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**Journal**
Proceedings of the Vertebrate Pest Conference, 19(19)

**ISSN**
0507-6773

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**Publication Date**
2000

**DOI**
10.5070/V419110154

# EVALUATION OF THE EFFICIENCY OF THREE TYPES OF TRAPS FOR CAPTURING POCKET GOPHERS

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ABSTRACT: Trapping is an integral tool in research and control of damage caused by pocket gophers (*Thomomys* spp.). We evaluated three types of traps (Macabee®, Cinch, Blackhole® Rodent™) in a California field trial by comparing the number of captures to activity at the sets (capture efficiency) and separately, the duration of time from first to last capture (time efficiency). On each of six study plots established on irrigated agriculture fields, 60 trap stations were established at locations of gopher mounds. One trap type was used per station and traplines were run continuously for about four days. We captured a total of 256 gophers. Overall, the Cinch trap had the highest capture efficiency (41.7%), followed by the Macabee® trap (27.7%) and the Blackhole® trap (18.3%). The Cinch trap had a significantly greater ($P=0.003$) capture efficiency than either of the other two trap types, which did not differ ($P>0.05$). From a time efficiency standpoint, the Cinch trap also ranked first (0.046), the Macabee® trap second at 0.036 and the Blackhole® trap last (0.032), though the differences were not significant ($P=0.693$). We conclude that the Cinch trap was the most efficient of the three trap types for capturing gophers in this study. Its chief drawback is that the large baseplate makes it more time-consuming to set. The Blackhole® Rodent™ trap was the least efficient for capturing gophers, and very time-consuming to set and check. Furthermore, the floor of the trap (solid plastic) may have induced trap shyness, even when covered by soil. The Macabee® ranked intermediate in both capture efficiency and time efficiency. Due to its small size and ease to set and check, it will probably remain a popular alternative for capturing pocket gophers. An integrated pest management approach is recommended for the most effective control of pocket gophers.

KEY WORDS: agriculture, alfalfa, control, flood irrigation, integrated pest management, pocket gopher, trapping

Proc. 19th Vertebr. Pest Conf. (T.P. Salmon & A.C. Crabb, Eds.) Published at Univ. of Calif., Davis. 2000.

(March 6-9, 2000, San Diego, California)

## INTRODUCTION

Pocket gophers can cause considerable damage in reforestation (Teipner et al. 1983; Bonar 1995) and rangeland (Foster and Stubbendieck 1980; Turner et al. 1973) settings. In agricultural settings, pocket gophers reduce forage yields by consuming vegetation and by the adverse effects of their tunneling and mound building (reducing plant vigor, smothering plants and changing species composition) (Luchsinger and Case 1989). Luce et al. (1981) found that dryland alfalfa yield was 43% to 46% less on plains pocket gopher-occupied fields in eastern Nebraska.

Trapping is an integral tool in research and control of damage caused by pocket gophers (*Thomomys* spp.). Kill traps designed exclusively for the control of pocket gophers are numerous and varied, and have a long, colorful history (Gerstell 1985; Marsh 1997). Over 100 trap types have been developed and marketed to various degrees over the years, but relatively few are still commonly used and commercially available (Marsh 1997). The Macabee® (Z. A. Macabee Gopher Trap Company, Inc., Los Gatos, CA) is perhaps the most popular of the gopher traps, primarily because it is a proven device for capturing gophers and requires little excavation to set (Marsh and Steele 1992). This is a pincher-type trap, characterized by sharply pointed wire jaws which close on the body from either side with an arching motion; the force of the strike and resulting constriction lead to death (Marsh 1997). The effectiveness of this type of trap has recently been criticized by Proulx (1997a), who evaluated a trap of comparable design, the Victor Easyset® (Woodstream Corporation, Lititz, PA).

Because trap success is critical in baiting studies for recovering as many animals as possible in the minimum amount of time, the most efficient trap (in theory, at least) will capture the most gophers in the least amount of time. The Macabee® trap was evaluated against the Cinch trap (Cinch Trap Company, Hubbard, OR) and the Blackhole® Rodent™ trap (F. B. N. Plastics, Tulare, CA). These traps are illustrated in Witmer et al. (1999) and Marsh (1997). The Cinch trap, although it has been in existence for some time, has not been used as commonly as the Macabee®, perhaps because it hasn't been marketed as extensively as some other models of traps (Marsh and Steele 1992). Like the Macabee®, it is a pincher trap, with a large baseplate (making excavating the set more time consuming) and much more powerful gripping jaws than the Macabee®. The Blackhole® Rodent™ trap is a choker box trap incorporating a body-constricting flexible cable. Its effectiveness has been demonstrated (Marsh 1997). The null hypothesis we tested is no difference in capture efficiency or time efficiency between the three trap types.

