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Tools And Technology

A New Live Trap For Pocket Gophers

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ABSTRACT Live-trapping is important for studying wildlife. In 2016 at Ordway-Swisher Biological Station in Melrose, Florida, USA, we tested the efficacy of a modified pitfall trap designed to safely and effectively capture southeastern pocket gophers (*Geomys pinetis*). When compared with the commonly used Hart trap, the new design captured 92% of all live captures of southeastern pocket gophers. The novel trap has a simple, passive design that eliminates dependence on trigger mechanisms, allows for safe overnight trapping, and reduces on-site hours by researchers. The new trap adds to the few live traps available to study ecologically important and understudied fossorial species. © 2019 The Wildlife Society.

KEY WORDS fossorial mammals, *Geomys pinetis*, live trap, southeastern pocket gopher.

Fossorial mammals are widely distributed around the world, occur in a variety of environments, and play important functional roles in ecosystems (Reichman and Seabloom 2002, Zhang et al. 2003, Begall et al. 2007, Davidson et al. 2012). However, studying fossorial mammals is challenging because of their cryptic, subterranean lifestyles (Hickman 1979, Begall et al. 2007). Many species rarely spend time above ground and often build elaborate burrow systems, which create difficulties for research that requires capturing and monitoring of individuals (Hickman 1979, Begall et al. 2007). We describe and test a new live trap designed for the safe live capture of fossorial species.

Like other fossorial mammals, pocket gophers can be challenging to live-trap because they excavate extensive burrow systems that are sealed with soil plugs and forage primarily below ground (Hickman 1977, Reichman et al. 1982, Andersen 1987, Cameron et al. 1988, Huntly and Inouye 1988). Several live traps have been designed for various pocket gopher genera (*Geomys, Pappogeomys,* and *Thomomys* spp. [Baker and Williams 1972]; *Thomomys* and *Geomys* spp. [Hart 1973]; *Geomys* spp. [Sherman 1941, Sargeant 1966, Connior and Risch 2009]); however, there are limitations of currently available trap designs. Many designs rely on trigger mechanisms that can malfunction or be erroneously tripped, or passive doors that can be propped open by soil being moved by the animal (Sherman 1941, Sargeant 1966, Baker and Williams 1972, Hart 1973, Connior and Risch 2009). Spring-loaded trap doors can also cause tail and limb breakage when they snap shut (Sargeant 1966, Baker and Williams 1972). Some studies have also reported deaths due to exposure, drowning, or shock (Sargeant 1966, Baker and Williams 1972). Therefore, our goal was to design an effective and safe live trap that does not depend on triggering mechanisms or doors for fossorial mammals. We tested the trap on a fossorial rodent native to the southeastern United States, the southeastern pocket gopher (*Geomys pinetis*).

STUDY AREA

We conducted the study at Ordway-Swisher Biological Station (OSBS), a facility of the University of Florida, Institute of Food and Agricultural Services in Melrose, Florida, USA. The OSBS was located in north-central Florida. The climate was humid subtropical and received approximately 122 cm of rain/year (National Oceanic and Atmospheric Administration 2016). The trapping site consisted of sandhill community with widely spaced longleaf (*Pinus palustris*) and shortleaf (*P. echinata*) pine, and a sparse wiregrass (*Aristida* spp.) –dominated understory with a

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diversity of herbs and shrubs (Florida Natural Areas Inventory 2010).

METHODS

Trap Design

The modified pitfall (hereafter, MP) trap has 2 main components: a body and an entrance tube. The body consists of a 7.6-L (2-gallon) bucket with a handle and lid (Letica Corporation, Valdosta, GA, USA; Fig. 1a,c). To reduce drowning risk, we drilled 16 (4.76-mm) drainage holes in the bucket: 4 in the bottom, 8 in the side 2 cm from the bottom, and 4 in the side 10 cm from the bottom (Fig. 1a,c).

