Conservation Programs and White-tail Deer Ecology

By

David Royeen

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Dr. Matt Eick (Chair)

Dr. Susan Day

Dr. Jacob Barney

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Abstract

White-tailed deer have reached historical numbers since nearly being wiped out due to overhunting and habitat loss. This paper seeks to review the rebound of white-tailed deer populations, specifically analyzing the role conservation practice and habitat management have played. A brief history of private land contracts in the United States is established before relating deer ecology to habitat availability. The importance of deer from the perspective of humans as well as the ecosystem is highlighted in an effort to encourage and promote conservation and habitat preservation efforts. This work seeks to answer the question "How do conservation programs influence white-tailed deer behavior and what steps can land managers take to protect wildlife on their property?". A list of recommendations for land owners is given to share best-practice policies for governing a healthy population of white-tailed deer. Lastly, study limitations and constraints of this paper are analyzed to promote transparency and identify areas of concern with data collection.

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Introduction

White-tailed deer (Odocoileus virginianus) occupy a broad range of habitats and can reproduce rapidly under favorable conditions, sharply increasing numbers throughout the United States in recent decades (Garrott et al., 1993). Current populations, however, are being threatened across the United States (Edmunds, 2016). Natural ecosystems for these animals are being destroyed at rapid levels. As land is converted into agriculture, nesting sites feeding grounds, and socialization areas for deer diminish (Grovenburg et al., 2011). Farmers are choosing to devote larger portions of property towards crop production in an effort to maximize profitability, displacing deer (Bangsund, 2013). In the past, Conservation Resource Programs (CRP) and joint land management practices have protected White-tailed deer. An increase in conservation program enrollment has been largely responsible for the growth in deer populations throughout the 1990's (Bangsund, 2013). However, a decline in participation is threatening the long-term stability of deer populations (Grovenburg et al., 2011). This paper will introduce the major threats against the White-tailed deer, including habitat loss, disease, and predation. Conservation programs will be highlighted in an effort to link habitat availability to White-tailed deer ecology. The final goal of this work is to advise land owners and property owners on sound management strategies for maintaining robust populations of White-tailed deer.

Threats to Deer

One of the most significant threats to the status of White-tailed relates to human expansion and overhunting. In 1950, there were approximately 2.5 billion people on Earth. In 2050, there will be a projected 9 billion; urbanization and population growth forces human presence on surrounding animals (prb.org). The creation of parking lots, residential communities, and clear-cut areas diminishes natural habitat for deer and influences the ecology of the animals within that community (Grovenburg et al., 2011). The early 20th century saw unregulated hunting nearly wipe-out populations of deer entirely in states such as Wisconsin (Rooney, et al., 2001). The success of regulated hunting and conservation practice has allowed for deer populations to stabilize

and even grow; historical deer densities have even surpassed pre-settlement figures in Northern Wisconsin (Rooney, et al., 2001). Deer numbers can double every two years under optimal conditions (Rooney, 2013). State resource departments have been able to work with biologists to develop and implement hunting programs supportive of deer populations. Bag limits and gender-based tags have allowed for selective culling of deer herds (Williams et al., 2012), reducing the impact modern hunting has towards the long-term stability of deer populations.

Modern agriculture directly threatens White-tail deer through the loss of habitat, even though it can provide a food source for local White-tailed deer (DePerno et al., 2003). The United States has vast, fertile plains that provide ideal growing conditions for a variety of crops. Yearly total acreage devoted towards crop production has been on the rise as the price for soybeans and corn are driven by the demand for bio-fuels (USDA.gov). Domestic corn production increased by 4.9 million hectares between 2005 and 2009 (USDA.gov). Preparing land for agriculture can result in deforestation, the removal of grasslands, or clear-cutting thickets. These natural layers of habitat play an important role in keeping the local biome balanced. Ecosystem disturbances can result in significant changes for White-tailed deer and other organisms occupying that ecological web (Rooney et al., 2001).

