Effects of Trap Door Width on Wild Pig Entrance into Corral Traps

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Abstract: Wild pigs (*Sus scrofa*) are arguably one of the greatest wildlife management challenges facing natural resource professionals and landowners in the U.S., and lethal removal by trapping is often the most cost- and time-effective means for managing populations. Whereas numerous studies have examined the effects of trap type, trap activation designs, and baits on trapping effectiveness, no studies utilizing a conditioning period and accounting for unique individuals/sounders and wild pig social structure have examined the effects of trap door width on wild pig entrance into corral-style traps. Modifying trap door width may impact wild pig entrance rates into corral-style traps with wider doors better facilitating entrance. Our objective was to examine wild pig entry times into standard three-panel corral traps with wooden guillotine trap doors of either 0.8-m or 1.2-m widths. We placed these doors on 12 traps at a study site in east-central Alabama from June–September 2014 and 2015. We positioned a motion-sensitive game camera on each trap to record wild pig visitation behavior and then began baiting each trap. We recorded the time when wild pigs initially visited the trap site, time until the first wild pig entered the trap, and the time until 50% and 100% of the sounder had entered the trap. We used camera imagery data collected from 27 solitary individuals and 47 sounders to evaluate the effect of door width on the length of time that wild pigs took to enter traps. First entry time for sounders did not differ between 0.8-m and 1.2-m widths, nor did time until entry by 50% and 100% of sounders. However, first entry time was similar among solitary individuals. Our results suggest trap door width may not have as large of an impact on entrance rates into traps as previously thought.

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Wild pigs (*Sus scrofa*) are a non-native invasive species that are expanding in range and subsequent damage across North America. They are arguably one of the greatest wildlife management challenges facing natural resource managers today (Mayer and Brisbin 2009, VerCauteren et al. 2020). As wild pig populations continue to expand, so do the tools, techniques, and strategies used to reduce their populations. Because wild pigs are highly social and often travel in familial groups termed sounders, live trapping with baited corral-style traps followed by euthanasia is one of the most frequently used methods for managing wild pig populations (Choquenot 1993, Mayer and Johns 2009, Massei et al. 2011, Bodenchuk 2014, Higginbotham 2014). This technique is relatively inexpensive and can capture numerous wild pigs at each trapping event with less effort than other commonly used techniques such as shooting, recreational hunting, hunting with the aid of dogs, and shooting over bait (Ditchkoff and Bodenchuk 2020).

The development of science-based best management practices for trapping wild pigs is a critical step towards advancing cost- and time-effective removal strategies. Several studies have examined issues related to baits and scents (Campbell and Long 2007, 2009), trap activation design (Sweitzer et al. 1997, Williams et al. 2011b), and door type (e.g., saloon, rooting, and trainer; Smith et al. 2014). For example, when examining the addition of scent attractants to reduce the mean initial arrival time at baited camera sites, Sandoval et al. (2019) found that initial sounder visitation was faster when using a wild pig urine scent attractant, whereas Choquenot (1993) observed that a female wild pig in estrous was ineffective in attracting adult males to traps. Of 11 candidate attractants, Campbell and Long (2008) found that wild pigs had greatest visitation to apple and strawberry liquid feed additives placed in the field than control capsules in Texas. While there is a wide range of baits used to attract wild pigs into traps, Foster et al. (2023) demonstrated that whole-kernel corn (*Zea mays*) is highly preferred and effective. In addition to studies on bait preferences for toxicant delivery (Campbell et al. 2006, Campbell and Long 2009, Snow et al. 2016), Williams et al. (2011a) observed that wild pigs spent longer periods feeding at sites baited with dry whole-kernel corn compared to soured corn or a combination of soured and dry corn. Furthermore, Foster et al. (2023) found that corn was more preferred over other test baits, including soybeans (*Glycine max*), split peas

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(*Pisum sativum*), mealworms (*Tenebrio molitor*), peanuts (*Arachis hypogaea*), oats (*Avena sativa*), and acorns (*Quercus fusiformis*), with the exception of earthworms (*Dendrobaena veneta*). Several studies have examined the relative efficacies of trap and door activation designs. For instance, Williams et al. (2011b) found that corral traps had nearly four times greater capture rates than box traps, while Long and Campbell (2012) reported that box traps with rooter doors (gravity activated) captured more juvenile wild pigs than box traps with side-swing doors (spring-tension activated), suggesting that the latter were more difficult for younger wild pigs to activate. However, Gaskamp et al. (2021) reported greater removal rates (as a percentage of the population) using drop nets (85.7%) and suspended traps (88.1%) relative to corral traps (48.5%). When examining different door configurations (e.g., saloon, rooter) on corral traps, Smith et al. (2014) reported that only 5% of wild pigs pushed through continuous-catch doors after the trap door had initially closed.