To create the entrance tube, we fastened together 2 45°, 7.62-cm (3 in) polyvinyl chloride (PVC) street elbows (Charlotte Pipe, Wildwood, FL, USA; Fig. 1b,c). We cut a 10.2-cm (4-inch) −diameter hole into the center of the lid. We attached a 7.62-cm (3 in) PVC flange (Oatey, Cleveland, OH, USA) to the lid using 2 #10-32 × 1-in round-head standard machine screws and bolts (The Hillman Group, Jacksonville, FL, USA) so that the flange lined up with the hole in the lid (Fig. 1b,c) and inserted the entrance tube into the flange (Fig. 1b,c). Werner et al. (2005) showed that gophers avoided traps when excessive light was present, so we wrapped black waterproof Gorilla duct tape (Gorilla Glue Co., Cincinnati, OH, USA) around the entrance tube to block out sunlight (Fig. 1b,c). Gray sewage PVC may also work well for this purpose. We then fastened the body and entrance tube together by locking the lid onto the bucket (Fig. 1c). Total cost of trap materials was US$19.28.

Field Testing

Two experienced researchers conducted the live-trapping sessions for field-testing of the MP trap. We trapped pocket gophers by locating fresh mounds and digging until we accessed the main tunnel system. We dug a hole in front of and under the opened tunnel that allowed enough space to accommodate the total height of the trap (48.26 cm). We placed the entrance tube even with the floor of the tunnel opening (Fig. 2). If the tunnel was larger than the entrance tube diameter, we packed soil into the gaps. We covered the trap with soil to block out additional light and ensure the trap remained in place (Fig. 2). Additionally, covering the trap with soil insulated traps from heat during the day and low temperatures at night. We did not bait the traps because it is unnecessary and largely ineffective (Werner et al. 2005, Connior and Risch 2009).

We tested the MP trap against the Hart trap (Hart 1973) because we were in need of a lightweight trap that could be easily carried to remote field sites and did not want to risk injury to pocket gophers with the spring-loaded traps. We accessed the tunnel network the same way as described above when using the Hart traps and set traps in the main tunnel as recommended by Hart (1973).

We conducted 2 trapping sessions, 28 November–2 December and 7 December–12 December 2016, on a

Figure 1. Modified pitfall trap designed to trap live southeastern pocket gophers in 2016 at Ordway-Swisher Biological Station, Melrose, Florida, USA. Left panel: a) View of the body (7.6-L bucket) of the trap with drainage holes, b) view of the entrance tube (2 45°, 7.62-cm polyvinyl chloride [PVC] street elbows fit together) connected to the bucket lid with a 7.62-cm PVC flange. Right panel: c) fully assembled trap.

Figure 2. *In situ* view of our set modified pitfall trap, used to capture southeastern pocket gophers in 2016 at Ordway-Swisher Biological Station, Melrose, Florida, USA. The trap is placed below the exposed pocket gopher's tunnel with the entrance tube inserted into the opening of the tunnel.

population of pocket gophers at the OSBS. We randomly assigned a mound within a cluster to receive either a Hart trap or MP trap. We recorded date, trap type, total trap-hours, and captures during each session. We also recorded site-hours, which we defined as trap-hours during which researchers were present on site. Determining site-hours allowed us to measure direct trapping effort and account for the ability to leave MP traps set overnight, both of which we hypothesized as benefits of the MP trap design. Additionally, we determined daytime captures per site-hour because Hart traps were removed each night on account of safety concerns for the gophers (see below).

We set traps after sunrise on the first day of each session (0700) and left traps set until the end of each session (5 and 6 days, respectively). During each session, we checked traps for activity every 2 hr until sundown every day. If a gopher plugged a trap with soil, the trap was cleared and reset. We removed Hart traps just before sunset because pocket gophers caught with Hart traps in prior trapping sessions sustained injuries from getting their incisors and claws caught in the wire (observation by Moore and Duncan). We reset Hart traps each morning at sunrise. We deployed 97 traps—44 MP traps and 53 Hart traps. We trapped at 36 individual mound clusters, with each cluster representing a single animal (Ford 1980). The University of Florida, Institutional Animal Care and Use Committee review board #201509101 approved trapping and live capture protocols.

We report success in 4 ways: percentage of total successful captures, total captures per trap-hour, total captures per site-hour, and daytime captures per site-hour. To assess differences in capture success in metrics of trap-hour and site-hour for both total captures and daytime captures, we conducted 3 standard chi-square tests of independence with one degree of freedom. We defined expected capture rate as total captures multiplied by the percentage of each metric—total trap-hours and site-hours—accounted for by each trap type. We set $\alpha = 0.05$.

