MARYLAND WHITE-TAILED DEER MANAGEMENT PLAN

2020–2034

EXECUTIVE SUMMARY

White-tailed deer (*Odocoileus virginianus*) are one of Maryland's most recognizable wildlife species. Wildlife-watchers, photographers and hunters contribute millions of dollars each year to the state's economy while pursuing deer, but, unfortunately, deer are also responsible for millions of dollars in damages annually to automobiles, agriculture, landscaping and young forests. The Maryland Department of Natural Resources (DNR) is charged with managing white-tailed deer in a way that balances the interests of those who support hunting as a management strategy and those who suffer economic loss from deer against the interests of outdoor enthusiasts who enjoy experiencing deer in the wild. Finding common ground and sustainable population goals that reasonably satisfy all stakeholders is a challenging and complex process. In response to this need, the department created the first deer management plan in 1998 to help guide deer management. The plan was revised in 2009; this document represents the second revision and will guide deer management through 2034.

White-tailed deer were plentiful in Maryland at the time of settlement in the 1600s. However, market-hunting and habitat loss nearly extirpated deer from the state by 1900. The early 1900s through the 1960s was a period of population restoration and deer proliferated due to ideal habitat conditions and the protection of female deer from harvest. By the 1980s, management philosophies across much of the state changed from restoring deer to stabilizing and reducing deer numbers.

Active management of deer is a necessity today to maintain population levels that are compatible with the varied interests of the citizenry of the state. As an evolutionary prey species, deer exhibit a high fecundity rate, enabling them to rapidly increase in number. Presently, non-lethal management techniques (such as contraceptives and sterilization) and non-hunting mortality (disease, injuries and predators) are not sufficient to maintain deer populations at satisfactory levels. Lethal control of deer via regulated hunting remains the most effective way to balance the deer population with environmental and cultural concerns on a landscape scale. However, lethal control of deer is not always feasible in the densely populated urban areas of the state. As a result, the Maryland deer plan addresses non-lethal deer management concepts and promotes their investigation and use to complement hunting and other lethal strategies so that the department may implement a full suite of management options statewide.

Along with addressing the use of lethal and non-lethal management, the deer plan documents the history of white-tailed deer and management in Maryland. It describes the current population status of white-tailed deer and hunters in the state and covers the positive and negative impacts of deer. Finally, the plan documents the responsibilities of the deer management program and outlines five major goals (Population, Education, Recreation, Damage and Operational Resources) and the underlying strategies and objectives for achieving those goals.

The deer plan is intended to represent the interests of all residents and nonresident stakeholders who have an interest in Maryland's deer population. Therefore, the plan, like previous renditions, was created with extensive input from the public. Outreach efforts included a 40-member stakeholder group who helped guide revision of the plan. The department also worked with the University of Delaware and Responsive Management, Inc., a professional public opinion survey firm, to conduct an extensive public opinion telephone survey. Lastly, public comments were accepted at four public meetings, as well as from letters, email, the internet and phone calls. The 2020–2034 Maryland Deer Management Plan will provide the foundation for all deer management activities and decisions for the coming 15 years.

CONTENTS

INTRODUCTION
Purpose of the Maryland White-tailed Deer Management Plan 6
Plan History and Development
Stakeholder Group Meetings 7
Public Meetings and Comments 7
Public Opinion Survey 7
Status of the 2009 Plan's Goals, Objectives, and Strategies 7
Population Goal 8
Education Goal 10
Recreation Goal 10
Damage Goal 11
Operational Resources Goal 12
Acknowledgements 12

HISTORY OF WHITE-TAILED DEER AND THEIR MANAGEMENT IN MARYLAND
Colonial Era 13
Modern Era 13
Excessive Deer 15
Creation of the 1998 Maryland White-tailed Deer Plan 15
Cooperation Among Management Entities 16
Alternative Management Tools 17

CURRENT STATUS OF WHITE-TAILED DEER AND WHITE-TAILED DEER HUNTERS IN MARYLAND
White-tailed Deer Population Status 18
White-tailed Deer Hunter Population Status 22

RELATIONSHIP BETWEEN WHITE-TAILED DEER AND HUMANS
Positive Impacts of White-tailed Deer 24
Negative Impacts of White-tailed Deer 25
Lyme Disease and White-tailed Deer 26
Biological and Cultural Carrying Capacities 26

MARYLAND WHITE-TAILED DEER MANAGEMENT PROGRAM
White-tailed Deer Population Regulation
White-tailed Deer Harvest 27
White-tailed Deer Harvest Regulations 30
Deer Management Permits 30
Deer Cooperators 32
Letters of Authority 32
Managed Hunts 32
White-tailed Deer Fertility Control Studies 33
Venison Donation Programs 35
White-tailed Deer Population Monitoring
Mandatory Deer Harvest Check-in 35

Biological Data Collection (Butcher Shop Surveys) 36
Deer Population Modeling 36
Annual Hunter Mail Survey 36
Annual Archery Hunter Survey 37
FLIR Surveys 37
Hunter Pressure Surveys 38
Scientific Research Studies 38
Disease Surveillance 38
Winter Mortality Surveys 38
Wildlife Response 39
Information and Education 39
Addressing Constituent Demands
Provide Recreational Deer Opportunities 39
Reduce Deer Crop Damage 40
Reduce Deer-vehicle Collisions 41
Reduce Urban/Suburban Deer Conflicts 41
Continue to Investigate Non-lethal Deer Control Methods 42
Other Management Activities
Captive Deer 42
Fawn Rehabilitation 43
Shooter Qualification Program 44

GOALS, OBJECTIVES AND STRATEGIES
Population Goal 45
Education Goal 48
Recreation Goal 49
Damage Goal 52
Operational Resources Goal 55

LIST OF FIGURES

Figure 1. Estimated statewide white-tailed deer population, 1988–2018 19
Figure 2. Maryland deer management regions, 2018 20
Figure 3. Estimated Region A white-tailed deer population (excluding all of Washington County), 1988–2018 21
Figure 4. Estimated Region B white-tailed deer population (including all of Washington County), 1988–2018 22
Figure 5. Maryland hunting license sales, 1940–2018 23
Figure 6. Maryland white-tailed deer harvest, 1927–2018 28
Figure 7. Maryland white-tailed deer harvest (%) by season, 1994–2018 29
Figure 8. Maryland Deer Management Permit (DMP) deer harvest, 1990–2018 31

LIST OF APPENDICES

Appendix 1. White-tailed deer biology 56
Appendix 2. 2020–2034 White-tailed Deer Management Plan stakeholder group participants 58

Appendix 3. Maryland Residents', Landowners', and Hunters' Attitudes Toward Deer Hunting and Deer Management, Executive Summary 59
Appendix 4. Deer management options and their advantages and disadvantages 84
Appendix 5. Common white-tailed deer diseases and ailments 87
Appendix 6. Summary of public comments regarding the draft 2020–2034 Maryland White-tailed Deer Management Plan 91

LITERATURE CITED 92

INTRODUCTION

White-tailed deer (*Odocoileus virginianus*) remain one of the most recognizable and well-known wildlife species in Maryland. They are admired by wildlife watchers who enjoy their gracefulness and by hunters who enjoy their wariness. At the same time, they negatively impact the economic livelihood of Maryland farmers, arborists, motorists, and general citizenry. Although white-tailed deer represent the preeminent example of bringing a species back from the brink of extinction, their continual over-abundance in many areas have posed decades-long threats to natural forest ecosystems and to other wildlife species.

Divergent opinions and interests concerning white-tailed deer present significant management challenges to the Maryland Department of Natural Resources ('DNR' or 'the department'), the state agency responsible for managing Maryland's wildlife. Establishing deer population goals to satisfy a myriad of constituents and finding a balance between lethal and non-lethal deer control methods remain two of the many challenging aspects of managing deer in Maryland today. This 15-year plan documents the goals and objectives put in place in previous plans to address these issues and many others related to managing this charismatic species in Maryland.

Purpose of the Maryland White-tailed Deer Management Plan

The Maryland White-tailed Deer Management Plan ('the deer plan') documents the history of white-tailed deer and white-tailed deer management in Maryland (information on basic white-tailed deer biology can be found in Appendix 1). It also describes the current status of white-tailed deer in Maryland and the positive and negative impacts of the species. Finally, the plan documents the responsibilities of the department's deer management program (i.e., deer project) and other department staff as they relate to white-tailed deer management, and outlines the goals and objectives for Maryland white-tailed deer management through 2034. It is important to note that this plan is a strategic plan and not an operational plan that identifies specific management details. Management details, such as changes to hunting seasons and bag limits, are addressed biennially by the department through regulatory changes and include their own public/stakeholder input process.

Plan History and Development

Maryland's 10-year white-tailed deer management plan was instituted in 1998, and revised for the first time in 2009. The plan was originally created in response to growing conflicts between humans and deer in many parts of the state. Unfortunately, many of those conflicts that existed in 1998 and 2009 still exist today and much of the plan has remained relevant since its inception.

With the second revision of the deer plan set to expire in 2018, the review process for the third revision of the plan began in 2017. Like the previous versions, the department incorporated stakeholder and public input into the current revision. Comments, suggestions and opinions were collected from stakeholder meetings and four public meetings, as well as telephone, internet, email and mail communications (over 850 public comments were received). Likewise, a public opinion survey of 2,200 Maryland residents (800 from the general public, 800 deer hunters and 600 landowners) was conducted, in cooperation with the University of Delaware and Responsive Management, Inc. to solicit opinions on current deer management issues. Finally, expert opinions from department staff were vital in crafting the final plan.

Stakeholder Group Meetings–The stakeholder group was comprised of individuals representing 27 different deer special-interest groups across Maryland. Representation included: animal welfare, equestrian, farming, forestry, government (county, state, federal), native plant protection, outdoor recreation, sportsmen, and university. Members of the DNRWildlife Advisory Commission were also stakeholders. A list of the interest groups can be found in Appendix 2. Stakeholders were convened for three meetings. At the first two meetings they aided in identifying major deer management issues that needed to be addressed in the plan and identified areas of the previous plan that could be modified. At the third and final meeting, they were given the opportunity to comment on a final draft of the plan that was provided to them prior to the meeting.

Public Meetings and Comments–Four public meetings were held across the state in 2019 to obtain public feedback concerning deer and deer management. Attendance ranged from 27 people in La Plata to 75 people in Owings Mills (34 people attended in Wye Mills and 35 people attended in Frostburg). Attendees were given a short presentation regarding the status of deer and management in Maryland, and then given the opportunity to provide comments/suggestions at work stations manned by department staff. Each station represented a deer management category, and attendees could visit each station to provide comments. Stations included the following categories: (1) Deer Population Management, (2) Suburban/Urban Deer Management, (3) Deer Hunting Seasons and Bag Limits, (4) Deer Diseases and Other Topics. The department received over 850 comments via the public meetings, internet, email, telephone and mail regarding deer and deer management in the state. Urban/suburban deer issues and agricultural damage from deer were common complaints.

Public Opinion Survey–Like previous iterations of the deer plan, the department contracted to have a professional public opinion telephone survey completed. The University of Delaware, in conjunction with Responsive Management, Inc., conducted the survey in 2018 (Responsive Management 2018). This survey provided needed information about public perception regarding deer and management in Maryland, and how it may be changing over time. A total of 2,200 Maryland residents (800 from the general public, 800 deer hunters and 600 landowners) were surveyed. The allocation of surveys mirrored the process used for the 1998 and 2009 plans and permitted comparison of results between the surveys. Sampling from the three major groups ensured the opinions of all Marylanders were equally represented. Responsive Management also provided additional analysis of the general public group by separating the hunters from the non-hunters to identify differences in opinions regarding deer management for these groups. Overall, opinions regarding deer and deer management have not changed appreciably over the past 20 years in Maryland. The Executive Summary from the survey is available in Appendix 3. The entire report is available online at the department website.

Status of the 2009 Plan's Goals, Objectives, and Strategies

Maryland's 2009 deer management plan built on the plan before it and contained five broad, long-term goals:

- Population Goal: Use diverse and progressive methods to ensure the long-term viability of Maryland's white-tailed deer population through comprehensive research, efficient monitoring, public outreach, trained staff and effective management;

- Education Goal: Educate Maryland citizens on all aspects of deer biology, including management tools, disease issues, economic aspects and recreational opportunities;

- Recreation Goal: Provide the opportunity for all citizens to safely, fairly and ethically enjoy diverse deer-related recreational experiences and traditions consistent with established deer population trend goals;

- Damage Goal: Identify and actively address the negative impacts the deer population has on human interests and the ecosystem in a manner consistent with the long-term viability of the deer population in Maryland; and

- Operational Resources Goal: Ensure that all necessary resources are available to support the proper management of white-tailed deer in Maryland.

These goals effectively addressed the diverse requirements of managing deer in Maryland and they remain largely unchanged for the 2020–2034 plan. Likewise, most of the goals' identified objectives and strategies in the previous plan are still relevant and included in this plan. In that way, this plan can and should be viewed as a continuation of the previous plan, with updates where needed.

During the past 10 years the department has implemented or continued with most of the objectives and strategies identified in the previous deer plan. A brief synopsis of major activities under each goal follows:

Population Goal–For the population goal, the department largely continued with aggressive deer population control methods for much of the state in order to stabilize and reduce the population during 2009-2018. Lethal harvest via regulated hunting remains the most effective method for managing deer. The department also continued the Deer Management Permit (DMP) system, primarily for agricultural producers experiencing deer damage, and the Deer Cooperator Permit (DCP), which authorizes sharp-shooting deer in problem areas. The deer cooperator permit was expanded to include agricultural areas, enabling permitted farmers to shoot deer at night to reduce crop damage. Also during the last 10 years, numerous public properties were acquired and opened for deer hunting to help control deer numbers.

Along with providing ample opportunities to harvest deer, the department continued focusing harvest on antlerless deer. Seasons and bag limits remained structured to prioritize female harvest, and outreach materials, including press releases and web information, stressed the importance of antlerless harvest to help maintain deer numbers. The antlerless portion of the annual harvest remained at 60% or above for the duration of the plan period.

To monitor the population status, the deer project began using antlered harvest per square mile as one metric and continued using an overall annual population estimate generated with a modified reconstruction model (Lang and Wood 1976; Downing 1980). Mandatory deer check-in, implemented in 1927, has remained a foundational block for being able to use these trend metrics to monitor the deer population. During the past 10 years, the electronic hunting license and deer check-in system was modified so each hunter, including landowners, is assigned a permanent

identification number. This change greatly improved the accuracy and efficiency of the electronic check-in system for monitoring the deer harvest.

To date, the deer project has not established county-specific deer population trend goals; doing so continues to remain challenging due to significantly varying opinions on how deer should be managed and at what population densities. The department continues to use both biological and cultural inputs when making management decisions about the deer population. However, the deer project will continue to investigate implementing county trend goals.

During the past 10 years the department has also continued to support and investigate non-lethal deer management techniques. This has primarily involved research projects aimed at limiting fertility in female deer. Some of these studies date back to the creation of the first deer plan in 1998. The department approved the use of one U.S. Environmental Protection Agency-certified deer contraceptive (GonaCon) for management purposes, but it has never been used in the state. Instead, in recent years, the focus has shifted from birth control using contraceptives to, instead, permanently sterilizing female deer. The department has cooperated on several sterilization research projects and will continue to cooperate on non-lethal deer management research in general.

The deer project also continued monitoring the effects of known deer diseases in the state. Epizootic hemorrhagic disease occurs annually and, in some years, can cause significant mortality in localized areas. However, deer populations rebound quickly. The department also monitored the incidences of brain abscesses in deer, which are reported less frequently. The deer project cooperates with various universities and institutions that study and monitor deer disease.

Unfortunately, it was during the span of the last deer plan that chronic wasting disease (CWD) was discovered in Maryland. The disease was detected in West Virginia near Allegany County in 2005, and then found in Maryland in 2010. The department randomly tests 500-1,000 hunter-harvested deer for the disease annually, primarily in Allegany and Washington counties where it is presently found. Additional information on CWD is presented later in the plan.

The deer project also continued with its successful urban/suburban deer management program. Staff met with numerous homeowner associations and county/local governments to provide education and support concerning proper deer management techniques. Outreach materials (handouts, website material, presentations, etc.) were developed and revised as needed to explain effective urban deer management.

The advent of social media during the past 10 years enabled the department to increase outreach to its constituents. Many facets of deer management and deer biology were promoted using popular social media platforms and the department webpage. Likewise, constituents continued to utilize the customer service portal to email questions and comments at their convenience. The deer project regularly issued press releases concerning upcoming deer hunting seasons, harvest results, disease testing results, and other deer management related issues. Staff also routinely wrote popular articles for various magazines and gave oral presentations and seminars related to Maryland deer management.

Lastly, during the past 10 years the department experienced stable staffing levels related to deer management. While some institutional knowledge was lost due to retirements, positions were typically backfilled quickly and with qualified individuals. Likewise, training and certifications were routinely conducted to ensure staff were properly prepared.

Education Goal–Outreach and education regarding deer and deer management remained a focus for the duration of the 2009 plan. Staff routinely met with all facets of the public about deer, including hunters, landowners, homeowners, government officials, public land managers, students, and members of the general public. The department's main message promoted the importance and value of deer along with the need for management due to the significant negative impacts they have on some constituents and the environment. Staff routinely discussed the importance of regulated hunting for managing deer numbers (specifically antlerless deer hunting and the value of quality deer management principles), along with the need for non-lethal management in some instances. Deer management topics were addressed using the department webpage, social media, press releases, other print articles, and direct conversations via Powerpoint presentations, telephone, email, and letters.

Recreation Goal–The popularity and overall recreational value of deer remained a primary consideration when making deer management decisions during the 2009 plan period. Deer are one of Maryland's most popular wildlife species and are enjoyed by many residents and visitors. Nearly 25% of Maryland residents reported in a 2018 survey that they frequently or occasionally made trips to specifically observe or photograph deer (Responsive Management 2018). Likewise, based on a hunter mail survey conducted each year by the department, hunters spent a total of 750,000 or more days annually pursuing deer during that period and deer hunters contributed in excess of $220 million annually to the Maryland economy via hunting gear, trips, and associated revenue (Southwick Associates 2012).

Unfortunately, in recent years, the number of days of deer hunting has dropped below the plan's goal minimum of 800,000 days per year. Numerous factors contribute to the decline in days, including fewer deer hunters in the population and reduced effort by remaining hunters due to time conflicts and other factors. Opportunities to hunt deer generally have not decreased due to season and bag limit changes or other actions by the department. The goal will remain to achieve 800,000 days per year for the coming years.

Various changes were made to hunting laws and regulations during the past 10 years to enhance the recreational aspect of deer hunting, which indirectly supported the population and damage goals, and the need to further reduce deer numbers in many areas. During this period, the department regularly supported legislative changes that added Sunday hunting opportunities, which greatly increased the amount of time many hunters had to deer hunt. An Apprentice License was created to recruit new hunters in Maryland. The Apprentice License made it easier to obtain a first hunting license, without sacrificing adequate safety standards. Also, restrictions on the use of crossbows and air-powered weapons were eased during the past 10 years to recruit hunters and offer additional recreational opportunities. Likewise, in some counties, the archery safety zone was reduced from 150 yards to 50 or 100 yards to provide additional access for deer hunting. Regulations were also adopted to allow daylight fluorescent pink safety clothing to be worn in place of daylight fluorescent orange clothing. Optional colors for safety clothing may make deer hunting more attractive to some individuals, aiding with hunter recruitment.

Deer hunting remains a safe, fair, and ethical recreational activity in Maryland, and the department has strived to maintain that status. During the past 10 years, the department has worked with Natural Resources Police to increase opportunities for potential new hunters to take hunter safety classes in order to get their first hunting license. Staff also continued oversight of the shooter qualification program that enables hunters to satisfy the requirement of demonstrating their shooting proficiency in order to participate in managed deer hunts. Lastly, the department supported legislation to significantly increase penalties for deer poaching and created a wanton waste regulation that requires hunters to make a reasonable attempt to retrieve and make use of any deer that they wound or kill.

Damage Goal–While it is a primary goal of the department to ensure adequate recreational opportunities associated with white-tailed deer remain available for constituents, the department is equally charged with ensuring deer numbers are managed at levels that minimize the negative impacts that deer can have. Finding a balance between having enough deer to satisfy recreational demands, but not too many that they cause significant economic and environmental damage, is one of the most challenging tasks the department is responsible for. During the past 10 years, the department has observed a decline in the estimated deer population from approximately 250,000 deer down to about 200,000 deer. In many rural areas of the state, deer numbers are noticeably lower than they were at their peak, but damage complaints are still commonplace, particularly from the farming community. Likewise, in urban and suburban areas where deer hunting is limited, deer numbers remain too high and residents experience significant damage to their properties. The department's goal will remain to minimize all deer damage to the extent possible.

Deer-vehicle collisions, crop damage, and urban/suburban damage (landscaping and yard damage) are the most common complaints the department receives about deer. During the past 10 years, the number of deer-vehicle collisions reported has remained stable (State Farm Insurance, pers. comm.), which, when accounting for the increase in total miles driven during the same time period, suggests that collision rates may have been reduced to some extent. However, collisions with deer still remain a significant issue and the department will continue to investigate methods to reduce them.

Along with deer-vehicle collisions, the department continued to address urban/suburban deer complaints, crop damage issues, and damage to natural habitats. Unfortunately, these complaints became even more commonplace during the duration of the last deer plan. Numerous instructional presentations were given to urban/suburban communities suffering with over-abundant deer, and staff participated with various working groups and workshops addressing urban deer issues. Staff also continued issuing deer management permits to farmers that allowed year-round harvest of deer, and conducted multiple workshops with the farming community to address deer damage. Deer hunting seasons and bag limits remained very liberal throughout the state, and state-owned properties were opened for deer hunting when possible. Staff also identified deer threats to natural habitats, including rare, threatened, and endangered species, and responded accordingly with non-lethal techniques, including fencing, and lethal techniques to directly reduce deer numbers in the affected areas.

The department also continued licensing Deer Cooperators (i.e., deer sharp-shooters) and expanded the program to include agricultural properties. Due to changes in state law, the period for removing deer under a deer cooperator permit was reduced to February-March in all cases,

except those involving human safety (airports, military test tracks, etc.). The department also continued issuing letters of authority to lethally remove deer from airports and other facilities where deer posed a significant human safety risk. However, these letters were rolled into the Deer Cooperator Permit process at the end of the last deer plan.

Lastly, the department closely monitored for any deer-related diseases, including CWD and Lyme disease, in order to provide accurate and reliable information to constituents. This included annually sampling hunter harvested deer for CWD and establishing a management area for the disease. Staff also cooperated on several tick research projects during the plan duration. Select staff were properly equipped to rapidly respond to wildlife emergencies, many of which involved deer, to minimize risks to public health.

Operational Resources Goal–During the last 10 years the department remained adequately staffed and equipped to manage deer. However, the number of hunters in the state continued to decline, negatively impacting the department's primary revenue source (the sale of hunting licenses). Efforts have been made to maximize the acquisition of federal monies available from the Federal Aid in Wildlife Restoration Act ("Pittman-Robertson Act"), but declining license sales places limits on these funds as well.

To counter the decline in hunters, staff were hired specifically to work on hunter recruitment, retention, and reactivation (R3), including an initiative which has been launched department-wide. Outreach and education staff have invested significant effort in creating outreach programs such as a "Deer Hunting 101" course designed to recruit new deer hunters. Similarly, the department offers a "Becoming an Outdoors Woman" program and a mentored hunt program, both of which include deer hunting, to build hunter numbers. These staff also regularly engage the public concerning deer management and produce a myriad of excellent outreach materials for web, print, and hands-on availability, including an educational "deer trunk" that schools can use to educate students about deer and deer management. The trends have now reversed and we are starting to see an increase in licensing sales.

The department also cooperated with universities and used grant monies, when available, to conduct deer research and management projects. Multiple deer-related graduate degree projects were completed during the last 10 years with the University of Delaware, many of which were at least partially funded by university-provided grants. Various other federal grants were also obtained and their use often indirectly benefited deer management.