As with any other ungulate (hoofed mammal), there are also pathological threats to the White-tailed deer. One of the most acute and prominent, Chronic Wasting Disease (CWD), is capable of wiping out or significantly reducing deer herds in a single season. Chronic Wasting Disease is a progressively fatal, degenerative disease of the nervous system that is caused by abnormal isoforms that take host to a normal cellular protein, or Prion Protein (PrP) (Edmunds et al., 2016). Positive deer have shown to have a 450% increased yearly mortality rate, with males showing a higher affinity for infection (Edmunds et al., 2016). This pathogen is thought to be transmitted through body fluid and shared food and water sources. Symptoms for infection can be sudden weight loss (wasting), loss of survival instincts and fear towards humans, lack of coordination, and drooping head or neck (CDC.gov). Property managers and land owners should regularly monitor local deer herds for symptoms so any outbreaks can be reported to local wildlife officials. Diversification of habitat and shared water/food sources lowers the risk of contact transmission for Chronic Wasting Disease (Edmunds et al., 2016).

Wasting Diseases are not the only illness that can plague deer populations: Epizootic Hemorrhagic Disease is derived from a viral pathogen; it is acute, contagious, and fatal for White-tailed deer. Related to "Blue Tongue Disease", EHD causes uncontrollable hemorrhaging in the tissue of the mammal. The biting fly, or midge, is the insect responsible for being the host vector. Prolonged drought and dry periods can result in higher infection rates as limited water sources concentrate deer movement (Missouri Department of Conservation). Disease outbreaks caused by the midge fly can be addressed by land owners; stable water sources and preservation of riparian habitat can aide in limiting seasonal fly outbreaks.

Lyme disease is the most reported vector-borne disease in the United States (Pennsylvania Game Commission). Spread to humans by the Deer Tick, the disease is named after Lyme Connecticut, the location of the first major outbreak. Twelve states in the northeast region of the U.S. account for 95% of reported Lyme Disease cases, showing the correlation between deer tick populations and confirmed cases of the disease (Pennsylvania Game Commission). Although deer provide the host blood for nymph ticks to develop into adults, they do not host Lyme disease. As a misconception, humans have directly targeted White-tailed deer and specifically aimed to reduce populations in urban zones (Sandberg et al., 1992). The stigma as being a disease carrier has negatively impacted the White-tailed deer. Populations, particularly in the Northeastern United States, have been most directly impacted by campaigns to reduce deer presence and the perception of risk for human contact with Lyme Disease. While White-tailed deer are needed to continue the life cycle of the tick, they do not carry the bacteria; reducing deer numbers does not reduce the risk of Lyme Disease (Tamara Awebuch, Department of Global Health and Population at Harvard School of Public Health) (Johnson, Rachel, 2010).

In addition to intentionally harvesting deer with hunting, humans also accidentally kill deer with motor vehicles. In 1980, an estimated 200,000 deer were killed from vehicle collisions in the United States (Federal Highway Administration). For the year 2008, the Federal Highway Administration estimated between 1-2 million vehicle and large animal collisions occurred, with as high as 90% of those reported involving deer (Federal Highway Administration). In 1991, approximately 538,000 deer were killed on the roadways based on a 36 state survey (Romin and Bissonette, 1996). The true figure of deer killed by vehicles is something that will remain conjecture as an estimated 50% of wildlife collisions are formally reported (Romin and Bissonette, 1996). Eighty-nine percent of

wildlife vehicle collisions occur on two lane roads, with the highest rate of occurrence between the hours of 5-9 a.m. and 4-12 p.m. (Federal Highway Administration). Accident locations have been associated with transitions in landscape or cover. Roads bordering riparian habitat, thickets, and food sources can be identified as areas at greatest risk (Federal Highway Administration). Mowers and tractors have been known to kill fawns in summer months as they nest in desirable protected grassy-cover. Inserting wildlife crossing barriers at roadways and refraining from mowing in summer are practices that landowners can implement to protect populations of White-tailed deer.

