

Private wildlife: Domestication of Wild Deer on Private Texas Ranches

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ABSTRACT

Although wild species face extinction in the wild, some species can be preserved on private lands such as ranches where they are subject to individual management decisions. These management decisions carry the potential to domesticate wild species such as white tailed deer because they may become reliant on humans. Factors on closed game ranches such as the size of the property, the height of the fence, human interaction through practices such feeding, and hunting access can contribute to the level of domestication. To determine the effect of management practices on ranches, I focused on white-tailed deer (*Odocoileus virginianus*) populations in the Edwards Plateau region of Texas. I surveyed ranch owners directly on their management practices as well as the characteristics of their wild deer herds, such as the size and density of their herds. To examine the differences between the management practices between the ranches, I used Wilcoxon Rank-Sum tests to compare the management practices of high-fenced and low-fenced managers. The survey confirmed that differences exist in the management practices, specifically the amount of feed provided, where high-fenced ranches provided on average 0.10 tons per year per acre, and low-fenced ranches provided 0.01 tons per year per acre of feed. The characteristics of the deer herds differed as well, including the ratio of does to bucks and the amount of immigration on the ranch. These differences illustrate the high-fenced ranch managers have begun to domesticate the deer on their ranches.

KEYWORDS

Odocoileus virginianus, wildlife management, range ecology, rangeland management, hunting

INTRODUCTION

Historically, management seeks to foster livestock such as cattle or sheep and to prevent wild species such as deer from competing for resources. However, management practices have pivoted, fencing both cattle and macrourungulates such as deer, ultimately restricting natural movements and migrations of wild species. This transition in management practices with fences occurred as a result of factors such as an increase in demand for animals to hunt, desire to control a wild species, and a decrease in the cost of fencing (Macaulay et al. 2013). Modern fences can restrict ungulate movements and confine exotic wildlife, and fenced landholdings are often smaller than range size (Webb et al. 2009). However, fencing and management of wild species has the potential to preserve wild species that would otherwise go extinct (Lantz 1910), a problem that has been occurring for centuries but has been exacerbated due to climate change. The changes in fencing that cause harm to natural movements also have the potential to benefit the ranch owners.

Enclosing wild species can maximize the economic benefit of their ranch, however these enclosures do not necessarily benefit the species. Range owners behave in economic and wealth-maximizing practices specific to each ranch, and when these practices are combined with state-owned land and government regulated practices, the overall effect on the management of wild deer becomes inefficient (Lueck 1991). Privately-owned land managers' goals are generally to maximize profits, but public lands are managed differently due to a difference in goals, which ultimately harms the management of the species. For example, selling hunting permits is a practice to maximize profits on private land, where the number of permits sold can increase as the size of the ranch increases. Larger ranches are expected to have proportional increases in game species actively fenced (Lueck 1995). These hunting permits can be used to hunt any game species such as deer, and modern ranchers must ensure they contain enough wildlife to hunt within their land through the use of high fences. High fences pose potential problems for deer by restricting their natural movements, where current management practices do not align with what is sustainable for the deer population. In general, home ranges for deer are often larger than fenced private land or fenced state-owned lands (Webb et al. 2010). Therefore, when ranchers fence their lands, wild species such as deer have a range smaller than their natural range, which may have unintended biological effects.

These management changes also carry the potential to domesticate wild species. As deer are fenced, wild populations may become reliant on humans and could be domesticated. For example, breeding patterns such as male dominance patterns differ in deer behind fences than with wild deer, where size becomes the most important factor for breeding success instead of age, indicating domestication (DeYoung et al. 2006). In domesticated species, other indicators of domestication include morphological changes like lightening of coat color, physiological changes at the genomic level, and behavioral changes to humans and predators (Mignon-Grasteau et al. 2005). Specifically, there is a gradient of levels of domestication: wild, semi-domestic and domestic, that can be measured using qualifiers (Clutton-Brock 1989). For wild deer, factors related to closed game ranches, such as the size of the property, the height of the fence, human interaction through practices such as feed, and hunting access can contribute to the level of domestication of the species. However, it remains unclear how these combinations of factors contributes to different levels of domestication.