The department also made limited use of volunteers for deer management activities, including college students. Students from Frostburg University, Garrett College, and Allegany College helped with deer biological data collection in the western part of the state. The department will continue to explore ways to expand the use of volunteers and college students in the future.

Acknowledgements
Appreciation is extended to all members of the stakeholder group and public who took the time to provide comments, suggestions and guidance in development of the 2020-2034 Maryland White-tailed Deer Management Plan. We also appreciate the many constructive comments received from staff, the WAC, and the wildlife professionals who took the time to review this plan.

HISTORY OF WHITE-TAILED DEER AND THEIR MANAGEMENT IN MARYLAND

Colonial Era

When European colonists arrived in the New World, they found numerous white-tailed deer within the fertile North American landscape. Native Americans and large predators, such as wolves and mountain lions, hunted white-tailed deer throughout the year. White-tailed deer provided the eastern Native American tribes with food, clothing, shelter and tools.

Maryland's early colonists soon relied on white-tailed deer for food and clothing as well. The colonists recognized the importance of the white-tailed deer resource and passed a legislative act in 1729 that prohibited the killing of deer between January 15 and July 31. Violators of the law were fined 400 pounds of tobacco for each deer they took out of season.

Unfortunately, the legislative act was not enough to protect white-tailed deer. The demand for deer meat and buckskin increased substantially as Great Britain imported white-tailed deer hides to support their thriving leather industry. The demand was magnified when the European cattle industry suffered an epidemic, thought to be hoof and mouth disease.

At the same time that deer were being exploited for meat and hide, expansive tracts of woodlands continued to be cleared to supply Maryland's growing population with wood for shelter, heating and other products. Deer habitat was being destroyed at an astounding rate and, as towns sprouted across the colonial landscape, unregulated market deer hunting helped to supply the food requirements of the growing Maryland population.

Modern Era

Early deer conservation in Maryland and other eastern states proved inadequate because there was little effort to enforce the few existing conservation laws. By the beginning of the 20th century, Maryland's white-tailed deer survived only in remote sections of Garrett, Allegany, Washington and Frederick counties. Deer hunting season was eventually closed statewide in 1902. In 1916, the Maryland General Assembly created a Conservation Commission to protect and propagate wildlife. The first Maryland hunting license requirement became law in 1918. These licenses provided funds to initiate wildlife conservation efforts for deer and other game species.

Deer conservation efforts during the 1920s focused on creating deer refuges. Relocated Maryland deer and deer purchased from nearby states served as breeding stock within these refuges. These deer soon reproduced and expanded their range into the surrounding habitat. An area near Gwynnbrook (Baltimore County) and the landscape near Libertytown (Worcester County) served as two of these refuges. Some deer naturally moved south from Pennsylvania into adjacent Maryland counties as well. These initial management efforts, coupled with effective law enforcement, resulted in an increase in deer numbers across the state by the late 1920s.

Maryland's deer habitat was improving at the same time that white-tailed deer populations were responding to initial wildlife management efforts. Lands that had been cleared of forests through the 1800s were returning to woodlands. During the Great Depression, modern forestry practices

and soil conservation activities encouraged the planting of trees on marginal farmlands, creating more deer habitat.

Maryland reopened deer hunting in Allegany County in 1927. At least five bucks were taken that season. Garrett County opened two years later with a one-buck bag limit that resulted in nine deer being taken. In 1931, a total of 32 bucks were harvested in Allegany and Garrett counties. The Woodmont Rod and Gun Club in Washington County, a private 5,000-acre deer propagation enclosure, took 26 additional deer that same year.

With the opening of the 1931 deer season, Maryland initiated the first-ever check-in requirements for deer. Hunters were required to register all harvested deer at a designated check station within 24 hours of the kill. This system was used through the 2004 deer hunting season and provided valuable information for the department to use to manage Maryland deer populations. In 2005, the department implemented internet and telephone check-in for deer hunters, and began collecting age, sex, and other needed deer biological data at deer processors and butcher shops. In 2012, the electronic system was further refined and every hunter was issued a permanent identification number (DNRid). This change greatly improved the efficiency and accuracy of the check-in system. In 2015, a smart phone app for check-in was added, making the system even more efficient for hunters and department staff.

During the 1930s, deer from a Pennsylvania game farm were released at Aberdeen Proving Ground (APG), a U. S. Army installation in Harford County. During World War II the APG deer population grew to levels that created a hazard to military operations. State wildlife personnel trapped over 2,000 deer on APG and released them in various locations across Maryland until the early 1960s.

By the mid 1950s, deer relocation efforts and population monitoring using modern wildlife science began to show results. A total of 1,549 deer were taken within seventeen Maryland counties during the 1954 firearm deer season.

The 1950s also spawned the earliest Maryland studies on white-tailed deer biology. State wildlife personnel examined deer that were brought to check stations, recorded weights and estimated ages by examining the teeth. Researchers used the data to monitor the health and density of the deer population across Maryland. That effort continues today at Maryland's statewide network of deer processors.

Based partially on the data that were now being collected, new deer management strategies began to emerge in the 1950s. Prior to that time, deer managers prohibited the taking of does in order to allow for continued herd growth and range expansion. This changed when the first either-sex archery season opened in 1951 in Baltimore and Harford counties. In 1957, antlerless deer were allowed to be taken during firearm season in Wicomico and Worcester counties. Antlerless deer hunting in firearm season was by special permit only and deer biologists limited the number of permits available by county in order to obtain a more controlled growth of the herd.

Through 1969, hunters picked up their antlerless deer permits from state wildlife staff at firehouses across Maryland. By 1972, computers allocated the predetermined number of

antlerless permits for each county and they were issued by mail. As the deer population grew, the requirement for these permits began to dissipate. By 1989, only deer populations in the far western counties required regulation through antlerless permits. Antlerless deer permits were eliminated in western Maryland during the late 1990s.

Excessive Deer

By the mid-1980s, an expanding deer population, coupled with a rapidly growing human population, led to increasing conflicts between deer and their human neighbors. Deer began to damage ornamental landscaping planted by residents of Maryland's new housing developments. Deer bounded in front of commuters traveling between work and home. Deer were also associated, perhaps too strongly, with the increased prevalence of Lyme disease. Deer managers soon realized that the cultural carrying capacity of deer (the deer density that the general public can tolerate) often was lower than the biological carrying capacity (the deer density that the habitat can sustain) and that deer must be managed with consideration for both thresholds.

During this period, agricultural and forest lands were eliminated and residential housing grew in its place. Curiously, white-tailed deer seemed to thrive in their new surroundings. Developers created suburban communities out of dairy farms, woodlands and cropland. Homeowners planted trees and shrubs to landscape their new homes. White-tailed deer found the excellent habitat created by backyard gardens and beautifully landscaped lawns just as desirable as the former ag-forest landscape and quickly created nuisance issues for homeowners.

While the Maryland landscape was being transformed, Maryland's farmers began employing modern farming practices on the remaining agricultural lands across the state. Crop yields climbed due to advances in improved crop varieties and fertilization methods. These superior plants, containing added nutrients, were highly attractive to Maryland's deer herd and the damage to agricultural crops increased.

Ecological impacts from high deer densities were beginning to become apparent on the landscape. Over-browsing of the forest understory was significantly impacting plant diversity and forest regeneration, damaging habitats for many other species of wildlife. Healthy forests are a critical part of a functioning watershed for the Chesapeake Bay so high deer densities can have negative impacts on the water quality of this important natural resource.

Along with creating prime deer habitat, increased development in the suburbs and new homes in the rural areas of the state resulted in reduced hunting opportunities for deer. White-tailed deer population growth accelerated as hunting was eliminated or became more difficult. In response to the perceived safety issues of neighbors and other outdoor recreationists, many local public land managers closed suburban natural areas to hunting. These natural areas began to function just like the deer refuges of the 1920s. Deer herds protected from regulated hunting grew at rapid rates and exacerbated the problems associated with a population exceeding its cultural carrying capacity.

Creation of the 1998 Maryland White-tailed Deer Plan

By the 1990s, Maryland's deer population had exceeded its cultural carrying capacity (or public acceptance level) in many parts of the state. The combination of a growing deer herd and a shift from an agricultural based society to an urban/suburban based society resulted in significant deer

management issues and elevated the need for a comprehensive deer management plan. In 1996, the department joined with the Wildlife Advisory Commission to develop a statewide deer management plan. The department recognized that a new and innovative approach was needed to manage white-tailed deer in the state. As a result, the citizens of Maryland were involved throughout the development process of Maryland's first white-tailed deer management plan.

C. Mason Ross Associates conducted a telephone public opinion survey during October 1996 to obtain attitudes and perceptions on various deer management issues from Maryland citizens. The results of this survey were used to further refine the department's deer management plan.
In December 1996, the department invited a special group of interested citizens, known as the Deer Planning Committee, to a meeting in Annapolis. These citizens represented the forest industry, agribusiness, animal rights/welfare groups, hunters, conservation organizations and the general public. The purpose of the meeting was threefold: (1) Increase public awareness of the state's deer management efforts and to encourage citizen participation in a series of statewide public workshops to be held in January 1997; (2) review the results of the public opinion survey conducted in October 1996; (3) discuss deer management concerns and suggested management strategies.

During January and February 1997, the department sponsored a series of seven public workshops throughout the state to provide an opportunity for citizens to voice their concerns and suggestions before the statewide deer management plan was drafted. Meetings were held in Annapolis, Chestertown, Cumberland, Frederick, Salisbury, Timonium and Waldorf. These workshops were very successful with over 3,500 interested people attending to share their views and offer suggestions for future deer management.

After the public workshops, Department administrators and biologists reviewed the public's concerns and recommendations. Maryland's Comprehensive White-tailed Deer Management Plan was then created based upon the public feedback and tenets of current scientific deer management. As previously stated, the 1998 Maryland White-tailed Deer Plan contained four long-term management goals:

1. Ensure the present and future well being of white-tailed deer and their habitat;

2. Maintain deer populations at levels necessary to ensure compatibility with human land uses and natural communities;

3. Encourage and promote the recreational use and enjoyment of the deer resource;

4. Inform and educate Maryland citizens concerning deer biology, management options and the impacts that deer have on landscapes and people.

Cooperation Among Management Entities

After being closed to hunting for many years, deer populations proliferated on many of the public lands in the state. Native vegetation on many of the natural areas suffered from significant deer damage. These impacts negatively affected the forests and other wildlife dependent on the habitat. Homeowners surrounding these areas also suffered deer impacts, in the form of browse damage and vehicle collisions, and they began petitioning land managers to provide relief to

their problems. Restoring deer hunting on many of these areas was an effective choice to restore balance to the system.

During the same time period that the department was creating the 1998 statewide deer management plan, two suburban Maryland counties embarked on deer management planning processes focused on public land deer problems. Montgomery County developed a county deer management plan through a planning process that involved stakeholder groups (farmers, conservationists, animal rights groups, animal welfare groups and the forest industry) and the general public (Montgomery County Deer Management Work Group 1995). Howard County followed with a county deer management plan using similar public participation methods (Howard County Deer Management Task Force 2002).

As a result of these planning processes, the department increased assistance to public land managers and communities that chose to address deer population issues. Public lands, such as military bases, agricultural research facilities, federal wildlife refuges, and county/municipal parks that developed deer hunting programs in conjunction with the department, were authorized to conduct hunts outside of the regular deer hunting season framework. Through this cooperative effort, facilities could plan managed deer hunts to address local deer population issues while still fulfilling their primary mission.

Alternative Management Tools

In accordance with the original 1998 deer plan, the department has recommended and used other deer management techniques in addition to hunting. Some communities incur deer problems within landscapes that are not conducive to hunting or other lethal management. Likewise, non-lethal deer management options can be effective in small areas or where deer numbers are not overly abundant, but they often are ineffective for managing larger landscapes or reducing a local deer population sufficiently to mitigate conflicts. For example, fencing can be effective for backyard gardens, and repellents may provide effective deterrents when applied to ornamental shrubs in a regular manner, but logistics and costs may limit their application on a large scale and neither will remove deer from the landscape.

As mentioned previously, the department employs a deer biologist who specializes in deer damage issues in suburban and urban landscapes. The urban/suburban deer biologist meets with organized community groups to explain white-tailed deer biology and offers management options that are viable for the local area. The community tries to come to consensus on the management strategies that the residents believe will meet their interests and needs. The biologist then provides technical assistance to the community so they can employ the management approach they selected. Unfortunately, it remains very challenging for communities to reach an agreement on how best to manage their deer problem.

The department continues to investigate new and experimental deer management options for all Maryland landscapes. Staff are closely monitoring deer contraception and sterilization, and other experimental methods of deer management that may be effective in the future. The department has approved multiple contraceptive and sterilization research projects since 1998. Many experts in the field of deer fertility control still suggest that the best chance for effective deer management through fertility control lies in small, closed populations such as fenced areas or island situations, and possibly in smaller communities where deer are approachable and easily

accessible. Larger and less-insular deer populations will likely remain best-managed by regulated hunting.

Although hunting is a traditional deer management tool, Maryland's deer hunting regulations have effectively shifted the traditional "bucks-only" paradigm to encouraging the take of antlerless deer. This model ultimately limits the taking of antlered bucks while removing the reproducing component of the population to stabilize and/or reduce deer populations. As a result of these regulations, Maryland deer hunters continue to take more antlerless than antlered deer; a historically unattainable objective and one that continues to represent a significant shift of traditional harvest models.

Future success in effectively managing Maryland's deer population across its diverse landscapes will require continued partnerships and cooperation with the residents, hunters, farmers, other government agencies, and communities to develop deer management practices that can be implemented across public and private lands. Lethal options continue to be the only effective method to manage deer on a landscape scale. However, access for hunting and/or other lethal control methods limits the effectiveness of lethal efforts in many areas. Increasing access for lethal control and increasing lethal efforts where they already exist are essential to solving Maryland's overpopulation of deer. The department will continue to work in conjunction with its stakeholders and constituents to provide the best deer management regimen possible within the legislative framework that governs it.

CURRENT STATUS OF WHITE-TAILED DEER AND WHITE-TAILED DEER HUNTERS IN MARYLAND

White-tailed Deer Population Status

Maryland's statewide deer population remains stable, but has been reduced since the first deer plan was created in 1998 (Fig. 1). The department uses a population reconstruction model (Lang and Wood 1976; Downing 1980) to estimate the deer population size based on the total annual deer harvest and the biological data collected by staff at deer processors during the hunting season. The population increased from an estimated 246,000 deer in 1998 to a high of nearly 300,000 individuals in 2002 before declining to an estimated low of 199,000 in 2014. The population was estimated at 207,000 individuals in 2018. Liberal seasons and bag limits enacted for antlerless deer have successfully stabilized and/or reduced deer populations in many areas. However, in areas with limited access for hunting, the deer population often remains higher than desired.

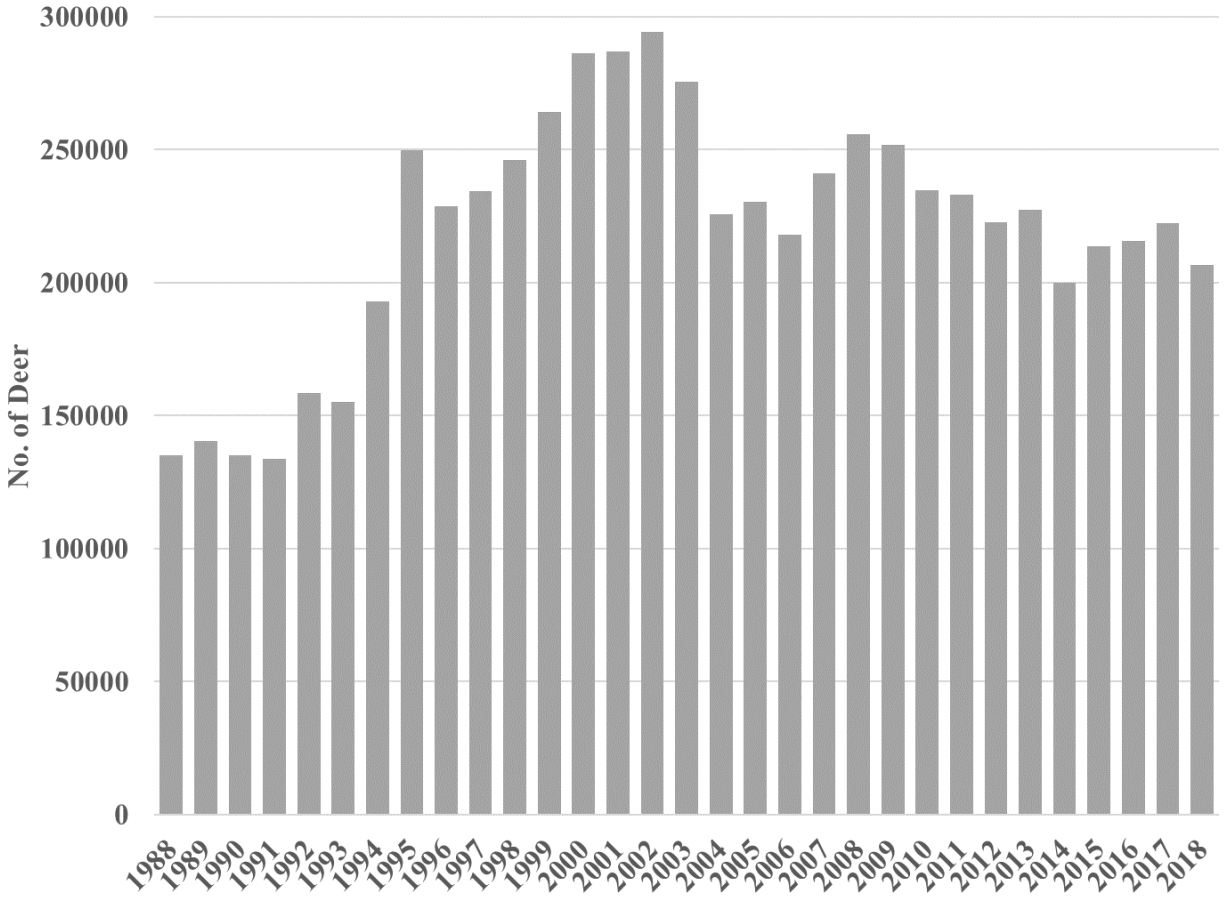

Figure 1. Estimated statewide white-tailed deer population, 1988–2018.

Beginning in 2004, the Maryland deer population has been managed under a two-region system. Region A is currently comprised of Garrett and Allegany counties and Harvest Management Units 250 and 251 in Washington County (from 2004–2009 Region A was only Garrett and Allegany counties). Region B comprises the rest of the state (Fig. 2). The Region A deer population has traditionally been more easily affected by hunting season and bag limit changes due to more hunting pressure, more access for deer hunting, and poorer quality deer habitat when compared to Region B. As a result, deer hunting seasons and bag limits, while still liberal for the region, are more conservative in Region A than Region B.

The Region A deer population followed the same trend, although more pronounced, as the statewide trend from 1998 through about 2011 (Fig. 3). However, more conservative seasons and bag limits were enacted after the population dropped significantly in the early 2000s. As a result of the regulation changes, the population slowly rebounded and has shown an increasing trend for the last 5–7 years. The population increased from approximately 40,000 deer at the start of the 1998 plan to a high of 77,000 deer in 2002 before declining to less than 30,000 deer in 2004 (Fig. 3). The population largely remained below 40,000 deer through 2011, but, since then, has typically been estimated at 40,000–50,000 deer.

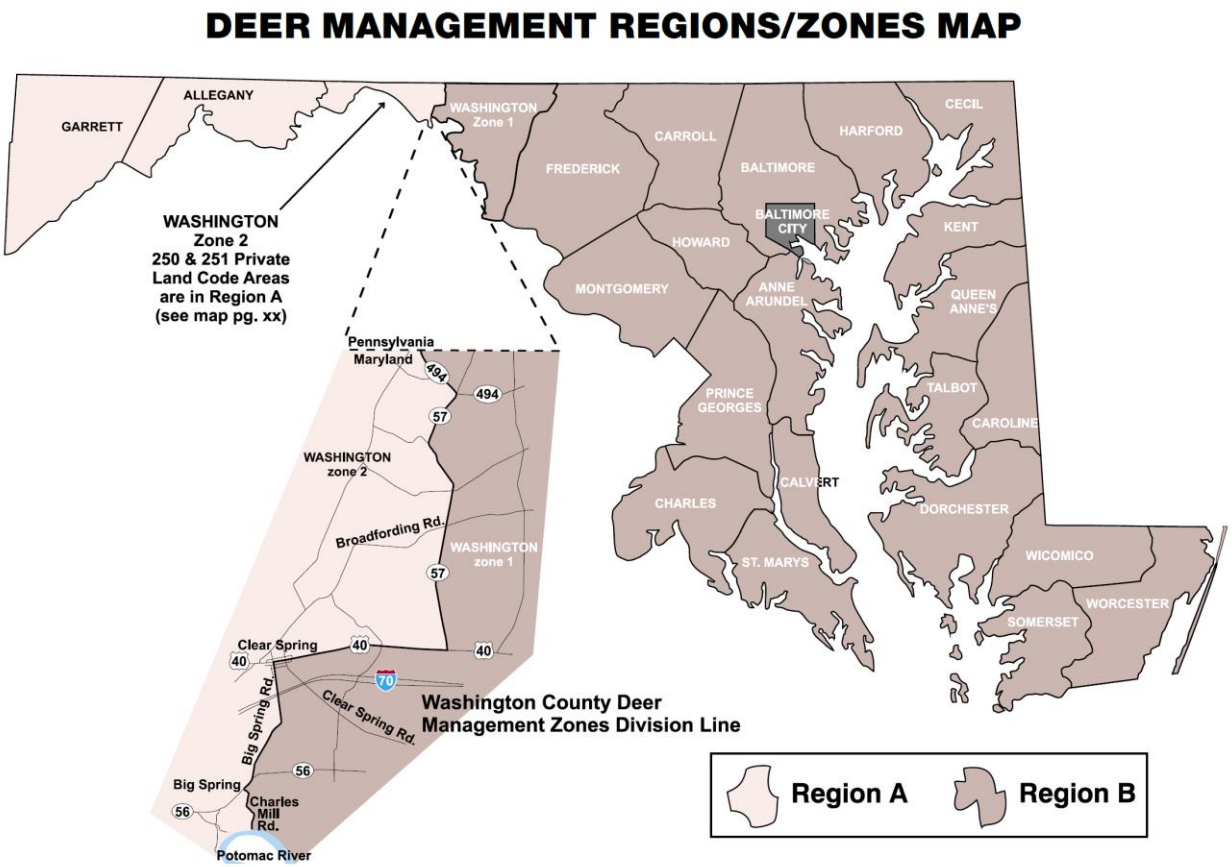

Figure 2. Maryland deer management regions, 2018.

