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Designing Quail Lanes to Increase Huntable Acreage and Distribute Hunting Pressure

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Hunting leases are in high demand in South Texas, and income from wildlife enterprises is an important element of sustaining the economic viability of ranches. The demand for leases, and the slow turnover (and therefore low availability) of lease holdings are reflected in the price of leases, usually expressed per acre of land. The price of a quail hunting lease in the South Texas Sand Sheet can vary from $15 per acre to $25 per acre. The high demand – and the resulting price – is driven by the fact that when the South Texas Sand Sheet gets rainfall, this region consistently supports huntable populations of bobwhites.

However, the total area of a hunting lease does not necessarily reflect its total huntable acreage. For example, both hunters and bobwhites have threshold limits of what they consider usable space. These limits are often determined by habitat characteristics, such as vegetation type and density. Northern bobwhites have been found to occupy brush density ranging from 1% to 90%, depending upon the spatial scale of the observation (i.e., point of use, home-range, pasture; Hernández 2014), with a general recommendation of 15% to 20% (Hernández and Guthery 2012). At the pasture scale (> 3,000 acres), the likelihood of long-term population persistence is highest when brush density ranges from 15% to 30% (DeMaso et al. 2014). Coincidently, the threshold of brush density for quail hunters has been estimated at 30% (Hernández and Guthery 2012).

"Quail will tolerate more brush than quail hunters."
– Leonard Brennan

In a recent East Foundation study, we tracked the spatial dynamics of quail hunts in South Texas (Woodard et al. 2022) to determine where hunters spend time on the landscape. We found that the area selected by hunters was influenced by both brush density and the availability of access (i.e., roads, paths, lanes) throughout a pasture (Figure 1), but these influences were not independent. Generally, hunting pressure decreased by 12% for every 5% increase in brush density and every 10-meter (10.9 yards) increase in the distance from the nearest road.

The proportion of a leased property within acceptable thresholds for quail hunters (i.e., huntable acreage) is important for two reasons. The first reason is simple economics. The effective price of a quail lease in South Texas is a function of the total price and the proportion of total acreage that would be considered huntable. Therefore, hunters lower the effective price of a lease when they maximize the huntable acreage without negatively affecting bobwhites' usable space. For instance, if a 2,000-acre hunting lease costs $15 per acre, but at its current state is only 50% huntable, the effective price of the huntable area (~1,000 acres) is $30 per acre. If the proportion of huntable acres were increased to 75%, then the effective price per huntable acre is reduced from $30 to $20 per acre, and so forth.

