FINAL REPORT FOR: Andermatt Biocontrol AG

STUDY TITLE:

A comparison of the efficacy of Topcat and Gophinator traps for capturing Botta's pocket gophers (*Thomomys bottae*).

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Abstract: We compared the efficacy of the Topcat and Gophinator traps at capturing pocket gophers. The Gophinator was clearly the more effective trap, as it resulted in nearly 2 times the capture rate and far fewer instances where it was plugged or sprung by pocket gophers. We observed no difference in weight of female pocket gophers captured by the two traps, but did observe significantly larger male pocket gophers captured by the Gophinator. The primary limitation for the Topcat trap appears to be the smaller size of the opening. Also, techniques to trap non-linear tunnels should be developed to increase the utility of the Topcat. However, the Topcat trap is quick and easy to set and appears to be sufficiently powerful to quickly kill captured pocket gophers. If these short-comings can be addressed, the Topcat could be an effective pocket gopher trap.

INTRODUCTION

Pocket gophers are very damaging rodent pests throughout California and much of the U.S. A variety of techniques are used to manage pocket gopher populations including habitat modification, the use of rodenticide baits, burrow fumigants, and trapping. Trapping can be a particularly valuable component of an Integrated Pest Management program as it allows for direct enumeration of individuals removed, does not require the use of toxic chemicals, is allowable for use in organic commodities, is an effective follow-up technique to for other less labor intensive control strategies, and can be economical and efficient when the user is proficient at trapping (Baldwin et al. 2013).

Many pocket gopher traps have been created over the last 148 years (see Marsh 1997 for comprehensive review). Most are no longer in production, but several are still used extensively in North America. The efficacy of these traps varies across differing trap types but remains relatively unstudied (but see Proulx 1997, Pipas et al. 2000, Baldwin et al. 2013). The most commonly used trap throughout the western U.S. is likely the Macabee (The Macabee Gopher Trap Co., Los Gatos, USA) which has been available since 1900 (Marsh 1998). In contrast, the Gophinator (Trapline Products, Menlo Park, USA; Fig. 1) is the newest trap on the market, with a patent awarded in 2008. The Gophinator has proven to be one of the most effective pocket gopher traps currently available (Baldwin et al. 2013), but newer trap designs are constantly being created that may prove more effective or efficient.

One such trap is the Topcat (Andermatt Biocontrol AG, Grossdietwill, Switzerland; Fig. 1). This trap was designed for trapping water voles (*Arvicola terrestris*) and the common vole (*Microtus aravalis*). However, given similar fossorial traits between European voles and pocket gophers, it is possible that the Topcat could be effective at removing pocket gophers as well. Therefore, we set up trials in California to compare the efficacy of Topcat and Gophinator traps at removing Botta's pocket gophers (*Thomomys bottae*). If efficacious, the Topcat trap could be a good alternative to other pocket gopher traps currently in the market in California and other states throughout the western U.S.

MATERIALS AND METHODS

We selected two sites to compare the Topcat and Gophinator traps. One site was located in a pasture setting in San Diego County, California (Pala site), while the other site was located in a

vineyard in Sonoma County, California (Laguna Ranch site; Fig. 2). The Pala site was trapped on 1 March, 2013, while the Laguna Ranch site was trapped on 21 April, 2013. At each site, we endeavored to set 30 Topcat and 30 Gophinator trap-sets, although we only set 29 Gophinator trap sets at the Pala site due to counting error. For the Topcat trap-sets, we used a probing device to find the pocket gopher tunnel systems, and used the supplied ground cutter to remove a soil plug. An activated Topcat trap was then inserted into the open hole, and any remaining open areas from the hole were covered with soil to eliminate the entrance of light or air into the tunnel system.

For Gophinator trap-sets, we probed to find tunnel systems in the same manner used for the Topcat trap. We then dug down into the tunnel system and set as many Gophinator traps as we had tunnels. We left these trap-sets uncovered given little benefit to the covering process for these traps (Baldwin et al. 2013). All traps were operated for approximately 24-hours.

The following day, we checked all traps for activity. If a pocket gopher was captured, we collected the individual to determine weight and sex in the lab. If a pocket gopher was not captured, we recorded if the trap was sprung, if it was plugged with soil but not sprung, or if no individual visited the site (i.e., no action).

We compared capture efficiency between the two trap types by dividing the number of sites with a capture by the number of sites that were visited (i.e., total number of trap sets – number of trap sets that received no action). We used Fisher's exact test (Zar 1999) to determine differences in capture efficiency between the two traps, as well as to test for differences in sex ratios captured by the two traps. We used *t*-tests (Zar 1999) to determine potential differences in weights of individuals captured by the two trap types.