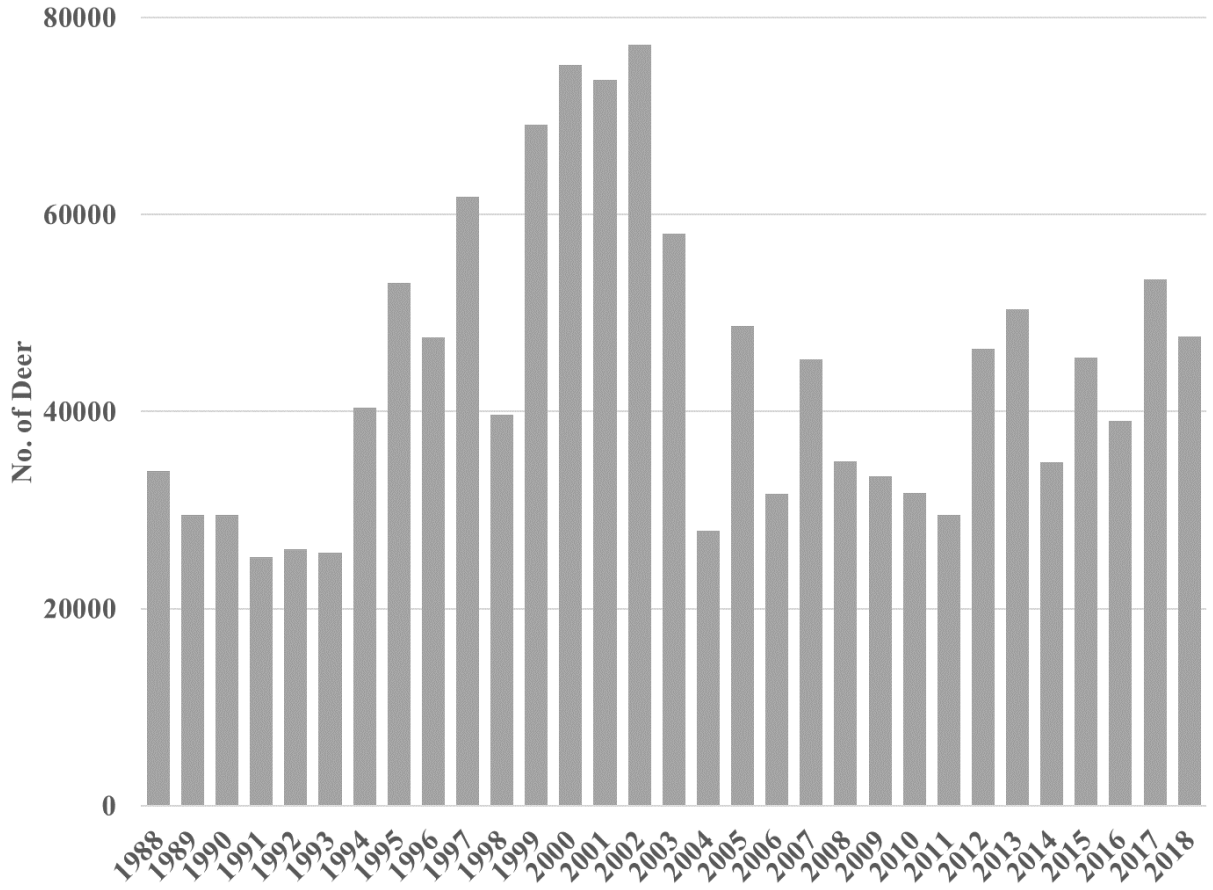

Figure 3. Estimated Region A white-tailed deer population (excluding all of Washington County), 1988–2018.

The Region B deer population has also declined over the past two decades (Fig. 4). At the start of the 1998 plan, the Region B population was estimated at about 205,000 deer. The population increased slightly to, approximately, 238,000 deer in 2002 before the implementation of liberal antlerless seasons and bag limits reduced the population to an estimated low of 170,000 deer in 2013. Since 2013, the Region B deer population has remained stable.

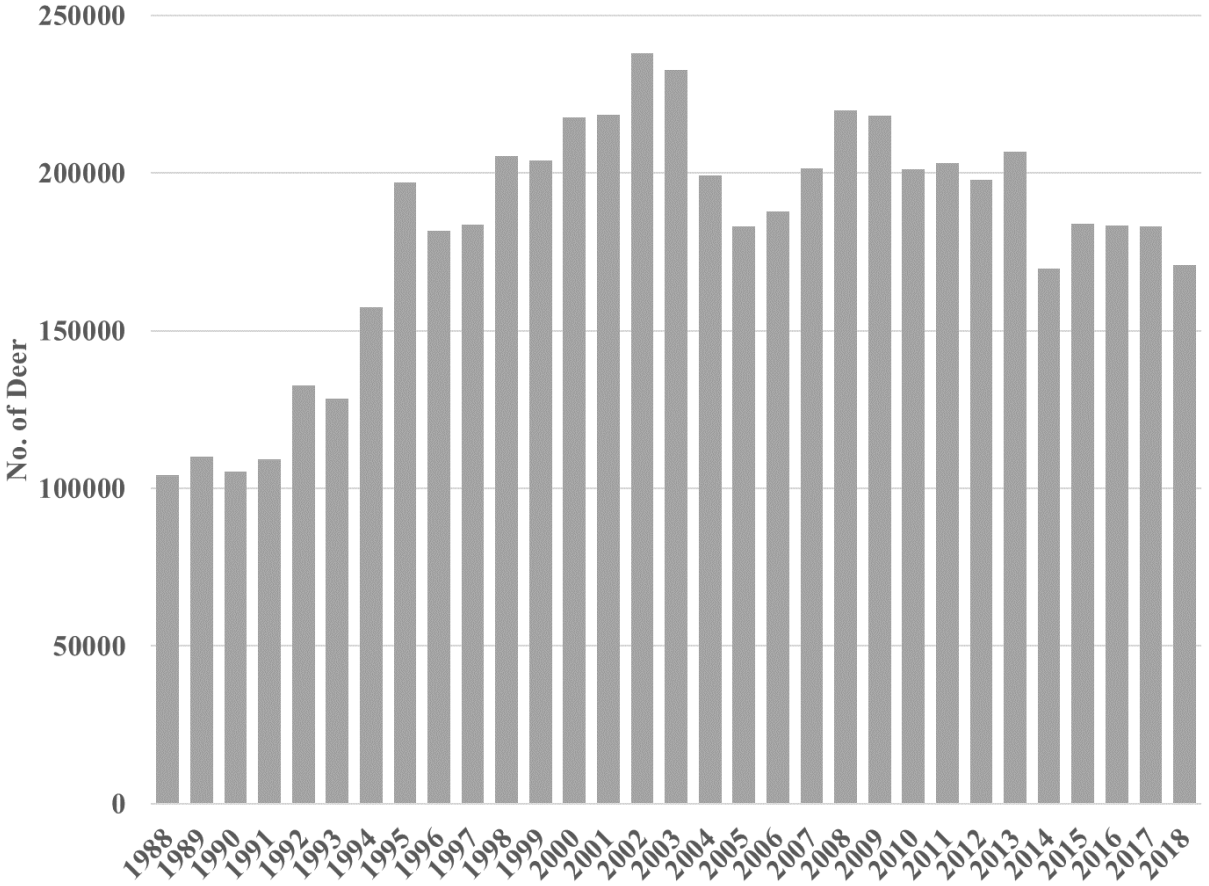

Figure 4. Estimated Region B white-tailed deer population (including all of Washington County), 1988–2018.

White-tailed Deer Hunter Population Status

White-tailed deer are the most popular game species and one of the most recognizable wildlife species in Maryland. Approximately 80% of all Maryland hunters pursue deer and hunters spend more days afield each year hunting deer than all other game species combined.

According to the department's Hunter Mail Survey, approximately 58,000 licensed hunters (resident and nonresident) spent 740,000 hunter-days hunting white-tailed deer in Maryland during one or more of the 2017-2018 deer seasons. An estimated 48,000 licensed hunters pursued white-tailed deer for 236,000 hunter-days with a firearm, 30,000 hunted deer with a muzzleloader for 125,000 hunter-days, 19,000 hunters used vertical bows for 205,000 hunter-days, and 17,000 hunters spent 177,000 hunter-days hunting white-tailed deer with crossbows.

Like numerous other states, the number of hunters in Maryland has declined as the hunter population ages, youth are not recruited into the sport, other activities demand or attract more of the public's time, and available places to deer hunt have declined dramatically. The sale of resident hunting licenses peaked in 1968 at about 183,000 licenses sold and has declined to approximately 85,000 resident licenses sold in recent years. Total license sales (including

nonresident) have followed a similar pattern, although the recent stable trend in nonresident license sales has buffered the decline somewhat. Total license sales peaked in 1975 at 194,000 licenses sold and have declined to about 112,000 in 2018 (Fig. 5).

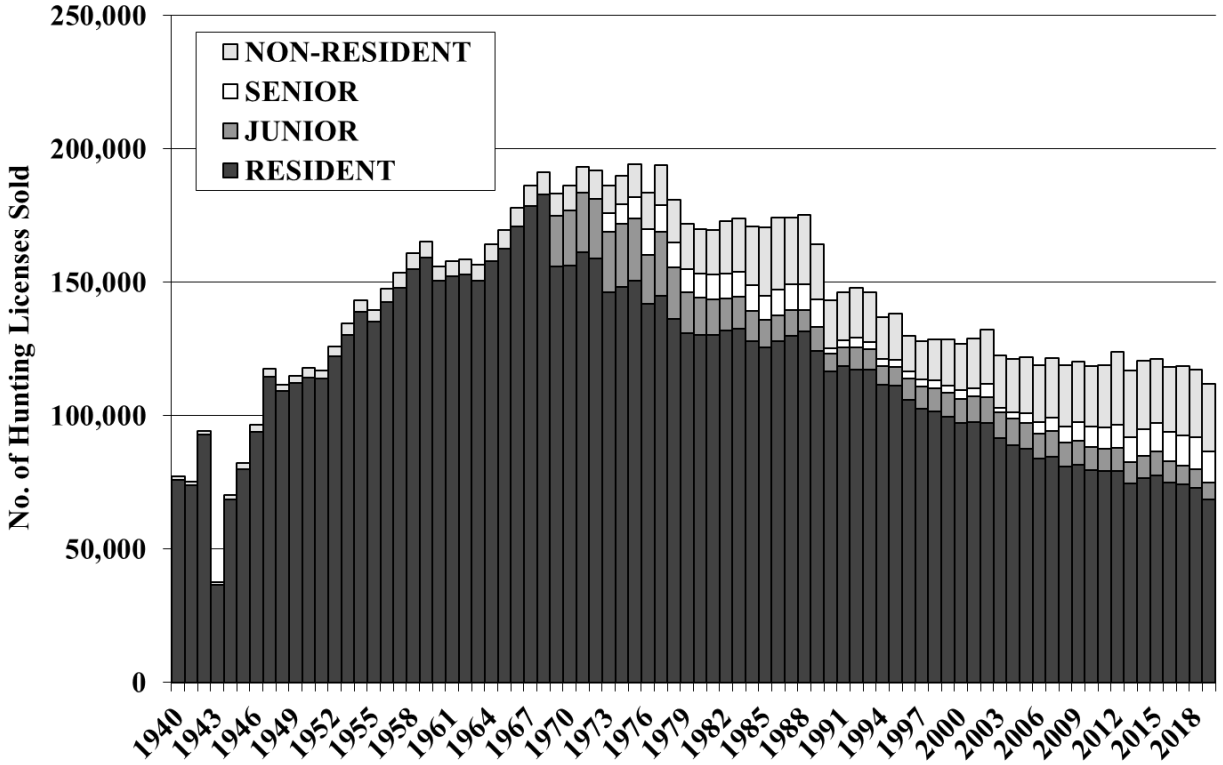

Figure 5. Maryland hunting license sales, 1940–2018.

A telephone survey conducted by Responsive Management (2018) found that 16% of the general Maryland population had hunted deer sometime during their lifetime. Of those that had hunted deer, only 50% had hunted deer in the past two years. The same survey found that 57% of Maryland landowners (owners of 20 or more acres used for commercial agriculture) had hunted deer in their lifetime. Based on past public opinion surveys, the most common reasons why people stop deer hunting are: (1) no longer interested in hunting; (2) no time/work obligations; (3) health/age. Time and access for deer hunting were the most common responses to why successful deer hunters did not harvest more deer.

Hunter recruitment is a serious concern for deer managers in all states. Deer hunting is the primary tool for effective deer management (i.e., population control) and as hunter numbers decline, hunting seasons and bag limits must be manipulated to encourage the remaining hunters to take more deer. However, deer hunters can reach a saturation point and are unable or unwilling to fill their allotted bag limit. As hunter numbers continue to decline, deer managers across the country continue to pursue alternative population control measures.

RELATIONSHIP BETWEEN WHITE-TAILED DEER AND HUMANS

White-tailed deer are one of the most popular wildlife species in Maryland. In 1996, 86% of the general Maryland public agreed or strongly agreed that deer were an important part of the balance of nature, and 87% agreed or strongly agreed that deer were an important natural resource in Maryland (C. Mason Ross Associates, Inc. 1996). Responsive Management reported in 2007 that 87% of Maryland citizens agreed or strongly agreed that deer are an important part of the balance of nature. This value increased to 88% in 2018 (Responsive Management 2018).

Positive Impacts of White-tailed Deer

Maryland's diverse wildlife populations, including white-tailed deer, are popular among non-hunters and hunters alike. Wildlife watchers enjoy the solace found in observing deer and other wildlife in their natural settings, and hunters enjoy the venison, camaraderie, and sport of pursuing deer during annual hunting seasons. In a 2011 survey by the U.S. Department of the Interior and U.S. Department of Commerce, it was estimated that nearly 1.4 million people, aged 16 and older, participated in non-consumptive wildlife watching activities, such as observing, feeding, or photographing wildlife in Maryland. Total expenditures in Maryland for wildlife watching were estimated to be nearly $500 million in 2011. Responsive Management (2018) reported that 24% of adult Maryland residents occasionally or frequently made trips expressly to view and experience deer for photography or other non-hunting purposes.

Deer hunters also contribute significantly to Maryland's economy. The U.S. Department of the Interior and U.S. Department of Commerce (2011) estimated there were 73,000 deer hunters in Maryland in 2011. These hunters spent an estimated $100 million on trip expenses alone. This amount is easily doubled or more when considering the additional revenue generated via jobs, taxes, etc. that are associated with the hunting. Deer continue to be a major resource in the Maryland and national recreational economy. In addition to direct expenditures on hunting licenses, equipment, transportation, and gear, there are many collateral economic benefits to individuals and businesses in Maryland derived from both hunting and non-hunting related deer activities.

There are two primary funding sources for most of Maryland's wildlife management programs: (1) The sale of hunting licenses and associated stamps; and (2) reimbursements to the state from the Federal Aid to Wildlife Restoration Act, more commonly known as the Pittman-Robertson Act. Pittman-Robertson funds are generated by an 11% excise tax on sporting arms and ammunition, including handguns and archery equipment. Nearly all of Maryland's annual budget for wildlife programs (game and non-game) comes from these two sources. The amount of Pittman-Robertson funds available to each state is partially dependent on the number of hunting licenses sold. The majority of hunting licenses sold in Maryland are purchased by deer hunters.

While there are good estimates for the economic value of deer hunting and non-hunting activities, the monetary value of deer hunting's role in preventing deer-related damage has not been estimated. Without hunting, deer populations would be much higher and losses to the agricultural, forest products, and residents and nonresidents of Maryland would be far greater. The Association of Fish and Wildlife Agencies (AFWA) reported in 2005 (International Association of Fish and Wildlife Agencies 2005) that an estimated $934.2 million to $9.3 billion of taxpayer's money would be required to accomplish the same amount of deer management that

hunters currently provide. The AFWA report also mentioned that more money would be needed to control habitat damage by deer not relocated or removed.

Negative Impacts of White-tailed Deer

While there are numerous positive impacts related to white-tailed deer, there are also many negative impacts, including agricultural damage, native habitat degradation/destruction, and deer-vehicle collisions. The insurance company, State Farm, estimated there were nearly 33,000 deer-vehicle collisions in Maryland in 2017 (State Farm 2018). The cost of these collisions exceeds $100 million annually. The number of deer-vehicle collisions in Maryland generally has been stable since prior to 2008 (State Farm pers. comm.).

White-tailed deer also cause significant damage to agricultural crops. A 2011 U.S. Department of Agriculture (USDA) National Agricultural Statistics Service survey of farmers estimated that Maryland growers suffered $10 million in wildlife-related crop damage during 2011 and spent over $400,000 on crop damage preventative measures (U.S. Department of Agriculture 2012). Deer were responsible for an estimated 77% ($7.7 million) of the damage. Damaged crops included common agricultural crops such as corn and soybeans, but also included trees and landscaping plants at nurseries and plantations. It is likely that damage losses in recent years are much higher than what was estimated in 2011. Farmers took a reported 9,365 deer in 2018 via department-issued Deer Management Permits.

Along with agricultural crop damage, excessively high white-tailed deer densities also damage the native flora and fauna of Maryland. Knapp and Wiegand (2014) documented a significant decline in orchids on Catoctin Mountain Park. The authors theorized excessive browsing by deer contributed to the decline. Similarly, a 2005 National Park Service study compared Catoctin Mountain Park, which does not permit deer hunting, to the adjacent Frederick City Watershed, which is open during Maryland's statewide hunting seasons. It was estimated that Catoctin had deer densities seven to nine times higher than the nearby Frederick City parcel (Bates et al. 2005). The Frederick City location also contained higher seedling and sapling regeneration and higher densities of ground-nesting birds than Catoctin. Beginning in 2010 the park began aggressive deer control using sharp-shooting and has reduced the deer population to target densities.

Studies also indicate that intensive deer browsing resulting from high deer densities can change the forest species composition and the associated wildlife (Alverson and Waller 1997; Averill 2017). Researchers at the Manassas National Battlefield Park in nearby Virginia concluded, "white-tailed deer may be modifying the structure of the forest interior to the extent that it adversely affects wildlife species dependent on a dense understory to thrive." Researchers predicted that the future composition of forests in the park would shift towards stands with fewer species and a greater dominance of ash, black cherry and hackberry, particularly in the oak-hickory and bottomland hardwood forests (Rossell et al. 2005).

High deer populations can also increase the density of exotic and invasive plants in many natural areas (Averill 2017). Exotics are those plants that have been imported (purposefully or by accident) from places other than Maryland. Maryland's natural ecosystems are often threatened by exotic plants that find the habitat and climatic conditions favorable. Excessive deer browsing on native plants reduces the production and distribution of native species and allows exotic

species to thrive. In addition, deer may spread exotic plants through their feces (Myers et al. 2004; Williams and Ward 2006).

Lyme Disease and White-tailed Deer

Lyme disease is caused by the spirochete *Borrelia burgdorferi* that is carried by the blacklegged tick, also commonly known as a deer tick (*Ixodes scapularis*). Lyme disease has affected thousands of people in the United States and is a serious human health concern. Because white-tailed deer serve as a host for the blacklegged tick, there is public concern regarding white-tailed deer and their relationship to the incidence of Lyme disease. Deer and other mammals, such as raccoons and foxes, serve as hosts for the adult stage of the tick while small rodents, such as mice, serve as hosts for the immature stages.

A direct relationship between numbers of deer and the incidence of Lyme disease remains unresolved. A June 2003 publication in The New England Journal of Medicine recommends the following strategies for decreasing the risk of Lyme disease and other tick-borne illnesses: (1) Area wide application of acaricides (mite and tick pesticides), (2) landscaping to provide desiccating barriers between tick-infested areas and lawns, (3) in some settings, the exclusion or removal of deer (Hayes and Piesman 2003)

Telford (2017) suggests that deer control is a cornerstone of tick management and should be considered a long-term approach to combating Lyme disease. Kilpatrick et al. (2014) reported that reducing deer densities via regulated hunting to 5.1 deer per square kilometer in a Connecticut community resulted in a 76% reduction in tick abundance, 70% reduction in the entomological risk index, and 80% reduction in resident-reported cases of Lyme disease.

However, other studies regarding Lyme disease and the relationship to deer suggest that controlling deer populations may not effectively control Lyme disease (Kugeler et al. 2015). Ostfeld et al. (2006) concluded the risk of exposure to Lyme disease was correlated positively with the abundance of key hosts of the immature stages of the tick and with critical food resources for those hosts. They suggested that once deer abundance exceeded a low threshold value, further increases in deer density had little if any affect on tick densities. Current best estimates suggest that deer densities must be maintained at <10/sq.mi. to observe a reduction in tick densities and associated Lyme disease cases.

The department will continue to monitor further research and developments concerning Lyme disease and other tick-borne diseases. However, given the numerous negative impacts associated with high deer densities, deer populations must be controlled whether or not there is a direct relationship between deer and these diseases. Currently, the best prevention of these diseases is through education that encourages people to recognize where ticks may be present and try to avoid these areas if possible, to use repellents, and to check themselves thoroughly for ticks after being in these environments. Individuals should consult The Centers for Disease Control and Prevention web page for the most current information regarding tick-borne diseases.

Biological and Cultural Carrying Capacities

The number of individuals of a given species that a specific parcel of habitat can support in good physical condition over an extended period of time is defined as the Biological Carrying Capacity (BCC). White-tailed deer have high productivity due to their evolution as large prey for

humans, wolves and mountain lions. Deer reproduction causes populations to exceed the BCC unless productivity is balanced by mortality. When the BCC is exceeded, habitat quality decreases and herd health and physical condition decline (McCullough 1979; McShea et al. 1997). Biologists use herd health indices and population density indices to assess the status of a herd relative to the BCC.

The importance of compatibility between land-use practices and deer populations in Maryland justifies the consideration of another aspect of carrying capacity. Cultural Carrying Capacity (CCC) is the maximum number of deer that can coexist compatibly with the local human population. CCC is a function of the sensitivity of the local human population to the presence of deer and may be higher or lower than BCC. This sensitivity is dependent on local land-use practices, local deer density and the attitudes and priorities of the local human population. Numerous deer-vehicle collisions, agricultural damage, home garden complaints, and over-browsed forests that reduce recreational opportunities for bird watchers and naturalists due to overabundant deer all are indicators that the CCC has been exceeded. It is important to note that even low densities can exceed the CCC; a single deer residing in an airport-landing zone is too many deer for that situation.

Effective deer management aims for a deer population level that will maintain a healthy environment and strike an acceptable balance between people and deer. It is a complex challenge that requires balancing biological, political and social demands.

MARYLAND WHITE-TAILED DEER MANAGEMENT PROGRAM

Just a century ago, the basics of deer management entailed restocking and protecting deer and creating and protecting deer habitat. As deer populations rebounded through the middle part of the 20th century, management became more complex. Deer managers found themselves trying to reconcile increasing sociological concerns with the fundamentals of biology. Deer-vehicle collisions, agricultural crop depredation, disease concerns, and forest regeneration impacts are just a few of the current issues associated with overabundant deer populations. Balancing deer populations with the desires of various constituent groups is a challenging process. Appendix 4 lists traditional management practices and their advantages and disadvantages. The department uses many of these options depending on the situation and the desired outcome. Today, the primary responsibilities of the deer project can be grouped into five main categories: (1) deer population regulation; (2) deer population monitoring; (3) information and education; (4) addressing constituent demands; and (5) other management activities.

White-tailed Deer Population Regulation

White-tailed Deer Harvest–The annual deer harvest, particularly of antlerless deer, is a cornerstone of the Maryland deer management program. No other management strategy for regulating deer populations is as effective or as economical as deer hunting. Deer hunting is necessary to keep deer populations from growing beyond their biological carrying capacity (McCullough 1979). Maryland enjoys a rich hunting heritage and a majority of the public supports deer hunting and recognizes its importance as an efficient and cost-effective management strategy. Responsive Management (2018) reported that 67% of Maryland residents were strongly or somewhat in favor of deer hunting and 77% agreed or strongly agreed that deer

should be hunted to maintain a healthy deer population. These attitudes have not changed during the past decade.

In 1927, Maryland deer hunters harvested five deer in the State's first regulated deer hunt. Today, deer hunters annually remove 70,000–85,000 deer from the Maryland landscape at little or no financial burden to the general public (Fig. 6). Approximately 50% of Maryland deer hunters are successful in bagging a deer in any given year and most (75%) successful deer hunters harvest no more than two deer each year.