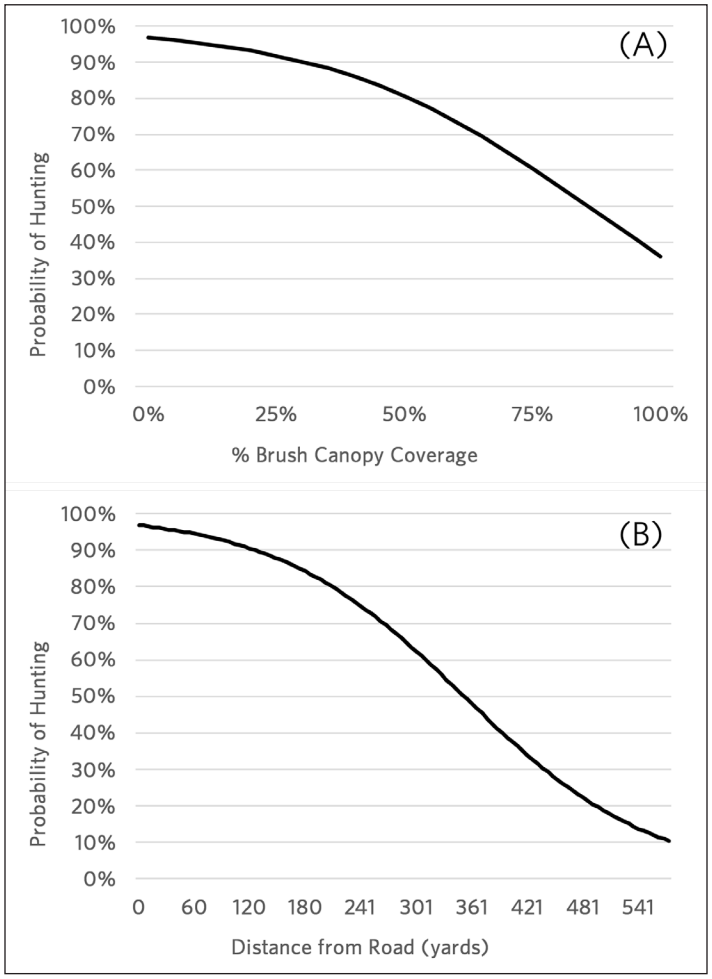

Figure 1. Quail hunting probability based on brush canopy coverage (A) and distance from the nearest access road (B) according to data collected by Woodard et al. (2022) during quail hunts in Jim Hogg County, Texas.

The second consideration is the distribution of hunting pressure across space and time. As the proportion of huntable acres decreases, hunting pressure becomes concentrated and more frequent in areas of higher suitability for hunters. This increase in hunting pressure at the local level (i.e., site, home-range scale) can affect population persistence (Sands et al. 2022), feeding and behavioral patterns (McGrath et al. 2018), and the overall success of hunting parties (Radomski and Guthery 2000). Depending on current harvest intensity and distribution, the creation of additional huntable acreage may generate a rise in total harvest opportunities or simply aid the distribution of hunting pressure across a broader area with less redundancy throughout a hunting season. Both are likely to increase hunter satisfaction and the perceived value of the lease.

A manager may increase huntable acreage by creating access in the form of a disk strip, dozer path, shredded lane, or a feed road. Collectively, these improvements are often called "quail lanes." Although the construction of quail lanes is relatively simple, planning the location and distribution of these roads requires a more strategic approach. We used the hunting distribution model from the East Foundation spatial dynamics study to design quail lanes for the Foundation's Ranchito Ranch (Site A) in Jim Hogg County, Texas, and for selected pastures within the Foundation's Santa Rosa Ranch (Site B) in Kenedy County, Texas (Figure 2). The quail lanes were constructed to optimize huntable acreage for northern bobwhites and distribute harvest spatially across the properties. The following is a step-by-step guide to the design and structure of these lane systems.

STEP 1. COLLECT VARIABLES: BRUSH AND DISTANCE TO CURRENT ROADS

Our first step was to collect the brush cover estimates and the distances of areas to the current road systems on both study sites (Figure 3). We analyzed variables at a resolution of 55-yards, segmenting each study site into 0.64-acre grid cells. This scale is associated with the maximum range of firearms used during quail hunts, and therefore represents the functional scale of bobwhite hunters (Woodard et al. 2022).