RESULTS

We observed significant differences (Fisher's exact test $P < 0.001$) in pocket gopher activity between the two tested traps with observed capture rates nearly twice as high for the Gophinator trap (82%) than the Topcat (42%; Table 1). Additionally, we observed 3.7 times as many sprung or plugged trap sets with the Topcat (Table 1). The sex ratio (M:F) of captured pocket gophers between the two traps differed (Topcat = 0.8:1.0, Gophinator = 0.3:1.0; Fisher's exact test $P = 0.082$) with a greater proportion of males captured with the Topcat. However, we observed heavier males captured with the Gophinator trap (Topcat $\bar{x} = 115$ g, SE = 14; Gophinator $\bar{x} = 173$ g, SE = 18; $t = -2.60$, $P = 0.019$). We did not observe a difference in the size of female pocket gophers captured by the two traps (Topcat $\bar{x} = 132$ g, SE = 8; Gophinator $\bar{x} = 127$ g, SE = 3; $t = 0.73$, $P = 0.468$).

DISCUSSION

The Gophinator trap was clearly the more effective trap for capturing pocket gophers. The primary problem with the Topcat stemmed from the fact that pocket gophers often plugged or sprung the trap with soil without getting captured. The Topcat trap was designed to capture voles which are smaller than pocket gophers. I suspect that part of the difficulty in capturing pocket gophers with the Topcat was related to the size of the individuals visiting the capture

sites. For example, we observed no difference in the weight of females captured with the two traps, but we did observe substantially larger male pocket gophers captured with the Gophinator. The Gophinator trap has already been documented to be very successful at capturing larger pocket gophers (Baldwin et al. 2013), in part because of its strong spring. The Topcat trap does not appear to lack in spring strength. Rather, the likely shortcoming of the Topcat is related to the size of the opening of the trap, as large adults may not feel comfortable trying to squeeze through this opening. Perhaps increasing the size of the opening of the Topcat trap might increase capture rates of these larger pocket gophers, thereby increasing the overall efficacy of this trap. This modification may be worth pursuing in the future.

The efficacy of the Topcat trap was also likely reduced by the presence of irregular tunnel shapes. The Topcat is designed to be placed in tunnels that run two directions that are more-or-less linear. However, pocket gopher burrow systems often have sharp bends in the tunnels (e.g., 90 degrees) to where the entrance to the trap does not intersect the tunnel. Obviously if a Topcat trap is set in such a tunnel, the chance of capturing a pocket gopher is either substantially reduced or impossible. Likewise, there are sections of pocket gopher burrow systems where multiple tunnels intersect. For pincer-style traps such as the Gophinator, this is not a problem as the trap is placed within the tunnel. For the Topcat, this is not possible. In these situations, multiple traps would need to be utilized, which is problematic when using only the coring tool. A shovel is often needed when this occurs. Additionally, the Topcat trap ($57.86 U.S.D.) is much more expensive than the Gophinator ($7.50 U.S.D.), so the need for multiple traps in a single trap-set becomes quite costly.

All that being said, the Topcat does have some very nice attributes to it.

1. The Topcat is an easy trap to set. This is particularly important to older homeowners who need a trap to capture occasional pocket gophers in their back yard. This is a potentially large market in the U.S. that has not been thoroughly addressed.

2. The Topcat was very quick to set when located in a single linear tunnel. Likewise, it was very easy to determine when a trap was sprung, so they were quick to check. If the trap could be designed in such a way that made it more efficient, a field could likely be trapped more quickly with the Topcat.

3. The Topcat was a very powerful trap. It typically captured pocket gophers on the top of the skull or directly behind the skull (Fig. 3). Death likely occurred very quickly, although this was not tested.

Given the benefits of this trap, I think there is some merit to redesigning the trap to specifically target pocket gophers. Of particular importance are increasing the size of the opening for the trap, and determining the best approach for capturing pocket gophers in non-linear and multiple tunnel burrow systems. It should be noted that different species of pocket gophers differ in size. For example, the *Thomomys* genus is a fair amount smaller than the *Geomys* genus found in the central plains states. As such, differing size traps may be needed depending on the targeted species of pocket gopher.

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Table 1. Pocket gopher (*Thomomys bottae*) trapping statistics (Cap = Capture, Spr = Sprung, Plg = Plugged, NA = No Action, Cap Rate = Capture Rate) for Topcat and Gophinator traps during trials across two sites in California during spring 2013.