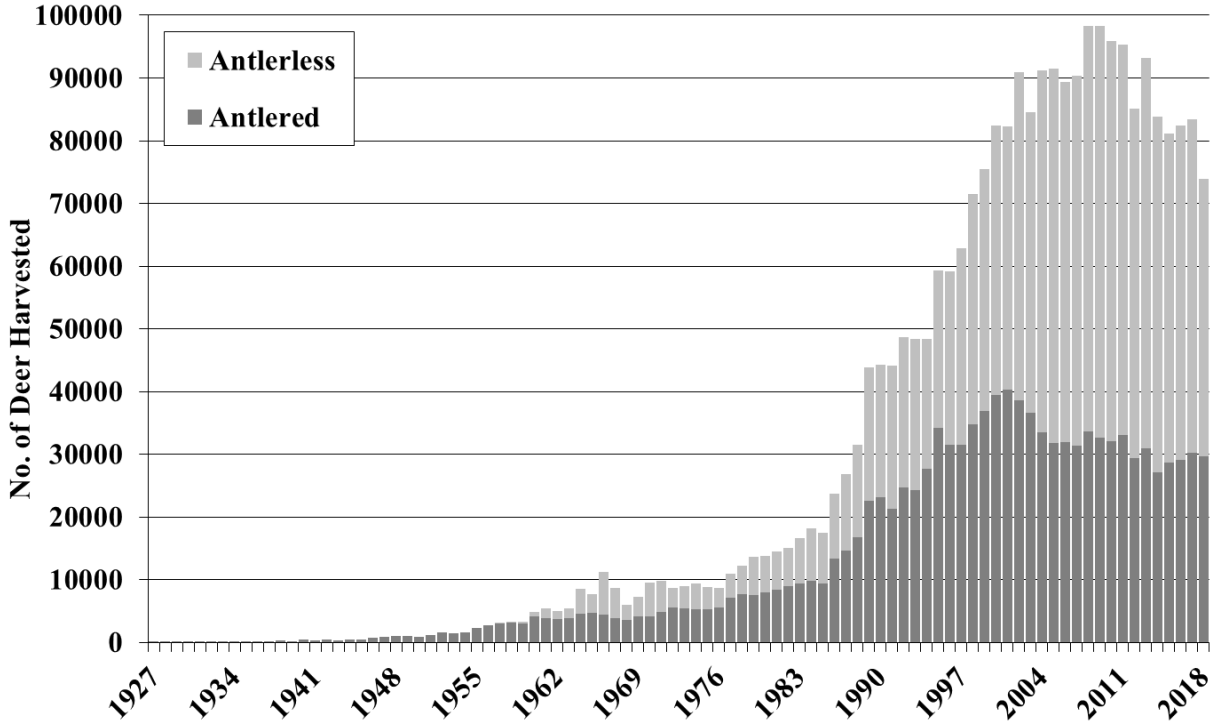

Figure 6. Maryland white-tailed deer harvest, 1927–2018.

Traditionally, deer hunting focused on antlered deer and antlerless deer were protected to promote population growth. However, as deer populations increased, it was recognized that antlerless harvest was needed to regulate population growth. Removing antlerless deer (predominantly female) from the population removes the female deer and the multiple offspring that could have been produced in future years. Removing antlered deer is not as effective for population control because one male deer can breed numerous females.

Maryland first recognized the need to harvest antlerless deer for population regulation in 1951 when bowhunters were permitted to harvest antlerless deer in Baltimore and Harford Counties. Antlerless deer hunting was first permitted with firearms in 1957 and 47 antlerless deer were harvested statewide. Today, over 45,000 antlerless deer are harvested annually and comprise 50-60% of the total harvest (Fig. 6).

Persuading hunters who were indoctrinated to take only bucks to begin harvesting antlerless deer has been a challenge for many states, including Maryland. However, the majority of Maryland deer hunters now recognize the need for deer population control and have demonstrated their willingness to harvest antlerless deer. Responsive Management (2018) found that 80% of Maryland deer hunters had hunted for antlerless deer during the past year. On the same survey, the majority (>65%) of deer hunters in Region B moderately or strongly supported the liberal antlerless bag limits enacted to stabilize the deer population.

Firearm hunting remains the most efficient method for harvesting deer in Maryland on a statewide scale. The firearm harvest has comprised approximately 45- 60% of the total harvest since 1994 when the modern muzzleloader season was expanded to include dates in October (Fig. 7). However, in recent years, more deer are being harvested by archers as a result of the long season (September through January) and the liberalization of crossbows. Archery has evolved into an important deer management tool, particularly in urban and suburban environments. In several counties, particularly less rural ones, more deer are harvested now with archery equipment than with either firearms or muzzleloaders.

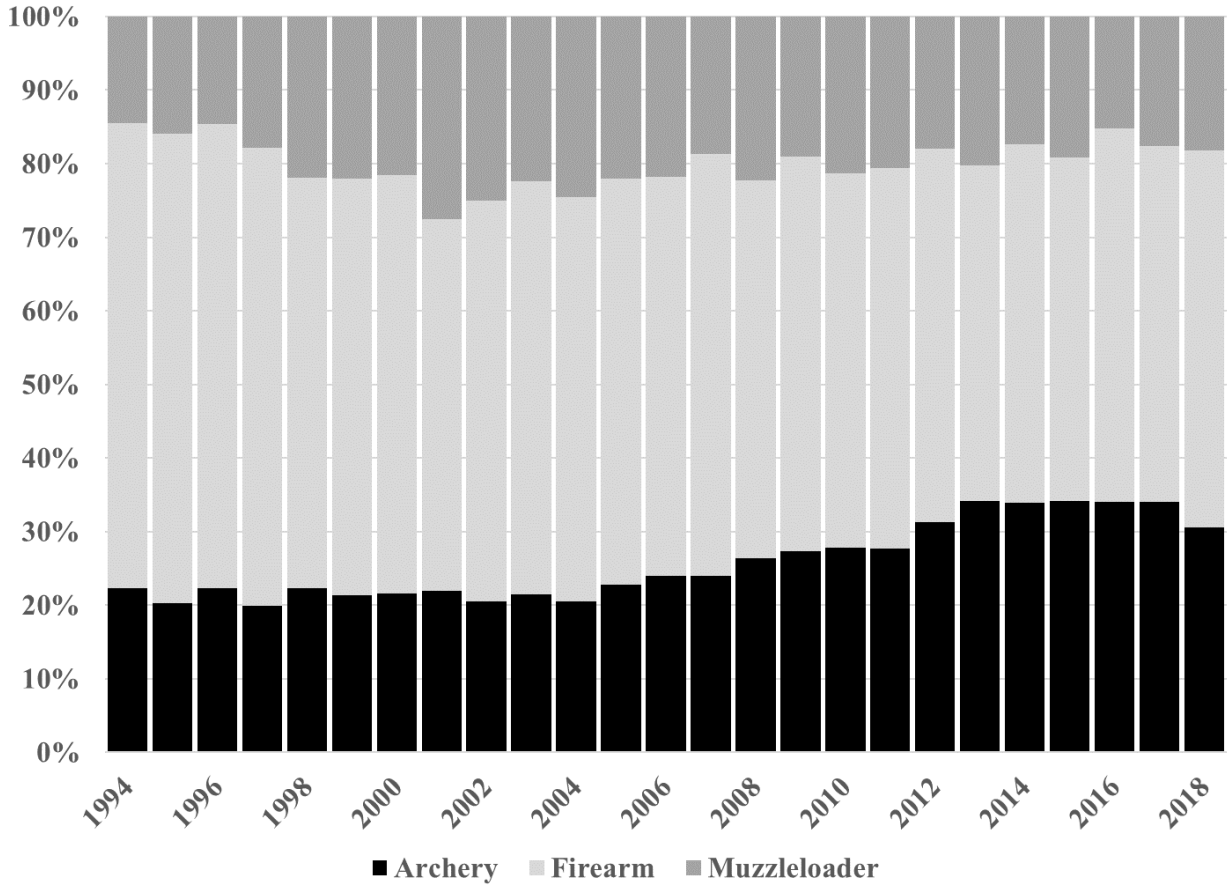

Figure 7. Maryland white-tailed deer harvest (%) by season, 1994–2018.

Responsive Management (2018) reported that 42% of hunters surveyed indicated archery season was their favorite season, while 36% favored firearm season. Fifteen percent of hunters surveyed preferred muzzleloader season and 7% had no preference or didn't know.

White-tailed Deer Harvest Regulations–Deer harvest regulations provide the framework for the department to accomplish its objectives. Additions and modifications to deer hunting regulations most often are spurred by: 1) the need to alter deer population trends via season and bag limit changes; 2) the need to accommodate new recreational opportunities for hunters and wildlife-watchers; or 3) the need to minimize risks of disease introduction/transmission into the Maryland deer herd.

Altering seasons and bag limits via regulation changes is the primary method used by the deer project to manage the Maryland deer population. Lengthening or shortening antlerless seasons and increasing or decreasing antlerless bag limits to increase or decrease harvest opportunities enables deer managers to regulate how many antlerless deer are taken each year (generally, reducing the antlerless harvest results in population growth while increasing the antlerless harvest results in population decline). Previous years' deer harvest data (mandatory hunter harvest check-in data and deer age data collected at processors) weigh heavily in determining future season and bag limit regulation changes.

Deer harvest regulations are typically evaluated and amended biennially. These regulations should not be confused with deer-related legislation. Legislation is law passed in the General Assembly, while regulations are the deer hunting "rules" that the department establishes. Certain aspects of deer hunting, including Sunday hunting and hunting safety zones, are specifically established in law and can only be changed via the legislative process. Unlike regulations, the department does not have the authority to amend state law.

The process to change and/or add regulations represents a major investment of staff time. Staff, the general public, the WAC, and political officials can submit regulation requests throughout the year. Suggested regulation additions/modifications deemed appropriate by the department are then taken before WAC and to a stakeholder group for comment in February. Comments are also solicited at public meetings held across the state, via the Internet, and by telephone, fax, or letters. Final decisions are made after all comments have been summarized, considered and incorporated into the decision-making process. Final regulations become effective prior to the following hunting season.

In recent years, there has been an increase in legislative actions by outside interests concerning deer management in Maryland. When laws are passed concerning deer, the department has no choice but to enforce what the law prescribes, regardless of whether or not it is compatible with the department's deer management program. Many times the department is not afforded the opportunity to provide input on such legislation and would not otherwise support such action. The department encourages outside interests to work with the department to make appropriate regulatory changes instead of using the legislative process to alter deer management in the state.

Deer Management Permits–Producers (i.e., farmers, arborists, etc.) can apply for Deer Management Permits (DMPs) in situations where established deer hunting seasons do not provide adequate deer population regulation for commercial farming operations. DMPs allow

farmers to take deer outside of the hunting season framework without regard for deer season bag limits. These permits also add another mechanism for the department to regulate the deer population. The vast majority of deer taken under DMPs are antlerless. On rare occasion, a nursery owner may receive permission to take individual antlered deer doing damage to nursery stock with their antlers during the breeding season. If antlered deer are harvested under a permit, all antlers must be turned over to the department.

Most DMPs are issued for a 12-month period. Landowners, agricultural lessees, or designated farm employees can apply for DMPs through the local department office. Operations with severe deer damage and economic loss to commercial agricultural crops, orchards or nursery stock qualify for DMPs. In addition, DMPs may be acquired for deer browse damage to natural woodland areas that have a forest management plan written by a professional forester.

Deer taken under the authority of DMPs are reported through the same telephone/internet reporting system that hunters use. Producers reported taking 9,365 deer in 2018. Fifty years ago, 36 deer were taken under the DMP process. The number of deer reported taken under the authority of DMPs peaked in 2003, but dropped substantially shortly afterwards when the department liberalized antlerless hunting seasons and bag limits (Fig. 8). Many deer that were being harvested under DMPs were instead now taken by hunters during the regular deer season. However, significantly rising costs to farmers in recent years has once again resulted in an increase in the number of deer harvested under DMPs.

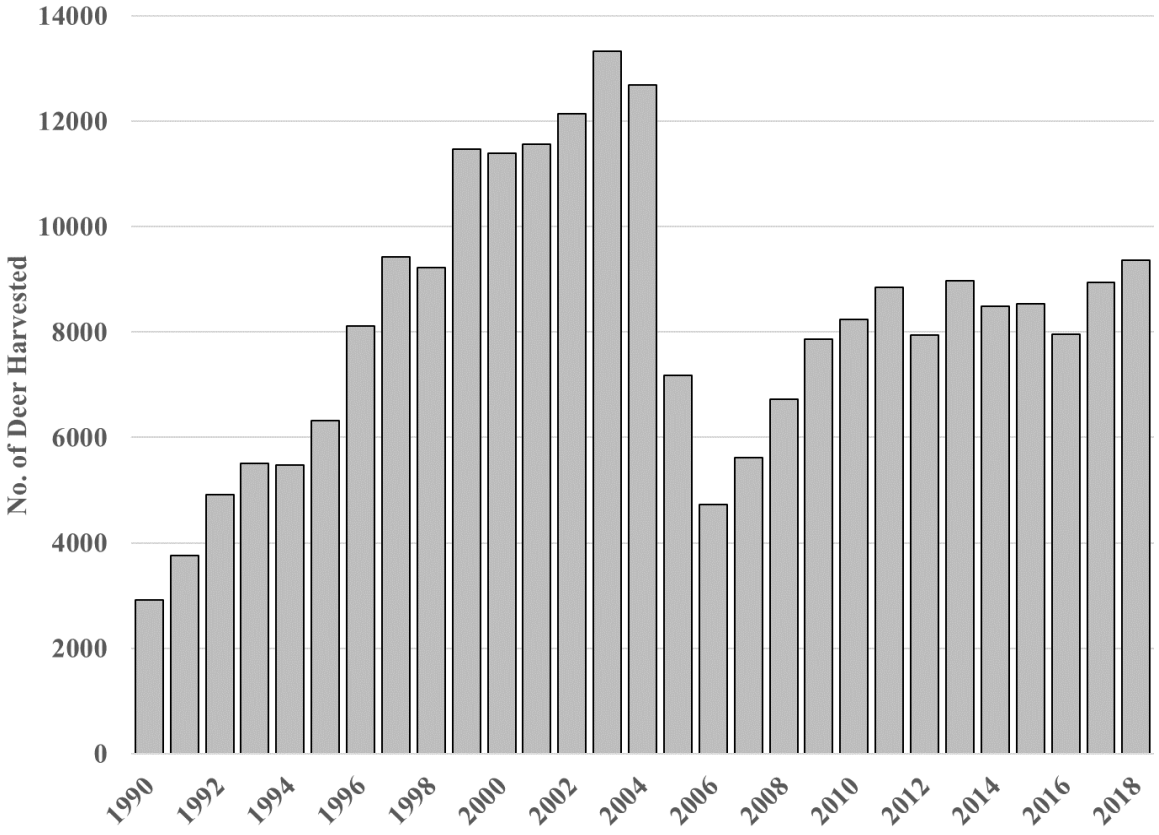

Figure 8. Maryland Deer Management Permit (DMP) deer harvest, 1990–2018.

Deer Cooperators–The Maryland Deer Cooperator Program (DCP) certifies private individuals and animal control businesses to lethally and non-lethally address deer overpopulation issues (for profit, if they choose) in areas where regulated hunting is not feasible or not effective alone. Beginning in 2018, the program was modified to include an agricultural deer cooperator permit (ADCP) for producers suffering deer damage. ADCPs are only valid for the farm they are issued to. There are less than 15 DCPs that operate in Maryland and they remove approximately 2,000 deer annually.

Sharpshooting is the primary method used to remove deer under a DCP or ADCP. The permit allows sharpshooting deer at night as well as the use of rifles in counties that don't allow rifles for deer hunting, as long as the appropriate county officials approve of the plan. Shooting is restricted to February and March, unless there is a human safety issue involved (airports, law enforcement test tracks, etc.).

Fertility control and capture-and-euthanize are also options under a DCP. To date, several fertility control projects have been conducted under authority of a DCP, but capture-and-euthanize has not been deployed . The vast majority of deer taken under DCPs are antlerless and a quota restriction is typically placed on the taking of antlered deer. The usable meat of deer taken under a DCP must be donated to charity or otherwise used, and antlers from any deer removed must be turned over to the department.

To become a deer cooperator, applicants must take a written test about deer biology and management and pass a shooting qualification test. Cooperators are required to submit an operation plan to the department for approval for each project. Cooperators must also submit quarterly and final project reports. Site visits by the department may also be warranted.

Letters of Authority–The department used to issue Letters of Authority (LOAs) to lethally remove deer from airports and high-speed driver training facilities where striking a deer posed a significant danger to people. These installations did not meet the requirements to obtain DMPs since agricultural crop damage was not involved, but they must remove deer due to human safety concerns. Beginning in 2018-2019, individuals who traditionally received LOAs were rolled into the DCP program.

Managed Hunts–The Deer Project authorizes various managed deer hunting programs in Maryland. Managed deer hunts are highly regulated and are designed to be primarily used in populated areas. Hunters often must undergo shooting proficiency tests and have specified tree stand locations and shooting directions. Managed hunts can occur outside the regular hunting seasons and, on some occasions, deer taken do not count against the hunter's regular bag limit.

Managed hunts have been successfully used on county and local government properties, military bases, federal wildlife refuges, other federal properties, and on numerous state-owned park and natural resource areas. State lands, including Fair Hill Natural Resource Management Area and Patapsco, Gunpowder, and Seneca Creek State Parks, have used managed hunts to control deer numbers for 20+ years.

At the county level, Montgomery County Department of Parks, Howard County Department of Recreation and Parks, and the Washington Suburban Sanitary Commission of Howard,

Montgomery and Prince George's counties have extensive managed deer hunting programs. These organizations annually offer managed hunting opportunities on many of the parks and reservoir properties they oversee. The hunts are a valuable tool for managing high-density deer populations in an urban/suburban setting.

Numerous managed hunts also occur on federal land within Maryland. Blackwater, Eastern Neck, and Patuxent Wildlife Refuges annually conduct managed hunts to control deer. Likewise, military installations including Aberdeen Proving Grounds, Indian Head Naval Ordnance Area, and Patuxent Naval Air Station annually conduct managed hunts. Assateague National Seashore, Beltsville Agricultural Research Center, and Smithsonian Environmental Research Center are other federal facilities that use managed hunting to help control deer.

White-tailed Deer Fertility-Control Studies–Contraception has been experimentally tested in white-tailed deer for several decades with mixed results. More recently, instead of using contraception, research has focused on permanently sterilizing female deer (via ovariectomies) to see if population numbers can be reduced. The department has cooperated on multiple white-tailed deer fertility-control studies in Maryland in an effort to develop new technology that may make fertility control a viable alternative in areas where other control methods are not feasible. Responsive Management (2018) found there was about equal support and opposition to the use of fertility control to manage deer. However, 56% of the public was opposed to using state tax money to fund this method of control.

The longest running Maryland fertility-control study has been at the National Institute of Standards and Technology (NIST) where the deer contraceptive agent porcine zona pellucida (PZP) was first tested beginning in 1995. More recently, deer have been sterilized at the site while PZP undergoes additional development. At the beginning of the study, the deer population on NIST was estimated at 211 deer. The population increased to an estimated 291 deer in 1997 before declining to 196 deer in 2007 (Rutberg and Naugle 2007). Since that time, the population has remained stable at 190–200 deer. Researchers reported that annual deer population change at NIST was strongly correlated with population fertility; when population fertility at NIST dropped below 0.40 fawns per female, the population declined (Rutberg and Naugle 2008).

The use of PZP at NIST appears to have been successful at stabilizing the deer population on the 0.9 square mile, fenced campus. However, the current deer population onsite remains at a density that is at least 10 times higher than the recommended density required to minimize habitat damage and human conflicts. Rutberg and Naugle (2008) report that the usefulness of PZP as a management tool will depend on the effectiveness of the vaccine, accessibility of deer for treatment, and site-specific birth, death, immigration, and emigration rates. Researchers will also continue to evaluate the effectiveness of sterilization at this location.

Sterilization research is also occurring at the National Institute of Health (NIH). Beginning in 2014, 24 female deer were captured and sterilized. From 2015–2019 an additional 1eighteendeer were treated. The population was reduced from an estimated 45 deer in 2014 to 23–25 deer in 2016 (44% decrease). The population has been stable since 2016. The current deer density is estimated at approximately fifty deer per square mile. Fawn recruitment has largely been eliminated on the site, but immigration has prevented the population from declining further.

There is one privately-funded deer sterilization research/management project in Maryland. This project started as a research study in 2010 and transitioned to a management program in 2015. Nearly 100 female deer were sterilized between 2011–2019 on a fourteen-acre suburban neighborhood property north of Baltimore. Since the project began, the estimated number of female deer using the property declined from approximately sixty deer to forty-five deer. Deer are primarily captured using dart guns. The cost of treatment, using volunteer help and veterinarian services for much of the work, is estimated to be between $100 and $500 per deer.

Two studies in Maryland evaluated the contraceptive agent GonaCon™. However, unlike the NIST study, the GonaCon™ studies lethally removed deer by sharpshooting prior to contraceptive treatment to achieve a desired population density. The studies were conducted to determine if the desired deer densities could be maintained using contraception. Fagerstone et al. (2008) reported that a single shot of GonaCon™ could render female white-tailed deer infertile for one to four years. Both studies in Maryland found that approximately 50% of the treated females became fertile again after one year and would require retreatment.

When the 2009 deer plan went to print in October 2009, GonaCon™ had just been approved by the U.S. Environmental Protection Agency as a restricted use pesticide for use in free-ranging white-tailed deer. The department adopted regulations authorizing its use shortly thereafter. However, the method has never been used in Maryland due to the limitations of its effectiveness. While it is approved for free-ranging deer, it is unlikely GonaCon™ will be effective for treating a wide spread, free-ranging deer population. To be effective, the contraceptive must provide a one-shot treatment that renders female deer infertile for multiple years (not just a single year) and it must be capable of being administered to a large enough proportion of the female deer population to alter population size. Based on current deer population estimates and contraceptive technology, a minimum of 80,000 female deer would need to be captured and administered GonaCon™ in Maryland for effective statewide population control. Most of these deer would need to be recaptured and retreated in subsequent years. It is impossible to meet these requirements. If GonaCon™ is to be used in Maryland, it will most likely find its niche in treating deer that have a restricted range, where there is adequate access to the majority of the deer for treatments, and where deer numbers are first reduced via lethal control.

To date, fertility control for deer has demonstrated limited success in Maryland. While deer populations have been stabilized, and even reduced using these techniques, densities often remain above desired levels. These techniques have shown they can reduce recruitment by limiting birth of fawns, but slow attrition of the treated adult deer and continual immigration of new deer into treatment areas offsets net gains. Where these techniques have been most successful is when the landscape surrounding the treatment area has low deer densities or serves as a barrier to immigrating deer. Unfortunately, even in these instances untreated deer routinely establish new home ranges within the treated population. Given the current technology, to be most successful, fertility control should be supplemented with lethal control to first lower the deer population to the desired density and then attempt to maintain that density with sterilization or contraception. The department will continue to monitor the development of deer fertility-control techniques and will cooperate on future studies as they are proposed and funding is identified.

Venison Donation Programs–Venison donation programs indirectly contribute to deer population regulation by providing a way for hunters to make use of more deer than they normally would in a given year, thus encouraging them to harvest more deer. Hunters can donate legally taken deer to local food banks through a network of participating deer processors.

Donation programs have been available to Maryland deer hunters for decades. In its infancy, hunters were required to pay the processing cost and designate that the venison be donated to local food banks. Participating processors were scattered across the state with some counties having several participating processors, while other counties had none. Several organizations stepped forward in the ensuing years to raise sufficient funds to pay the processing costs and recruit more processors, but none proved successful in the long-term.

Since 2002, varying amounts of annual funding have been available from the department for a contractor to coordinate venison donation. Farmers and Hunters Feeding the Hungry (FHFH), a Washington County based organization, has been the winning contractor since the early 2000s. FHFH contacts processors, negotiates processing fees, and works with local food banks to ensure donated venison reaches those that need it. FHFH is also responsible for raising the funds needed, above what the department provides, to maintain the program. Typically, several thousand deer are processed through FHFH during the hunting season.

Maryland has had liberal deer bag limits for many years. The availability of a venison donation program allows hunters to take advantage of these limits and donate deer to local food banks. Unfortunately, funding limitations often prevent processing all of the deer that are potentially available. Identifying additional funding sources has proven challenging to date. However, at the close of the 2009 deer plan in 2018, legislation was passed that afforded hunters the opportunity to claim a state tax credit for donating processed venison. Going forward, hunters who legally harvest a deer and pay to have the deer processed and donated to a nonprofit food sharing program may take a credit of up to $50 per processed deer on their taxes. The maximum credit per tax year is $200.

