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From the Field

A Novel Method for Camera-Trapping Small Mammals

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ABSTRACT Camera traps have increased our knowledge of animal distribution, activity, and behavior, but they are rarely used for small mammal research. This is likely because there are few techniques to that allow for species identification, reduce disturbance of bait from non-target animals (e.g., raccoon [*Procyon lotor*]), and that can be used in all environments. In this paper we present a small mammal camera-trapping methodology, the Hunt trap, which was designed to 1) work in tidal environments, 2) eliminate capture myopathy, 3) allow for successful identification of small mammal species, and 4) allow for continued trapping after disturbance by non-target species. We tested the Hunt trap in the Lower Suwannee National Wildlife Refuge, Florida, USA, during February 2012 to February 2013. Live traps are still the best option when individuals must be physically captured for marking, radiotagging, demographic studies, or physiological assessments. However, if such data are not required, the Hunt trap design is an excellent technique to monitor species diversity, community composition, habitat selection, and distribution with efficiency and minimal effort. Published 2014. This article is a U.S. Government work and is in the public domain in the USA.

KEY WORDS camera trap, endangered species, floatation trap, Florida salt marsh vole, live trap, salt marsh.

Small mammals play an important role in most ecosystems as herbivores, seed consumers, and prey species. Additionally, they can be strong indicators of overall ecosystem health (Keesing 2000, Manson et al. 2001, Monadjem and Perrin 2003, Avenant and Cavallini 2007). There are several established methods for capturing small mammals, but live-trapping in box traps, such as Sherman (H.B. Sherman Traps, Tallahassee, FL) or Fitch traps (Rose 1994), is the most common. However, there are several constraints to using live box traps for small mammal research. They are designed so that only one animal can be trapped or detected per night. Additionally, the physical capture of an animal, short term or long term, can increase the probability of injury or death to individuals (Dien et al. 2005). Alternatively, pitfall traps can be used to catch small mammals (Williams and Braun 1983). These traps permit multiple captures of small mammals, but there is a high risk of injury or death (Karraker 2001). Snap traps can be an effective sampling method for small mammals but all captures are killed in the trap (Lane et al. 2010). Moreover, all of these methods may not be practical in some ecosystems, such as tidal systems, where traps can be washed away or become inundated before researchers can check them.

Given these limitations, there are a number of advantages to using passive methods to study small mammals and other wildlife species. Many passive methods do not have to be checked or monitored on a regular basis and can be left untended in harsh and remote environments. Another advantage of passive methods is that they can often detect animals with less effort than active methods while greatly reducing stress and harm to animals and researchers (Schmidt and Bruner 1981, Proulx and Barrett 1989). There is also an increased likelihood of detecting >1 individual in a trap/night with passive traps, because they do not close and exclude other individuals.

Passive methods for detecting small mammals, including the use of cameras (Osterberg 1962) and track pads (Drennan et al. 1998, Stanley and Royle 2005), are less common than live-trapping. The utility of track pads is limited because it can be difficult to distinguish between some species, environmental damage to pads (e.g., rainfall, dust), and non-target tracks (Glennon et al. 2002, DeSa et al. 2012). Alternatively, camera traps have enhanced our knowledge of animal distributions, activity patterns, and behaviors, particularly as statistical methods are developed to deal with this type of data (Karanth and Nichols 1998).

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Nonetheless, cameras are rarely used for small mammal research (De Bondi et al. 2010), likely because of the difficulty distinguishing among similar small mammal species (DeSa et al. 2012). Other constraints of camera-trapping for all wildlife include: disturbances of target animals from flash photography, constraints of using cameras in variable environments (hot, humid, freezing, etc.) and disturbance from non-target animals at baited traps. In this paper, we present a novel small mammal camera-trapping methodology, known as the Hunt trap, which is designed to 1) work in tidal environments, 2) eliminate capture myopathy, 3) allow for successful identification of small mammal species, and 4) allow for continued trapping after disturbance by non-target species. To evaluate our methodologies we deployed cameras to detect small mammals in salt marshes of coastal Florida, USA.