	Topcat					Gophinator				
	Cap	Spr	Plg	NA	Cap Rate	Cap	Spr	Plg	NA	Cap Rate
Pala	12	12	6	0	40%	25	1	3	0	86%
Laguna Ranch	12	14	1	3	44%	16	4	1	9	76%
Total	24	26	7	3	42%	41	5	4	9	82%

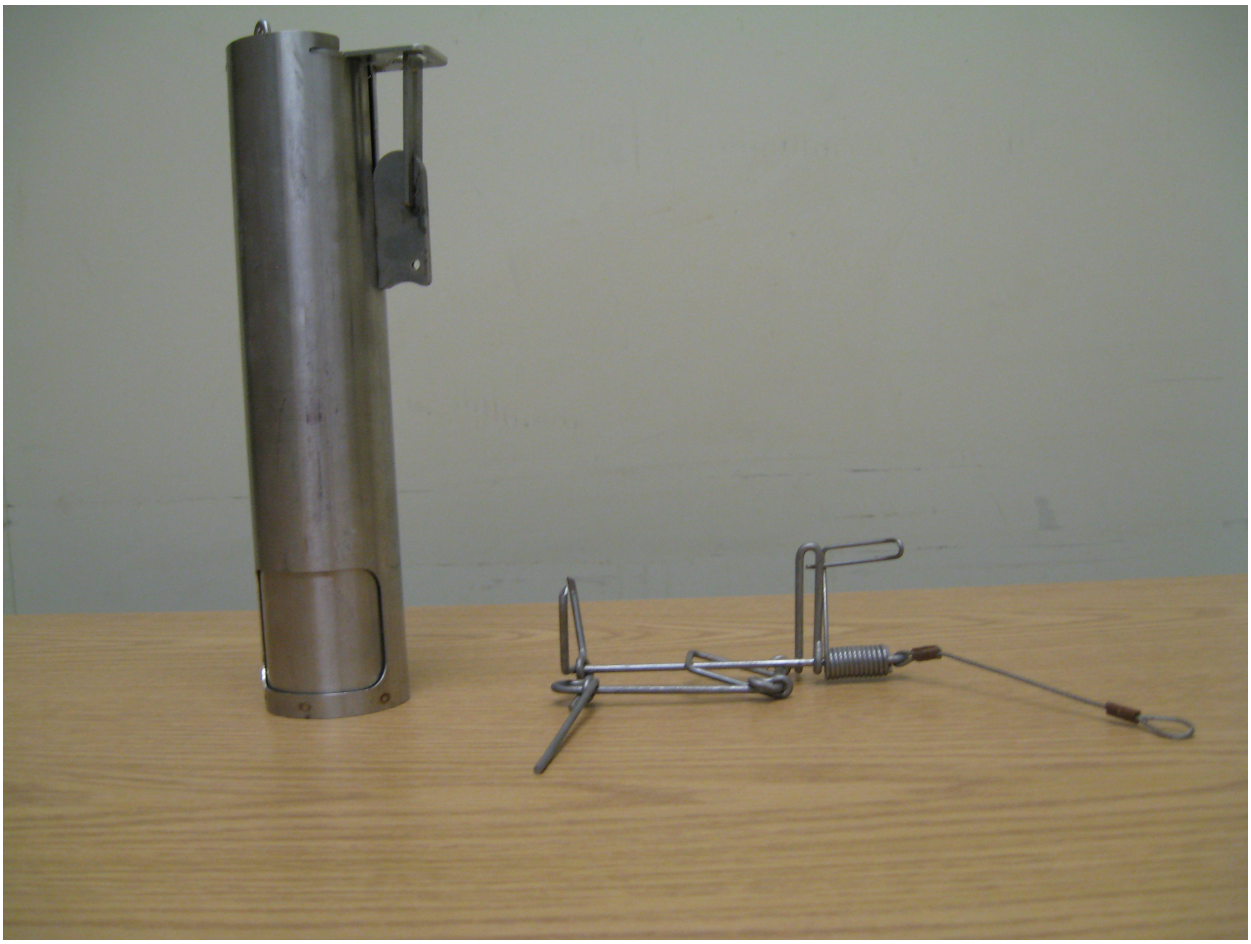

Figure 1. Topcat (left) and Gophinator traps compared for efficacy at capturing Botta's pocket gophers (*Thomomys bottae*).

Figure 2. The location of field sites for this study.

Figure 3. Capture location for pocket gophers from Topcat trap was almost always on top of, or directly behind, the skull.