Efficacy of Concussion Blast Equipment for the Elimination of Groundhogs in Burrows

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ABSTRACT: Groundhogs cause extensive damage to crops, landscaping, and structures throughout their range. However, control methods can be objectionable to the public. Concussion blasting equipment provides an alternative to historic groundhog control (i.e., live-capture and lethal traps, asphyxiation, poison, and firearms) in suburban and rural settings. Prior to use in our market, we tested the efficacy of the VARMITgetter device during 3 trials in September 2006. Trials were performed to determine the amount of gas (oxygen and propane mix) and length of injection time needed to provide a quick and consistent kill at minimum cost including labor, materials spent, and wear-and-tear. After detonation, dens were excavated to verify the effectiveness of the concussion blast method. During subsequent market testing, calibrations were adjusted to account for soil type, soil compaction, age of the burrow system, number of burrow entrances, and ground moisture. Testing to date has proven this method to be a viable alternative over other methods. Unique advantages of concussion blasting equipment include: one site visit; rapid kill; no equipment left behind; increased safety to pets, livestock, and people; and increased employee productivity.

KEY WORDS: burrow fumigation, concussion, den, efficacy, explosion, groundhog, *Marmota monax*, Pennsylvania, propane, rodent control, VARMITgetter

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INTRODUCTION

Groundhogs (*Marmota monax*) – what are they good for? This is a question many of our customers would ask. Of course, I would share all the good reasons they exist in nature's economy, including creating dens and burrows for other animals, aerating the soil, and that groundhogs are food for many predators. Before my next breath, our customers would add, in no particular order, "they facilitate in the breaking of my hay wagon axles," "they make crop harvesting a pain," "they love my soybeans and eat lots of them," and "they put my horses and cattle at risk." We do a lot of groundhog control work, and while the traditional methods we use are effective, they can be slow, laborious, time consuming, and for some, cost-prohibitive.

So, we were left with a dilemma of sorts: solve the problem– do it quicker, faster, and cheaper. This problem is not new to the world. My investigations led us to revisit our current methods and others of the "tried and true" category to see if any improvements could be made. These included live and lethal trap devices, shooting, snaring, and asphyxiation. I was concerned primarily with time, price, and provable effectiveness.

Lethal traps, otherwise known as body-gripping or "Conibears" (Frank Conibear was the inventor), are by far the best trap tool available to rid animals from large geographic areas. Their benefits include the proof of animal death (you know you have your target, and so does the customer), and ease of setting. Downsides with lethal traps vary by job but may include their bulkiness and weight, the need for multiple traps (since many dens have more than 1 exit hole and thus require more then 1 trap per animal), increased transport of equipment in the field, the limitation of holding only 1 animal at a time, and the length of time necessary to set and check traps and dispose of animal carcasses. At minimum, 2 trips to the site are necessary. My average time to set and return to check 1 body-gripping trap, including travel, is 30 minutes per den. After den discovery, work would include trap placement, staking traps in place (primarily to keep canines from dragging off the carcass and trap together, a definite problem in a farm environment where one trap stake through a tire or into a harvesting machine can stop everything for days), returning to check traps, emptying traps and leaving them in place, emptying and pulling traps, and loading equipment for transport back to the truck or to move it to another location at the site. The bottom line: trapping is time consuming, and equipment is left in the field for extended periods, but trap success is high.

Asphyxiation utilizing gas cartridges has benefits over trapping, which include quicker "set" time and ease of transport. Disadvantages include the time required to locate and plug all den exits with dirt to stop gas loss, smoldering combustion devices remaining in the field or hedgerow (which are a fire hazard that lasts for days), and no visible confirmation of a kill (dig-outs within hours are common, indicating that the groundhog was not killed). My time to perform this work is approximately half that for body gripping traps, but due to the marked decrease in effectiveness and the need to retreat den sites, total time per den site treatment is roughly the same as body-gripping traps. The bottom line: burrow fumigation is time-consuming, kill rates are lower then acceptable (<60%), and fire risks are greatly elevated when gas cartridges are used in large numbers.

METHODS

Our research directed us to a western tool with little East Coast exposure: concussion blast technology. This method has been used for the last 10 years, mainly in the West, for prairie dog (*Cynomys* spp.) control, among other things. Given the similarities in size and tunneling prowess between groundhogs and prairie dogs, we felt that this method needed consideration, and if successful, it would satisfy the needs of our customer base– quicker,

faster, cheaper.

I choose the VARMITgetter (VARMITgetter LLC, Payette, ID; http://www.varmitgetter.com) for use in all trials. Its remote detonation system allows the operator to fill the den system and safely detonate from a minimum distance of 25 feet (VARMITgetter *no date*). Additional distance is possible by coupling another hose set to the system. I used a standard hose length of 50 feet.

The premise behind concussion blast equipment is the creation of a shock wave that kills the target animal. Through the use of an oxygen and propane gas mixture, a shock wave is generated, via gas detonation, having sufficient power to quickly kill the target animal and in some cases collapse the den burrow system. The gas mixture ratio (95% oxygen to 5% propane) is factory set and creates a concussion with little or no flame.

The completed setup includes a propane gas cylinder (the same 10-lb bottle that is used with a conventional gas grill, user-supplied), an oxygen gas bottle (a 40-lb cylinder, secured at bottled gas and /or welding supply houses, user-supplied), appropriate tank gauges (Harris compressed gas regulators, VARMITgetter-supplied), delivery hoses from each bottle to the control box (high pressure hoses utilized in the welding industry, VARMITgetter-supplied), a control box manufactured and supplied by VARMITgetter, a line set that includes the gas delivery hose and ignition cord combination (VARMITgetter-supplied), two 9-volt batteries, and the applicator wand manufactured and supplied by VARMITgetter. Additional equipment includes shovels, a stopwatch, a fire extinguisher, assorted wrenches, and site transportation. Costs of all equipment including gas cylinders, associated tools, and transport customization, were $2,900 per operating unit.