STUDY AREA

We camera-trapped small mammals using the Hunt trap in the Lower Suwannee National Wildlife Refuge, an area of >21,000 ha, protecting one of the largest undeveloped, river-delta estuarine systems in the United States. The refuge was located along the northwestern Gulf coast of Florida, spanning Dixie and Levy counties. The landscape was a typical Big Bend low-energy marsh ecosystem characterized by broad stretches of salt marsh dominated by black needlerush (*Juncus roemerianus*) and remnant stands of coastal forest and islands (Raabe and Gauron 1997). Slight variations in elevation, flooding, wave energy, and salinity determine presence and extent of smooth cordgrass (*Spartina alterniflora*), black needlerush, saltgrass (*Distichlis spicata*), and other high-marsh and salt-tolerant species (Montague and Weigert 1990). Small mammals found in this environment included Florida salt marsh voles (*Microtus pennsylvanicus dukecampbelli*), rice rats (*Oryzomys palustris*), and cotton rats (*Sigmodon hispidus*).

We were challenged by daily tidal fluctuations that could submerge or flip traps. The irregularity of Big Bend tides also presented logistical challenges in accessing remote field sites because the twice-daily high and low tides varied in extent and time of day, not always coinciding with an efficient live-trapping schedule. During hot (average daily high = 32°C) and rainy (monthly average for Jun, Jul, and Aug = 217 mm) summer months (Southeast Regional Climate Center 2011), there was an increased chance of mortality from overheating, while winter months would also be lethal when temperatures dropped below 10°C.

METHODS

Camera Traps

The overall design of the Hunt trap was an upside down bucket attached to a floating base, and anchored into the substrate with poles. The design allowed for free movement up and down with the ebb and flow of tides, but prevented toppling or being carried away. The camera was housed inside the bucket at the top, aiming downward at a food cup where animals are photographed.

Figure 1. Floating camera trap for small mammals, tested in Florida, USA, during February 2012 to February 2013. The 7-gallon (26.5-L) bucket sits on a base that floats when the tide is high and fiberglass poles keep the trap in place. Lid will be painted white for heat deflection.

The main body of the trap was an upside down 26.5-L bucket (7 gallon, 50 cm tall, from US Plastic Corp., Lima, OH) and fitted lid (Fig. 1). Two openings (7.6 × 8.9 cm) were cut into the lid and sides of the bucket. The bottom of the bucket was removed and replaced with a square piece of Plexiglas (30.5 × 30.5, 0.64-cm thickness). Two L-brackets (3.81 × 3.81 × 0.13 cm) were attached on the outside of the bucket and the Plexiglas lid was secured to the L-brackets with mounting bolts (0.64 × 3.8 cm cap screws) and 0.64 wing nuts (Fig. 2). Two 0.64-cm hex nuts held the mounting

Figure 2. Top view of camera trap showing attachment of camera and lid to body of trap. Note L-brackets on left and right side of photo. Lid is painted white after completion of trap to reflect sunlight and to keep trap and camera cool. Trap was tested in Florida, USA, during February 2012 to February 2013.

bolts onto the L brackets and acted as spacers to allow for air circulation. This design created a removable lid with easy access to the camera that was attached to the Plexiglass lid with a 0.64-cm mounting screw and wing nut.

The floatation base of the trap was made by placing a piece of plywood (40.6 × 40.6 cm, 0.95-cm thickness), and similar sized (5 cm thick) Styrofoam together, wrapped in waterproof Gorilla (Gorilla Glue Co., Cincinnati, OH) duct tape. Short pieces of 1.3-cm polyvinyl chloride pieces were glued into 2 holes drilled into the floatation platform at opposite ends, providing an insert for anchors. Two 2-m-long fiberglass rods were pressed into the peat soil through the polyvinyl chloride-lined holes in the platform and 2 1.3-cm holes in the plastic top, allowing the trap to rise and fall with the tide, but stay upright and in place (Fig. 1). We glued a small plastic container for bait opposite the entryways and a ruler on the floor for scale and measuring distinguishing body characteristics such as hind foot or tail length (Fig. 3).