Conservation Programs

Although humans pose a significant threat to White-tailed deer, there are also conservation programs that we have implemented to combat habitat loss and degradation, protecting deer. In 2010, an estimated 30 million White-tailed deer occupy the United States. 100 years ago, deer were on the verge of complete eradication with extinction in states such as Kansas and Indiana (Rooney, 2010). Conservation law enforcement, predator control, deer re-introduction, and conservation Reserve Programs (CRP) played a major part in population recovery efforts. CRPs are organized efforts between the government and land owners designed to improve the quality of habitat and natural resources in a region. These programs, along with the stringent regulation of hunting, have worked to re-vitalize deer populations across the entire United States (Grovenburg et al., 2012). While the original conservation programs administered by the United States Department of Agriculture (USDA) were originally aimed to address water quality, they have evolved to address other environmental concerns such as soil erosion, deforestation, and loss of grasslands (Grovenburg et al., 2007). As a result, white-tailed deer have become the beneficiary to these programs as they protect the preferred habitat needed for daily living.

Most current conservation programs offer a per-acre rental fee paid to farmers who enroll (USDA.gov), ensuring their land will not be devoted for agriculture. This payment is designed to be beneficial for both parties: the government regulates private lots that might be at risk for soil erosion or water source contamination. Land owners benefit financially, while also giving their croplands needed rest from farming. The most competitive payment rates have historically occurred on larger tracts of land that are at risk for soil erosion or water contamination (USDA.gov). Conservation programs address the needed variations in cover-type for a local

ecosystem that compose preferred white-tail habitat, including grasslands, hardwood forests, riparian areas, and uncut thickets.

"Grassroots" and other water-source protection programs have been implemented by the USDA to reduce the contamination of surface and ground water for consumption by humans and wildlife alike. Full time water service technicians are contracted with members of the National Resource Conservation Service (USDA.gov) to identify properties located near natural wells, streams, or water tables. This program identifies target areas of protection (near natural wells and water sources) by sending surveyors that provide a risk assessment analysis for water contamination and erosion. Having a clean water table protects riparian habitat; parcels located near water provide particularly important habitat for white-tailed deer, especially during breeding season (Edmunds et al., 2011).

Land owners selected states can enroll in hardwood tree planting programs. Hardwood forests support bio-diversity, prevent soil erosion, and provide aesthetic value and economic value to land tracts. To qualify for one of these programs, the farmer must prove their land has been in active agriculture the past 4 of 6 years (NRCS Michigan, 2013). Below is an example of listed trees that were approved for planting in Michigan by the Natural Resources Conservation Service Program for the year of 2013:

Basswood
American Beech
Yellow Birch
Black Cherry
Cottonwood
Bittnernut Hickory
Shagbark Hickory
Shellbark Hickory
Pignut Hickory
Sugar Maple

Black Oak
Bur Oak
Northern Red Oak
Pin Oak
Swamp White Oak
White Oak
Yellow Poplar
Sycamore
Black Walnut

In addition to the list of approved species, land-owners must conform to other regulations designed to ensure quality and conformity of plantings. Each cover-type is graded and mast-producing trees might have to be added in order to abide by local field office regulations. Planted areas must be appropriately weeded and protected from damage by wildlife during the early stages of growth. These regulations ensure habitat quality and act is a protection mechanism for deer habitat. In addition to providing basal area for shelter, as well as cover from predation for White-tailed deer (DePerno et al., 2003). These protected forests influence deer ecology through several means. As a food source, deer select premium foraging options contained within forests, including higher calorie shoots, growth, and mast (DePerno et al., 2003). Oaks trees play a role in carbohydrate deposition for white-tailed deer heading into traditionally lean winters. Understory vegetation provides readily available browse for ungulates and includes plants such as juniper, spiraea, and native berry plants (DePerno et al., 2003). Sapling, bush, and shoot growth are influenced by taller hardwoods that dictate canopy growth. As a result, deer have a variable and potentially expansive home range depending on available browse, suggesting forests play a role in seasonal movement patterns. Planting hardwood forests can support ecosystem biodiversity, increase the economic desirability of land, while potentially providing income for enrolled managers.

Conservation Enhancement Programs conduct surveys and determine areas that are at risk for deterioration or environmental decomposition (FSA.USDA.gov). As an incentive to enroll acreage in the program,

farmers are paid a variable annual rental rate that increases with inflation. Conservation Reserve Enhancement Programs (CREPs) provide the highest rates of reimbursement per acre since the government seeks to regulate the areas with environmental concern as a priority. Land owners can use CREPs to earn money when the their land is not suitable for agriculture, or needs a break from being farmed. Land contracts typically take place for 10-15 year increments, giving deer and other wildlife that live on the property long-term stability (FSA.USDA.gov).