The goal of the study is to explore the impacts of high fencing on domestication on white-tailed deer. In addition to fence height, I consider factors such as deer reliance on human feed and human control over breeding patterns, such as the ratio of does per buck. I gather data from 13 variables of management practices and biological conditions on high-fenced ranches and low-fenced ranches that allow for off-ranch migration to examine the relationship between fence height and level of domestication.

METHODS

Study site

To determine the effect of management practices on ranches in Texas, I selected the Edwards Plateau region, which serves as a representation of Texas based on its central location. The Edwards Plateau is an ecoregion located in west-central Texas roughly bounded by the cities of Austin, San Antonio, San Angelo, and Mexico. In this mixed-oak savanna, most of the region is used for grazing species such as beef cattle, sheep, goats, exotic game mammals, and wildlife; and hunting leases are a major source of income (Griffith et al. 2012). Ranchers can sell hunting permits (leases) for their private land based on the number of animals on the land. Texas is one

of three states in the US that allows for high fences with no maximum height, no restrictions on the type of fencing used, no minimum ranch size and no specific hunting permits required, making it an ideal environment for hunters on private land (DeZelle 2009).

Study species

To examine population dynamics of hunted species on fenced ranches, I focused on white-tailed deer (*Odocoileus virginianus*) as the target species. In general, white-tailed deer in Texas have been expanding in range across the state and slowly increasing in numbers. White-tailed deer in the Edwards Plateau can have up to a density of 10-25 deer per acre depending on management practices. Within the Edwards Plateau, the white-tailed deer have roughly stabilized populations with an expanding distribution (Traweek et al. 1996). White-tailed deer typically breed in Texas in early November, so most hunting permits are sold for early fall (August-November), to not disrupt the breeding cycle. These hunting permits are sold for a specified amount of days, or can be sold for a specified number of animals to be hunted.

Survey of Ranches

To collect data on white-tailed deer in Texas ranches, I surveyed ranch owners directly on their management practices as well as the characteristics of their wild deer herds. I used non-probability sampling using the snowball method where I found target ranches with the help of my mentor, Luke Macaulay, the Huntsinger lab at UC Berkeley, and by asking for references from ranch managers I interviewed. The qualification for the ranches was to be located in the Edwards Plateau. I used a sample size $N=39$, where each ranch varied in size and management practices to try to overcome potential bias from non-probability sampling. I counted a ranch “nonresponsive” after leaving seven messages with no response.

To obtain the data from the target ranches, I conducted phone interviews with managers inquiring about eight variables related to management practices and five variables related to their estimates on herd characteristics (Table 1). I first contacted the ranches by a phone call to give them an introduction to my research and to see if they would be willing to participate. I followed

up with an email to set up an interview time. Then I contacted the managers again by phone to perform a 10-minute interview to obtain the data.

Table 1. Variables collected from ranch managers. All variables were collected in the form of data as the units listed and any relevant quotes were recorded.

Predictor variables: Management Practices	Response variables: Herd Characteristics
Size: continuous (acreage)	Size: continuous (individuals)
High-fencing: categorical (binary)	Does/Buck: continuous
Fence height: continuous (feet)	Fitness, percent of does reproducing: continuous (%)
Hunting: categorical (binary)	In-migration: continuous (%)
Hunting limits: categorical (stag/year)	Density: continuous (individuals/acre)
Hunting permits: percent of annual income (%)	
Feed: categorical (binary)	
Amount of feed: continuous (tons/year/acre)	

Analysis

To examine the differences between the management practices between the ranches, I used Wilcoxon Rank-Sum tests by fence type, due to the small sample size and non-normality of the data. Additionally, I used Wilcoxon Rank-Sum tests to determine if the herd characteristics were different when examined by the type of fence used. I compared 7 variables between the high- and low-fenced ranches, such as the average density. I used R software and R studio (R Development Core Team 2014) to perform all the calculations.