## STUDY SITE

The study was conducted in the vicinity of Visalia, California, Tulare County, approximately 64 km southeast of Fresno. Visalia lies in the San Joaquin Valley, an important agricultural area. The San Joaquin Valley is classified as a steppe vegetation zone, characterized by low rainfall (approximately 36 cm per year), mostly falling in the winter months. Consequently, irrigation is the rule. Flood irrigation is the predominant means of watering crops. Fields are typically bermed and fed by a system of irrigation canals and pipelines.

## METHODS

Six plots were established in irrigated agricultural fields (a walnut orchard and two large alfalfa fields) characterized by moderate to high pocket gopher densities. Plot size was variable ($\bar{x}$ =0.90 ha, range 0.5 to 1.48 ha), depending on the distribution of mounds, which tended to be clustered along the berms of the fields (due to the seasonal "flooding"). Plots were primarily rectangular (some polygonal) in shape and surrounded by a buffer zone 7.6 m in width. In some cases, adjacent single lane dirt farm roads served as buffers on one or two sides. These buffer zones served to reduce dispersing gophers from invading the plots during the course of the study. The buffer zones (except roads) were intensively trapped to ensure near or complete absence of gophers in these areas. On each plot, 60 mounds (not necessarily separate burrow systems) were marked with numbered flags. The burrow associated with each mound was exposed and each tunnel opening baited with approximately 4 g of oat groats treated with DuPont oil blue A, a biomarker dye. The burrow entrance was filled with crumpled newspaper, then backfilled with soil. Three days post-baiting, the holes were reopened and examined for bait consumption. Gophers were then recovered for evaluation of bait consumption by kill trapping. Trapping was conducted from January 13 through February 5, 1999.

The three trap types (Blackhole®, Cinch, Macabee®) were randomly assigned to the 60 stations on each plot so that each of the three trap types was represented once in each group of three consecutively-numbered stations; only one trap type was used per station. The number of traps set at each station was determined by burrow geometry, and ranged from 1-6, with 2 and 3 being most common. This number often changed from day to day at any given station, as activity (backfilling) changed burrow anatomy. Traps were set in the morning and checked once that evening, twice each of the next three days (morning and late afternoon), and once on the morning of the fifth day, after which all traps were pulled. Hence, the trapline on each plot was checked a total of eight times. Traplines were active continuously throughout this time period. At each check, notes were taken on disposition of each trap (capture, tripped trap but no capture, plugged burrow or undisturbed). Each of the three trappers was randomly assigned a block of 20 consecutively-numbered stations on each plot for trapping. All captures were saved in labeled bags and frozen pending analysis for presence of the biomarker dye.

Due to the variability in the number of traps set at any given station during the trapping periods and the unequal trap check intervals, trap success could not be determined simply by comparing captures relative to trap nights. Hence, traps were evaluated by comparing number of captures to activity at the sets (capture efficiency) and separately, on a time basis defined as the interval between the initial setting and last capture (time efficiency). More specifically, capture efficiency is defined as the ratio of pocket gopher captures to the sum of all activity (e.g., captures, tripped traps, plugged burrows with no captures). Time efficiency is the ratio of pocket gopher captures to the period of time elapsed from setting the traps at a given station until the last gopher was caught. A general linear models procedure ANOVA (SAS Institute 1988) was used to test for differences between the three trap types in trap efficiency and time efficiency. Duncan's multiple range test (Milliken and Johnson 1992) was used to reveal the locations of significant differences.

## RESULTS

We captured a total of 256 gophers in approximately 4 days of trapping effort on each of the 6 plots. Overall, the Cinch trap had the highest capture efficiency (41.7%), followed by the Macabee® trap (27.7%) and the Blackhole® trap (18.3%) (Table 1). From a time efficiency standpoint, the Cinch trap once again ranked first (0.046), the Macabee® trap second (0.036) and the Blackhole® trap last (0.032) (Table 1). We noted no differences in either capture efficiency ($F=2.39$, df=5, $P=0.113$) or time efficiency ($F=1.57$, df=5, $P=0.255$) between plots. Across plots, capture efficiency differed ($F=11.36$, df=2, $P=0.003$). The Cinch trap had a significantly greater capture efficiency than either of the other two trap types, which did not differ ($P>0.05$). Time efficiency (across plots) did not differ between trap types ($F=0.38$, df=2, $P=0.693$).