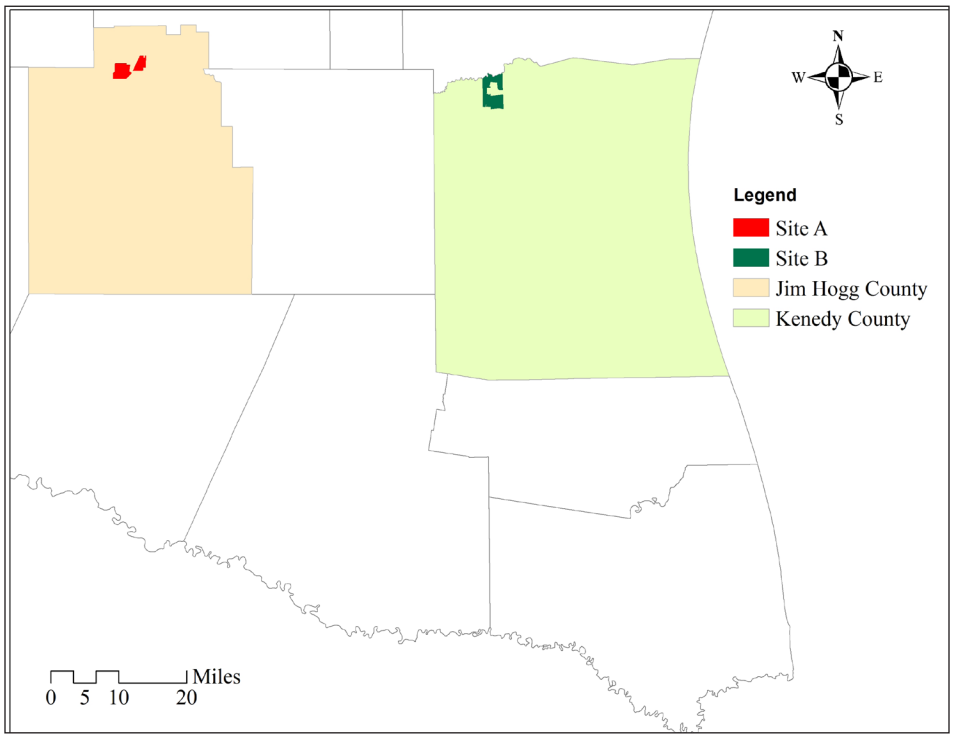

Figure 2. Locations of Ranchito Ranch (Site A) and pastures within the Santa Rosa Ranch (Site B) in Jim Hogg and Kenedy Counties, Texas.

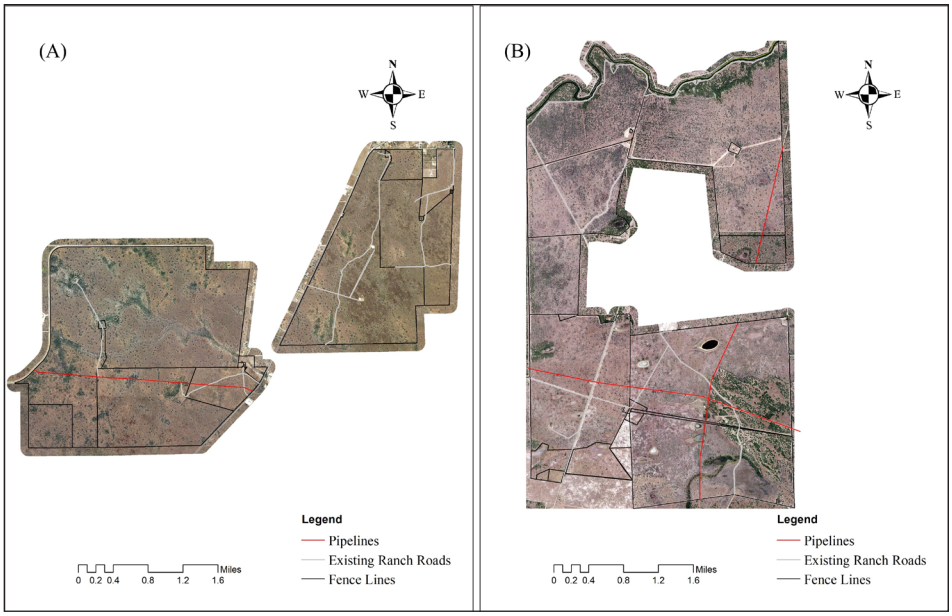

Figure 3. Existing access roads (Pipelines, Existing Ranch Roads, and Fence Lines) and brush configurations as viewed from 2020 National Agriculture Imagery Program (NAIP; 2.0 foot resolution) for the Ranchito Ranch (Site A) in Jim Hogg County, Texas, and pastures within the Santa Rosa Ranch (Site B) in Kenedy County, Texas.

Brush Cover Measurement – Brush cover estimates were collected using aerial imagery provided by the National Agriculture Imagery Program (NAIP; 2.0-foot resolution) downloaded from Texas Natural Resources Information System (http://tnris.org/). Within every 0.64-acre grid cell on our map, we classified each 4 square foot section as "brush" or "non-brush" and then calculated the brush density of each 0.64-acre grid cell (i.e., percent brush in the grid cell). The average brush density of all grid cells was 20.7% across Site A and 21.2% on Site B.

Distance from Roads – Existing road systems were comprised of pipelines, fence line paths, and ranch roads established for operating purposes (e.g., oilfield, cattle pens, windmill access; Table 1). The shortest distance from each cell center to existing roads was measured in ArcMap 10.8.0. The average distance from the cell center to existing roads was 233 yards on Site A and 182 yards on Site B. These average distances were 2 to 2.5-fold greater than those observed in hunted areas by Woodard et al. (2022; $\bar{x}$ = 92 yards).