White-tailed Deer Population Monitoring

Mandatory Deer Harvest Check-in–The mandatory check-in of harvested white-tailed deer in Maryland provides the primary data the department uses to monitor the white-tailed deer population. Deer check-in has been required in Maryland since the 1931 season and the long-term harvest trends of antlered and antlerless deer serve as indices that are invaluable for determining overall population trends for the species (Fig. 6).

Data collected at check-in include: species, sex, number of antler points, type of weapon used for the harvest, date, county, management unit and the hunter's identification number (DNRid). Data are used to monitor harvest rates by location and season for each of the sex classes (antlered and antlerless). The data are also used in the deer population model currently employed by the department to provide an annual population estimate.

From 1931 through the 2004-2005 deer season, deer check-in was accomplished at official check stations throughout the state. Check stations commonly were butcher shops, convenience stores, and sporting good stores that were compensated for their service ($1 per deer checked in 2004). However, the check-in system changed to a telephone/internet based system in 2005-2006 due to

increasingly large deer harvests and the difficulty of locating check stations in urban and suburban areas of the state. The check station system was designed when less than 1,000 deer were harvested statewide. At the end of the check station era, over 90,000 deer were being checked.

Telephone/internet (and smart phone app, beginning in 2015) check-in has provided the same quality data as the previous check station system. However, unlike the past when much of the data from check stations had to be hand-entered into a computer, telephone/internet data are already in digital format when the department receives it. Data are typically available the day after the check-in occurs, enabling managers to monitor the harvest more closely and to summarize the results in a more timely fashion in preparation for public dissemination and other uses.

Biological Data Collection (Butcher Shop Surveys)–Along with mandatory deer check-in, collecting biological data each year is critical for monitoring Maryland's deer population. Department personnel and volunteers annually examine over 4,000 deer during early muzzleloader season and firearm season at deer processors (butcher shops) across the state. Species, sex, age, antler measurements, county of kill, and signs of disease or illness are recorded for each deer brought to the processors by hunters. Agency personnel are charged with a goal of examining 75 antlered deer and 75 antlerless deer per county each year (with a portion of the quota collected during early muzzleloader season and the remainder collected during the two-week firearm season). The current sample size represents about 5% of the annual harvest and provides a statistically sound measure of standard error.

Deer age and sex data are used directly in the population reconstruction model used by the department, and antler measurements are indicative of herd health and habitat quality. Collecting biological data statewide also is an important outreach effort and gives staff the opportunity to meet one-on-one with its constituents.

Deer Population Modeling–The department uses a combination of two models to estimate the yearly size of Maryland's deer population. The annual deer harvest data from mandatory deer check-in and biological data collected at deer processors are used in a reconstruction model (Downing 1980) to estimate antlered male population size. Adult sex ratio and female productivity rate is estimated using a model by Lang and Wood (1976) and then combined with the antlered male estimate to generate a total population estimate.

Reconstruction models have been shown to be robust for white-tailed deer (Davis et al. 2007) and provide a valuable tool to track trends in deer population size. However, the estimates generated are a minimum population size and true abundance could be much higher. Likewise, significantly altering harvest rate (i.e., changing the season length or bag limit) can affect the population estimate. The department uses the population trend from the reconstruction model for management decisions. Likewise, the annual antlered buck harvest serves as a valuable index to monitor deer population trends.

Annual Hunter Mail Survey–The department has conducted an annual hunter mail survey since 1975. Approximately 7,500 surveys are mailed each year to randomly chosen hunters. The survey employs a three-mailing system (i.e., sending second and third reminder letters if surveys

are not returned in allotted time). The survey typically has a 30% return rate. Along with specific questions concerning current hunting topics or issues, hunters are asked what species they hunted, how many days they hunted each species and how many of each species they harvested.

The hunter mail survey provides important trend data for how many hunters pursue deer each year in the various seasons, how many days they invest in deer hunting, and how many deer they harvest. Staff use these data when making management and regulation decisions, and as a comparison to data collected from other sources (i.e., hunter harvest data, license sales data, etc.). The annual survey also routinely asks questions pertaining to recent deer management issues.

Annual Archery Hunter Survey–The archery hunter survey was established in 2002 primarily as a method to monitor furbearer populations. However, the survey provides excellent data on white-tailed deer as well.

Each year before the archery season begins, approximately 5,000 licensed archery hunters are randomly selected and mailed a form to record what they observe during each of their archery hunts. Individuals are asked what county they were hunting in, how many hours they hunted, type and count of any wildlife species observed, and other technical information about their hunts (lure use, cover scent use, public or private land, bait use, etc.). Archers are asked to return the forms at the end of the season, after which the data are analyzed and a report is generated. Participating archery hunters are then mailed a copy of the report and new survey form along with an appreciation certificate for their efforts.

Approximately 300–400 hunters return usable survey forms each year. Not surprisingly, white-tailed deer are one of the most common wildlife species reported. Each year participating archers report seeing approximately 15,000 white-tailed deer during their hunts. The survey has provided quality data on white-tailed deer populations in Maryland and provides another method to compare population trends between deer management regions, public and private lands, and physiographic provinces. The survey also provides useful data on adult deer sex ratios and female to fawn ratios.

FLIR Surveys–Forward Looking Infrared Radar (FLIR) has been used by the department to monitor and assess deer population levels in certain areas of the state. The technique involves using helicopters equipped with FLIR that fly a prescribed course over certain areas, or by using hand-held FLIR units and driving fixed routes by vehicle. Surveys occur at dusk or at night, typically during colder weather and when leaf cover is minimal. The FLIR detects the heat sources of deer and other animals so that they can be observed and counted. This method can provide deer population trend data for localized areas if an adequate number of surveys are performed.

Aerial FLIR via helicopters was used extensively in central Maryland in the late 1990s and early 2000s. Post-9/11 restricted flight zones in the metropolitan Washington, DC area made it impossible to fly an adequate number of transects to continue these routes. Graduate students from the University of Delaware have used hand-held FLIR units to estimate deer population size on public lands in western Maryland (Haus 2013; Ness 2017; Haus et al., in press), and Maryland Park Service staff annually survey some park properties using similar units.

Hunter Pressure Surveys–Maryland's public hunting areas are utilized by many deer hunters. Department staff annually survey the larger public hunting areas in western Maryland in an effort to determine deer hunting pressure. Personnel count the number of vehicles in hunter parking lots to determine hunter pressure on peak hunting days. Some of these areas have been surveyed for over 30 years. Comparing hunting pressure over long periods identifies trends in hunter use that the department can utilize in future management decisions. Unfortunately, these counts have shown a significant decline in hunter participation over the past several decades.

Scientific Research Studies–The department routinely contracts with local universities to conduct graduate research studies concerning white-tailed deer biology and management topics. The University of Delaware has completed several research projects involving both white-tailed deer and the exotic sika deer. Graduate students have studied exurban deer movements in the vicinity of Fair Hill NRMA (Ebersole et al. 2007; Rhodes et al. 2010; Rhodes et al. 2013), hunter attitudes regarding chronic wasting disease in western Maryland (Haus et al. 2017), fawn recruitment and predator abundance rates in western Maryland (Ness 2017), and the effectiveness of various estimators of deer abundance (Haus et al., in press). Graduate research projects are invaluable for providing insight into the dynamics of Maryland's white-tailed deer population and answering important questions regarding their management needs. Funding for such studies is relatively inexpensive when matching grants and graduate student labor costs are factored into the analysis.

The department also cooperates on other research projects that it does not directly fund. Various universities typically have any number of research studies ongoing that involve deer. The University of Maryland is currently studying interactions among white-tailed deer, ticks, and Lyme disease in Howard County. Stevenson University has studied malaria within white-tailed deer (it has not been found to infect Maryland deer), and Penn State University has studied white-tailed deer and sika deer on Assateague Island, and what role genetics play in the distribution of chronic wasting disease within deer in the mid-Atlantic region.

Disease Surveillance–White-tailed deer, like other wildlife, can carry diseases and parasites. Most of these are not fatal to deer or infectious to humans but are part of the deer's natural life cycle. Two of the more prominent diseases currently associated with white-tailed deer, hemorrhagic disease and chronic wasting disease, are monitored closely by the department. Both of these diseases are now present in Maryland. Effective disease monitoring is critical to ensure the well-being of white-tailed deer, other wildlife, and Maryland's human population. Detailed information on these and other common diseases and ailments that afflict white-tailed deer can be found in Appendix 5.

Winter Mortality Surveys–Maryland's geography is such that many weather extremes occur as a normal part of the annual cycle. Deep snows in western Maryland occur frequently enough that winter deer mortality can occur due to starvation. In years when deep snow lasts for a substantial time period, deer will gather in large numbers in protected areas (i.e., deer yards). When this occurs, food can quickly become limited.

In particularly severe years, staff may survey deer yards and document mortality. Some of the yards have been monitored for more than 40 years. Samples are sometimes collected from dead deer to determine the cause of death. More often than not, younger deer die first because they

cannot reach as high as adult deer when browsing. Rarely, in extreme years, even adult deer will occasionally starve.

Wildlife Response–Department staff often respond to calls from citizens regarding sick or injured deer. Timely response to these calls enables the department to track any potential disease outbreaks in Maryland deer. It also enables staff to monitor certain areas for repeated calls that may indicate an emerging disease issue on the landscape.

The department does not rehabilitate injured or sick deer. More often than not, the stress from capture and handling would kill an already compromised animal. The standard policy of the department is to let nature take its course unless the animal is severely injured and appears to be suffering. In these cases, the department employs humane euthanasia methods.

Occasionally, the department receives calls from concerned citizens about unique deer situations. These calls often involve deer trapped or confined in areas where they cannot extricate themselves, deer with large plastic containers stuck on their heads, deer caught in fences, etc. Staff respond promptly to these calls and are often successful in resolving the issues.

Information and Education

Maintaining a current knowledge base concerning white-tailed deer biology and management and disseminating it to the public is another primary function of the department. The deer project is a member of the Northeast Deer Technical Committee and the Southeast Deer Study Group. Staff annually attend committee meetings with both organizations to become better-informed on relevant deer issues across the regions. Likewise, deer project staff participate in various technical working groups involving deer and are members of professional groups including The Wildlife Society. Information gleaned from these groups is helpful to both agency personnel and stakeholders who receive this information from the department.

Effective dissemination of deer information and data is critical to the success of the department. Deer project staff routinely work with the outreach and education professionals of the department to communicate with the public through a variety of mediums. An important means of written communication with the public is through press releases. Press releases are used to report deer harvest results, upcoming hunting seasons, disease prevalence and testing results, and other current topics that arise. Likewise, staff members provide updated information to the department website and for use on various social media platforms. They also write popular articles for various media outlets including the department's own "Natural Resource" magazine.

Addressing Constituent Demands

Provide Recreational Deer Opportunities–White-tailed deer are one of the most popular wildlife species in Maryland and the most popular game species. Wildlife watchers and hunters enjoy seeing deer. Hunters also appreciate a balanced deer population that supports adequate hunting opportunities. The department recognizes the value of white-tailed deer to the Maryland public and is committed to maintaining white-tailed deer at levels that provide recreational experiences and opportunities for all.

The department invests substantial funding in deer-related management activities to ensure Maryland's deer population remains healthy. The department employs multiple staff members

who are largely dedicated to deer management activities and invests heavily in public lands that can be used for deer watching and hunting. Likewise, the department ensures the decision-making process related to deer management includes all facets of public participation, including stakeholder groups, public meetings, public opinion surveys, and extensive information and education outreach.

While the department is committed to providing recreational opportunities related to deer, it is also committed to reducing the negative impacts associated with high deer numbers. Defining what population level is needed to reduce negative deer impacts, but still provide adequate recreation, is a challenging process. The department will continue to address this subject extensively in the coming 15 years.

Reduce Deer Crop Damage–White-tailed deer feed on a wide variety of vegetation including many Maryland agricultural crops. Corn and soybeans are two of the most common crops grown in Maryland and, unfortunately, they are preferred by deer. Deer also browse on woody vegetation found in forests and in nurseries. Deer damage to crops and nurseries cause significant economic losses. Maryland landowners lost an estimated $7.7 million in deer damage during 2011 (U.S. Department of Agriculture 2012), and 77% of Maryland landowners who have commercial agricultural operations indicated they experienced deer crop damage during the past year (Responsive Management, 2018). In 2007, 63% of landowners responded they had experienced deer crop damage in the past year (Responsive Management 2007). As a result, most Maryland landowners would like to see a decrease in the local deer population.

Farm operations without hunting programs often have high deer populations and increased crop damage. A study on three Maryland National Park Service properties that had agricultural leases found deer densities from 115 to 138 per square mile (Stewart et al. 2007). Deer browsing on these leases reduced corn silage production between five and forty-three percent. The study concluded that non-lethal deer management options for cropland are limited and that "lethal deer management appears to be the only viable, cost-effective option at reducing deer damage at this time." Unfortunately, many agricultural properties in Maryland are either not hunted or are not hunted intensively enough to reduce deer numbers appreciably. It is critical that landowners develop a deer management plan that employs hunters willing to harvest an adequate number of antlerless (i.e., female) deer throughout the deer season in order to reduce deer numbers and crop damage.

The department issues Deer Management Permits (DMPs) to commercial producers who are experiencing crop damage. Likewise, the department continues with liberalized antlerless seasons and bag limits in an effort to reduce the deer population and aid commercial producers in controlling deer. In recent years, the department has offered workshops, in conjunction with the Maryland Farm Bureau, to assist farmers with wildlife damage problems. The department also modified the Deer Cooperator Permit system to include agricultural producers so they could shoot deer at night on their fields on a limited basis. Lastly, numerous laws have been created or modified to aid landowners with deer crop damage problems. Landowners can harvest deer under the authority of their Deer Management Permit 365 days a year, including all Sundays. Likewise, in some counties they are permitted to use rifles even when deer hunting is restricted to shotguns, and all persons listed on the permit to harvest deer may use firearms during the entire year. The department will continue to work with Maryland producers to minimize losses

due to deer by providing them a variety of lethal and non-lethal management options that are effective, safe, and culturally acceptable.

Reduce Deer-vehicle Collisions–Deer-vehicle collisions (DVCs) are hazardous to travelers of Maryland roadways and can cause personal injury and even death. Other problems that result from DVCs include damage to personal property, lost wages, and car repair expenses. Not surprisingly, reducing the number of DVCs via deer population reduction is a common demand made to the department.

Responsive Management (2007 and 2018) found that 8% of Maryland residents surveyed indicated they had a vehicular accident with a deer in the past year. These numbers are similar to a 1996 survey by C. Mason Ross that found 9% of Maryland residents had experienced a DVC in the past year and 41% had a family member or friend who had experienced a DVC.

DVCs are reported to the department by a broad spectrum of agencies, including state, county and local law enforcement agencies, animal control officers, park rangers, roadway maintenance crews, private contractors and motorists. The department annually tabulates data on DVCs from each county jurisdiction via totals provided by roadway authorities and through the return of Maryland Non-Hunting Deer Tags issued by various agencies that recover deer carcasses or report DVCs on Maryland's roadways.

The exact number of DVCs that occur in Maryland is not known, although it is clear that thousands of them occur annually. Many DVCs go unreported by motorists and an unknown number of struck deer travel away from roadways and are not observed. State Farm Insurance (2018) uses claim data to project the annual number of DVCs that occur in all states. They estimate that approximately 30,000 DVCs occur annually in Maryland.

The department informs the public about DVCs and the methods that can be used to avoid DVCs through the print and television media, via press releases, online forums, and the department's website. The department also cooperates with local jurisdictions to provide DVC information. Presently, roadside fencing, over/underpasses for animals, deer population reduction, and encouraging drivers to remain alert for deer are the most productive strategies for reducing deer-vehicle collisions. The department will continue to monitor future developments of deterrents for deer-vehicle collisions and will actively promote any advances in technology.

Reduce Urban/Suburban Deer Conflicts–Urban and suburban deer management is a significant challenge to wildlife managers across the United States. In Maryland, human conflicts with deer continue to be a common issue addressed by the department. As a result, the department employs staff dedicated to addressing these types of deer problems.

The urban deer program is dedicated to assisting Marylanders with the resolution of human-deer conflicts. Staff regularly communicate with Maryland residents and provide them with written and verbal information on the methods that exist to reduce deer damage and the problems that deer can cause. Upon request, staff can meet with individual communities or local governments to present information on the various deer management options in more detail and to answer specific questions about deer management issues.

Informing and educating the concerned public and their elected officials on available deer management options is vital to proceeding with any deer management effort. To better provide that information to the public, the department maintains a deer management webpage (dnr.maryland.gov/wildlife/Pages/hunt_trap/DeerManagement.aspx). The webpage provides comprehensive information on the non-lethal and lethal deer management options that are available to assist Maryland's residents with the resolution of deer issues.

In many cases, individual landowners or homeowners can utilize the various deer management methods on their own properties to reduce the problems caused by deer. In contrast, deer management at the community level often must be carried out with consensus from the members of the community. Often, this consensus is difficult, if not impossible, to achieve and management actions are slow to happen. As a result, deer issues escalate as the deer population increases.
Some Maryland county governments have taken on the responsibility of assisting their residents with the resolution of deer management issues and have created their own deer management programs. They have dedicated staff, webpages, and other outreach materials that can assist with the resolution of deer management issues. Anne Arundel, Baltimore, Howard, Montgomery, and Prince George's counties all have their own webpages dedicated to resolving human-deer conflicts. The department encourages other counties to adopt similar deer management programs to assist their citizens with the resolution of local deer management issues, and is willing to guide them in implementing their own deer plans.

The Deer Project stresses that no single deer management option can alleviate all deer problems. Land managers, homeowners, and suburban residents experiencing deer problems should consider using a combination of options when managing deer and resolving deer problems.

Continue to Investigate Non-lethal Deer Control Methods–The department will continue to investigate, promote, and implement effective non-lethal deer control methods as they become available and are appropriate. It is the department's responsibility to provide the most accurate information available regarding deer management and provide professional guidance on deer control methods for specific settings. In some instances, non-lethal control methods may be the most effective measures available and will be promoted. The department will continue to promote hunting as an effective management tool in controlling deer numbers in concert with non-lethal methods where they may be effective.

Other Management Activities

Captive Deer–The department has not issued permits to possess white-tailed deer or other cervids (members of the deer family) since 1984 due to potential disease threats to native free-ranging deer, livestock, and humans. Currently there are approximately six individuals that hold a valid Maryland Game Husbandry permit to possess deer.

Because captive deer are often kept in confined areas at high densities, the risk of disease and disease transmission is increased. Likewise, the buying, selling, and moving of deer can result in diseases being introduced into areas where they did not exist. Bovine tuberculosis (TB) and chronic wasting disease (CWD) are thought to have infected wild populations of deer and elk in several areas of the United States and Canada through the release/escape of diseased captive deer and/or through the contact of diseased captive deer with wild deer through perimeter fences.

To reduce the potential for disease threats from captive deer, the department has a Captive Deer Response Plan and has enacted regulations pertaining to the possession of captive deer. Current regulations prohibit the breeding of captive deer in most instances. Additionally, all captive deer must be ear-tagged, and fencing must meet minimum standards. Permittees are not allowed to move deer to other permittees in the state, but may, upon permission from another state, move the deer out of Maryland. Deer project staff, in cooperation with the Maryland Natural Resources Police, perform annual inspections of captive deer facilities to check for compliance with permit requirements.

The possession of captive deer in Maryland without a permit is a violation of Maryland regulation. Similar to the Captive Deer Response Plan, the department has developed a response plan for illegally possessed deer. Owners of illegally held deer are given the opportunity to relocate their deer out of state. If owners do not comply, the deer are confiscated, euthanized, and tested for disease.

Maryland citizens are informed on the reasons it is illegal to keep deer captive without a permit. The department also does outreach through periodic press releases and information on the department website to inform the public about the problems that can result from keeping deer in captivity.

Fawn Rehabilitation–White-tailed deer fawns with their conspicuous spots and dainty features are probably the most recognized "baby" animals known to Marylanders. The Disney movie, "Bambi," popularized deer, especially fawns, making them an instantly recognized wildlife species to countless people. The 'cute and cuddly' features, coupled with a look of helplessness, makes the white-tailed deer fawn one of the most awe-inspiring sights in nature.

Unfortunately, this sense of awe often triggers an inclination to help, where no help is required. Maryland residents occasionally find fawns that they believe have been abandoned or orphaned. In most cases, the fawns do not need human assistance as they have been intentionally left alone by the doe. A doe will leave its fawns alone while it forages or ruminates so it can produce the milk necessary to feed the fawns. The doe will return periodically to nurse and preen the fawns and to relocate them to new secluded habitat as is necessary.

The department issues seasonal press releases and provides website information to inform the public on what to do if they encounter a fawn. This outreach includes information on why it is illegal to remove deer and other native wild animals from the wild and keep them in captivity without the approval of the department. The unnatural conditions of life in captivity can cause malnutrition, injury, and stress which could lead to sickness or death for the fawn. Wild animals, such as adult deer that become accustomed to humans, can also pose a threat to people.

Individuals who find injured or orphaned fawns are advised to contact their local Wildlife & Heritage Service office for advice. In cases where fawns are known to be orphaned, the person is advised to contact a qualified Maryland Wildlife Rehabilitator and arrange for the fawn to be transferred to them for care. Certain Maryland Wildlife Rehabilitators are permitted to rehabilitate and care for fawns until they are healthy enough to be released back to the wild.

Shooter Qualification Program–Many of the managed deer hunts held by governmental organizations in Maryland require all participants to first pass a shooting proficiency test. Consequently, the department facilitates a shooter qualification program using local sportsmen's clubs, shooting ranges, and other groups that avail their facilities and expertise to certify hunters. A standardized shooting certification has been established, allowing a hunter to satisfy the proficiency testing requirements by qualifying one time at a single location each year. The Shooter Qualification process ensures that hunters participating in managed deer hunts are safe and proficient with their weapons.

GOALS, OBJECTIVES AND STRATEGIES

This section identifies the broad, long-term goals for managing white-tailed deer in Maryland through 2034. The goals were originally developed for the 2009 plan with input from the white-tailed deer plan stakeholder group, WAC, general public comment, and expert opinion from department staff. All of the goals remain relevant for the 2020 plan, and after vetting them through the same process as the 2009 plan, they remain largely unchanged. The goals represent the values of a diverse citizenry and are general statements of how deer management in Maryland should proceed over the next 15 years.

Following each goal are objectives and strategies. The objectives describe how the goals will be achieved and some have measurable milestones. For those objectives that do not have a milestone, it is assumed the action will occur throughout the duration of the plan unless the objective should change. Under each objective, specific strategies are listed that further detail how the objectives and ultimate goal will be met.

While the broad goals for this plan should not change over the next 15 years or more, it is possible the objectives and strategies will change given the dynamic nature of deer management. Changing social, environmental, technical, administrative, and political conditions can quickly alter deer management priorities and objectives. To be effective, a deer management program and its guiding plan must be adaptable to these potential changes. Therefore, objectives and strategies currently addressed in the white-tailed deer plan may not be accomplished or may be modified or replaced with other objectives and strategies in the future. Goals, objectives, and strategies will be reviewed periodically during the 15 year span to evaluate progress and identify any changes needed.

Population Goal: Use diverse and progressive methods to ensure the long-term viability of Maryland's white-tailed deer population through comprehensive research, efficient monitoring, public outreach, trained staff and effective management.

The department is legislatively mandated (§10-202) to conserve and manage the wildlife resources of the state. The management of white-tailed deer, one of Maryland's most prominent wildlife species, has to be based on sound science and public acceptance. Scrutiny of deer management techniques is intense from both the proponents and opponents of any given management option. This scrutiny requires the careful and thoughtful review of any new or existing program if it is to remain viable. While deer management will continue to largely rely on lethal control due to its overall effectiveness, a publicly accepted deer program must remain current on both lethal and non-lethal options, and recommend both judiciously.

Maryland's mix of urban, suburban and rural landscapes requires a multi-faceted approach to deer management. More traditional, hunting-based management practices remain most effective in rural areas, but deer management in urban and suburban areas is much more difficult and requires a diversity of approaches.

> Objective 1: Maintain a current and working knowledge of various methods to accurately estimate and track deer population numbers.

