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Research Article

Trap Style Influences Wild Pig Behavior and Trapping Success

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ABSTRACT Despite the efforts of many natural resource professionals, wild pig (*Sus scrofa*) populations are expanding in many areas of the world. Although many creative techniques for controlling pig populations are being explored, trapping has been and still is the most commonly used method of population control for many public and private land managers. We conducted an observational study to examine the efficiency of 2 frequently used trap styles: a small, portable box-style trap and a larger, semi-permanent, corral-style trap. We used game cameras to examine patterns of trap entry by wild pigs around each style of trap, and we conducted a trapping session to compare trapping success between trap styles. Adult female and juvenile wild pigs entered both styles of trap more readily than did adult males, and adult males seemed particularly averse to entering box traps. Less than 10% of adult male visits to box traps resulted in entries, easily the least percentage of any class at any style of trap. Adult females entered corral traps approximately 2.2 times more often per visit than box traps and re-entered corral traps >2 times more frequently. Juveniles entered and re-entered both box and corral traps at similar rates. Overall (all-class) entry-per-visit rates at corral traps (0.71) were nearly double that of box traps (0.37). Subsequent trapping data supported these preliminary entry data; the capture rate for corral traps was >4 times that of box traps. Our data suggest that corral traps are temporally and economically superior to box traps with respect to efficiency; that is, corral traps effectively trap more pigs per trap night at a lower cost per pig than do box traps.

KEY WORDS box traps, corral traps, Fort Benning, *Sus scrofa*, trapping efficiency, wild pigs.

Trapping, in some form or another, is one of the most commonly used control measures for many invasive animal species, including wild pigs (*Sus scrofa*; Choquenot et al. 1993, 1996; Sweitzer et al. 1997). However, as wild pigs are a large, rapidly reproducing species (Wood and Barrett 1979, Ditchkoff and West 2007), the economic and temporal investment associated with trapping wild pigs can be extraordinary. Furthermore, many of these efforts do not approach the scale necessary to have a significant, long-term effect on reducing wild pig populations across a large tract of land. Although current trapping strategies may not be as effective at reducing long-term wild pig populations as managers might wish (Dzieciolowski et al. 1992; Engeman et al. 2001, 2003), the purchase or construction and subsequent monitoring of traps still presents a more cost-effective alternative than other proposed control techniques (Choquenot et al. 1993, Bomford and O'Brien 1995). Although a combination of control techniques will probably provide the ultimate resolution, it seems likely that trapping will be included in future wild pig research and control efforts. Therefore, the need for increased effectiveness and efficiency of trapping is apparent.

Two general styles of trap have long been popular for capturing wild pigs: a small and portable trap, often called a box trap, and a larger, semi-permanent trap, often called a corral trap (Wood et al. 1992). Box-style traps may be moved quickly to new areas, but their size substantially limits the number of individual pigs that can be captured at any 1 time. Corral-style traps, alternatively, although more time consuming to construct, may be more effective at targeting groups of pigs, which may actually decrease the amount of time and per-pig cost necessary to remove most pigs from an area. We attempted to objectively compare these 2 trap styles and determine which, if either, was more economically and temporally efficient. We predicted that corral traps would trap more pigs per trap night and per dollar than would box traps.

In furtherance of increasing trap efficiency, it also seems logical to understand whether trap style influences the number, size, and sex of individuals captured. Management efforts aimed at removing individuals will likely attempt to maximize the total number of individuals trapped, and, therefore, we also examined how 2 styles of traps affected behavior of wild pigs when presented with a trap. Years of observations on behavior of pigs around traps led us to suspect that wild pigs may avoid entering smaller, box-style traps for a period of days, if pigs enter at all. Elements including a roof often only slightly higher than the shoulders of an adult pig, a door often only slightly wider than the width of an adult pig, and a wire mesh floor may all contribute to a decrease in the potential effectiveness of trapping efforts using box-style traps (Diong 1980). To investigate these concepts, we examined whether

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wild pigs enter larger, corral-style traps more frequently than smaller, box-style traps. Previous research and observation also suggested that juvenile and adult female wild pigs are quicker to enter a trap than adult males (Choquenot et al. 1993, Kaminski et al. 2005). Therefore, we also examined whether juvenile or adult female wild pigs enter traps more readily than adult male wild pigs.