The United States Department of Agriculture encourages the continuous enrollment of CRP land through the use transition programs. When the enrollment contract period is expired, land owners have the chance to earn two additional years of payments; the stipulation is property must be rented or sold to an individual who will also participate in a conservation program (USDA.gov). Essentially operating as a referral system, transition programs contribute to the current and future state of conservation by locking land contracts into subsequent periods. Transition programs halt the development of new agricultural fields and work to slow deforestation and excessive clear-cutting, two practices that can negatively impact white-tailed deer survival rates.

Conservation programs have been an integral part of US agricultural cropland management since the mid 80's (Bangsund et al., 2004). Thirty-seven percent of farm operators had CRP contracts or enrollment in place during the year of 2001, with 36% receiving reimbursement, indicating the financial significance of these programs. Since the 2000's, however, CRP enrollment has been trending on the decline. Thirty-three million hectares in 2001 was reduced to 29 million in 2012. Land enrolled in CRP peaked at 14.9 million hectares in 2014. New yearly enrollment of land went from 7 million hectares in 1998 to under 1 million in 2014 (USDA.gov). The loss of new enrollment and decline in the number of participating landowners are threatening deer populations as preferred habitat is destroyed for agricultural production. White-tailed deer rely on conservation and their long-term survival is dependent on these programs staying relevant.

Ethanol and alternative fuel sources have worked to increase the demand for corn and soy. The rising prices for these crops have incentivized land-owners to devote larger portions of land towards agriculture. To further compound the issue, there has been legislation passed that is driving agricultural production. The Open Fuel Standards Act of 2011 (H.R. 1687) requires a certain percentage of light-passenger vehicles to operate on alternative fuel sources. Congress has also authorized tax credits for organizations that use Alternative Fuel

Vehicles (AFVs), further incentivizing companies to utilize alternative energy sources that are created through agriculture (AFDC.gov). The demand for corn and soybeans has led to a downfall of preserved habitat as a protection mechanism for White-tailed deer, although they do benefit from the crops as a food source.

Deer Ecology and Natural Habitat

Conserved habitat is important for a variety of reasons when it comes to deer ecology. Unaltered cover provides a higher concentration of preferred bedding, feeding, and socialization locations (Grovenburg et al, 2011). An increase of habitat for the White-tailed deer is largely responsible for explosive growth in overall domestic population throughout the 1990s (Bangsund et al., 2004). Habitat modification, the reduction of predators, and an abundance of food have acted to boost populations of White-tailed Deer to historical peaks. Communicatory behavior, feeding patterns, and travel routes are unaltered in natural ecosystems, allowing deer to reproduce and populate smaller home ranges when food sources are available. Grasslands, hardwood forests, thickets, swales, and dense underbrush compose some of the growth known to influence deer movement and behavior; a study of home ranges indicated that an increase of distance travelled by deer is associated with a reduction of grasslands in that area (Grovenburg et al., 2011). Habitat and nesting selection has been documented to be significantly higher in desirable, protected sites providing thermal, vertical, and basal cover. Since deer movement is influenced by habitat availability so heavily, they are susceptible to influence from even subtle ecological shifts.

White-tail neonates or newborns are particularly vulnerable during the early stages of life. Because neonates rely on vertical structure for thermal insulation and concealment from predators such as coyotes or fox (Huegel et al., 1986), a shift of home range area from CRP to wheat may lead to greater neonate mortality in partitions of habitat (Grovenburg et al., 2012). Vertical concealment, an important cover-characteristic for deer, can be defined as bushes, saplings, or other undergrowth that obscures sight lines from predators (Grovenburg et al., 2012). Thermal cover is defined as vegetation or land features that shelter the threat of direct elements such as extreme weather or precipitation. Sapling density and basal area are two forest characteristics that provide visual obstruction for newborns. River-bottoms, swales, and thickets are found in natural land features and protect local deer from harsh elements when needed. Unaltered habitat works to provide ideal bedding sites for newborns,

suggesting these environmental factors work together as a protective mechanism for deer, especially during (when the risk for predation is greatest) (DePerno et al., 2003).