RESULTS

Traps were set for 1,715 total trap-hours—MP traps for 970.3 hr and Hart traps for 744.6 hr. We trapped 1,046.9 site-hours, of which the MP and Hart traps accounted for 302.3 and 744.6 hr, respectively. Modified pitfall traps accounted for 45% of traps set during the trap session, 57% of total trap-hours, and 29% of total site-hours.

More pocket gophers were captured in MP traps than in Hart traps, both in terms of trap-hours ($z = -3.06$, $P = 0.009$) and site-hours ($z = -5.86$, $P \leq 0.001$). We captured 13 pocket gophers over the 2 trapping sessions; 12 (92%) were captured in MP traps. Of the 12 gophers captured in the MP traps, 8 were captured overnight when researchers were off site. During the daytime hours when both traps were deployed simultaneously, MP traps captured more animals than Hart traps ($z = -2.42$, $P = 0.011$).

DISCUSSION

We designed the MP trap to increase trapping success, reduce researcher on-site hours, and decrease injuries associated with trapping fossorial mammals. We found the MP trap, when tested on the southeastern pocket gopher, significantly improved capture success relative to use of Hart traps; MP traps accounted for <50% of the traps set in the study but 92% of captures. The greatest improvement in capture success was associated with the site-hour comparison, with more captures despite less time spent on site by researchers and no incidence of injury or death. Warren et al. (2017) found that greatest activity of southeastern pocket gophers occurred between 0000–0400 and 1600–2000; therefore, one goal with the MP trap was to be able to leave traps overnight without need to check them every 2 hr and without increased risk to captured animals. The MP trap is less restrictive in size compared with the Hart trap and does not have metal hardware cloth that can entangle the animal's incisors and claws. The trap does not have spring-loaded mechanisms that can cause limb or tail breakage. Additionally, the animals are insulated from the external environment because MP traps are set in the ground and covered with soil.

Several live traps have been successfully developed for pocket gophers (e.g., Baker and Williams 1972, Hart 1973, Connior and Risch 2009); however, having a combination of trap types available to fit specific study-site conditions could be beneficial. For example, the lower efficacy of the Hart trap in our study may be in part due to the dry, sandy soils in which southeastern pocket gophers live. We observed that the Hart trap would often fill with the sand as it dried throughout the day; this caused the trigger loop to malfunction and prevented the door from closing, thus inhibiting captures. Additionally, because the MP trap required more effort by the gophers to plug, we observed that less soil was used to backfill the actual tunnels, which reduced labor and time spent resetting traps and required less digging to reopen the tunnel.

The time building both the MP and Hart traps was similar, 20–30 min/trap, with cost of trap materials being US$19.58/trap and US$2.26/trap, respectively. Even though the MP was more expensive to build than the Hart trap, we found that the simple, passive design required no maintenance, did not rust, and did not have problems associated with traps that have multiple moving components (e.g., trigger plate or door hinge) that increase likelihood of malfunction. The reduction in time and labor associated with checking traps in the field would likely offset the larger initial cost of the MP trap as well. The MP trap does require researchers to dig a larger hole than for Hart traps to accommodate the 48.26-cm (19-inch) height. Depending on the soil features at trapping sites (e.g., rocky or high clay content), this may be a difficulty when setting MP traps.

Although we focused our comparison on ability to capture southeastern pocket gophers, the MP trap could be a beneficial live trap for other fossorial mammals, particularly for species that build extensive burrow systems including various species of moles (*Condylura cristata* [Hickman 1983]; family Talpidae [Reichman and Smith 1990]) and mole rats (*Bathyergus suillus*, *Cryptomys hottentotus* [Davies and Jarvis 1986]; *Spalax ehrenbergi* [Heth 1989]; *Fukomys mechowii*, *Heliophobius argenteocinereus* [Šumbera et al. 2008, 2012]). In addition to safety features mentioned above for trapping pocket gophers, the MP trap can accommodate food and bedding, which can be added to the bucket if needed without decreasing trap functionality. The trap can also be completely buried and still function safely (e.g., overnight trapping in cattle fields), but can be modified for smaller or larger fossorial mammals by changing the size of the PVC elbows to match the tunnel size of the species in question. Thus, use of the MP trap provides an efficient, safe, and flexible option for live-trapping while reducing labor demands associated with maintaining and checking traps.

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