STUDY AREA

We conducted our research on the approximately 737 km^2 Fort Benning military installation, located along the Chattahoochee River just outside of Columbus, Georgia, and an adjoining few square kilometers across the river in Alabama (32°21′N, 84°58′W). Terrain at Fort Benning consisted mainly of low, sandy hills, many of which were planted stands of longleaf pine (*Pinus palustris*), separated by stretches of hardwood bottomland. King et al. (1998), Dilustro et al. (2002), and Hanson et al. (2009) offer more detailed descriptions of habitat characteristics at Fort Benning. We utilized 2 separate study areas, 1 approximately 100 km^2 and the other approximately 35 km^2, designated for wild pig research by the Fort Benning Natural Resources Branch (Hanson et al. 2008, Sparklin et al. 2009, Jolley et al. 2010). Wild pigs were at an approximate density of 1.2 pigs/km^2 on Fort Benning immediately prior to our study (R.W. Holtfreter, Auburn University, unpublished data), a density comparable to previous estimates of the population of wild pigs on Fort Benning (Hanson et al. 2008).

METHODS

Corral-style traps consisted of an angle-iron- or wood-framed door section connected on both sides to an angle-iron-framed 1.5 m × 2.4 m panel filled with heavy-gauge wire-mesh. We connected each panel in turn to a 1.5 m × 4.9 m section of portable utility panel fencing. We secured the 2 utility panels together to form the rear apex of the trap. Door-frame sections measured approximately 0.9 m × 1.8 m, with the vertically hinged door occupying the bottom half of the frame. We wired sections of panel together and supported them with *t*-posts at any potential weak spots. We either staked sections of fence left off the ground or filled the empty space with debris. We set traps by leading a rope tied to the bottom of the lifted door over the top of the frame, over the top of the trap, down the outside to the bottom of the rear section of fence, and across a back corner to a trigger mechanism. Triggers consisted of a twig balanced in an opening of fence panel. We used monofilament fishing line for the last approximately 1 m of rope (the section most likely to be encountered by pigs) to decrease trigger detection.

Box-style traps consisted of 2.4 m × 1.2 m × 0.9 m (length × width × height) angle-iron frames filled on all sides with hog fencing. The door mechanism occupied one-half of 1 of the 1.2 m × 0.9 m sections of the box. The door and trigger mechanism were similar to the corral-style trap, except that both were oriented horizontally on the box traps instead of vertically as on the corral traps. Although different door styles can influence trapping success and pig behavior, we assumed that these effects were negligible, as door sizes were approximately the same for both trap types.

We evaluated behavior patterns of wild pigs related to entry of box- and corral-style traps by randomly selecting 24 sites from a larger pool of previously located sites exhibiting pig sign (e.g., wallows, scat, tree rubs). We randomly assigned either a corral-style trap or a box-style trap to each of the 24 sites. As traps became available from other research underway at Fort Benning, we moved each to a site assigned to that trap style (1 trap per site). We prebaited a selection of sites within each group for ≥1 week prior to trap placement so that we could move traps to sites with recent pig activity. Upon placement of a trap, we situated 2 cameras, at a height of 1.8 m and a 15° downward angle, facing the front and rear of each trap. For box traps, we placed the rear camera approximately 2.7 m from the rear of the trap and the front camera diagonally approximately 7.3 m from the door-side corner of the trap. For corral traps, we placed the rear camera approximately 0.9 m from the rear panel of the trap and the front camera approximately 7.3 m from the door. Considering the longer front-to-back distance involved due to the greater size of corral traps, we placed an additional camera at 1 corner of the door, facing into the trap, to ensure photographic capture of any pig inside the trap. We set all heights and distances of cameras (RECONYX Silent Image™ game cameras, Model PM35M13; Reconyx LLP, Holmen, WI) to maximize viewing area and resolution. Upon initial trap and camera placement, we baited each trap with an even layer of approximately 11.3 kg of dry, whole-kernel corn spread equally inside and outside the trap. We left cameras on site set at 3-min time-lapse intervals for 7 days. Using the same interval for the same length of time, Holtfreter et al. (2008) found pig detection probabilities >0.8; we assumed, with ≥2 cameras at each site, that few pigs visited a site and escaped observation on >1 camera. We made observations between 21 July and 25 September 2008.