Strategy 1: Participate in professional organizations (i.e., the Wildlife Society, Northeast Deer Technical Committee, and Southeast Deer Study Group) that have members who are experts in the subject matter.

Strategy 2: Routinely review peer-reviewed literature on the subject matter.

Strategy 3: Consult with Universities on an as-needed basis.

Objective 2: Use a diverse set of management tools to manage deer at population levels compatible with Maryland's diverse human population, including stakeholders directly impacted by deer.

Strategy 1: Continue to use antlered harvest per square mile in combination with public input to monitor deer population trends as they relate to cultural carrying capacity. Track these metrics at the state, region, county, and sub-county level (i.e., harvest management units) as needed.

Strategy 2: Use adaptive management to define deer management regions by grouping similar counties and/or municipalities in order to simplify hunting regulations and manage deer at a landscape scale.

Strategy 3: Use the regulatory process to adjust lethal control rates (i.e., deer hunting seasons and bag limits) up or down to respond to cultural demands regarding the deer population.

Strategy 4: Where feasible, use non-lethal deer population control methods that are proven effective to help meet desired deer population objectives.

Strategy 5: Foster the use of regulated hunting for deer population management while maximizing recreational opportunities for hunters.

Strategy 6: Promote the need for active deer management, particularly via regulated hunting, on more public and private lands to meet deer population objectives.

Strategy 7: Recognize the special management needs of urban/suburban entities and facilitate any appropriate additional opportunities for deer population management.

Objective 3: Develop and maintain a current understanding of potential management techniques that can be used in populated and other unique areas where traditional lethal deer management techniques cannot be effectively employed.

Strategy 1: When available, use new techniques on a trial basis and monitor their effectiveness.

Strategy 2: Cooperate with non-traditional partners to identify feasible new techniques and apply them as appropriate.

Strategy 3: Continue to cooperate on research studies and management projects that involve non-lethal deer management techniques including sterilization and contraceptives.

Strategy 4: Monitor the continual development of deer contraceptives and maintain an applicator certification program for any that are approved and deemed appropriate by the department.

Objective 4: Recognize and evaluate other sources of potential deer mortality and the corresponding impacts to the population (and other animal populations) and identify ways to address these impacts.

Strategy 1: Monitor deer diseases and proactively initiate programs to minimize the threat to other wildlife populations and Maryland citizens.

Strategy 2: Strictly limit the possession of live cervids in Maryland in a way that minimizes the transfer of disease to wild deer, domestic animals, and humans.

Strategy 3: Strictly limit the importation of dead cervids or parts from areas of the country with diseases of concern.

Strategy 4: Monitor the potential threats created by trends in deer management, such as feeding/baiting, the use of natural deer lures, the development of tick control methodologies, or other potentially hazardous practices. When warranted, address these activities via the regulatory process.

Strategy 5: Continue to monitor any impacts that large predators (especially coyotes and bears) may have on deer populations.

Objective 5: Proactively inform Maryland citizens of the department's management approach, goals, and techniques so they may gain a better understanding of what options are available, what the anticipated outcomes are for those options, and why the already-selected options are in place.

Strategy 1: Identify and use effective mechanisms to get information on the department's deer management program to the general public (see Education Goal, pg. 47).

Objective 6: Maintain a staff of well-trained, properly equipped, and adequately protected employees to conduct deer-related management activities.

Strategy 1: Provide periodic training and certification of staff so they are current on proper techniques, including refresher training.

Strategy 2: Communicate with health officials in the state to proactively inform staff on the health risks associated with handling deer.

Education Goal: Educate Maryland citizens on all aspects of deer biology, including management tools, disease issues, economic aspects, and recreational opportunities.

This goal is intended to increase the public's understanding of deer biology and the impacts deer have on landscapes and people. A number of outreach mechanisms exist and these should be carefully selected to enable staff to reach a diverse set of customers. An emphasis should be placed on providing information on the realities of deer population dynamics and the impacts that too many deer can have on cultural interests, habitat, and other wildlife species. Concurrent with this emphasis should be a focus on non-lethal and lethal management tools. Finally, information on the recreational opportunities provided by deer should be included.

Objective 1: Increase public understanding of deer biology and the impacts deer have on habitat, people, water quality, and the health of the Bay.

Strategy 1: Provide current and useful information on the department website and various social media platforms. This information should be diverse in order to appeal to the general public, not just specific user groups.

Strategy 2: Provide press releases, media interviews, and popular articles covering diverse subjects related to deer.

Strategy 3: Partner with other organizations to conduct deer related outreach on topics compatible with the department message.

Strategy 4: Increase outreach efforts to schools by continuing and expanding the use of educational deer trunks and other tools to ensure this approach is consistent with what the school systems want to use.

Objective 2: Assist community groups or other organizations in managing specific deer populations and provide staff support to accomplish shared goals when appropriate.

Strategy 1: Make presentations to organized groups to provide the different management options available to address problems in specific situations, such as communities, local government tracts, corporate holdings, military bases, and school campuses.

Strategy 2: Where feasible, advise these groups how they can use public hunting as an economical and effective management option and offer assistance on establishing a managed hunt program.

Objective 3: Increase the public's understanding and acceptance of regulated deer hunting and its importance as a management tool.

Strategy 1: Using the outreach mechanisms noted above, provide timely, focused information on the role deer hunting has in managing deer in Maryland.

Strategy 2: Proactively provide information on the safety of deer hunting for participants and non-participants.

Strategy 3: Establish deer hunting regulations that promote the safe, fair, and ethical pursuit of this species in order to remain compatible with the values of the majority of Maryland citizens.

Objective 4: Increase public understanding of non-lethal deer management techniques in a manner that allows them to make informed decisions on the applicability of these techniques in a given situation.

Strategy 1: Using the outreach mechanisms noted above, provide timely, focused information on new and existing non-lethal deer management options.

Objective 5: Focus outreach efforts on the impacts deer have on the ecosystem, to include the deleterious effects high deer densities have on other fauna, flora, water quality, and the health of the Chesapeake Bay.

Strategy 1: As they become available, use the outreach mechanisms noted above to provide timely, focused information on the impacts deer have on the environment. Where possible, tie this information to issues related to the health of the Chesapeake Bay, focusing on the role sound ecosystems have on water quality, and the diversity of the Bay's living resources.

Objective 6: Educate Maryland deer hunters on the concept of Quality Deer Management (QDM) and encourage voluntary use of QDM.

Strategy 1: Provide current and user-friendly QDM information on the department website and in other outreach and education materials as appropriate.

Strategy 2: Educate selected staff on the application of QDM so that they can assist landowners, clubs, and hunters in applying this approach where they manage deer.

Recreation Goal: Provide the opportunity for all citizens to safely, fairly, and ethically enjoy diverse deer-related recreational experiences and traditions consistent with established deer population trend goals.

Enjoyment of the deer resource in Maryland is very diverse, ranging from casual enjoyment by citizens while they are participating in other activities, to intensely focused hunting with strong traditional connections. The economic benefit of these uses is considerable, exceeding $200 million annually in Maryland. Deer hunters spend an estimated 750,000 days afield each year pursuing deer.

Objective 1: Provide adequate viewing opportunities of white-tailed deer combined with an outreach program designed to inform citizens on the biological and cultural aspects of deer.

Strategy 1: Incorporate input from non-consumptive white-tailed deer users when determining deer population objectives (Population Goal, Objective 1, Strategy 1).

Strategy 2: Provide educational programs on the biology and cultural issues of deer designed to reach diverse audiences in Maryland.

Objective 2: Identify new non-consumptive deer-related recreational demands as they occur and develop quantifiable objectives for non-consumptive deer-related recreation.

Strategy 1: Use surveys, review popular literature, etc. to identify new non-consumptive demands for white-tailed deer. Use stakeholder groups/public input as needed to develop quantifiable objectives.

Objective 3: Consistent with deer population objectives and the legislative mandate to conserve and manage the wildlife of Maryland, maintain an annual average of 800,000 hunter-days for deer hunting.

Strategy 1: Incorporate input from consumptive white-tailed deer users (i.e., hunters) when determining deer population objectives (Population Goal, Objective 1, Strategy 1).

Strategy 2: Use regulated hunting wherever feasible as the primary tool to achieve deer population objectives.

Strategy 3: Ensure that deer hunting regulations are responsive to the needs and traditions of the hunting community while remaining compatible with the expectations of the majority of the public.

Strategy 4: Recognize the value of venison donation programs in Maryland and support these programs to the extent our resources allow.

Strategy 5: Promote deer hunting among youth, women, minorities and non-traditional groups.

Strategy 6: Use the deer hunter satisfaction index obtained annually via the department's hunter mail survey to monitor hunter satisfaction.

Objective 4: Investigate and potentially endorse new deer hunting opportunities, techniques, and management options that provide increased recreation, meet user expectations, and help reach or maintain established deer population objectives. Monitor new techniques for long- term feasibility, safety, and compatibility with the cultural values of deer hunters and the general public.

Strategy 1: Evaluate the biological need to use new management approaches (such as Quality Deer Management) in order to meet or maintain established deer population objectives. Enact the appropriate regulation(s) when these programs, or the components of these programs, will significantly assist in achieving population objectives. Combine these new regulations with effective education programs.

Strategy 2: Evaluate the cultural demand to use new management approaches (such as Quality Deer Management) in order to increase user satisfaction. Be responsive to those demands in a manner that maintains hunting as the primary tool used to reach or maintain deer population objectives, is compatible with the desires of the majority of our users, and is culturally acceptable to the general public.

Strategy 3: Evaluate the safety and efficacy of new hunting techniques, seasons, or weapons, and review these for compatibility with hunter expectations and acceptance by the general public. This evaluation should consider local conditions that impact the ability of hunting to meet or maintain population objectives. Examples would be suburban areas, areas with localized ecological concerns, or land tracts with unique conditions (such as urban parks or corporate grounds). Enact the appropriate regulations if the evaluations show positive results.

Objective 5: Ensure deer hunting remains a safe, fair, and ethical activity that meets the expectations of the majority of Maryland citizens.

Strategy 1: Maintain high standards for the hunter and firearm safety programs required in Maryland.

Strategy 2: Promote the Hunter Education Program and provide technical assistance and advice to Natural Resources Police personnel who oversee the program.

Strategy 3: Evaluate, improve, and standardize hunter qualification courses required to participate in managed hunts on public and private grounds.

Strategy 4: Retain or create regulations to keep hunting safe, fair, and ethical while keeping this activity the most effective tool available to meet or maintain population trend goals.

Strategy 5: Ensure enforcement of deer hunting laws and regulations remains a priority of the agency.

Damage Goal: Identify and actively address the negative impacts the deer population has on human interests and the ecosystem in a manner consistent with the long-term viability of the deer population in Maryland.

This goal includes economic losses, as well as situations that detract from the overall quality of life for Maryland citizens. Economic losses due to excessive deer can be wide ranging, from agricultural impacts to deer-vehicle collisions to damaging ornamental plantings. Overabundant deer also damage ecosystems with excessive browsing that damages native habitats, negatively influences other wildlife populations, and promotes establishment of invasive species. All of these can directly impact human health, safety, hygiene, and peace of mind.

Objective 1: Reduce deer-vehicle collisions across Maryland as measured by the number of vehicles registered in the state compared to the frequency of reported deer strikes.

Strategy 1: Continue to educate the public on defensive driving techniques by issuing press releases and social media messages at strategic times.

Strategy 2: Encourage state, county, and city highway departments to maintain or erect new fences and incorporate wildlife passageways under/over roads.

Strategy 3: Work in conjunction with the Maryland Department of Transportation (MDOT) to improve the reporting of deer-vehicle collisions and develop models to determine the relationships between habitat, geography, and road conditions with the frequency of a deer-vehicle collision occurrence. Use this information to target education and prevention measures to problem areas.

Strategy 4: Continue to participate in interstate and interagency task forces concerning deer-vehicle collision reduction strategies.

Strategy 5: Work with local governments, communities, and other owners of open space to reduce deer populations in high traffic areas via lethal and non-lethal approaches deemed appropriate.

Objective 2: Reduce deer damage incurred by agricultural producers in Maryland.

Strategy 1: Partner with leaders in the agricultural community to address deer damage in ways that are economically feasible, culturally acceptable, and compatible with recreational hunting interests.

Strategy 2: Continue to issue Deer Management Permits and Agricultural Deer Cooperator Permits as per existing protocols. Review the protocols every five years at a minimum to ensure compatibility with the expectations and needs of recipients and staff.

Strategy 3: Offer guidance to producers concerning alternative deer damage control measures (fencing, repellents, dogs, etc.). Monitor the progress of some of

these approaches to ascertain effectiveness, using the results to further educate producers and refine techniques.

Strategy 4: Establish regular deer hunting seasons and bag limits in a manner intended to reach population objectives. These goals should be established to meet many criteria, including being responsive to agricultural interests.

Strategy 5: Identify public tracts of land with high deer populations that are adjacent to, or near agricultural producers, and work with the managers or owners to address the overpopulation of deer.

Strategy 6: Create or enhance available resources for deer on public lands to reduce deer damage on adjacent private lands. Managers should carefully evaluate whether such enhancements will artificially increase deer numbers and further negatively impact adjacent private lands.

Objective 3: Remain current on the potential deer-related disease threats to human health and maintain a responsive approach to minimizing these threats.

Strategy 1: Monitor new developments and research concerning the potential disease threats to human health that are directly or indirectly associated with deer (Lyme disease, chronic wasting disease, ehrlichiosis, human babesiosis, fecal contamination, etc) and incorporate new information into a responsive technical assistance approach with the public.

Strategy 2: Take management actions to reduce any significant health threats to the public when warranted and feasible.

Strategy 3: Maintain deer populations at levels that minimize the threat of deer associated diseases or other human health implications.

Objective 4: Identify public tracts or other large parcels of land with high deer populations and work with the managers or owners to address the situation via lethal or non-lethal means. These tracts may be experiencing significant damage to their natural communities and/or providing a refuge for deer impacting surrounding properties.

Strategy 1: Meet with the appropriate land managers to inform them of the problems presented and provide technical guidance on how to rectify the situation.

Strategy 2: Assess the ability of the department to actively manage any deer control measures on a tract by tract basis and initiate appropriate programs where feasible to do so.

Strategy 3: On a case-by-case basis, implement changes to hunter access restrictions to ease deer carcass retrieval from more remote areas of public lands.

Strategy 4: Strengthen relations with federal, county, and local government land managers to improve access for deer management.

Objective 5: Work with urban/suburban communities to reduce deer problems, including damage to gardens, shrubs and landscaping, and the impacts to personal hygiene from extensive deer feces around homes, schools, parks, athletic fields and other public places.

Strategy 1: Provide technical guidance, as needed via various department outreach methods.

Strategy 2: Establish regular deer hunting seasons and bag limits in a manner intended to reach population objectives. These goals should be established to meet many criteria, including being responsive to urban/suburban community needs.

Objective 6: Provide a responsive means for effective localized deer management actions to address special situations where deer control outside existing hunting regulations is in the public interest.

Strategy 1: Offer a Deer Cooperator Permit program that maintains a safe and professional approach to addressing local deer population issues that is socially acceptable to most citizens.

Objective 7: Provide staff with appropriate equipment and training to respond quickly to localized deer emergencies on a statewide basis. This would include deer that have entered buildings or are entangled in various manners; are injured; appear diseased; or are threatening public safety.

Strategy 1: Offer periodic staff training and certification on current techniques.

Strategy 2: Monitor new developments in firearms, immobilization drugs, and delivery equipment and incorporate into staff training as appropriate.

.

Objective 8: Establish a means to quantify deer impacts to natural communities and/or listed species with the goal of identifying where those impacts are the most critical.

Strategy 1: Partner with Maryland Natural Heritage Program, other sister agencies, and non-governmental partners to identify natural communities most impacted by deer. Where feasible, marry the 2020-2034 White-tailed Deer Management Plan with strategic plans from these groups (i.e., Natural Heritage species plans, Forestry management plans, etc.) to develop more effective management strategies to minimize deer damage.

Strategy 2: Identify the natural communities most critically impacted by deer and develop remedial programs to address the deer population locally. Monitor ecosystem response as the remedial programs are enacted.

Operational Resources Goal: Ensure that all necessary resources are available to support the proper management of white-tailed deer in Maryland.

Managing white-tailed deer in Maryland requires substantial resources. Nearly all of the budget for DNR's unit comes from hunting license sales and federal Pittman-Robertson matching funds. When hunter numbers decline and license sales go down, available funding decreases as well. This funding is not only used for managing deer, but also for managing all wildlife in Maryland. Therefore, other sources of funding must be identified for the department to fulfill its mission.

Objective 1: Maintain and/or increase revenue through the sale of hunting licenses and stamps.

Strategy 1: Maintain staff who are charged with maintaining a national level understanding of hunter recruitment, retention, and reactivation trends and the programs in place to address these issues.

Strategy 2: Create programs to address hunter recruitment, retention, and reactivation.

Objective 2: Identify alternative sources of funding and support to conduct deer management in Maryland.

Strategy 1: Identify and apply for alternative grants that pertain to deer research, management, disease monitoring, and public education.

Strategy 2: Develop a program to enlist volunteers to conduct certain management activities. These volunteers should be well trained and offered incentives to assist with deer management efforts.

Strategy 3: Investigate the applicability of successful efforts elsewhere in the nation to obtain funding that is not tied to the consumptive user groups. Seek to enact any of these programs, or innovative new ones that would apply in Maryland.

Appendix 1. White-tailed deer biology

Physical Description–Native white-tailed deer live in all Maryland counties across a wide range of landscapes. The white-tailed deer's distinctive white tail and white rump patch is readily visible when they bound away from real or perceived danger. White-tailed deer can sprint up to 35 miles per hour and are able to vertically leap over eight feet.

Adult white-tailed deer are about three feet tall at the shoulder. Yearling whitetail bucks (1.5 year old males) weigh an average of 135 pounds and yearling does (females) average 120 pounds in Maryland. During the warm months, deer possess reddish-brown hair. A grayish-brown coat with a thick undercoat replaces the reddish hair during the cold time period.

Whitetail bucks grow and shed antlers each year. On rare occasions, females may exhibit antlers. Bucks use their antlers to establish dominance over other bucks during breeding season. Antlers, which are composed of true bone, begin to grow in late March and early April. The growing antlers are covered with skin and blood vessels called velvet. As testosterone levels increase for the fall breeding season, the antlers harden and the velvet is rubbed off. Antlers typically are shed in January and February. Bucks in poor physical condition tend to drop their antlers first.

Habitat–Maryland white-tailed deer habitat includes most parts of the state, except for open water and the intensely developed urban areas (i.e., downtown Baltimore). Deer thrive in landscapes intermixed with wooded/brushy sections and open areas, such as cropland, pasture, or landscaped yards. Deer use the wooded areas for food and cover, while open areas provide food. Landscapes with a bountiful interface of forested and open areas provide prime deer habitats.

Suburban development and exurban growth can create ideal habitat conditions for white-tailed deer. When forested areas are converted into housing developments, portions are cleared for roads and home sites, while other sections remain forested. When open farmland is transformed into residential areas, new homeowners plant trees, shrubs and perennials. Both of these types of residential conversions provide excellent deer habitat.

Home Range–The typical annual average home range for white-tailed deer is about one square mile (640 acres). However, sex, age, and habitat quality can influence an individual deer's home range size. Yearling males will typically move many miles before establishing a stable home range while adult females usually travel much shorter distances before doing so. Deer in quality habitat typically travel less than deer in poorer habitat.

Food Habits–Deer feed on nuts, berries, leaves, woody shoots, plant stems, grasses, and cultivated crops. Some of their preferred foods include acorns, honeysuckle, poison ivy, greenbrier, young tree seedlings and mushrooms. Soybeans, corn, and ornamental shrubs are several of their favorite foods planted by humans.

Deer have a four-chambered stomach that is required to digest the vegetation they eat. Food first travels to the rumen, where bacteria and protozoa begin the digestive process. The reticulum then circulates food back to the mouth so deer can chew it more thoroughly. The omasum functions as a pump and directs the partially digested food from the reticulum to the abomasum. This final chamber functions as a true stomach and completes the digestive process.

Reproduction–The white-tailed deer breeding season in Maryland begins in October and continues until about mid-December. The shortening of the day length (photo period) triggers the breeding season. Most do become pregnant during the first half of November. Any receptive doe that does not become pregnant will recycle back into estrous in about 28 days and will mate again.

Fawns are born during May and June after a gestation period of about 200 days. Yearling does usually give birth to single fawns. Mature does in good physical condition frequently produce twins. Newborn spotted fawns remain hidden and solitary for about three weeks. The doe initially visits its young only two to three times per day in order to nurse and groom the offspring. When the fawn is strong enough, it will follow the doe and begin to sample the foods she eats. Fawns can live independently of the doe at about two months old.

Mortality–Hunting is the primary cause of mortality for white-tailed deer in most rural sections of Maryland. Other deer mortality factors include collisions with vehicles, diseases, parasites, malnutrition, and accidental injuries. Where hunting is limited or not possible (i.e., some suburban and urban locales), vehicle collisions, diseases, and malnutrition often become the primary mortality factors.

In pre-Colonial Maryland, wolves and mountain lions served as effective predators of white-tailed deer and Native Americans hunted them for sustenance. All were capable of taking any age class of healthy deer (fawns or adults). Today, bears, bobcats, and coyotes (a recent immigrant to Maryland) are the only remaining non-human predators of deer in Maryland, and they primarily take fawns or sick/injured adults. While these predators can have an effect on the deer population at a localized level, they represent a very small portion of overall deer mortality on a landscape scale. Humans remain the most effective modern era predator.

Appendix 2. 2020–2034 White-tailed Deer Management Plan stakeholder group participants

Allegany-Garrett Sportsmen's Association

Anne Arundel County Recreation and Parks

Carroll County Sportsmen's Association

Chesapeake Farms

Deer Cooperator Permit Holders

Howard County Recreation and Parks

Maryland Department of Natural Resources Forest Service

Maryland Farm Bureau

Maryland Horse Council

Maryland Hunting Coalition

Maryland Native Plant Society

Maryland-Delaware Chapter of The Wildlife Society

Montgomery County Parks

Mountain Club of Maryland

National Park Service

Prince George's County Department of Parks and Recreation

Quality Deer Management Association

The Humane Society of the United States

U.S. Army

U.S Department of Agriculture Wildlife Services

U.S. Fish & Wildlife Service

University of Delaware

University of Maryland

Washington County Federation of Sportsmen's Clubs, Inc.

Washington Suburban Sanitary Commission

Western Maryland Sportsmen's Coalition

Wildlife Advisory Commission

Wildlife Rescue, Inc.

Appendix 3.

Responsive Management™

MARYLAND RESIDENTS', LANDOWNERS', AND HUNTERS' ATTITUDES TOWARD DEER HUNTING AND DEER MANAGEMENT

Prepared for the Maryland Department of Natural Resources in cooperation with the University of Delaware

by Responsive Management

2018

MARYLAND RESIDENTS', LANDOWNERS', AND HUNTERS' ATTITUDES TOWARD DEER HUNTING AND DEER MANAGEMENT

2018

Responsive Management National Office
Mark Damian Duda, Executive Director
Martin Jones, Senior Research Associate
Tom Beppler, Senior Research Associate
Steven J. Bissell, Ph.D., Qualitative Research Associate
Amanda Center, Research Associate
Andrea Criscione, Senior Research Associate
Patrick Doherty, Research Associate
Gregory L. Hughes, P.E., Research Associate
Alison Lanier, Business Manager

130 Franklin Street
Harrisonburg, VA 22801
540/432-1888
E-mail: mark@responsivemanagement.com
www.responsivemanagement.com

Acknowledgments

Responsive Management would like to thank Brian Eyler of the Maryland Department of Natural Resources and Jacob M. Haus, Ph.D., and Jacob L. Bowman, Ph.D., of the University of Delaware for their input, support, and guidance on this project.