To avoid camera batteries from overheating and losing charge in direct sun, we painted the plastic lid white. The white lid reflects sunlight and, in combination with the spacers, cools the inside of the trap, which maintains functionality of the camera. We used a Reconyx Professional Series PC900 Hyperfire camera (Reconyx, Inc., Holmen, WI) with an adjusted focal distance (40 cm) because of its lack of red glow and flash, and the infrared night vision camera. The manufacturer set a custom focal distance of 40 cm prior to shipping. We programmed the camera to take 3 consecutive pictures (5 s apart when motion was detected), with 1 min between sets of 3 photos.

Study Design

We laid out 8 grids with 24 camera traps, 20 m spacing in a 6 × 4 configuration (0.75 ha), on salt marsh islands within Lower Suwannee National Wildlife Refuge from February 2012 to February 2013. Each grid was trapped for 7 nights. We baited traps once on the first day with a mix of black oil sunflower seed and chicken scratch. After the survey we collected cameras, looked for rodents in the traps (capture myopathy), and reviewed the photographs, and recorded the number of species detected. Species were identified by distinguishing characteristics (tail length, pelage color, ear size, and hind foot size).

RESULTS

The camera-trap design performed well in the tidal environment with no displacement or flooding of traps

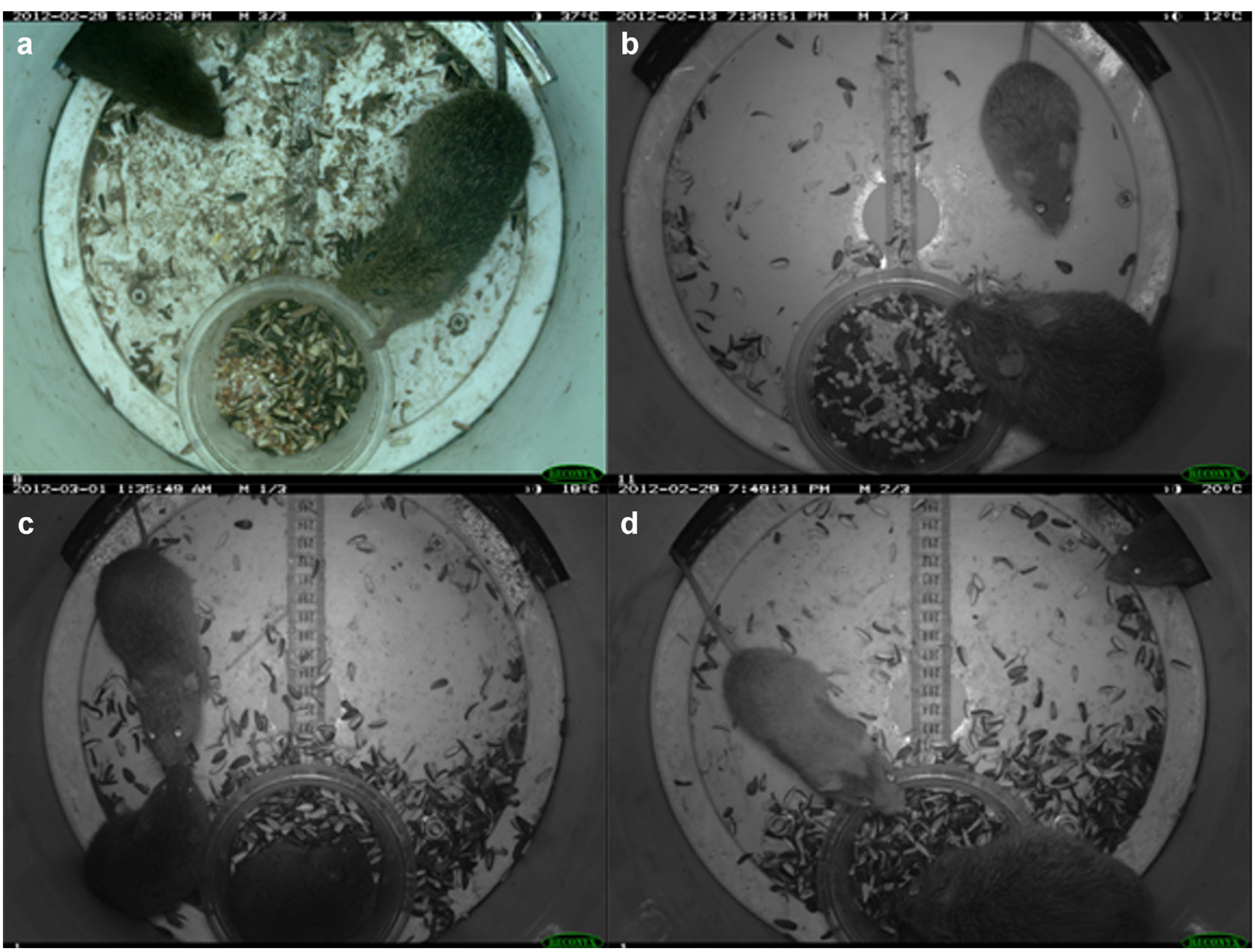