RESULTS

Survey results

23 of 39 total ranches responded to the survey (59%) (Figure 1). Nine ranches declined to participate, because of hesitations in answering questions about their management practices, and 7 ranches were nonresponsive. Of the 23 ranches that participated, managers were reliably willing to answer all the questions I asked and offered their best estimates on all variables. After

examining the respondents, I divided the ranches into two groups: the high-fenced ranches and the low-fenced ranches.



Figure 1. Map of ranch respondents. The locations of the ranches that participated. High-fenced ranches are marked in red and low-fenced ranches are marked in green.

I categorized ranches as high-fenced if fences were eight feet tall or higher, the height at which deer cannot jump. 20 high fenced ranches responded. I categorized ranches as low-fenced if the fence was less than 8 feet high, with the height generally measuring between four- to six-and a half-feet high. 3 low-fenced ranches responded.

Analysis

Overall, the high- and low-fenced ranches had similar management practices (Table 2). I found there was not a significant difference ($W=34$, $p=0.7493$) of the average ranch size between the high- and low-fenced ranches. The average ranch size for the high-fenced ranches was slightly larger at 4854 acres, while the average ranch size for the low-fenced ranches was 4742 acres. Additionally, there was not a significant difference between the densities of the deer between the ranch types ($W=38.5$, $p=0.4062$). The density was slightly higher on the high-fenced ranches at 0.1535 deer per acre, compared with an average density of 0.1278 deer per acre on the low- fenced ranches.

Table 2. Comparison of high and low fenced ranches for a range of management variables and herd characteristics. P values were tested using Wilcoxon Rank-Sum tests. Significant values are bolded.

	High-fenced	Low-Fenced	P-Value
Size: acres	4853.8000	4741.6667	0.7493
Density: deer/acre	0.1535	0.1278	0.4602
Feed: tons/year/acre	0.1015	0.0097	0.0552
Fitness: percent of does	83.2500	78.3333	0.4055
Percent of income	75.9500	83.3333	0.6094
Does/bucks	1.02	4.00	0.0080
Percent of in-migration	1.00	46.67	0.0000

I found there was not a significant difference ($W=24$, $p=0.6094$) of hunting deer as a percent of income between the high- and low-fenced ranches. High-fenced ranches received on average 76% of their income from hunting, and low-fenced ranches received on average 83% of their income from hunting. Other factors contributing to the income of the ranch included raising beef cattle, hunting exotic species, and other recreational activities on the ranch.

I found there was not a strong significant difference ($W=51.5$, $p=0.05517$) in the amount of feed used between the high- and low-fenced ranches (Figure 1). The majority of managers surveyed provided some feed for their ranch, but high-fenced ranches used slightly more feed at 0.10 tons per year per acre, compared with low-fenced ranches that used an average of 0.01 tons per year per acre.

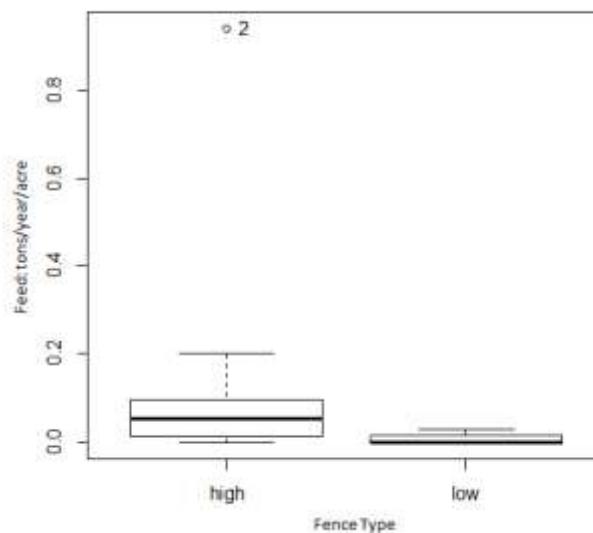


Figure 1. Differences in the amount of feed used between the fence types. Box and whisker plot comparisons of the tons/acre/year of the high- and low-fenced ranches.