For comparing efficiency of each trap style, we deployed 24 traps, 12 of each style, and monitored them, as our schedules allowed, from 29 February 2008 to 29 April 2008. We assigned 6 box traps and 6 corral traps to each of the 2 study areas and randomly assigned all 24 traps to sites previously identified as containing pig sign. Once we chose trap sites and placed traps (1 trap/site), we prebaited traps with dry whole-kernel corn for approximately 1 week until active trapping began. We set the trigger mechanisms on all traps during prebaiting but tied all doors open so that pigs would acclimate to the sensation of tripping the trigger without the door actually closing. Once active trapping began, we ear-tagged and released all captured pigs; we recorded and released recaptures.

We examined all photographic data, identified each pig at each site, and noted any entries each pig made into a trap. We classified all individuals by presumed age (juv vs. ad) based on size, and by sex, among adults. We made age or maturity distinctions based on individual body size and group characteristics (e.g., we considered small pigs in groups with larger adult females to be juvenile; we considered solitary or bachelor groups of male pigs to be adult; we always considered pigs visually estimated at weights <22.7 kg to be juvenile, regardless of group characteristics). We compared the number of entries by each class of pig using contingency tables to determine whether the ratios of entries-to-visits were the same between box and corral traps. Because a pig could potentially enter, exit, and re-enter a trap numerous times during 1 visit, we also calculated rates of entries per visit for each class of pig. Additionally, because repeated re-entries by 1 pig during 1 visit could have potentially inflated overall entry numbers, we also calculated a rate of entries per individual for each class of pig.

To compare the temporal and economic trapping efficiency of box-style versus corral-style traps, we recorded all time spent transporting, constructing, setting, baiting, maintaining, and traveling to trap sites and documented all costs associated with the purchase, setup, baiting, and maintenance of all traps. Because the trap styles were mixed within the study areas and we therefore visited them in no particular order, we halved the costs associated with total time, mileage, and bait used preparing to trap and trapping; we then used 1 of the resulting halves of these costs for the calculation of the per-pig cost for each style of trap. We calculated the total cost of trapping associated with each style of trap and divided it by the total number of individual pigs trapped in each style of trap. All of our procedures were approved by the Institutional Animal Care and Use Committee at Auburn University (PRN 2007-1196).

RESULTS

Our cameras collected 213,761 pictures at 24 traps. Wild pigs visited 10 traps of each style at least once. One corral trap malfunctioned during the observation period so we did not include it in any visit or entry totals. Pigs entered 6 of the 10 visited box traps (6 of 12 total) and 8 of the 10 visited corral traps (8 of 11 total). Although more visits occurred at box traps (141 vs. 109 in corral traps), more entries occurred in corral traps (77 vs. 52 in box traps), yielding an overall entry-per-visit ratio in corral traps (0.71) nearly double that of box traps (0.37). We observed no differences in trap entry-per-visit ratios between traps styles among either adult females (box = 0.50; corral = 1.20; $\chi^2 = 0.17$; $P = 0.68$; Table 1) or juveniles (box = 0.40; corral = 0.60; $\chi^2 = 2.32$; $P = 0.13$); however, adult males entered box traps less often

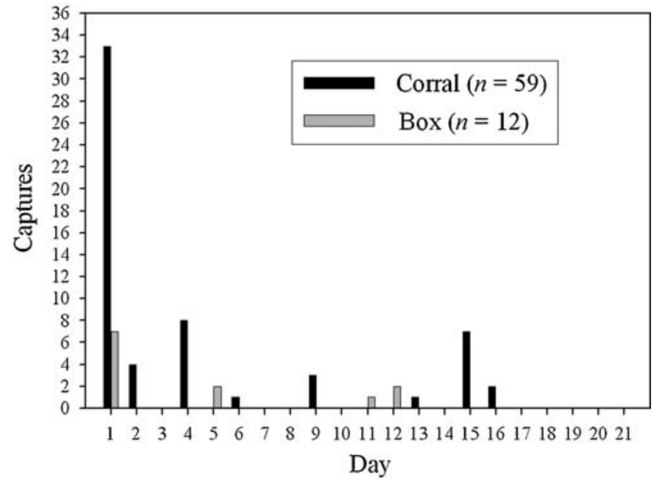

Figure 1. Unique wild pig captures, by trap day and style, on Fort Benning, Georgia, between 29 February and 29 April 2008.