EXECUTIVE SUMMARY

INTRODUCTION AND METHODOLOGY

This study was conducted for the Maryland Department of Natural Resources (DNR) to determine the opinions and attitudes of residents, landowners, and hunters regarding deer hunting and deer management. The study entailed three scientific telephone surveys of Maryland residents (i.e., a general population survey), landowners who own a parcel of at least 20 acres and who grow agricultural crops, and hunters who have licenses that allow deer hunting.

For the surveys, telephones were selected as the preferred sampling medium because of the almost universal ownership of telephones among all three samples (both landlines and cell phones were called). Additionally, telephone surveys, relative to mail or Internet surveys, allow for more scientific sampling and data collection, provide higher quality data, obtain higher response rates, are more timely, and are more cost-effective. Telephone surveys also have better representation of the sample than do surveys that are read by the respondent (i.e., mail and Internet surveys) because the latter systematically exclude those who are not literate enough to complete the surveys or who would be intimidated by having to complete a written survey—by an estimate of the U.S. Department of Education's National Institute of Literacy (2016), up to 43% of the general population read no higher than a "basic level," suggesting that they would be reticent to complete a survey that they have to read to themselves. Finally, telephone surveys also have fewer negative effects on the environment than do mail surveys because of reduced use of paper and reduced energy consumption for delivering and returning the questionnaires.

The telephone survey questionnaires were developed cooperatively by Responsive Management, the DNR, and the University of Delaware. Responsive Management conducted pre-tests of the questionnaires to ensure proper wording, flow, and logic in the surveys.

The sample of the general population was obtained from SSI, a firm that specializes in providing scientifically valid samples for survey research. The general population sample included both landlines and cell phones in their proper proportions. The report may refer to these people as "residents" or "the general population."

The sample of landowners was provided by the DNR. Screeners in the survey ensured that all landowners in the survey owned a parcel of at least 20 acres and grew agricultural crops on their land. Any reference to "landowners" in the survey refers specifically to those who meet these parameters.

The sample of hunters was obtained from the DNR based on license records for hunting licenses that allowed deer hunting in the 2017-2018 seasons. A screener ensured that the hunters had hunted deer in Maryland within the previous 2 years. Any reference to "deer hunters" or just "hunters" in the report refers to those who had hunted deer within the previous 2 years.

Telephone surveying times are Monday through Friday from noon to 9:00 p.m., Saturday from noon to 5:00 p.m., and Sunday from 5:00 p.m. to 9:00 p.m., local time. These surveys were conducted in July 2018. The software used for data collection was Questionnaire Programming Language. Responsive Management obtained 800 completed interviews of residents in the general population survey, 606 completed interviews with landowners, and 801 completed interviews with deer hunters.

The analysis of data was performed using IBM SPSS Statistics as well as proprietary software developed by Responsive Management.

OPINIONS ON THE DEER POPULATION

- The survey asked respondents whether they would like to see the deer population where they live (or where their property is) increase, stay the same, or decrease.
  - In the general population survey, the majority of residents (62%) want to see the deer population stay the same. Otherwise, they are four times more likely to want to see a decrease (28%) than an increase (7%).
    - Common reasons for wanting to see an increase are to improve chances of seeing a deer or a feeling that the deer population is too low.
    - The most common reasons for wanting a decrease is to reduce chances of vehicular accidents, the general feeling that there are too many deer, and to reduce damage to flower beds, gardens, and yards.

- The majority of landowners (57%) want to see the deer population decrease, far exceeding those who want it to stay the same (37%); only 4% of landowners want to see the deer population increase.
  - The most common reasons given by landowners for wanting to see an increase (among the small percentage of landowners who wanted an increase) is that they feel the deer population is too low, to improve hunting opportunities, and to improve a chance of seeing a deer.
  - Among landowners, the most common reason for wanting to decrease the deer population is to reduce agricultural damage—by far the top reason. This is followed by simply thinking that there are too many deer, to reduce vehicle collisions, and to reduce damage to flower beds, gardens, or yards.
- Just over half of hunters (53%) want the deer population to stay the same; otherwise, they are about evenly split between wanting to see it increase (25%) or decrease (21%).
  - The most common reasons that hunters want to see the deer population increase is the feeling that the deer population is simply too low, to improve hunting opportunities, to improve hunter success, and to improve the opportunity to see a deer.
  - On the other hand, common reasons for wanting the deer population to decrease is the feeling that there are too many deer, to reduce vehicle collisions with deer, to reduce agricultural and timber losses from deer, to reduce damage to gardens and landscaping, and to improve the health of the deer herd.

➢ All three surveys asked respondents to indicate how they feel about deer in their county on a continuum from enjoying seeing deer around to thinking that they are a nuisance. There is also a fourth response outside of the continuum for those with no particular feeling about deer.

- In the general population survey, 41% of residents say that they enjoy seeing and having deer around. Nonetheless, 45% express some concern, including 8% who generally regard deer as a nuisance.
- Landowners as a whole are concerned about deer: only 28% say that they enjoy seeing and having deer around, while the large majority (67%) express concern, including 29% who generally regard deer as a nuisance.

- In the hunter survey, the majority of hunters (65%) say that they enjoy seeing and having deer around; however, more than a quarter (29%) express some concern about problems caused by deer (this latter includes 6% who regard deer as a nuisance).

➢ All the surveys also asked whether respondents agree or disagree that deer are an important part of the balance of nature. Agreement is high in all the surveys.

- The overwhelming majority of residents (88%) agree with the statement, while only 6% disagree.
- The large majority of landowners (77%) agree with the statement. On the other hand, 15% of them disagree.
- The overwhelming majority of hunters (95%) agree with the statement; only 3% disagree.

KNOWLEDGE OF DEER, DEER MANAGEMENT, AND DEER HUNTING

➢ All three surveys asked about knowledge levels regarding three things: deer in general, deer hunting laws, and the Maryland Department of Natural Resources' Deer Management Program (the full name of the agency was used in the question).

- Just more than half of residents (54%) say that they know a great deal or a moderate amount about deer in general. The percentages are less regarding knowledge of deer hunting laws (31% know a great deal or moderate amount) and knowledge of the DNR's Deer Management Program (20%).
- Landowners claim to be more knowledgeable about deer in general (81% know a great deal or moderate amount) than about deer hunting laws (68%) or about the DNR's deer management program (54%).
- Hunters overwhelmingly indicate knowing a great deal or moderate amount about deer in general and deer hunting laws (92% and 95%, respectively), but their self-professed knowledge level of the DNR's Deer Management Program is slightly lower (but still in the majority): 65% know a great deal or moderate amount about it.

OPINIONS ON DEER HUNTING AND ALLOWING HUNTING ON PROPERTY

- The surveys of residents and landowners both asked about opinions on deer hunting itself.
  - Two thirds of the general population in Maryland (67%) are in favor of hunting; nonetheless, 17% are opposed.
  - Nearly all the landowners (92%) are in favor of hunting.

- All three surveys asked whether respondents agree or disagree that deer should be hunted to maintain a healthy deer population; agreement is high across all three surveys.
  - More than three fourths of residents (77%) agree with the statement, while 17% disagree.
  - Landowners overwhelmingly agree (95%) with the statement, with almost no disagreement.
  - Hunters, too, overwhelmingly agree (99%) with the statement, with almost no disagreement.

- The large majority of landowners in the survey (83%) allow deer hunting on their property. However, about three quarters of those who allow hunting restrict it to friends and family only.
  - Of those who allow non-family and non-friends to hunt on their property, about a third of them charge hunters to hunt there.

OPINIONS ON THE DNR'S MANAGEMENT OF DEER AND EFFORTS TO CONTROL DEER

- The three surveys asked respondents whether they agree or disagree that the DNR does a good job conserving its deer population.
  - A bit more than half of residents (56%) agree, while just 15% disagree.
  - Just over half of landowners (55%) agree, although a substantial percentage (26%) disagree.
  - The large majority of hunters (79%) agree that the DNR does a good job; nonetheless, 15% disagree.

- More than a dozen questions about opinions on and knowledge of methods to control deer populations were asked of the general population but were not asked in the other surveys. These results are reported below.

- Among the general population, 69% support controlling deer populations on urban and suburban lands (that is, not allowing populations to naturally increase). On the other end, 17% oppose.
  - Those who support were asked for their preferred methods for deer to be controlled. The most common response (multiple methods could be selected as acceptable) is live trapping and relocating (44% think this is one of the methods that should be used), closely followed by hunting (39%) (including bow and arrow hunting at 38%), and biological birth control (37%).

- After the questions above, the survey asked residents directly if they supported or opposed the various methods of controlling deer populations, starting with the use of professionals or sharpshooters. Residents are split on this: 44% support and 45% oppose the use of professionals or sharpshooters to control deer in urban and suburban areas.

- Residents were directly asked about support for or opposition to the use of bow and arrow hunting to control deer populations in urban and suburban areas, and they more often support (60%) than oppose (32%) by about a 2:1 margin.

- The survey then asked about immunocontraceptives, also referred to in this survey as deer contraceptives. About a quarter of residents (26%) had heard of immunocontraceptives prior to the survey. However, only 9% claim to know a great deal or moderate amount about them.
  - The survey then asked about support for or opposition to the use of immunocontraceptives for controlling deer populations. Among the general population, support (54%) exceeds opposition (31%).

- The last part of the deer control section of the survey asked about sterilization of female deer to prevent pregnancy: 39% of residents have heard of this method, although only 13% say that they know a great deal or moderate amount about it.
  - Residents are about split regarding support for (48%) or opposition to (41%) the use of deer sterilization to control deer populations.
  - Most residents would *not* volunteer time to help sterilize deer (81% indicated being not at all likely); at the other end, 18% indicated being likely, but only 6% said that they would be very likely to do so. Also, most would *not* donate money to help with a sterilization effort (74% would not do so), while 22% said that they would be likely to do so (although only 4% said that they would be very likely).

OPINIONS ON THE IMPORTANCE OF VARIOUS FACTORS TO CONSIDER IN DEER MANAGEMENT

- The general population survey asked about the importance of seven entities that could be considered in decision-making about deer management. Two of them are overwhelmingly considered important by residents: scientific information (67% think this should be very important, and 23% think it should be somewhat important, a sum of 91% when summed using unrounded numbers) and the professional judgement of biologists with the DNR (64% think this should be very important, and 23% think it should be somewhat important, a sum of 87%). Political and economic concerns are considered the least important.

- The landowner survey also asked about these entities in decision-making. Among landowners, the most important are scientific information (63% say it is very important, and 26% say somewhat important, a sum of 89%), the professional judgement of biologists with the DNR (52% and 28%, a sum of 80%), and hunters' concerns (50% and 35%, a sum of 85%).

YARD, LANDSCAPING, AGRICULTURAL, AND OTHER DAMAGE CAUSED BY DEER

- Among the general population, 35% have experienced damage to their yard, garden or landscaping. Landowners (recall that they had to have owned at least 20 acres) had a higher rate: 48% of landowners in the survey experienced damage to their yards or gardens.
  - Landowners in the survey (who had to have grown agricultural crops to be in the survey) were asked about damage to those crops separate from the question about damage to yards, personal gardens, and landscaping: 77% of landowners have experienced damage to their agricultural crops.

- Respondents were asked for their perceptions regarding the trend in deer damage, whether it is increasing, staying about the same, or decreasing. Although most commonly residents think it is about the same (57% of residents), they otherwise are more apt to say it is increasing than decreasing: 35% of residents say it is increasing, compared to 6% who say it is decreasing. Landowners, on the other hand, most commonly say it is increasing (49%), exceeding the percentage who say it is staying about the same (43%), and well more than the percentage who say it is decreasing (4%).
  - In the general population survey, only those who experienced damage were asked the follow-up question about the trends in damage. In the landowner survey, all respondents were asked.

- Regardless of whether damage occurs, the survey asked whether respondents thought that deer are important enough that they (the respondents) are willing to tolerate some damage to their yards, gardens, or agricultural crops: 67% of the general population, 66% of landowners, and 82% of deer hunters agreed with the statement.
  - Landowners, who grow crops and have, perhaps, the most to lose are the most likely to disagree with the statement: 28% of landowners disagree, compared to 26% of the general population and 14% of hunters.

PREVENTATIVE MEASURES

- All three surveys asked about preventative measures that people take to deter deer.
  - Most commonly, residents use fencing (17%) or repellants (12%).
  - Landowners most commonly use hunting (45%) to prevent deer damage (either their own hunting or allowing hunting). Otherwise, 15% use fencing and 11% use repellants, with all other responses at less than 10%.
  - Among hunters, hunting (21%) is their top choice, followed by fences (16%) and repellants (11%). The slight majority of hunters (52%) do not do anything to prevent deer damage.

- One option to prevent damage (but currently not legal) is to cull the deer herd through night shooting, as night shooting greatly improves harvest success. The survey asked about approval or disapproval of this, and then it asked if landowners would allow it.
  - Only a third of landowners approve of this (34% do so), while the majority (59%) disapprove.

DAMAGE PERMITS

- Awareness of the Deer Management Permit program is high: 76% of landowners and 91% of hunters are very or somewhat aware that the DNR issues Deer Management Permits (also known as Crop Damage Permits) to farmers experiencing damage from deer eating their crops.
  - Use of the permits was also examined: 25% of landowners have used them to help with crop damage; 20% of hunters have hunted using the permits in Maryland.
    - Landowners who know about the permits were asked about their satisfaction with the process for obtaining them: 50% say that they are satisfied, while 13% are not (the remainder do not know).
    - Landowners who use the permits were asked about their satisfaction with the telephone and Internet reporting system for deer harvested under the permits: 80% are satisfied with this aspect, while only 7% are dissatisfied.

- Support for having the DNR issue Deer Management Permits to farmers for crop damage is high among hunters: 85% of hunters support the permits.

VEHICLE ACCIDENTS WITH DEER

- All three surveys asked whether respondents had, in the past year, been in a vehicular accident with a deer: 8% of the general population, 11% of landowners, and 13% of hunters had been in a vehicular accident with a deer in the past year. (The survey asked about being involved, not specifically about being the driver, so percentages include those who had accidents as passengers.)

PARTICIPATION IN DEER HUNTING

- Both the general population and landowner surveys asked about deer hunting ever, within the past 10 years, and within the past 2 years.
  - Among the general population, 8% hunted deer in the past 2 years. The overwhelming majority (84%) have never hunted deer in Maryland.
  - Landowners have a higher rate of hunting: 29% say that they hunted deer in the past 2 years, and another 11% hunted in the past 10 years but not the past 2 years.

- For deer hunters to be included in the survey, they had to have hunted within the previous 2 years. Of these deer hunters, 95% had hunted deer in the past year, 80% had hunted for antlerless deer, and 47% had hunted deer with a crossbow.

HARVEST OF DEER

- Half of those who hunted in the past year (51%) harvested a deer.
  - Those who harvested a deer were asked about harvesting antlered deer: 62% of these hunters had harvested an antlered deer.
  - Hunters who had harvested were also asked about harvest of antlerless deer: 68% of those who harvested deer harvested an antlerless deer.

- Hunters who had harvested were read a list of items that could have potentially helped them harvest more deer, with the survey asking, "Do you think you would have harvested more deer if...?" Access and opportunity top the list: 42% of these hunters said they would have harvested more if more private landowners would allow deer hunting on their land, and 41% said they would have harvested more if more Sundays were available to hunt deer.

- Similar to the above, hunters who had *not* harvested were asked, "Do you think you would have harvested a deer if...?"
  - Again, access and opportunity top the list: 43% of these unsuccessful hunters said that they would have harvested if more private landowners would allow deer hunting on their land, and 43% said that they would have harvested if more Sundays were available to hunt deer.

MOTIVATIONS FOR HUNTING DEER

- The hunter survey asked hunters to choose their most important reason for hunting; the landowner survey asked for the most important reasons for hunting, including the reasons for others to hunt among the landowners who did not personally hunt deer.
  - Landowners are almost completely utilitarian: the most commonly chosen reasons for hunting deer are for deer population control (a majority of 53% choosing this reason) and for the meat (24%). Only 9% say it is for sport or recreation, and almost none (just 3% and 2%, respectively) say it is to be with friends and family or to be close to nature.
  - In the hunter survey, for the meat (42%) is the top reason to hunt deer in Maryland, with four of the remaining five reasons having from 11% to 15%: for the sport/recreation (15%), to be with family and friends (14%), deer population control (13%), and to be close to nature (11%). In other words, while the top reason among hunters is utilitarian, the other reasons have substantial percentages, compared to the landowners' results.

SATISFACTION WITH DEER HUNTING

- More deer hunters say that their satisfaction with deer hunting in Maryland has increased over the past 10 years than say it has decreased: 31% say it has increased, while 21% say it has decreased. Most commonly, they say it has remained about the same (46%).

PREFERRED HUNTING SEASONS

- The firearms season is the most preferred season among deer hunters: 36% say that they prefer firearms season. This exceeds the percentages who prefer archery season using a vertical bow (i.e., not a crossbow) (23%), archery season using a crossbow (19%), or muzzleloader season (15%).

HUNTING IN REGION A

- The DNR separates Maryland into two regions: Region A, made up of Allegany County, Garrett County, and western Washington County, and Region B, consisting of the rest of the state.

- Among all hunters in the survey, 24% hunted deer in Region A. They were asked follow-up questions.
  - Among Region A hunters, about half hunted deer on public land there frequently or sometimes over the past 2 years (47% did so).
  - Among Region A hunters, 70% hunted on private lands in Region A frequently or sometimes.

- Region A hunters were asked about their perceptions of the deer population there.
  - Those who had hunted deer on public lands in Region A were asked for their opinions on the deer population on public lands. The large majority of these Region A public land hunters (73%) would like to see the deer population on public lands in Region A to increase. Otherwise, 20% want it to stay the same, and only 3% want it to decrease.
  - Those who had hunted on private land most commonly want the deer population there to increase (50% give this response), and 42% want it to stay the same. Only 6% want the deer population to decrease on private lands in Region A.

HUNTING IN REGION B

- Among all hunters in the survey, 84% hunted deer in Region B.
  - Among Region B hunters, about a quarter hunted deer on public land there frequently or sometimes over the past 2 years (28% did so).
  - Among Region B hunters, 84% hunted on private lands in Region B frequently or sometimes.

- Region B hunters were asked about their perceptions of the deer population there.
  - The majority of Region B public land deer hunters would like to see the deer population on public land in Region B to increase (58% do so), while only 4% want to see it decreased. Meanwhile, 35% want it to stay the same.
  - Those who had hunted on private land in Region B most commonly want the deer population there to stay the same (53% give this response); otherwise, they, by far, want to see it increased (36%) rather than decreased (9%).

- Region B hunters were asked about their opinions on various regulations in Region B.
  - Support (75%) far exceeds opposition (18%) to the 10 antlerless deer per season bag limit for muzzleloader season and firearms season for Region B.
  - Regarding archery season, at the time of the survey there was an unlimited antlerless deer bag limit in Region B. Two thirds of Region B hunters (67%) support this unlimited bag limit, while 27% oppose it.

HUNTING IN WASHINGTON AND FREDERICK COUNTIES

- The survey also asked Region B hunters specifically about hunting in Washington and Frederick Counties. The questions about these counties were within the survey section on Region B; therefore, the questions were asked of all hunters who had hunted in Region B.
  - Among those who hunted in Region B, 6% hunted on public lands in Washington or Frederick Counties frequently or sometimes.
  - Of Region B hunters, 18% hunted on private land in Washington or Frederick Counties in the past 2 years.

- All those who hunted on public lands in Washington or Frederick Counties were asked about the deer population: 49% would like to see an increase in the deer population on public lands in these two counties, while 40% would like to see it stay the same. Only 5% want to see it decreased.

- Those who hunted deer on private land in Washington or Frederick Counties in the past 2 years were asked whether they agree or disagree that deer hunting on public lands there should be managed separately from deer hunting on private lands: agreement (35%) is a bit higher than disagreement (20%); however, they most commonly answer neutrally or that they do not know (45% give one of these two responses).

OPINIONS ON QUALITY DEER MANAGEMENT

- An open-ended question asked hunters to say what "quality deer management" means to them. While they most commonly give a response relating to having bigger deer and bigger bucks (35%), the next most common response is an increase in overall deer herd health (22%).

- Most hunters (79%) support recently enacted regulations where deer hunters can harvest two antlered deer of less than 3 points on one antler but any additional antlered deer must have at least 3 points on one antler. A small percentage (15%) oppose this quality deer management regulation.

- Lastly in this section, hunters were asked about which they would prefer regarding deer with less than 3 points on one antler. They would prefer harvest of only one deer of less than 3 points on one side (48%) rather than harvest of two such deer (25%) or three such deer (8%) or more than that (7%).

HUNTING OVER BAIT

- A little less than half of deer hunters (43%) hunted deer over bait in the past 2 years.

- Regardless of whether they hunted over bait, a large majority of deer hunters (69%) support hunting deer by attracting them using bait, such as corn or another food.
  - Reasons given for supporting hunting deer over bait include a better chance of harvest (by far the top answer among deer hunters who support hunting over bait), that such hunting allows for better control of the deer population, and that such hunting helps with quality deer management.
  - The top reason for opposing is that hunters feel it is unethical/not fair to the deer to hunt over bait—by far the top response category.

- Landowners were asked about their support for or opposition to hunting deer over bait as well, and they are split, with a little more in the support (51%) side rather than the opposition (36%) side.
  - Their top reasons for supporting hunting over bait are increased harvest success and that it allows better control of the deer population.
  - As it is with hunters, the top reason that landowners oppose is that they feel it is unethical/not fair to the deer to hunt over bait—by far the top response category.

- The large majority of deer hunters would oppose (75%) making it illegal to hunt deer using bait on private lands, while 18% would support.

SUNDAY HUNTING

- All three surveys asked about opinions on deer hunting on Sundays in Maryland.
  - There is a greater percentage in favor among the general population (45% are in favor) than in opposition (29%) to Sunday deer hunting.
  - Among landowners, 56% are in favor of Sunday deer hunting; however, 33% are opposed.
  - The overwhelming majority of deer hunters (83%) support Sunday deer hunting, while only 14% oppose it.

- The majority of Maryland's deer hunters (60%) hunted deer on a Sunday within the past 2 years.
  - Most commonly, these Sunday deer hunters hunted the firearms season (77% did so), although a majority hunted the archery season (61%) (some, obviously, did both). Also, 46% hunted the muzzleloader season.
  - These Sunday deer hunters overwhelmingly think Sunday hunting is very or somewhat important to their success in harvesting a deer: 90% say it is very or somewhat important.
  - These hunters also overwhelmingly say that they want additional Sundays open for deer hunting (79% say this), compared to 19% who want the same and only 2% who want fewer days of Sunday deer hunting.
  - Most of these Sunday deer hunters did *not* hunt on public land on Sundays: only 11% did so.
  - A final question of these Sunday deer hunters found that a majority (81%) agree that all public lands currently open to deer hunting should also be open on Sundays during the deer season.

- The large majority of landowners who allow deer hunting on their land and who live in a county that has Sunday hunting allow Sunday hunting on their land (65% do so).

- Looking at Sunday hunting from the other recreationists' view, the survey asked if respondents had altered times of other recreation because of Sunday hunting. This line of questioning was in both the survey of residents and landowners. The results are first looked at as a whole, and then among those who have not hunted in the past 10 years.
  - Among the general population, 17% say that they have altered times because of deer season at least a little, with a quarter of these respondents (25%) saying that they altered times because of Sunday hunting.
    - Another question asked about avoiding areas because of hunting. In total, 38% of residents (34% of non-hunting residents) in the general population survey say that they avoid certain areas in which hunters might be hunting. In follow-up, 27% of

these respondents overall, and 31% of the non-hunting respondents, who avoid areas said that they avoid areas because of Sunday hunting.

- Just less than a quarter of landowners (22%) say that Sunday hunting has caused them to alter times of other outdoor recreation at least a little, with 5% saying that they have altered times a whole lot.

➢ The general population survey asked about support for or opposition to the opening of additional Sundays for bow and arrow deer hunting and for firearms deer hunting (in separate questions): 49% supported this for bow and arrow hunting (34% opposing), and 42% supported the opening of additional days for firearms deer hunting (with 42% opposing).