There was some variation in the biological aspects of the deer between the ranch types. I found there was a significant difference ($W=1.5$, $p=0.0080$) in the ratio of does to bucks between the high- and low-fenced ranches, where the low-fenced ranches had a much higher ratio of 4 does to 1 buck, compared with a 1 to 1 ratio on the high-fenced ranches (Figure 2). Additionally, the amount of in-migration between the ranches varied ($W=0.5$, $p=0.0000$) (Figure 3). Only one high-fenced ranch brought in new deer for the previous season, while all three of the low-fenced managers reported having some level of in-migration of new deer for the season, with an average in-migration of 47%.

However, I found there was not a significant difference in the fitness of the does between high- and low-fenced ranches ($W=39.5$, $p=0.4055$). High-fenced ranches had on average 84% of the does reproducing for the season, while the low-fenced average was slightly lower at 78% of females reproducing.

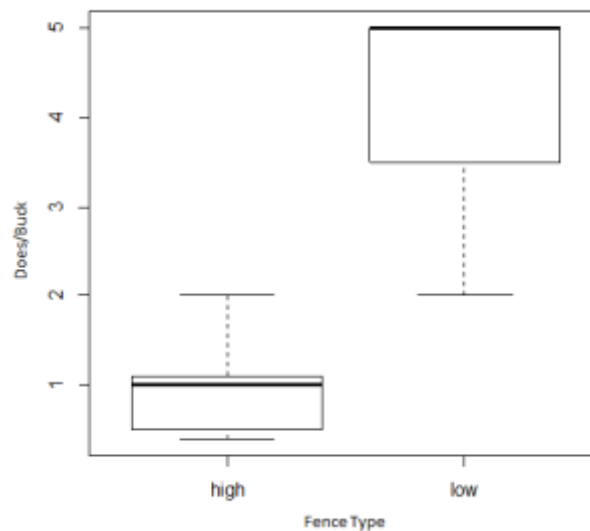


Figure 2. Differences in sex ratio of does per buck between the fence types. Box and whisker plot comparisons of the does/buck the high- and low-fenced ranches.

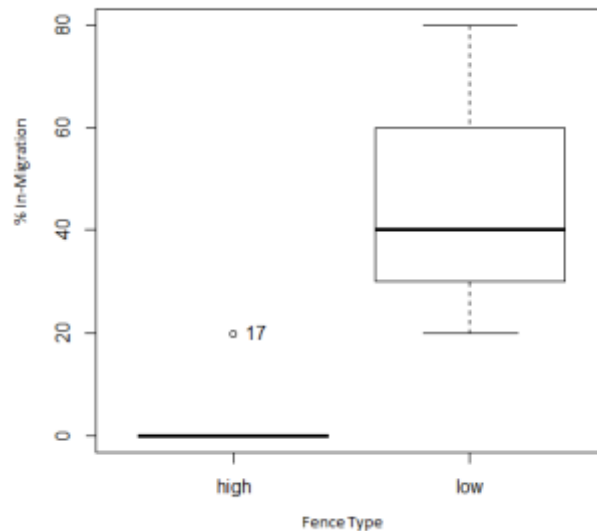


Figure 3. Differences in the percent of in-migration between the fence types. Box and whisker plot comparisons of the percent of deer new to the ranch of the high- and low-fenced ranches.