than corral traps (box = 0.10; corral = 0.57; $\chi^2 = 6.08$, $P = 0.01$). Although values were slightly greater for corral traps, overall, adult males entered both styles of trap less frequently per visit and were less apt to re-enter either style than were adult females or juveniles. Juveniles entered both styles of trap at similar per-visit rates, and were also similarly likely to re-enter either style of trap. Adult females, however, were 2.2 times more likely to enter a corral trap than a box trap during a visit and >2 times more likely to re-enter a corral trap than a box trap.

We trapped for 21 nights, producing 504 trap-nights, 252 for each style of trap. We trapped 71 individual pigs, 59 in corral traps, and 12 in box traps (Fig. 1). Capture rates were 0.23 new pigs per trap-night and 0.05 new pigs per trap-night for corral and box traps, respectively. We made 39 recaptures in corral traps and only 8 in box traps. Once we accounted for all approximate costs (Table 2), pigs trapped in box traps cost approximately 5.5 times as much per pig as did pigs trapped in corral traps (Table 3).

DISCUSSION

Our data suggest that larger traps consistently trapped more pigs in a shorter amount of time than did smaller traps.

Table 1. Comparison of wild pig trap entry frequency at box traps and corral traps at Fort Benning, Georgia, 21 July–25 September 2008.

	Box traps					Corral traps						
Class	Total visits[a]	Total entries[b]	Visits with entry[c]	Entries per visit	Entries per entry[d]	Visits	Entries	Visits with entry	Entries per visit	Entries per entry	χ^{2e}	*P*-value
Ad M	31	3	3	0.10	1.00	37	21	13	0.57	1.60	6.08	0.014
Ad F	44	22	12	0.50	1.80	25	30	8	1.20	3.80	0.17	0.677
Juv	66	27	14	0.40	1.90	47	26	16	0.60	1.60	2.32	0.128

[a] Individual pigs we observed each night summed across 7 nights.
[b] Total no. of unique times we observed a pig completely within the entrance of a trap (including re-entries during a visit).
[c] No. of visits that resulted in ≥1 entry (total excluding re-entries).
[d] Entries/visits with entry (likelihood of re-entry, 1.00 = no re-entries).
[e] Comparison of number of entries/visit between trap styles. Statistic assumes entry observations were equal for both styles of trap; we calculated expected values as (Ad M box entries used for example): [(box visits with entries + corral visits with entries)/total combined entries] × total box visits.

Table 2. Approximate costs of all non-trap-related investments associated with wild pig trapping at Fort Benning, Georgia, 29 February–29 April 2008.

Description of cost	Approximate amount
Labor	
Man hours	462.00
Rate per hour	$10.00
Total cost	$4,620.00
Travel	
Commute miles	2,520.00
On-site miles	1,328.00
Total mileage	3,848.00
Rate per mile	$0.55
Total cost	$2,116.40
Bait	
Corn used (kg)	680.40
Rate per palette (453.6 kg)	$650.00
Total cost	$975.00
Total non-trap-related costs	$7,711.40

Photographic data suggest adult pigs entered corral traps more readily than box traps and made repeat entries into corral traps more frequently than into box traps. Subsequent data collected from active traps (R.W. Holtfreter, unpublished data) further support this concept, as the capture rate for corral traps was >4 times that of box traps. Our data, especially the photographic data, suggest that absence of a floor in corral traps (Diong 1980) in addition to a much larger opening for a doorway both played a role in the increased effectiveness of the corral traps, but further experimentation is necessary to confirm these concepts.