All den entrances were filled with enough dirt, rocks, and grass sod to provide a minimum 8-inch-deep plug. Initial use of the equipment proved less than satisfactory at the manufacturer's suggested gas application time for groundhogs of 15 to 60 seconds. The first 50 den sites were filled for 25 seconds and then detonated. At this early stage, records were not kept, but success, as measured by visual inspection of the dens the day after treatment, was poor, with most dens having been dug out. Early efforts to monitor success were measured by filling dens with dirt and sod, and then checking to see if the den had been re-opened 1 to 3 days post-treatment. This method was utilized for the first 4 months of trial. Gas application times continued to be increased throughout this period, increasing from 25 seconds to 90 seconds.

RESULTS

The number of dens detonated from April 2006 through September 2006 totaled in excess of 2,800. Success was positively related to an increase in gas injection time. During trials with 90-second injection times, dig-outs were all but eliminated (<8%; random sampling of 450 dens), with those dug out being attributed to canines (16, as determined by prints and scat left at the site, and by enlargement of the den hole face that was typical of a predator's efforts to secure prey), or to dispersing groundhogs (17, as determined by placement of dirt plug spoils outside the hole, scat, the hole face size being maintained, and that these occurred during groundhog dispersal season), with most dig-outs occurring 2 to 5 days after concussion. At this point, our efforts, via observation, were yielding an apparently high kill rate with 1 trip to the den. This differed tremendously from our initial efforts, where over 80% of all dens were opened within 1 day of concussion blasting; my inspections revealed many of these dens were opened from the inside, based on dirt placement, and I also observed groundhogs at the dens. Job time at the den site was reduced to an average of 11 minutes. While our confidence was high that concussion blasting was yielding the desired results, we excavated a subset of dens to conclusively confirm the kill rates by locating the carcass.

In September 2006, I excavated 24 den sites using a track hoes (excavator) or a rubber-wheeled backhoe. For all 24 dens, gas injection time was 90 seconds with the gas injection ratio calibrated to factory settings (95% oxygen to 5% propane). Soil type was shale topsoil and shale sub-soils. The average tunnel length was estimated at 33 linear feet. Soil moisture was very low, creating generally dry topsoil and sub-soils. Den entrances averaged 2 to 5 openings per site. Excavation averaged between 2 and 5 minutes per tunnel complex. Times varied due to the length and depth of the tunnels. Average depth of the deepest leg of each tunnel system was 40 inches. Each tunnel system had an average of 3 nest sites, located at the dead end of a lateral.

Seventeen (17) groundhogs were found dead; no live groundhogs were found. The general condition of the carcass was that the overall coat and tail was lightly singed; there was blood at the mouth, nose and ears; and the general body condition was analogous to a water balloon. The animals typically were found in the deepest portions of the tunnel system and often at a nest dead end. No struggles were apparent, and death appeared immediate. Den sites not yielding any groundhogs, even though the den appeared active, were assumed to be secondary den sites or empty due to predation. Damage to the internal den sites was negligible. Use of this device for collapsing groundhog dens in shale-based soils is not recommended.

In 2007, use was expanded to sand and loamy soil types with different moisture conditions. Observational testing in these new conditions warranted a change in gas injection time. Detonated den sites in sandy and loamy soils had a higher incidence of dig-outs then their counterparts in shale soil. Because moisture levels were considerably higher in the loamy soils, I was not sure if this had any bearing on the increased dig-outs. My assumption was that dig-outs resulted from less compaction or looseness of the soils, rather than from increased moisture content in the soil. Because the soils were more open, the concussion was likely getting absorbed into the earth rather than being reflected back into the den cavity. For this reason, injection times for sandy, extra loamy, and old den systems (those with 4 or more holes and more overall volume to fill) were increased to 120 seconds. Sandbags were also placed over soil plugs in order to hold down blow-out caused by

the loose soils. Observational testing confirmed that the increase to 120 seconds was warranted, and our "re-digs" were all but eliminated. Continued use in shale soils with higher moisture rates did not yield any changes in our observational data.

Excavated groundhogs continued to show the same physical patterns including a lightly-singed coat and tail; blood drainage from mouth, ears, and nose; and a flaccid condition of the overall body. Signs of struggle, such as broken nails or dirt inside the mouth, nose, and claws were not present. Sixteen (16) dens sites were excavated from May through mid-July 2007; 11 groundhog carcasses and no live groundhogs were discovered. Den excavation was completed within 5 minutes of the concussion blast. Den sites in sandy soil suffered some internal collapse.

During early October 2007, 8 additional shale soil den sites were excavated in order to provide necropsy specimens for testing. Gas injection time for these dens was 90 seconds. Four dead groundhogs were excavated; no live groundhogs were discovered. Three of the 4 dead animals were shipped to the Utah State University Diagnostic Laboratory for additional study into the exact cause of death. Findings indicated "massive intrapulmonary and intrathoracic hemorrhage" as the cause of death.

CONCLUSION

Concussion blast technology at stated injection rates will quickly kill groundhogs in the den on a consistent basis, providing a safe alternative to historical control methods. Concussion blasting provides a cost- and labor-efficient tool for wildlife control professionals, agricultural interests, and equine operations.

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