DISCUSSION

Ranch managers differed in the type of fencing used and other management decisions, such as providing supplemental feed. Additionally, the biological characteristics of the deer varied, such as the sex ratio of the herds and the percent of in-migration. Ultimately, the biological differences in the herds between the high- and low-fenced ranches suggests that management practices contribute to some level of domestication of the white-tailed deer.

Motivations for deer game management

Overall, managers were willing to speak with me about their management decisions. Nine of the 39 ranches contacted did not wish to participate, which is lower than anticipated (Ferranto et al. 2013). However, managers who did not participate did so because they were skeptical about the nature of the research and were concerned that I was writing an anti-hunting propaganda piece. The practices ranch managers employ are deeply personal, and often rooted in tradition, to achieve the goal they have set for their private ranch. As one manager explained, his practices have been refined over decades to get the best deer possible for hunting.

Similarities in management approaches

Both high- and low-fenced ranches were similar in average size and had similar average densities of deer, with an average density of 0.15 deer per acre on high-fenced ranches and 0.13 deer per acre on low-fenced ranches. Additionally, all ranch managers allow hunting on their private lands as a source of income. I anticipated the high-fenced ranch managers to have hunting be a higher proportion of income, because the high fence protects their investment of the deer. However, after speaking with managers, I found two possible explanations for the similarities in income. Another source of income for the ranches was hunting other species such as exotics. Of the high-fenced ranches, 17 of the 20 had exotic species available for hunting; one ranch manager explained he offered over 60 exotic species. This circumstance allowed the percent of income from solely white-tailed deer to be lowered on the high-fenced ranches, while none of the three low-fenced ranches had exotic species available. Additionally, I learned from the low-fenced ranch managers, who historically would raise cattle as a source of income, that the current drought in Texas meant cattle were not as profitable as in the past so they relied more on hunting to receive extra income, which could also have artificially compressed the gap between the average income from white-tailed hunting.

The fitness of the does was fairly similar between the two types of ranches. However, the way the deer were bred varied between the two types. Of the 20 high-fenced ranches, 8 were also breeding operations, where they specifically bred certain does with bucks to get a desired antler size. These facilities also sold their bucks to other ranches throughout Texas to help those ranches increase their antler size. None of the 3 low-fenced ranches had any part in the breeding of the deer; they let it occur naturally.

Differences in herd characteristics

One difference between the high- and low-fenced managers was how much feed they provided for the deer. Although not statistically significant, the high-fenced managers provided more feed per acre for the year than the low-fenced with high-fenced ranchers feeding their deer on average 0.09 tons per year per acre more than low-fenced ranches. The managers who contain their deer within the high fence need more feed in order to maintain the high densities because

the deer have no other food source. The low-fenced feed has most likely increased over the past few years, artificially compressing the gap of feed between the fence types. When speaking with a low-fenced manager, he explained that he has had to increase his annual tons of feed over the past three years due to the current drought situation.

The main difference in the herd characteristics was the sex ratio of the herds. High-fenced ranches had a much smaller ratio, close to 1 doe per buck. Low-fenced ranches had a higher ratio, at 4 does per buck. In the Edwards Plateau, the average ratio for 2013 was 3 does per buck, which has been consistent for the past nine years (Cain et al. 2014). In Texas, the high doe to buck ratio illustrates that the majority of deer hunted in the wild are bucks and not does. This is reflected in the low-fenced ranches, where the deer are free to move between the open land and the private land, making the low-fenced ranches close to this ratio. However, on the high-fenced ranches, where the ranch can manage to a desired sex ratio, the does tends to be higher because this allows managers for more breeding opportunities. One high-fenced manager explained how he likes to keep his ratio closer to 2 does per buck in order to maximize the amount of fawns each year.