Type	Site A	Site B
Ranch Roads	8.9 miles	10.8 miles
Fence Line Paths	35.8 miles	44.7 miles
Pipelines	2.5 miles	20.6 miles
Totals	*47.2 miles*	*76.1 miles*

Table 1. Existing Road systems before quail lanes on Ranchito Ranch (Site A) in Jim Hogg County, Texas, and pastures within Santa Rosa Ranch (Site B) in Kenedy County, Texas.

STEP 2. PREDICT HUNTING PRESSURE WITH CURRENT ROAD SYSTEMS AND BRUSH

Using information collected in Step 1, we predicted the spatial hunting pressure distribution across our grid cells using the model developed from our observations of hunting activity (Woodard et al. 2022). We modified the model results to a 0–1 frequency like McGrath et al. (2018), with cell values representing predicted hunting intensity throughout a season (Figure 4). We categorized each cell as either a Low, Moderate, or High level of hunting suitability based on predicted hunting intensities (Low = 0.0 to 0.25, Moderate = 0.26 to 0.75, and High = 0.75 to 1.0). According to the model, 31% of Site A and 25% of Site B were considered Low suitability, with only 18% and 20% classified as High suitability for each site, respectively.

STEP 3. DESIGNING AND ADDITION OF QUAIL LANES

Considering roads currently established throughout each property, we began our road design by identifying the 0.64-acre grid cells with brush density values below the average ($\bar{x}$ = 21.7%) of all hunted areas from our earlier study (Woodard et al. 2022). This allowed us to determine areas that would most benefit from increased road access and avoid areas where suitability (i.e., huntability) was more limited by brush density than by accessibility. There is little benefit in creating lane access to an area where brush density limits hunting opportunity.

Completed quail lanes, pictured above, increase huntable acreage by creating access through a pasture. Although the construction of quail lanes is relatively simple, planning the location and distribution of these roads requires a more strategic approach.

Figure 4. Predicted hunting intensity categorized into Low [0.0–0.25], Moderate [0.26–0.75], and High [0.75–1.0] suitability according to brush density and distance from the nearest access road at a 0.64-acre resolution for Ranchito Ranch (Site A) in Jim Hogg County, Texas, and pastures within Santa Rosa Ranch (Site B) in Kenedy County, Texas.

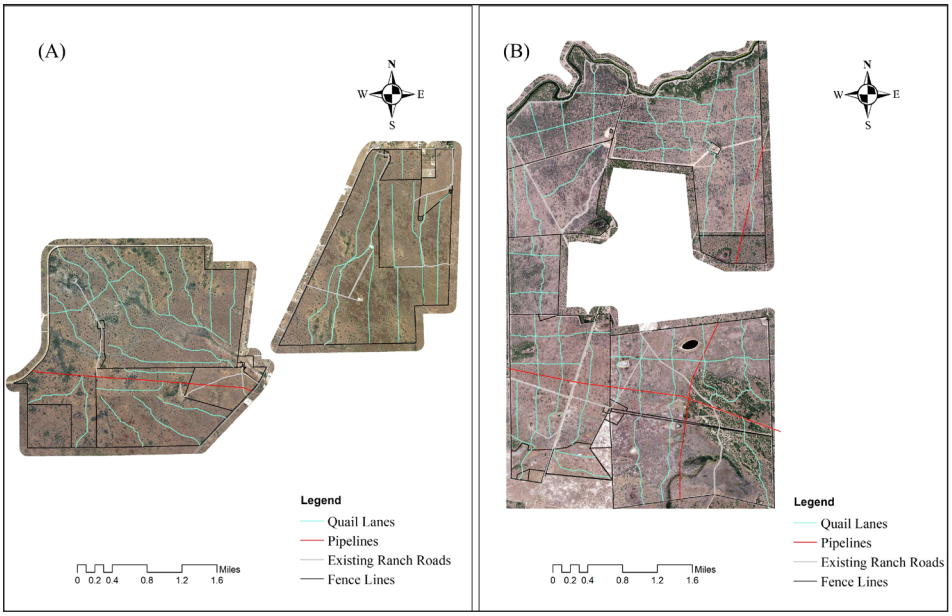

Figure 5. Designated quail lanes for Ranchito Ranch (Site A) in Jim Hogg County, Texas, and pastures within Santa Rosa Ranch (Site B) in Kenedy County, Texas.