Because conditioning wild pigs to enter a trap is a critical aspect of the trapping process, there still exists conflicting viewpoints regarding the appropriate trap door width to best facilitate wild pig trapping. Some professional trappers suggest wider doors (e.g., >1.2 m wide) enhance overall trapping effectiveness by reducing the time required to condition wild pigs to enter a trap, presumably because they believe wild pigs do not perceive the wider entrance as a potential risk. Conversely, others contend that door width is less important and that widths as narrow as 0.9 m are sufficient. Metcalf et al. (2014) evaluated a variety of door widths (i.e., 0.9 m, 1.2 m, 1.5 m, and 1.8 m) in Texas and found no differences in wild pig entrance. However, excluding the trap conditioning period from their data, not accounting for the population's social structure, and not distinguishing between unique sounders and solitary individuals made their conclusions less robust. Our objective was to uniquely identify wild pigs and determine if entry times into corral-style traps differ between 0.8-m and 1.2-m trap doors during trap conditioning and active periods.

Study Area

Our study was conducted on contiguous private lands owned by three landowners in Macon County, Alabama. The study area was 1716 ha and consisted predominantly of loblolly pine (*Pinus taeda*) plantations and bottomland hardwood forests of various oaks (*Quercus* spp.) and bald cypress (*Taxodium distichum*). Bughall Creek, a perennial stream, bordered the study area to the west. Elevation ranged 76.2–91.4 m above sea level, and the area received approximately 137.2 cm of annual precipitation (NOAA 2022). Non-forested areas consisted of recreational food plots, with a few small agricultural and fallow fields also scattered throughout each property. Prescribed fire was used in loblolly pine stands to manage the understory for white-tailed deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), and northern bobwhite (*Colinus virginianus*). The owners of the property were required to not hunt, trap, or otherwise harass wild pigs during the study, although some sporadic trapping and opportunistic shooting occurred prior to this study.

Methods

Trap Design and Data Collection

The study was conducted within the context of wild pig removal operations by the U.S. Department of Agriculture (USDA) Wildlife Services from April–September (2014) and June–September (2015) on the study area. Part of the operation was to condition wild pigs to enter corral traps to increase the probability of capturing entire sounders during initial trapping events. Game cameras (Moultrie Model M880i, Pradco Outdoor Brands, Alabama) were set for three-picture bursts, with 10 sec between pictures, and 1 min between bursts, during this conditioning period to determine how many solitary individuals and sounders were using the trap, and for post-removal monitoring. Game cameras remained running throughout the entire season. It was during this conditioning period, which lasted a single day to several weeks, that we monitored wild pig interactions with corral trap doors. Two door sizes (0.8 m and 1.2 m) were based on commonly used self-fabricated design plans whereby three 0.8-m or two 1.2-m doors could be cut from one sheet of treated plywood. The duration of each conditioning period depended on how soon wild pigs became conditioned to entering the trap, but in most cases (approximately 90%) lasted <3 wk. After this conditioning period, traps were activated and checked daily until wild pigs were captured and euthanized. After the euthanized wild pigs were removed from the trap, we reactivated the trap and began monitoring for the next solitary individual or sounder to begin using the trap.

To test the effects of door width on wild pig entry, we constructed 12 corral-style traps with wooden guillotine doors. Traps were constructed using three 1.5-m × 4.9-m galvanized wire panels with a 5.1-cm × 10.2-cm mesh, formed into an approximately 4.5-m diameter circular corral, which left an opening 1.0–1.4 m wide in which a door was placed. Metal 2.1-m T-posts (approximately 14) were placed at intervals of 0.9–1.2 m around the corral, and hammered into the ground approximately 0.5 m deep, allowing the panels to be secured using baling wire or rebar ties. We constructed trap doors from 1.2-m × 2.4-m × 1.3-cm sheets of treated plywood that were cut to either 0.8 m wide ($n = 9$) or 1.2 m wide ($n = 3$). Doors were set into a frame made from 5.1 cm × 10.2 cm and 5.1 cm × 5.1 cm treated lumber to form the door assembly.