The difference in migration patterns is also significant between the two ranches. Only one high-fenced ranch brought in new deer for the 2014 season, while all three low-fenced ranches experienced some level of migration for the season. The high-fenced ranch who brought deer in did so for the purpose to specifically increase his average antler size in his herd, such that he was managing to increase a specific trait. Other high-fenced manager reported bringing in new deer once every five to six years for this same reason. However, migration is essential for maintaining new genetics in the gene pool of the deer, however with the amount of deer on the properties (with an average of nearly 5000 deer), problems due to low gene flow may not be an issue.

Biological impacts and management implications

The differences in the herd characteristics implies some level of domestication of the deer on the high-fenced ranches. Moreover, obtaining more control over the feeding cycle of a species, including what they eat and when they eat, is a major indicator of domesticating a species (Peterson et al. 2005, Price 1999). The results from the high-fenced managers suggest that managers may have greater control on the species, and will result in a higher domestication

level than deer on low-fenced ranches. Domestication is understood as levels on a spectrum that result in the possible presence of phenotypic changes that help an animal adapt to a new environment (Price 1999). Domestication is a process, and by controlling the feeding patterns of the deer the managers are beginning this process. Providing feed allows for a higher density of deer to survive on the same size land than those that could in the wild. Essentially, the presence of feed reduces finding food as a limiting factor in population growth (Price 1999), therefore ranches can essentially manage to have higher densities and allow more females to reproduce every year.

Another major factor of domestication is controlling the breeding patterns of the deer (Price 1999). By selectively managing for a specific sex ratio of the deer, the high-fenced managers are taking some level of control over the deer. Additionally, as many high-managers explained, they are specifically breeding their deer to increase the average antler size, a desired trait among hunters. Selectively breeding for a desired trait is a hallmark of domestication; however, in most ungulate species the animal is bred to become smaller to be easier to handle (Mignon-Grastau et al. 2005). On the ranches, smaller is not necessarily better because a larger deer is worth more (it can be sold for more to be hunted), therefore the managers are specifically changing the phenology of the body size and the antler size.

Limitations and Future Research

This study examines ranchers in Texas, where hunting on private land is less regulated than other states, so implications to the greater American hunting community may not be appropriate (Pleininger et al. 2012). Additionally the sample size was smaller than typical than other surveys of ranch managers (Huntsinger and Oveido 2014) and may underestimate the effect of fencing. Additionally, I surveyed fewer low-fenced sites than high-fenced sites, making it difficult to conclude whether variations in deer herds result from management (Brownsey et al. 2013). The lack of low-fenced ranches illustrates how popular high-fences have become in the area. Most ranches I spoke with did not know of any other ranches that continued to use low-fences. Overall, this study can primarily serve as a pilot study into the differences between high- and low-fenced management for future broad, state-wide surveys with more resources for higher responses and random sampling.

Climate change and species diversity loss make this area of research increasingly relevant (Brownsey et al. 2013), because of possible genotypic or phenotypic differences between the deer herds on the different types of managed lands. A cohort-level approach, as opposed to the cross-sectional analysis used in this study, would allow researchers to closely follow the deer herds and examine other factors such as longevity or behavioral changes (Trut et al. 2009). Behaviors of the deer may also change due to domestication, such as a relaxed relationship with humans and predators (Mignon-Grasteau et al. 2005). Testing the reactionary behavior is more difficult and would need a closer examination at the individual-level of the deer as opposed to the population level. However, examining the behaviors is necessary to understand the effects of beginning the domestication process. Additional genetic research into possible ranching effects will solidify the differences between the herd characteristics.

Conclusion

With climate change and increased rates of species extinction, it is necessary to preserve species, even on private lands including those used for hunting. Due to diversity in management practices by ranch owners, it is increasingly necessary to understand the implications a practice can have on the herd. Domestication can be viewed as both an evolutionary process as well as a developmental phenomenon, and therefore the characteristics exhibited in the herds will exist along a spectrum (Price 1999). Although high-fenced ranches can be viewed as viable conservation efforts, the deer on these ranches may be domesticated and therefore different from the wild species.

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