White-tailed deer females search for areas to birth their young, preferring thick vegetation that adequately hides and protects neonates from predators. The availability of cover and other forest characteristics has been directly correlated to survival rates (Grovenburg et al., 2012). When females select neonate bedding sites, they prioritize cover that provide ample vertical and thermal shelter. Vertical cover protects the new-born from the sight-line of predators. Thermal cover protects deer from the raw elements of wind, precipitation, and solar radiation. Deer bedding sites have been documented to have a greater basal area (diameter of trunks and stalks) and increased height of visual obstruction (DePerno et al., 2003). Deer will select and occupy areas that provide ample vertical cover from predators, thermal cover from the elements, and food sources for year-round use. Neonate survival is directly linked to the availability of protective cover and preferred nesting habitat.

Natural partitions of habitat are heavily travelled by deer and utilized as a socialization platform. White-tailed deer communicate through a detailed sense of smell and glandular marking; their surrounding environment is not painted through visual, but rather olfactory senses (Hewitt, 2011). White-tailed deer utilize plants, shrubs, saplings, and the terrain inhabiting the local biome to scent mark. Particularly important during breeding season, bucks travel large tracts of land to scent check and locate receptive does nearing reproductive availability. Prior to mating season, starting in the summer months, bucks mark their territories and release aggression on saplings. By rubbing their antlers and glands on small trees, males use plants as a platform for glandular communication. Females urinate on patches of leaf litter and soil to let males in the area know their stage of sexual availability. White-tailed deer have shown an inclination to mark softer woods such as pine that are more easily destroyed (Hewitt, 2011). Saplings are not only used to shed yearly velvet growth, but also as a means for salivary communication via licking branches. Small windows of reproductive availability encourage white-tailed deer travel large distances in a short span of time to find mates. River-bottoms, draws, swales, and bottle-necks are highly traveled tracts that concentrate deer movement and play an important part in deer behavior and socialization (Deperno et al., 2003). Thick cover areas, consisting of natural habitat, bushes, and dense forests provide the ideal platforms for communication between White-tailed deer (Hewitt, 2011).

The Importance of Deer

Deer are important to other animals, plants, and humans. Ungulates (hoofed mammals) alter the forest composition by direct and indirect mechanisms. Directly, sustained browsing pressure can limit the generation of preferred woody or herbaceous plants. The average deer can eat over 1,000 pounds of vegetation a year, significantly altering the local ecosystem (Rooney, 2010). Deer create patches of nutrients through defecation and urination, while spreading seeds and parasites (Persson et al., 2000). Through trampling vegetation, deer mechanically influence the physical structure of their surroundings, even shifting forest composition from conifer to hardwood, accelerating mineralization rates of the forest floor (Frelich and Lorimer, 1985). Indirect effects are a result of tropic cascades or physical habitat modification (Rooney et al., 2003). The concept of trophic cascades applies when deer suppress the availability of certain species, creating a void for the next plant to rise from the process of herbivory (Rooney et al., 2003). Deer interact regularly with flora through browsing, ultimately influencing abundance, while acting as keystone herbivores to restructure ecological communities (Rooney et al., 2003). Deer live in a symbiotic relationship with their local ecosystem and play a vital link in the chain structuring the local biome. Keeping robust populations of deer is in the best interest of plants, animals, and land managers looking to provide balance to the biological web occupying their property.

Besides providing value towards the ecosystem they live within, deer also provide benefits to the local human economy. Licenses and tags generate millions in revenue for state conservation agencies, seasonally boosting small businesses and providing year-round employment at state agencies and extension programs. In 1996, hunting generated an estimated 700,000 jobs nationwide with an economic impact of 61 billion (California Department of Game and Fish). Generated profits are in turn re-invested into maintaining and developing new or existing conservation programs. Rural communities are those most impacted by deer and small businesses are sustained by seasonal hunters paying for food, lodging, and gear. Deer are an ecological commodity and stable populations boost the economy of the surrounding area.