Each assembly was fastened to the T-posts at each end of the trap opening, and we used a root stick or trip wire to trigger the door.

We placed traps in areas with known wild pig activity to maximize encounters. Traps were placed in forested areas along waterways or adjacent to permanent water sources such as ponds, natural food sources (e.g., mast-producing trees), and in areas where sign (i.e., trails, wallows, and rooting) had consistently been observed. In all but two cases, traps were located >900 m apart, with most traps accessible via unimproved private roads or trails. Once each trap was placed, the door was tied open and the interior was baited with 11.3 kg of whole kernel corn, with small amounts (approximately 0.11 kg) scattered in front of the door. For most traps (i.e., approximately 90%), we used hanging, battery-operated 18.9-L game feeders to dispense corn for approximately 30 sec daily, whereas traps without automatic feeders were checked on a 3–5-day interval to ensure bait was present. We placed a motion-sensitive game camera 4–8 m from each trap at 1–2 m above ground level facing the front of each trap door set to record three picture bursts with 10 sec between pictures, and 1 min between bursts. We began monitoring traps continuously as soon as each was baited.

Each week we visited traps, changed camera memory cards, replaced batteries as needed, and uploaded images. We visually inspected each image to identify individual wild pigs using combinations of pelage characteristics, relative size, sex, and other unique identifying marks (e.g., torn ear; Holtfreter et al. 2008). We also identified wild pigs as either solitary individuals or members of a sounder based on absence or presence of other wild pigs, respectively. Sounders were distinguished from other sounders based on combinations of total number observed, relative size (i.e., age), color, presence of unique pelage characteristics, and sex distribution within the sounder. There were no noticeable instances of individuals moving between sounders. This research was approved by the Auburn University Institutional Animal Care and Use Committee (IACUC Protocol #2015-2744).

Statistical Analysis

We defined a sounder as two or more wild pigs which we consistently observed across multiple observation periods. For sounders, we recorded first entry time, time required for 50% of the sounder to enter each trap type (i.e., 0.8-m or 1.2-m door width), and time required for 100% of the sounder to enter each trap type. We defined first entry as the elapsed time (in minutes) from the date and time any wild pig from a sounder was first observed on camera until one or more wild pigs from that sounder entered the trap. Time to 50% (in minutes) began on the initial date and time a sounder was first observed at the trap and continued until 50% of the sounder entered the trap. Similarly, time to 100% (in minutes) began from the initial date and time the sounder was first observed on camera until all members of the sounder had entered the trap at least once. We considered a wild pig to have entered a trap if the entire individual passed through the door. In many cases, cameras did not capture images until after some or all individuals had already entered the trap. For these instances, we assigned a zero for time to 50% or 100% if we observed the respective percentages of wild pigs within the trap. On rare occasions, we observed the same sounder at multiple traps of the same door width, and these were not reintroduced as "new" sounders in our dataset. We did not observe any instances in which a sounder entered traps of varying door widths. For solitary individuals, we only measured first entry time using the same criteria as above. We used linear mixed-effects models using package 'lme4' (Bates et al. 2015) in program R (R Core Development Team 2022) to evaluate differences between 0.8-m and 1.2-m door widths independently for first entry time, time to 50%, and time to 100% for sounders, and first entry time only for solitary individuals. To avoid potential pseudoreplication and to account for variation in multiple solitary individual/sounder observations at an individual trap, we included observations (i.e., distinct solitary individuals/sounders) nested within individual traps as a random effect. We converted response values (in minutes) to days for reporting. All tests were significant at $P < 0.05$.

Results

From 2014–2015, we observed 27 solitary individuals and 47 sounders from >400,000 images. We recorded imagery from an average of 7 different solitary individuals and/or sounders (range = 2–10) per corral trap, while 9 solitary individuals and 3 sounders were observed outside of traps but never entered, regardless of door width. Our random effect of observations within individual traps was not statistically significant and therefore was not included in our models.