To further guide the spacing of the road systems, we overlaid a 440-yard by 440-yard grid across both properties. This area corresponds to the average home range of bobwhites in South Texas (Haines et al. 2004, Miller et al. 2017) and, therefore, would place the center of any bobwhite's home range within 220-yards of an access road. This spacing also reduces the chance of encountering a previously hunted covey from a separate road (i.e., reduces unintentional redundancy of hunting pressure), especially when feeding is used to increase covey-hunter contacts.

Using estimated brush cover values and our spacing reference, along with the pasture configuration (i.e., fence lines, drainages), we designed quail lanes to maximize length across pastures along prevailing wind direction for the region (i.e., south-south-east to the north-north-west). This resulted in the addition of 31 new quail lanes (29 total miles) to Site A, and 45 new quail lanes (41 total miles to Site B (Figure 5). The average distance from the center of a plot to the nearest lane was reduced by more than 50% on both sites, with new average distances of 90 yards on Site A and 83 yards on Site B.

STEP 4. PREDICTING HUNTING PRESSURE WITH NEW LANES

Using the values for distance to new access roads, we re-estimated hunting intensity (Figure 6). Adding new quail lanes decreased the percentage of Low-quality grid cells from 31% to 5% on Site A, and from 25% to 5% on Site B (Table 2), corresponding to a 26-percentage unit increase in Moderate and High cells on Site A and a 20-percentage unit increase in Moderate and High cells on Site B. Although there are still areas categorized as Low-quality on both Sites, those areas are unlikely to benefit from increased accessibility because they exceeded the hunter tolerance for brush density.

STEP 5. ECONOMIC EVALUATION

When we make management decisions on a ranch or hunting lease, we must evaluate the financial tradeoffs. The cost associated with constructing new roads is often determined by the vegetative characteristics of the ranch and what type of equipment is required. Establishing new quail lanes on Site A required only a tractor-shredder, while the new quail lanes on Site B required a combination of tractor-shredder and bulldozer (Table 3). The cost per mile for the additional quail lanes on Site A was $70 per mile, while the cost per mile for the quail lanes on Site B was $326 per mile.

Figure 6. Predicted hunting intensity after the addition of quail lanes categorized into Low [0.0–0.25], Moderate [0.26–0.75], and High [0.75–1.0] suitability for Ranchito Ranch (Site A) in Jim Hogg County, Texas, and pastures within Santa Rosa Ranch (Site B) in Kenedy County, Texas.

We estimated the resulting first-year net financial gain for the hunter or ranch owner at 23% on Site A and 9% on Site B (Table 4). Assuming the maintenance of dozer work following initial treatment will be completed with a tractor-shredder or tractor-disk (~$71.22 per mile), the estimated financial gain for Site B will increase by 20% after the initial treatment year.

	Site A			Site B		
	Low	Moderate	High	Low	Moderate	High
Existing Roads	31%	51%	18%	25%	55%	20%
After Quail Lanes	5%	64%	31%	5%	60%	35%
Δ%	*- 26%*	*+ 13%*	*+ 13%*	*- 20%*	*+ 5%*	*+ 15%*

Table 2. Ratios of hunting suitability before quail lanes and after quail lanes according to brush cover and distance from the nearest access road at a 0.64-acre resolution for Ranchito Ranch (Site A) in Jim Hogg County, Texas, and pastures within Santa Rosa Ranch (Site B) in Kenedy County, Texas. Predicted hunting intensity converted to 0–1 frequency and categorized into Low [0.0–0.25], Moderate [0.26–0.75], and High [0.75–1.0] suitability.