Photographic evidence of open traps and data collected from live traps suggest that large adult male wild pigs did not enter traps as readily as did either juveniles or adult females. Previous studies reported high rates of juvenile capture (>50% of animals captured; e.g., McCann and Garcelon 2008, Hanson et al. 2009), but high juvenile capture rates may be due in large part to the proportion of juveniles in the population. However, we captured adult male wild pigs at Fort Benning less often than other demographic groups, based on abundance (Holtfreter et al. 2008). Our findings support those of, for example, Choquenot et al. (1993), who reported that a roughly equal sex ratio prior to trapping was skewed heavily in favor of males subsequent to trapping. However, whether this lower capture rate for males arises solely from the larger average size of adult males in comparison to a trap or trap door, from a greater degree of wariness (Diong 1980) gathered over a lifetime spent in a hazardous area frequented by hog hunters, or from a combination of these and other factors remains unknown. If total eradication is the target of a landowner or manager, additional removal techniques may be needed to eliminate any large adult boars remaining in an area following intense trapping; however, presence of a few remnant adult boars in an area should not affect the rebound potential of a population nearly as much as if juvenile or adult females were allowed to remain (Dzieciolowski et al. 1992, Hanson et al. 2009).

The overall economic viability and efficiency of any removal strategy is largely dependent upon the environmental and legal factors affecting a given area. Aerial culling via helicopter has proven effective in open, flat lands not easily accessible by other methods (Saunders 1993, Mitchell and Kanowski 2003); hunting dogs have shown promise at targeting individual pigs (Caley and Ottley 1995, McCann and Garcelon 2008); use of species-specific baits to deliver toxicants has shown promise in environments where such species specificity exists and where such baits are legal (Choquenot et al. 1996, Cowled et al. 2006); and, in areas where other removal techniques may prove impractical or even illegal, intense trapping can reduce pig populations, at least in the short term (Wood et al. 1992, Mitchell and Kanowski 2003, McCann and Garcelon 2008). Because no toxicants have been approved for use on wild pigs in the United States, and because much of the range of wild pigs is forested (thereby limiting chances of spotting, tracking, and shooting wild pigs from the air), trapping, in its most efficient form, remains one of the most economically logical choices to capture as many pigs as quickly as possible. Although such trapping is labor intensive, the purchase of prebuilt traps or trap-building materials represents a potentially sizeable initial investment, and the bait necessary to keep traps active over a large area may represent a substantial cost, our data suggest that the long-term benefits, in terms of cost-per-pig, accrued by targeting multiple pigs with corral traps placed in areas known to contain ≥1 sounder are likely to justify these investments. It should also be noted that our per-pig costs were inflated by the inclusion of non-recurring costs such as the initial purchase price of all traps and trap constructing materials, salaries explicitly designated for wild pig removal, and travel costs associated with daily trips from Auburn to Fort Benning. Many landowners or managers may not encounter some of these costs, and without these additional variables traps would cost $142.12/pig for box traps and $28.91/pig for corral traps. These figures are similar to others previously reported (Wood et al. 1992, McCann and Garcelon 2008), but we highlight the difference between the 2 styles of traps, and thereby the relative efficiency of each compared to the other, rather than any specific values.

Table 3. Approximate per-pig costs associated with wild pig trapping at Fort Benning, 29 February–29 April 2008.

Trap style	Trap nights[a]	New captures[b]	Trap costs	Half additional costs[c]	Total approximate costs	Cost per pig
Box	252	12	$4,200.00	$3,855.70	$8,055.70	$671.31
Corral	252	59	$3,300.00	$3,855.70	$7,155.70	$121.28

[a] 21 nights of trapping × 12 traps of each style.
[b] Unique individuals only; excludes recaptures.
[c] Total non-trap-related costs ($7,711.40; includes labor, travel, and bait expenses)/2; assumes approx. equal labor and travel expenditures for each style of trap, as we placed, constructed, and visited traps arbitrarily each day of preparation and trapping.

MANAGEMENT IMPLICATIONS

Our data suggest that trap area (i.e., trap openness) is an important factor in trap design influencing rapid success in trapping wild pigs. Although on-site construction of corral-style traps may represent a greater investment of time and effort in the preliminary stages of trapping, we hold that the long-term benefits (i.e., increases in temporal and economic trapping efficiency using large, open traps) far outweigh the relative portability offered by smaller box-style traps. Although wild pigs may be captured in either style of trap, our data suggest that in an application with 1 trap per site, corral traps are more efficient than box traps in terms of time, money, and effort spent trapping.

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