First entry time for sounders (Table 1) did not differ between 0.8-m ($\bar{x} = 0.7$ days, SE = 0.4) and 1.2-m ($\bar{x} = 3.3$ days, SE = 2.5) wide doors ($P = 0.14$). Overall mean first entry time for sounders was 1.4 days (SE = 4.9). Likewise, first entry time for solitary

Table 1. First entry time (in days) for sounders and solitary individuals, and time until 50% and 100% of a sounder had entered through 0.8-m ($n = 9$) and 1.2-m ($n = 3$) wide doors on gates affixed to corral traps in Macon County, Alabama, 2014–2015.

	Sounder				Solitary individual			
	0.8 m		1.2 m		0.8 m		1.2 m	
Entry	Mean	SE	Mean	SE	Mean	SE	Mean	SE
First	0.7	0.4	3.3	2.5	7.2	3.7	12.5	9.1
50%	0.4	0.2	1.2	1.0				
100%	3.9	1.8	5.2	4.2				

individuals did not differ between 0.8-m ($\bar{x} = 7.2$ days, SE = 3.7) and 1.2-m ($\bar{x} = 12.5$ days, SE = 9.1) wide doors ($P = 0.59$). Time for 50% sounder entry did not differ between 0.8-m ($\bar{x} = 0.4$ days, SE = 0.2) and 1.2-m ($\bar{x} = 1.2$ days, SE = 1.0) wide doors ($P = 0.25$). Finally, time for 100% sounder entry did not differ between 0.8-m ($\bar{x} = 3.9$ days, SE = 1.8) and 1.2-m ($\bar{x} = 5.2$ days, SE = 4.2) wide doors ($P = 0.84$).

Discussion

Consistent with Metcalf et al. (2014), door width did not appear to influence the willingness of wild pigs to enter traps. Many sounders and solitary individuals readily entered traps soon after first being detected, regardless of door width. However, we noticed that larger (i.e., older) wild pigs tended to be more hesitant than smaller (i.e., younger) wild pigs in entering traps, a common observation which may relate to the perceived naivete of younger individuals. While we observed greater variation in mean entrance times through 1.2-m doors, this was likely a function of sample size and may have contributed to our inability to detect differences between door widths. Although we attempted to follow all sounders from initial observation until all members became conditioned to the trap, this was not always possible given camera failures, the practical need to remove wild pigs, and/or failure to communicate among researchers and field staff as to which sounders had been observed sufficiently and were available to be trapped and euthanized. Moreover, we did identify unique sounders and solitary individuals, but we did not have confidence in our ability to consistently assign sex and age to all individuals throughout all images collected during a sounder-trap interaction event. Because of this, we could not test the effects of age or sex on entry times, which has also been a point of contention among wild pig trappers. Therefore, further research is needed to explore potential differences that exist between sexes and ages of wild pigs and their respective willingness to enter traps.

Our research was limited in that we did not test door widths >1.2 m, and therefore, our results cannot be used to posit the effects of wider doors (e.g., 1.8 m, 2.4 m) that are also commercially common. We can only speculate that a notably greater door width will reduce trap entrance times. However, given first entry times of <1 wk for sounders in our study, which is consistent with other observations (Smith et al. 2014), any gains realized by using wider doors may be negligible. It is important to note that wild pigs in our study area were not actively managed by the landowners during the study and only received minimal management pressure in the two years preceding this study. Much of our research was also conducted during the summer months, a time of nutritional stress for wild pigs due to food availability and the energetic expenses of parturition and lactation (King and Williams 1984). As such, entry times observed in our study may be shorter than those observed in areas where wild pigs receive greater management pressure, or in relation to seasonal access to pulse resources (e.g., agricultural crops, hard mast). However, several solitary individuals and sounders never entered traps and only fed along trap edges. This observation may not relate to door width but instead to previous experiences these wild pigs may have had with traps in the area. Entry times were more variable and longer for solitary individuals than for sounders, which may have been a function of age (i.e., size as a proxy) and total number of individuals interacting with, and perhaps influencing, the likelihood of individuals entering a trap. Whereas most solitary individuals readily entered traps, one individual would not enter until 43 days after it was first detected on camera.

Corral trapping continues to be a common and, in many cases, a time- and cost-effective means for landowners and natural resource managers to reduce local wild pig populations. However, given the lack of apparent differences between sounders and solitary individuals during their interactions with varying trap door widths, trappers may want to emphasize other facets of the trapping process (e.g., trap placement, baiting, monitoring) that may provide more substantive effects on efficiency and effectiveness.

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