Figure 3. Species captured in camera trap to demonstrate ease of identification. Species include (clockwise from top left; a) *Microtus pennsylvanicus dukecampbelli* and *Sigmodon hispidus*, b) *Oryzomys palustris* and *S. hispidus*, c) *M. pennsylvanicus dukecampbelli* and *O. palustris*, and d) *O. palustris*, *M. pennsylvanicus dukecampbelli*, and *S. hispidus*. Trap was tested in Florida, USA, during February 2012 to February 2013.

and no camera malfunctions. From 1,344 total trap-nights, we identified captures to species: Florida salt marsh voles, rice rats, or cotton rats (Fig. 3). We were able to identify >95% of small mammals in the photos to species. No injuries or myopathies were noted in photographs or during inspection of the traps. As an indication that the traps may have limited stress, we recorded an individual resting for >50 min in the trap. We detected 2 non-target species raccoon (*Procyon lotor*) and gulf salt marsh mink (*Neovison vison halilimnetes*; Fig. 4). Mink entered the traps but raccoons did not (only arms and nose). Nonetheless, we always recorded small mammals on camera surveys after the non-target species were detected. The average number of photos per trap was 595.2, with a maximum of 6,441 and a minimum of 3. There was a maximum of 3 species/trap/trapping session, and minimum of 0 species/trap/trapping session. There was evidence of multiple individuals (up to 3) visiting traps at the same time (Fig. 3). Time stamps showed that small mammal activity occurred between 1800 hours and 0900 hours.

