats, excluded bats, aging bats, or sickly bats "wandering" into occupied areas of buildings or hanging around the exterior areas of a nursery roost. Once again, it seems probable that the number of bat-people contacts following a pesticide application would be highly variable and depend upon several factors such as the toxicant used, toxicant mode of action, the time of day and month the toxicant is applied, the size of the bat colony, the location of the colony (urban, suburban or rural areas) as well as the type of building involved.

Despite these questions, it is again stressed that bat-proofing always be the method approached first in coping with nuisance bats. In the majority of cases, toxicants probably should not be employed. But to completely rule out the possibility that toxicants may be of value in certain situations or suggest that toxicants never be used may be unrealistic or even unwise. Marsh and Howard (1982) state "to do nothing about a bat infestation in populated areas may also permit rabid bats to die outside the roost and, although fewer in number, such exposure could be of a much longer duration. Even bat-proofing, which is so well acclaimed as the ultimate solution to bat problems, causes the dispersal of many bats which may be rabid and thus could potentially increase the health hazard."

The use of toxicants may be justified in certain cases: Namely:

(1) when bat proofing or repellent programs have failed;

(2) when bat proofing or repellent programs are not possible or economically feasible; and

(3) in the instances where the bats prove to be a health threat.

Studies comparing various methods of controlling bats involving bat toxicants and repellents have been conducted by Barclay et al. (1980) and Hurley and Fenton (1980). These studies are helpful in providing some preliminary observations. But more quantitative, statistically-oriented studies are needed to document the efficaciousness, hazards, residual effects and benefit-risk ratios of toxicants and repellents against nuisance bats.

Two toxicants which have been used to control nuisance bat colonies are DDT and the rodenticide chlorophacinone (Rozol).

DDT in past years was used as a 50% tracking powder, and many pest control operators felt DDT was safe, practical, and effective. In 1971, the Environmental Protection Agency determined DDT to be an environmentally hazardous material and placed it under a general ban. The EPA can lift the ban under Section 18 of the Federal Insecticide Fungicide and Rodenticide Act, as amended, if a significant public health problem, e.g., rabies, is shown to exist. But this procedure requires a considerable amount of bureaucratic red tape and certainly doesn't provide a ready access to a bat toxicant should one be needed. Also, DDT may not be the best selection of a bat toxicant due to its persistant nature. Greenhall and Stell (1960) found DDT to kill bats for at least one year. Kunz et al. (1977) reported that DDT killed bats for four years following applications.

Chlorophacinone as a 0.2% tracking powder formulation has been used against nuisance bats. It has been claimed by pest control operators to be an effective batacide and has a 24c (special local needs) permit in 21 states.

Corrigan and Bennett conducted a formal study on the efficacy of Rozol tracking powder in field populations of the big brown bat (Eptesicus fuscus) in Indiana (manuscript in prep.).

Twelve buildings containing nuisance bat colonies (nursery colonies) of big brown bat were used in the study. The test sites were randomly placed into four groups containing three "treatments" over a period of six months (Table 1). Test sites were randomly assigned to one of three treatments: 1) Rozol treatment (applied as per 24c label directions; 2) "disturbance" control (a non-toxic clay tracking powder was applied in the same manner and at the same rates as the Rozol treatment); and 3) control site (control site colonies were numerically monitored and were not disturbed in any manner).

Table 1. Test layout for the Rozol® efficacy experimentation.

Season Period	TEST		
	Rozol	clay	control
I Early Summer June 1 - July 10	T1	T1	T1
II Mid Summer Rep 1 July 10 - Aug. 10	T2	T2	T2
Rep 2 Aug. 15 - Sept. 15	T2A	T2A	T2A
III Late Summer Sept. 17 - Oct. 17	T3	T3	T3

Statistical treatment of the data (analysis of variance) revealed the Rozol treatment to be highly significant ($P < .01$) compared to the disturbance control treatments and control sites. Significant mean reductions (> 40%) in colony populations resulted in three days. Mean reductions of 88% were obtained within two weeks and nearly total control was obtained within one month following application (Figure 1).