## DISCUSSION

The Cinch trap was the all around best performer. It ranked highest in both capture efficiency and time efficiency. Additionally, it had the best holding power, which translated to fewer escapes. Minor drawbacks include its large size and the extra excavation effort required to seat the large baseplate.

The Macabee® trap ranked second in both efficiency categories. In addition, it is easy to set, check and relocate. Its chief drawback is holding power, not typically a problem when the gopher is captured in the thorax or abdomen, but marginal captures (by the foot or tail) are more likely to escape.

The Blackhole® trap ranked third in capture efficiency and time efficiency. Its chief drawback may be a reluctance of gophers to enter the trap. Many of these traps were packed solid with soil, some repeatedly. This is probably the result of a reluctance on the part of gophers to enter foreign, enclosed spaces. Neither the Cinch or Macabee traps present this problem. In addition, the trap is rather time-consuming to set. The floor of the trap must be covered with fine soil, and the front edge of the trap sealed against the burrow entrance to prevent light from entering at this point. Furthermore, each trap must be removed to check it, necessitating extra time to reposition it and seal off any light entering the front of the trap. In addition, the trigger wire is very sensitive where it attaches to the treadle, sometimes resulting in misfires. On the positive side, the trap has great holding power. Captures, as a rule, were centered on the thorax or abdomen, the ideal location.

When conducting trapping studies, one must keep in mind the physiological and behavioral aspects of the species, which often influence trapping success. Proulx (1997a) noted that capture success may vary at different times of the year according to the sex, age, size and physiological state of the animals. We captured individuals of both sexes and various age classes

Table 1. Capture efficiency and time efficiency of three different types of gopher traps, Tulare County, California, January-February, 1999.

| Trap Type | Number Trap Stations | Capture Efficiency (%)[1,2] | Time Efficiency[1,3] |
|---|---|---|---|
| Blackhole | 121 | 18.3[a] | 0.032[a] |
| Cinch | 115 | 41.7[b] | 0.046[a] |
| Macabee | 124 | 27.7[a] | 0.036[a] |

[1]Trap types with the same letter in a given column are not significantly different.
[2]Capture efficiency is the ratio of pocket gopher captures to the sum of all activity at the respective traps (e.g., captures, tripped traps, plugged burrows with no captures).
[3]Time efficiency is the ratio of pocket gopher captures to the period of time elapsed from setting the traps at a given station until the last gopher was caught.

in all three trap types. Because many females had recently reproduced and the pups were beginning to gain autonomy, numerous captures from the same burrow system were common.

We accounted for most, if not all, of the burrow systems in each plot. This procedure was simplified by the fact that most of the trap stations were located in, or near, the field levees, or berms. These elevated areas serve as the only refuge to gophers during the intermittent flooding periods. Miller (1957) documented such a distribution of burrow systems in the Sacramento Valley pocket gopher (*Thomomys bottae navus* Merriam) in flood-irrigated alfalfa fields in Davis, California. In some cases, trap stations were closely spaced by necessity to achieve the 60 station quota for each plot. Although this means that not all trap stations were independent (e.g., more than one trap station per burrow system was common), it was not unusual to capture multiple individuals (mostly females and young) from the same, or closely spaced, trap stations. Furthermore, there may be considerable turnover in occupancy of established burrows as individuals are removed or disperse (Miller 1957).

Trapping can be very effective, but it is just one tool in the arsenal of pocket gopher control. Proulx (1997b) demonstrated the effectiveness of perimeter trapping to maintain low gopher densities in alfalfa fields in Alberta, but typically trapping is too labor intensive to practice on a large scale. Additionally, it must be repeated, at minimum, on an annual basis because of the high reproductive rate of surviving or reinvading individuals (Witmer et al. 1999). An integrated pest management program incorporating a combination of methods, including toxicants, repellents, physical barriers and cultural practices (e.g., habitat manipulation) is the best approach to controlling damage by pocket gophers in any setting (Marsh and Steele 1992; Black 1994).

## ACKNOWLEDGMENTS

We thank the Tulare County Agricultural Commissioner's office for extending use of their facilities and for helpful advice. This study was funded by the Vertebrate Pest Control Research Advisory Council through a grant to the California Department of Food and Agriculture.

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