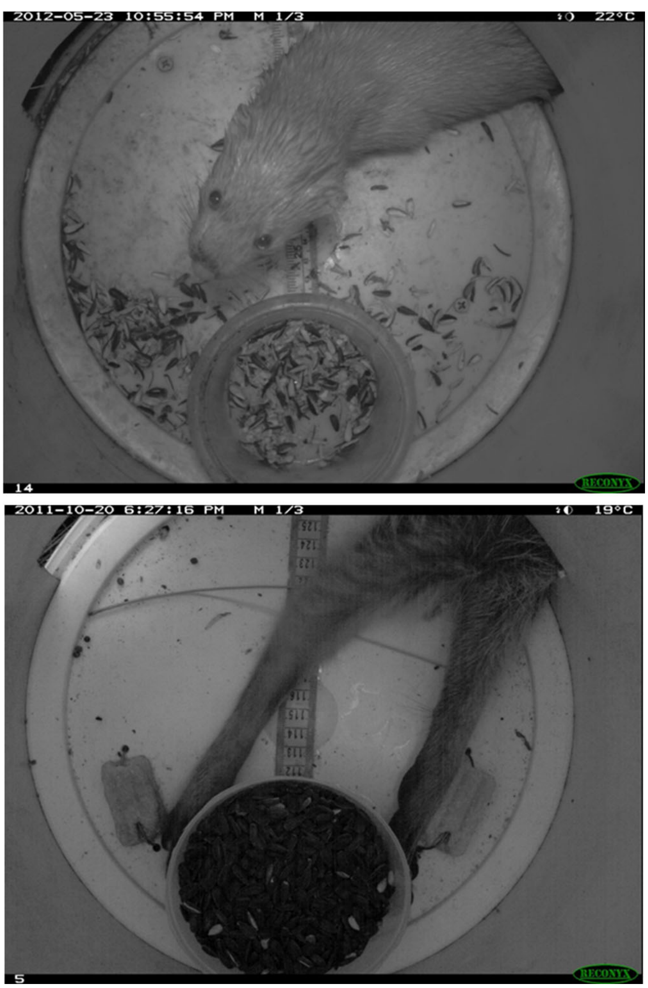

Figure 4. Non-target species captured in camera trap tested in Florida, USA, during February 2012 to February 2013. *Neovison vison halilimnetes* (top) and *Procyon lotor* (bottom).

DISCUSSION

Camera traps are an established method for monitoring populations of medium- to large-sized mammals (Cutler and Don 1999, Garden et al. 2007, Trolle et al. 2008, De Bondi et al. 2010), but are rarely used for smaller mammals. In this paper, we demonstrate how the novel Hunt traps work well in a harsh tidal environment that previously constrained research on small mammals. The Hunt trap's open design appeared to eliminate capture myopathy and permitted small mammals to move in and out of trap, and allowed small mammals to avoid the stress of capture and handling. This reduction in the risk to animals may be particularly advantageous for research on endangered species. As such, our design may be useful in a wider variety of weather and environmental conditions, when live traps pose a risk to animal welfare (Sikes et al. 2011). The traps were particularly useful when field sites could not be accessed at the standard early morning hours because of tidal conditions.

By taking pictures from a set distance, using a custom focal distance (30–50 cm), and capturing animals on a uniform surface next to a ruler, the Hunt trap provided a standard method to compare individuals and allowed for species identification of captures. We found we could easily differentiate defining characteristics such as tail length, size, and fur color and/or texture against the white background. Another advantage of our design was that the camera in our trap had no flash or red light to startle animals, but could still obtain night-time photos. Additionally, the bucket design successfully prevented damage and/or disturbance and loss of bait by nuisance animals, such as raccoons and feral pigs (*Sus scrofa*).

The Hunt trap could easily be used to monitor small mammal diversity, community composition, activity patterns, habitat selection, and distributions in a variety of conditions and environments. The trap might be particularly useful for surveying for rare species when a wider search is preferred over repeated visits to a few locations (Thompson 2004). One advantage of the Hunt trap is that it allows for multiple detections throughout the night. On numerous occasions, cameras were visited by multiple species in 1 day, including the endangered Florida salt marsh vole. Live traps, on the other hand, remove the possibility of multiple detections per night if an animal was captured or the trap was falsely triggered. Additionally, we found no need to clean our traps between captures as recommended for box traps (Heske 1987). Voles in particular were believed to avoid traps that captured cotton rats (Terman 1974). However, a vole was detected in one of our traps at the same time as a cotton and rice rat (Fig. 3) and also after a cotton rat was detected in the trap earlier that day.

There are important constraints to note for the Hunt trap. One potential shortcoming of the bucket trap design is that we presume the cameras took several photos of the same individual throughout its deployment. When presence–absence data are all that is required, only one species occurrence per night is needed, but often tens or even thousands of photos of the same species are captured in one night. More personnel hours are needed in front of a computer to analyze photos for camera surveys, as compared with live-trap surveys. Furthermore, Hunt traps also cannot be used for traditional population estimation analyses that require marked individuals because the animals "trapped" cannot be handled and tagged. Live-trapping would also be a more viable option when attaching radiotags or conducting physiological assessments. However, we believe this is an important contribution to small mammal trapping and is valuable for increasing our knowledge of animal distribution, activity, and behavior.

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