	Site A			Site B		
	Miles	Hours	Costs	Miles	Hours	Costs
Ranch Roads	8.9	9.8	$622	10.8	15.3	$767
Fence Line Paths	35.8	39.3	$2,502	44.7	63.5	$3,173
Pipelines*	2.5	-	-	20.6	-	-
Totals	*47.2*	*49.1*	*$3,124*	*76.1*	*78.8*	*$3,940*
Quail Lanes	29.0	31.9	$2,027	41.1	58.2	$2,910
Dozer	-	-	-	15.2	95.0	$10,450
Totals	*29.0*	*17.7*	*$2,027*	*41.1***	*153.2*	*$13,360*

Table 3. The cost associated with the maintenance of access roads and the construction of quail lanes on the Ranchito Ranch (Site A) in Jim Hogg County, Texas, and pastures within the Santa Rosa Ranch in Kennedy County, Texas. Tractor-shedder or tractor-disk was used in general maintenance for ranch roads, fence line paths, and quail lanes not labeled as Dozer.

*Pipelines are maintained by oil and gas leases.

**Tractor and shredder returned to all dozed lanes. Total miles of dozer work are included within the 41.1 miles of quail lanes on Site B.

Establishing new quail lanes on Santa Rosa Ranch (Site B) required a combination of tractor-shredder and bulldozer. The cost per mile for the quail lanes on this site was $326 per mile.

Establishing new quail lanes on Ranchito Ranch (Site A) required only a tractor-shredder. The cost per mile for the quail lanes on this site was $70 per mile. We estimated the resulting first-year net financial gain for hunters or ranch owners at 23%.

		Site A			Site B		
	Hunting Quality	Low	Moderate	High	Low	Moderate	High
	Value per Acre	$5	$15	$20	$5	$15	$22
Before Quail Lanes	Acres	1,617.2	2,660.5	939.0	1,762.2	3,876.9	1,409.8
	Maintenance Cost		- $3,124			- $3,940	
	Net Lease Value		$63,649			$94,039	
With Quail Lanes	Acres	260.8	3,338.6	1,617.2	1,762.2	3,876.9	1,409.8
	Maintenance Cost		- $3,124			- $3,940	
	Quail Lane Cost		- $2,027			- $2,920	
	Dozer Cost*		-			- $10,450	
	Net Lease Value		$78,577			$102,178	

Table 4. An economic evaluation of quail lane construction using changes in predicted hunting suitability for the Ranchito Ranch (Site A) in Jim Hogg County, Texas, and pastures within Santa Rosa Ranch (Site B) in Kennedy County, Texas.

*Dozer Cost is a one-time fixed cost for constructing a quail lane, followed annually with regular tractor-shredder, tractor-disk, or other regular maintenance.

SUMMARY

The management goals of hunters and landowners vary from ranch to ranch. Brush cover and accessibility combine to influence both quail and hunters. While some properties are already well-suited for even distribution of annual hunting pressure, others may benefit from additional modifications. Managing huntable acreage should be a critical component of harvest management in South Texas. The amount of huntable acreage available affects the distribution of hunting pressure across the landscape through a hunting season. Properties with a higher proportion of huntable acres may be perceived as a better value by hunters, because a higher proportion of huntable acreage lowers their effective price per acre hunted.

Of course, sustainable populations of quail are the most important asset for quail leases, and strategies that effectively redistribute hunting pressure are likely to aid in population management as well as increase hunter satisfaction. Using a model that considers the tolerance of both hunters and quail for brush density and road access provides land managers with a strategic approach to evaluate and design quail lanes to increase huntable acreage and aid with the distribution of hunting pressure. Using this type of evaluation can help landowners or leaseholders assess the costs and benefits of developing quail lanes, enabling them to make the most effective decision for their individual goals and circumstances.

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CONTRIBUTOR

D. ABRAHAM WOODARD, Ph.D. is a Range and Wildlife Scientist at the East Foundation in Hebbronville, Texas. His research focuses on population ecology and sustainable management of game species, with a primary focus on upland game birds.

Abe has a B.S. in Wildlife and Fisheries from Rio Grande University, an M.S. in Wildlife Science from Texas A&M University, and a Ph.D. in Wildlife Science from Texas A&M - Kingsville, where he investigated the effects of harvest on northern bobwhite populations.

Abe had 10 years of experience managing wildlife and hunting enterprises on private lands prior to returning to grad school in Kingsville. He spent six years on King Ranch as a Wildlife Biologist for Halliburton's Mota Bonita Lodge and three years working for Deseret Ranches, first as a Wildlife Biologist in Florida and then as a Natural Resource Manager covering ranches in Oklahoma, Kansas, Nebraska, and Texas.

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