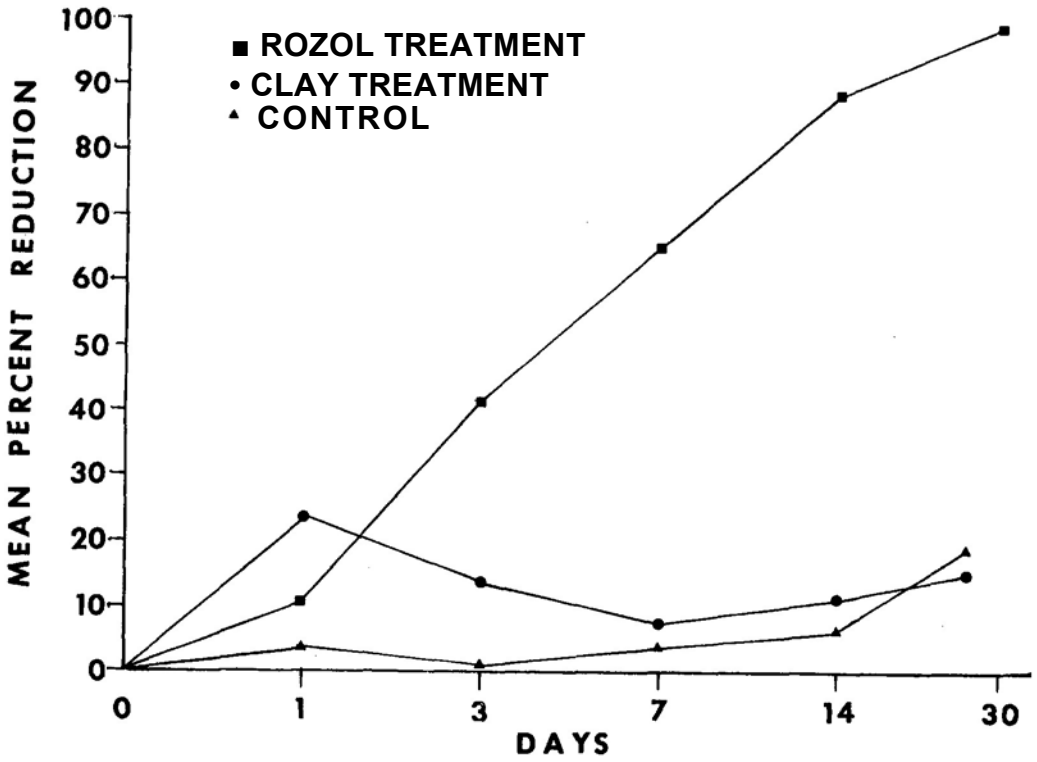

Figure 1. Mean percent reductions of field bat populations for the Rozol®, clay control, and control site treatments.

Disadvantages associated with the use of an anticoagulant batacide include: 1) the relatively long length of time required to achieve 100% mortality, and 2) the slow response of a bat to an anticoagulant toxicant. Although there are these disadvantages associated with Rozol as a batacide, discussion concerning chlorophacinone should be kept in perspective, Greenhall (1981) states: "The hazardous nature of chlorophacinone for house bat control was demonstrated in a major prosecution of a Minnesota pest control operator for the misuse of Rozol in bat control work (EPA 1980). In a wide-ranging, 50-page opinion, Judge Marvin E. Jones ruled on 8 May 1980 that the use of Rozol for bat control constituted a health hazard." Clearly, if Rozol (or any other pesticide) is misused, hazardous situations can result. But should we ban pesticides based upon cases of misuse? To date, there has not been a case of a human fatality, nor even any case of a serious human illness associated with the use of Rozol tracking powder against nuisance bats in structures (personal communication, Chempar 1984).

Constantine (1979) reporting on "experimental" attempts to eradicate colonies of insectivorous bats using chlorophacinone as "unproductive, since the use of chlorophacinone resulted in the destruction of no more than ten percent (usually far less) of resident bats, despite massive applications of massive amounts of the material to attic ceilings and walls." However, no quantitative data or mention of bat species is provided for these findings.

In the instances when a toxicant is the most practical solution, Rozol may be advantageous to DDT. The advantages of Rozol as a batacide include: 1) nonpersistence in the environment; 2) efficaciousness; 3) safety (the mode of action of anticoagulants provide intrinsic safety factors to humans and nontarget animals); and 4) an easily administered antidote (Vitamin K) is available in the unlikely event of accidental ingestion of large amounts of the tracking powder.

Whenever Rozol or any other toxicant is being considered for use, the following are recommended:

1) Toxicants be considered for use only when other nonlethal management procedures have been tried and exhausted, or have been deemed impossible or inappropriate.

2) The decision to use toxicants should be made by wildlife damage specialists, health officials, or similar experienced and knowledgeable personnel.

3) Approval for 24c permits should be granted on a prescription-use basis only.

4) Applications of a toxicant should be applied under direct supervision of wildlife damage specialists or similar personnel trained in the correct usage of pesticides.

5) A follow-up program is implemented for retrieving any convulsing, morbid or dead bats.

The disadvantages of using toxicants must be carefully thought out in any proposed attempt to control bats. However, the problems that may arise when a frustrated, uninformed, and inexperienced public attempts to control an undesirable colony of bats in some haphazard (and often dangerous) manner must also be considered (see Cox 1980). These procedures also increase the chance of rabid bats contacting humans. They may also subject the bats to excessive inhumane treatment, as well as jeopardize the health of individuals who attempt to apply some type of pesticide without knowledge of pesticides and their varying toxicities. Thus, such practices may create more of a disturbance and health hazard to a community than a professionally supervised and administered toxicant program utilizing registered toxicants about which all the technical and toxicological information is known.

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