Land Owner Recommendations

White-tailed deer are facing a continued battle unless conservation management practices continue to be employed. Loss of preferred habitat, agriculture, disease, and human influence can be mitigated with simple land management practices:

- Search and register for conservation programs to facilitate breaks in active agriculture. Landowners can determine what programs are available in their region and utilize those that address the individual needs of their property. The Farm Service Agency and United States Department of Agriculture both provide program lists that can be assessed through a public domain (http://www.fsa.usda.gov).
- In order to preserve the health of the local deer herd, land owners must monitor for deer disease. Becoming familiar with common pathogens and symptoms will assist in identifying and quarantining outbreaks and at-risk years. Local game and fish agencies post public lines for reporting suspected disease; landowners should also call these numbers to report wildlife vehicle collisions. Deer fatalities on the roadway need to be identified so yearly population estimates can be accurately represented.
- Riparian habitat and thick cover-sites should be given extra levels of protection by land managers. These partitions of habitat provide not only needed clean water, but also act as a primary staging area for deer communication, travel, and nesting. Cover type on a property should be diversified as each section of habitat provides value and alternative use to the white-tailed deer. Managing cover and forage on land can work to protect vulnerable deer nesting and bedding sites. By providing variations in cover-type, land managers can ensure they are reducing neonate mortality rates, while providing forage for seasonal use by the white-tailed deer (Gould and Jenkins, 1993). Where possible, water sources, grasslands, thickets, hardwood forests, and other parcels of habitat should be managed simultaneously. Land owners should know that grasslands and thickets are most important to nesting white-tailed deer during fawn-rearing periods. Identifying variations in cover type will aide land managers in controlling white-tailed deer populations.

- Where urban roads meet rural communities, land-owners should consider wildlife barriers such as fences or subterranean crossways. These can help to reduce deer-vehicle collisions and can be a low-cost solution for protecting life. Wildlife crossing areas can be identified and appropriately marked with roadway signs to notify approaching motor vehicles.
- Tractors and other agricultural equipment kill nesting fawns every year; agriculturalists should refrain from mowing and clear-cutting practices during summer months, when neonates are not yet developed enough to evade threats. If mowing is performed, it should be segmented and there should be portions left of untouched standing cover (Gould and Jenkins, 1993).

Research Limitations and Restraints

There are research limitations when evaluating studies that analyze animal populations and natural ecosystem disturbances (Guidice and Haroldson, 2007). There is limited information available regarding summer resource selection for White-tailed deer (Odocoileus virginianus). In addition to the difficulties present while evaluating ecological processes, providing accurate population estimates proves challenging (Guidice and Haroldson, 2007) due to the nature of survey design. It is also difficult to appraise the value or environmental susceptibility of land. While parcel size and resource availability can be easily identified, the influence a section of property has on the surrounding ecosystem is difficult to interpret. As a result, each land-owner has their own prioritization of resources and ideals when it comes to managing resources.

Conclusion

Deer and other wildlife subject to influence from ecosystem shifts and disturbances face growing threats in the 21st Century. As humans expand in population, the demand for resources drives land development for agricultural and personal use. This destruction of natural habitat results in a loss of preferred living space for white-tailed Deer (Odocoileus Virginianus). As habitat is destroyed, white-tailed deer ecology is negatively impacted, ultimately influencing mortality and survival rates for these animals. In addition to loss of habitat, the white-tailed deer shows susceptibility to pathogens that can be transmitted through prion disease or insect vectors. Regulated hunting, predators, and motor vehicle collisions further drive down populations of

White-tailed deer. Conservation Programs have been an important part of rebounding deer populations across the United States. Land owners can participate in programs and other conservation practice that reduce the risk for deer disease and support a healthy biological web on their property. By managing variations in cover-type, habitat is diversified, and complex ecological communities can be preserved along with the stability of the local tropic web. By planting hardwood forests, land-owners provide food and cover for animals. Diversifying water sources on a property can work to reduce the threat of disease and soil erosion. Selected cutting or burning can work to regenerate thickets, however, should be done to avoid neonate nesting periods in the summer months. Leaving portions of unaltered habitat can work to preserve species biodiversity, while also generating valuable vertical and thermal cover for animals seeking protection. Farmers can participate in regulated hunting to control populations and sexual ratios of white-tailed deer. Habitat bordering roadways should incorporating wildlife-crossing barriers where appropriate to mitigate the risk of wildlife vehicle collisions.

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