Efficacy of concussion blast equipment for the elimination of ground hogs in the burrow system

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Abstract: Groundhogs – (*Marmota monax)* cause extensive damage to crops, landscaping and structures throughout their range. However, control methods can be objectionable by the public. Concussion blasting equipment provides an alternative to historic groundhog control (i.e. live capture and lethal traps, asphyxiation, poison, and fire arms) in suburban and rural settings. Prior to use in our market, we tested its efficacy during three 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 costs 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: blast, burrow, concussion, den, groundhog, *marmota monax,* propane, tunnel

Introduction

Groundhogs, what are they good for? 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 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 work, and while the traditional methods we use are effective, they can be slow, laborious, time consuming and for some, cost prohibitive.

So we where 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 interested primarily with time, price and provable effectiveness.

Lethal traps—otherwise known as body gripping or 'Conibears' (Frank Conibear inventor)-- are by far the best trap tool available to rid animals from large geographic areas. Their benefits include the direct observation 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 bulkiness and weight, the need for multiple traps since many dens have more then one exit hole and thus require more then one trap per animal, increased transport of equipment in the field, limitation of holding one animal at a time, and the length of time necessary to set and check traps and dispose of animal carcasses. At minimum, two trips to the site are necessary. My average time to set and return to check one body gripping trap, including travel is 30 minutes per den. After den discovery, work would include trap placement, staking 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, empty traps and leave in place, empty and pull traps, load equipment for transport back to the truck or move to another location at the site. Bottom line: time consuming and equipment is left in the field for extended periods, but trap success is high.

Asphyxiation, utilizing gas cartridges. Their benefits over traps include quicker 'set' time , and ease of transport. Down-sides includes time required to locate and plug up all den exits with dirt to stop gas loss, smoldering combustion devices remaining in the field or hedgerow are a fire hazard that lasts for days and no visible confirmation of a kill (dig outs are common within hours indicating that the ground hog 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. Bottom line: time consuming, kill rates are lower then acceptable (< 60 %), and fire risks are greatly elevated when used in large numbers.

Methods

Our research directed us to a western technology with little east coast exposure, concussion blast technology. This method has been used for the last 10 years mainly in the west for among other things prairie dog control. Given the similarities in size and tunneling prowess between groundhogs and prairie dogs, we felt that this method needed consideration and if successful would satisfy the needs of our customer base---- quicker, faster , cheaper.

I choose the *VARMITgetter* (manufactured by VARMITgetter LLC., Payette Idaho 83661, www.varmitgetter.com) for use in all trials. It's remote detonation system safely allows the operator to fill the den system and detonate from a minimum distance of 25 feet. 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 mix a shock wave is generated, via gas detonation, with sufficient power to quickly kill the target animal and in some cases collapse the den burrow system. Gas mix rates (95% oxygen to 5 % propane) are factory set and create a concussion with little or no flame.

The completed set up includes a propane gas cylinder (same 10 lb bottle used with conventional gas grill, user supplied), an oxygen gas bottle (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), control box manufactured and supplied by Varmitgetter, line set which includes gas delivery hose and ignition cord combination (Varmitgetter supplied), two 9 volt batteries and applicator wand manufactured and supplied by Varmitgetter. Additional equipment includes shovels, stop watch, fire extinguisher, assorted wrenches and site transportation. Costs of all equipment including gas cylinders, associated tools and transport customization were $2900 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 then satisfactory at the manufacturer suggested gas application times of 15 to 60 seconds for ground hogs. The first 50 den sites were filled for 25 seconds and then detonated. Records were not kept at this early stage of use but success was poor as measured by visual inspection of the dens the day after use

with most dens re-opened at inspection. Early efforts to monitor success were measured by filling of dens with dirt and sod then re-checking to see if the den opened back up 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

Total dens detonated from April 2006 through September 2006 totaled in excess of 2800. Success was positively related to an increase in gas injection time. During trials of 90 seconds, dig outs were all but eliminated (< 8%, random sampling of 450 dens) with those dug out being attributed to canines (16, determined by prints and scat left at the site and den hole face enlargement typical of predator efforts to secure prey) or dispersing ground hogs (17, determined by placement of dirt plug spoils outside the hole, scat, hole face size maintained, and during groundhog dispersal season) with most dig outs occurring 2 to 5 days after concussion. Our efforts to date were yielding an assumed, via observation, high kill rate with one trip to the den. This differed tremendously from our initial efforts where over 80% of all dens were opened up within 1 day of concussion blasting. My inspections revealed many of these dens were opened from the inside based on dirt placement. I also observed groundhogs at the dens. Job time at the den site was reduced to an average of 11 minutes. While confidence was high that concussion blasting was yielding the desired results, we excavated a subset of dens to conclusively (i.e., locate the carcass) confirm the kill rates.

In September 2006 I excavated 24 den sites using track hoes (excavator) and rubber wheeled backhoes. For all 24 dens gas injection run time was 90 seconds and gas injection rates were calibrated to factory settings (95% oxygen to 5 % propane). Soil type was shale topsoil and shale sub-soils. The average tunnel lengths were estimated at 33 linear feet. Soil moisture

was very low creating generally dry top 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 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) ground hogs were found dead. No live ground hogs were found. The general condition of each was light singeing of the overall coat and tail, blood at the mouth, nose and ears, and a general body condition analogous to a water balloon. The animals were typically found in the deepest portions of the tunnel system and often at a nest dead end. No struggles were apparent, death appeared immediate. Den sites not yielding any ground hogs, 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 ground hog 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 assumptions were that moisture content in the soil was not responsible for this but rather was due to less compaction or tightness of the soils. Because the soils were more open the concussion was getting absorbed into the earth rather then be 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. Sand bags 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 ground hogs continued to show the same physical patterns including lightly singed coat and tail, blood drainage from mouth, ears and nose and flaccid feel 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 May thru mid July of 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 groundhogs were excavated and all were dead; no live ground hogs were discovered. Three of the four dead animals were shipped to the Utah University Diagnostic Laboratory for additional study into the exact cause of death. Findings indicate "massive intrapulmonary and intrathoracic hemorrhage" as the cause of death.

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

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