CHRONIC WASTING DISEASE

➢ All three surveys asked about awareness of Chronic Wasting Disease, or CWD. The general population and landowner surveys asked only those who had hunted deer, as the question was primarily a lead-in to the three-county comparison discussed later in the report.

- In the general population survey, those who hunted in the past 10 years were asked about their awareness: 61% of them were aware of CWD prior to the survey.
- The large majority of landowners who had hunted deer in the past 10 years (85%) had heard of CWD.
- The vast majority of deer hunters (89%) had heard of CWD.

➢ The surveys explored the level of concern about CWD.

- In the general population survey, those who had hunted deer in the past 10 years are evenly split: 50% are very or somewhat concerned about CWD, and 50% are not at all concerned or have not heard of it.
- Among landowners who had hunted in the past 10 years, 74% are very or somewhat concerned.
- In total, 79% of hunters are very or somewhat concerned about CWD.

- Despite a high level of concern among deer hunters regarding CWD in the hunter survey, only 10% of deer hunters have changed where they hunt in Maryland because of CWD, and only 4% say that CWD has caused them to hunt deer less in Maryland in general.
  - A question on the same theme asked hunters in the general population survey if CWD had caused them to stop hunting deer in Maryland: 1% agreed that it had.

- Three Maryland counties were compared regarding hunters' behaviors in light of CWD. One of the counties (Allegany) has confirmed cases of CWD in deer, another county is close to the CWD area (Garrett), and the third is far away from the CWD area (Dorchester). The first question simply asks deer hunters to indicate if they have hunted in the three counties.
  - In total, 16% of deer hunters in the survey had hunted in Allegany County within the previous 10 years, 18% had hunted in Garrett County, and 20% had hunted in Dorchester County. For each county in which the hunter had hunted, three questions were asked: did the hunter *hunt less* in the county because of CWD, did the hunter *stop hunting bucks* in the county because or it, and did the hunter *stop hunting does* in the county because of CWD. All three counties are shown on the same graph for each of these questions for comparison. It appears that hunters are more likely to *hunt less* rather than stopping hunting either bucks or does altogether.
    - Regarding hunting less: those who had hunted in Allegany County had a higher percentage agreeing that they had hunted less in the county because of CWD (16%), compared to either Garrett County hunters (6%) or Dorchester County hunters (4%). The most disagreement (including those who had not heard of CWD and, therefore, can be assumed to align with "disagreement" in this question) is among Garrett and Dorchester County hunters (91% and 90%, respectively).
    - Regarding whether they have stopped hunting bucks: the counties are quite similar, with only from 3% to 8% agreeing that they have stopped hunting bucks, a small range. An even smaller range is in disagreement (with not hearing about CWD being aligned with disagreement): from 88% to 91% disagree.
    - Regarding whether they have stopped hunting does: again, the ranges of percentages are small, with only 4% to 9% agreeing (Allegany County hunters being the most likely to agree) and 85% to 92% disagreeing (Garrett County hunters being the most likely to disagree).

EATING VENISON AND THE VENISON DONATION PROGRAM

- Respondents in the surveys were asked about their level of awareness that venison donation programs are available in Maryland where hunters can donate extra harvested deer.
  - Just more than a third of residents (37%) say that they were aware, prior to the survey, of venison donation programs in Maryland.
  - The large majority of landowners (81%) were very or somewhat aware of the programs.
  - The overwhelming majority of hunters (93%) were very or somewhat aware of the programs. In addition, 21% of deer hunters have donated deer to such programs in Maryland in the past 2 years.

- The general population and landowner surveys both asked about support for or opposition to venison donation programs. Both residents and landowners are overwhelmingly in support (92% and 97%, respectively) of the programs.

- The general population and landowner surveys asked about eating venison.
  - A quarter of residents say that they eat venison frequently or sometimes, while 75% say that they eat it rarely or never (with 45% never eating it).
  - Landowners are about evenly split: 44% eat venison frequently or sometimes, while 55% eat it rarely or never (including 29% who never eat it).

SIKA DEER

- Regarding sika deer, 13% of deer hunters had hunted sika deer in Maryland during the past 2 years.

LANDOWNERS' AND OTHER RECREATIONISTS' INTERACTIONS AND CONFLICTS WITH HUNTERS

- Landowners were asked about any problems that they may have had with hunters in the past 2 years: 16% of landowners have had problems.
  - Trespassing is the most common reason, by far (80% of those with problems cited this). Also with substantial percentages are responses pertaining to hunters' rude/threatening behavior (20% of those with problems) and unsafe behavior (16%).

- Among non-hunters in the general population survey, 14% say that deer season causes them to alter their times of participation in other outdoor recreation.

- In the general population survey, both hunters and non-hunters indicated that they avoid areas in which they know hunters are or might be hunting (38% overall, 62% of hunters within the general population, and 34% of non-hunters).
  - More than half of non-hunters *who indicated previously that they avoid areas* (53% *of those who avoid areas*) are avoiding areas because they do not want to disturb hunters; however, 45% are avoiding areas out of personal safety concerns.

- The general population survey asked if residents had encountered hunters while they (the respondents themselves) were engaged in other outdoor recreation within the past 5 years: 16% of non-hunters encountered hunters while engaging in outdoor recreation.
  - Of those who encountered hunters, 14% of non-hunters indicated that they experienced problems with the hunters that they encountered (note that this percentage is of those who encountered hunters while they—the respondents themselves—were engaged in other recreation). Rude or discourteous behavior is the top complaint. Deer hunters predominate regarding the types of hunters that caused problems.

VIEWING AND PHOTOGRAPHING DEER

- About a quarter of residents (24%) frequently or occasionally make trips specifically to view and experience deer in their native habitat for photography or other non-hunting purposes.

OPINIONS ON NON-HUNTING RECREATIONAL PASSES

- The majority of residents (66%) would support the creation of a non-hunting recreational pass to access Wildlife Management Areas (with non-hunters even higher in support). Nonetheless, 18% of residents would oppose.
  - Those who support were asked to name a reasonable fee: the median is $25.

SOURCES OF INFORMATION

- All the surveys asked respondents, in open-ended questions, to say where they get information about deer in Maryland.
  - Residents most commonly get information from friends/family/word-of-mouth, the DNR (at 16%), and the Internet in general.
  - Landowners' most common sources are friends/family/word-of-mouth, newspapers, their own experience, and the Maryland DNR website (this latter visited by 14% of landowners).
  - Among hunters, the DNR is the top source (at 53%), distantly followed by friends/family/word-of-mouth.

- The general population and landowner surveys asked respondents to rate the credibility of five sources of information.
  - Of the five sources, the top ratings of credibility among the general population are given to a biologist with the DNR (67% give a rating of very credible, and 19% say somewhat credible, a sum of 86%), followed by a professor at a Maryland college or university (50% say very credible, and 34% say somewhat credible, a sum of 84%).
  - Similarly, the top ratings of credibility among landowners are for a biologist with the DNR (46% give a rating of very credible, and 36% say somewhat credible, a sum of 82%), followed by a professor at a Maryland college or university (31% say very credible, and 41% say somewhat credible, a sum of 73% when summed using unrounded numbers).

Appendix 4. Deer management options and their advantages and disadvantages

The following deer management actions are often proposed as options to be considered when managing white-tailed deer in Maryland. Several of the options are viable in Maryland while others are not. Information in this section was adapted from the publication "An Evaluation of Deer Management Options" originally produced in 1996 and revised in 2009 by the Northeast Deer Technical Committee and the New England Chapter of The Wildlife Society (Ellingwood and Caturano 1996).

No Action (Allow Nature to Take Its Course)–Settlers and Native Americans in North America altered many natural ecosystems. Some native plants and animals have been eliminated while exotic plants and animals have been introduced as modernization spread across the continent. Wolves and mountain lions, the large native predators of Maryland white-tailed deer, disappeared with the expansion of settlements. Maryland settlers removed and degraded deer habitat through extensive timber harvest in order to build homes and to heat their dwellings.

Modern humans, who were responsible for the near extinction of deer, relocated white-tailed deer back into its original range of Maryland. After an era of protection and management, deer numbers in some locations now are at levels that negatively impact native habitats and other wildlife such as forest dwelling birds (Bates and Dawson 2005).

White-tailed deer at high densities often are in poorer condition than deer at lower densities due to competition for limited resources. High-density deer herds also increase the potential for spreading diseases and parasites (Davidson and Doster 1997).

Humans have been involved in the survival, demise and return of the white-tailed deer from pre-colonial times to the computer age. The resulting changes to the landscape and fauna of the state have so drastically modified natural processes that they no longer function adequately enough to keep a species such as white-tailed deer in check with the environment. To suggest that we now remove ourselves from the active management of deer would be ecologically irresponsible.

Relocation–Relocating deer requires the existence of habitat lacking suitable deer numbers to act as the release site. Most traditional white-tailed deer habitat in North America already contains adequate white-tailed deer densities. Deer released from problem areas into new areas may contribute to crop and ornamental plant damage within the new range.

Relocating excess deer requires baiting, capturing, handling, and transporting deer over substantial distances. The capture of deer, as with any wild animal, involves risks. Deer relocation projects often experience significant deer mortality related to the stress of capture and to human activity at the release sites (Beringer et al. 2002). When wildlife is being relocated to vacant habitat, mortality rates resulting from capture must be accounted for in the wildlife restoration project.

Relocation of white-tailed deer and other animals may contribute to the spread of disease. Once thought to be a western state deer and elk disease, chronic wasting disease (CWD), a fatal disease of deer and elk, has been found in white-tailed deer east of the Mississippi River in

numerous states. Most states, including Maryland, have imposed strict limitations on the importation of live deer and elk in order to help stop the spread of this serious wildlife health threat. Maryland also limits the movement of live white-tailed deer within the state.

Relocating deer incurs financial burdens as well. In 1997, the Gaithersburg City Council investigated the potential for relocating deer to Kentucky. Costs to capture and relocate each deer were estimated at $800. The relocation effort did not occur due to cost concerns and to the risk of spreading hemorrhagic disease and Lyme disease.

Repellants–Repellents deter deer from feeding on plants (DeNicola et al. 2000). 'Contact' repellents are placed directly on the plant and discourage deer by producing an unpleasant taste. 'Area' repellents are placed in the vicinity of the vegetation and repel deer by an unpleasant odor.

Repellents provide the best protection when used in small areas such as gardens or landscaping ornamentals and when regularly applied after rainfall. Commercial croplands require large amounts of repellents and usually make their use cost prohibitive.

Repellents fail to address the growing deer population. The effectiveness of repellents declines as deer numbers rise. Competition for food can force deer to eat previously less palatable vegetation.

Fences–Fences create a barrier between deer and the protected vegetation. Fences may be an eight-foot-tall barrier or a shorter electric fence (Miller et al. 2001). The barrier fence is costlier than the electric fence. Both require regular inspection and maintenance to ensure their effectiveness. Small fenced enclosures can protect small backyard garden plots and some high value commercial agricultural crops.

The Smithsonian Environmental Research Center (SERC) located in Edgewater (Anne Arundel County) used eight-foot-high electric fences in an experimental deer control project for 80 acres of soybeans (Correll 1994). The SERC final Environmental Assessment stated "The fence was not a sufficient barrier to the dense deer population and in 1993 crop damage to soybeans within the fenced area was severe. This result convinced the farmers that they could no longer afford to farm the fields on SERC property or on private properties adjacent to SERC."

Contraceptives and Sterilization–Interest in fertility control of deer populations continues within the scientific and private communities. As research has progressed, questions remain regarding the overall effectiveness of fertility control. Likewise, there are still concerns about public health implications for contraceptive drugs, the percentage of does requiring treatment (either via contraceptives or sterilization), the methods of treating each deer, possible effects on deer social structure, and overall long-term health of the deer population.

Deer management through fertility control largely remains experimental. Researchers continue to believe that small, isolated populations, such as those found on islands, or in adequately fenced

areas, or possibly urban/suburban neighborhoods have the greatest potential for success. Managing free-ranging white-tailed deer populations over large landscapes with contraceptives or sterilization still present significant challenges.
The department will continue to cooperate on research studies and management projects involving fertility control of deer.

Supplemental Feed–Supplemental feeding programs are most often designed to attempt to attract deer away from ornamental vegetation and gardens to minimize damage. Advocates of this approach believe that deer will eat the supplemental forage and stop damaging crops or ornamental plants.

Unfortunately, deer feeding programs can cause deer damage to increase over the long-term. Providing an artificial food source can actually increase deer densities and the potential for damage can escalate as well.

Wildlife biologists discourage the long-term supplemental feeding of deer (Williamson 2000) because concentrating deer at food sources for extended periods of time elevates the potential for disease and parasite transmission. Likewise, the surrounding natural vegetation often is over-browsed by the large concentration of deer attracted to the artificial food source.

Predator Reintroduction–The white-tailed deer's ability to leap over objects and run at high speed evolved from their need to escape large predators such as wolves and mountain lions. Some groups have suggested that large predators could be reintroduced into their historical ranges in Maryland to control deer. The urban and suburban locations, which harbor some of the most dense deer populations in Maryland, could not supply suitable habitat for these wide ranging predators. The safety of humans and domesticated animals would obviously hamper the release of mountain lions and wolves anywhere in Maryland.

Existing Maryland predators such as bobcats, coyotes, and bears do occasionally predate deer (especially fawns in the spring), however they are not effective in regulation deer numbers. Deer productivity data in sections of the state with long-term coyote, bear, and bobcat populations do not suggest that these animals are measurably affecting deer productivity.

Sharpshooting–Facilities or areas that have high densities of homes or may have security concerns are often conducive to deer sharpshooting operations (DeNicola et al. 2000). Secure military facilities, often with airfields where roaming deer are a serious danger to incoming and outgoing aircraft, commonly use sharpshooters to remove deer in Maryland. Narrow stream valley public parklands with residences lining the woodlands are other typical landscapes where sharpshooting can provide deer population control.

Sharpshooting provides a tightly controlled method for removing deer. Deer are often baited to specific shooting locations that offer safe shooting conditions that enable shooters to choose specific deer to kill (i.e., females). While sharpshooting is very effective, it is also expensive. Costs for deer removal using sharpshooting typically include venison donation costs and range from $150 to $450 per deer.

Modern Regulated Hunting–Experience from the past 100 years of deer management indicates that regulated hunting is the most effective method available to manage white-tailed deer. Regulated deer hunting is ecologically sound and fiscally responsible. Presently, hunters remove 75,000–85,000 deer a year from the Maryland population at virtually no cost to the public. Conservative estimates suggest it would cost in excess of $50 million to lethally remove the same number of deer each year using other methods. At the same time, non-lethal techniques do not exist to effectively manage deer on a statewide basis.

The disadvantages of regulated hunting are mostly culture-based. Some citizens do not accept the need to kill any animal via hunting. Likewise, extensive development in many parts of Maryland creates severe limitations on where hunting may occur legally or safely. Unfortunately, deer populations can quickly rise in these areas due to low mortality rates and excellent habitat, exacerbating the cultural and ecological problems associated with too many deer. In these localized areas, other lethal and non-lethal control methods must often be employed.

Appendix 5. Common white-tailed deer diseases and ailments

Hemorrhagic Disease–Hemorrhagic disease (HD) is the most common deer disease in Maryland and across many of the southeastern states. There are two types of HD caused by two different viruses: epizootic hemorrhagic disease (EHD) and blue-tongue (BT) (Davidson and Nettles 2006).

Biting midges in the genus *Culicoides* spread the HD virus among animals. Cattle may become infected and spread the virus but they rarely exhibit clinical symptoms of HD. Humans, dogs, and cats are not infected. Infected deer that develop secondary bacterial infections or abscesses may not be suitable for human consumption.

Deer infected with HD lose their appetite and often their fear of humans. As the disease progresses, deer grow weaker, salivate excessively, and are short of breath. Lesions on the tongue and upper front palate may appear. High fever associated with the disease drives deer to water for relief and sick or dead deer are often found near ponds and streams. Farmers may find groups of deer carcasses near farm ponds or in their crop fields during the harvest season.

Deer that survive the initial onslaught of HD may exhibit the sloughing of tissue on the hooves. Staff routinely check the hooves of harvested deer for signs of HD while collecting biological data from deer at deer processors. These data are reported to the Southeast Cooperative Wildlife Disease Study (SCWDS) at the University of Georgia. SCWDS staff discovered HD and have extensive research experience with this disease.

There are no preventative measures available to control HD. The department collects suspected HD deer and transports them to the Maryland Department of Agriculture Animal Health Laboratory. Health lab staff collect samples and ship them to SCWDS for isolation of HD viruses and final diagnosis.

The impact HD has on white-tailed deer populations is difficult to determine. Localized outbreaks in West Virginia and Missouri had estimated infection rates of 29% and 24% and estimated overall fatality rates of 20% and 8% (Davidson and Nettles 2006).

In September 1999, HD infected a group of radio-collared white-tailed deer in Dorchester County. Seventeen white-tailed deer were collared and 3 deer died with HD type symptoms (18%). One of the deer was tested for HD and tested positive.

Maryland also experienced significant outbreaks of HD in 2007 and 2017. Direct estimates of mortality are not available, but a decline in the annual deer harvest in some counties suggests it is likely that greater than 20% of the population may have been impacted in localized areas. Affected deer populations normally rebound to previous levels within several years of an outbreak.

Chronic Wasting Disease–Chronic Wasting Disease (CWD) is a fatal neurological disease of deer, moose and elk, including white-tailed deer and mule deer. The disease causes degeneration of the brain and eventual death. In the early stages of the disease, an infected animal may not show any signs that it is sick. As the disease progresses, animals will show signs of weight loss,

generally accompanied by behavioral changes. In later stages, affected animals may show emaciation, excessive drooling, increased drinking and urination, listlessness, stumbling, trembling, loss of fear of humans and nervousness.

CWD is not caused by a bacteria or virus. It is classified as a prion disease. A prion is an altered protein that causes other normal proteins to change and cause sponge-like holes in the brain. CWD is related to, but different from, scrapie in sheep, Bovine Spongiform Encephalopathy (BSE or mad cow disease) in cattle and Creutzfelt-Jacob Disease (CJD) in humans. These diseases also attack the brain and cause deterioration and eventual death. CWD was first identified in the 1960s in a Colorado research facility and since that time has been found in multiple states and Canadian provinces. It is unknown whether sika deer are susceptible to CWD.

CWD appears to be passed between animals via saliva and possibly feces and urine. Animals can also become infected through direct contact with an environment (i.e., soils) that is contaminated with the prions. At this time, it is unclear whether transmission between females and their fetuses (maternal transmission) can occur. CWD may be transmitted more readily within overpopulated herds and at feeding stations where direct physical contact among individuals is more likely. There is currently no evidence that CWD is transmissible to humans, but public health officials recommend that human exposure to CWD be avoided and recommend not consuming venison from infected deer.

The department has tested 10,176 deer for CWD since 1999. The disease was detected for the first time in Maryland from a deer taken by a hunter in November 2010. At the end of 2019, 52 infected deer had been documented in Allegany and Washington counties. Thirty-three of the deer originated in Allegany County Harvest Management Unit 233, including three on Billmeyer Wildlife Management Area, 14 on Green Ridge State Forest, and one on Sideling Hill Wildlife Management Area. Seven positive deer have been detected in Allegany County Harvest Management Unit 231 near Cumberland, and two have been detected in Harvest Management Unit 232. In Washington County, seven positive deer have now been detected in Harvest Management Unit 250, and three have been found in Harvest Management Unit 251.

The department has been testing deer for CWD with increasing intensity since 1999. Initially, only deer that appeared to have classic CWD symptoms were tested. Beginning in 2002, the department began more intensive sampling and collected samples from deer in all counties of the state. In 2010, sampling efforts were focused on Allegany and western Washington counties due to the presence of positive cases in nearby West Virginia and Virginia. West Virginia first detected CWD in Hampshire County in 2005 and it was found in Frederick County, Virginia in early 2010. Pennsylvania documented a deer positive for CWD in 2012.

Sampling is conducted on road-kills and deer brought by hunters to cooperating deer processors. Staff remove the brain stem and certain lymph nodes and those tissues are sent to a laboratory for testing. Any samples that test positive by the first lab are then sent to the USDA National Veterinary Services Laboratories for confirmation. This testing takes several months to complete. Positive samples are traced back to the hunter that harvested the deer and the department works with that hunter to determine the exact location where the animal was taken.

The Maryland Department of Agriculture, Maryland Department of Health & Mental Hygiene, the Southeastern Cooperative Wildlife Disease Study, and the United States Department of Agriculture are integral partners in all CWD surveillance plans to assist in monitoring wild deer populations, protect domestic animals and preserve human health. Staff also meet annually with their peers from the northeastern and southeastern states and SCWDS to discuss new information and management plans regarding the disease.

The department has a management plan for chronic wasting disease (dnr.maryland.gov/wildlife/Documents/2016_CWD_ResponsePlan.pdf) and has implemented measures to slow the spread of the disease, including restrictions on transporting carcasses. The department website (dnr.maryland.gov) has the most up-to-date information regarding the disease.

Cutaneous Fibroma–Cutaneous fibroma are warty hairless growths on the skin of white-tailed deer caused by viruses that are believed to be spread by biting insects. The nonfatal tumors vary in size from less than an inch to more than 8 inches in diameter. The tumors may be smooth or warty and vary from black to gray in color. Transmission to other animals such as livestock does not occur. Human consumption of infected deer would only be compromised by extremely large tumors with secondary infections. Deer managers have no method of preventing or controlling the spread of this condition.

Arterial Nematode Infection (Lumpy Jaw)–"Lumpy jaw" is the result of an infection by the arterial nematode *Elaeophora schneideri*. The adult arterial nematode worm lives primarily in the deer's carotid arteries. High worm infestations reduce blood flow, causing partial paralysis of the deer's jaw muscles. Food becomes impacted inside the deer's mouth due to the jaw muscle paralysis. The food impaction causes the "lumpy jaw" appearance. The common horsefly passes the nematode larvae from an infected deer to an uninfected one by feeding on deer blood. Infection rates do not impact deer populations and no human health implication has been reported. There is no method that can prevent or control the spread of this parasite.

Nasal Bot Fly Larvae–Fly larvae of the genus *Cephenemyia* live in the nasal passages and retropharyngeal pouches of deer. The adult fly lays an egg packet on the deer's skin around the nose or mouth. The deer licks the egg packet and the larvae are released into the deer's mouth. The larvae grow within the deer's nasal passages. Mature larvae drop on the ground to pupate in the soil. Nasal bots are not harmful to deer and do not make the meat unsuitable for consumption. When hunters are dressing deer, they may observe these bots exiting the nasal passages. The transmission of this larva cannot be prevented through deer management techniques.

Brain Abscess–Brain abscesses are a fatal deer disease caused by bacterial infections of the brain (a primary bacteria agent is *Actinomyces pyogenes)*. For yet unknown reasons, white-tailed deer on the eastern shore appear more susceptible to brain abscesses than deer elsewhere in the country (Karns et al. 2009; Turner et al. 2013). Bacteria typically enters the brain through skin infections near the antlers; therefore, antlered bucks are more prone to having this malady due to antler rubbing and sparring. This disease usually occurs during the time period immediately following velvet shedding through antler drop (September through March). Infected deer exhibit

neurological problems, such as circling and lack of coordination and some deer may exhibit strange behavior such as walking toward humans. Deer may be in poor physical condition. Total mortality in the deer population is probably low with adult antlered bucks being at higher risk than females and yearling bucks. Deer with brain abscesses should not be consumed. There is no deer management remedy for the spread of these bacteria.

Appendix 6. Summary of public comments regarding the draft 2020-2034 Maryland White-tailed Deer Management Plan

To be completed after the public comment period.

LITERATURE CITED

Alverson, W. S. and D. M. Waller. 1997. Deer populations and the widespread failure of hemlock regeneration in northern forests. Pages 280–285 *in* W. J. McShea, H. B. Underwood and J. H. Rappole, eds. The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington D.C.

Averill K.M., D. A. Mortensen, E. A. H. Smithwick, S. Kalisz, W. J. McShea, N. A. Bourg, J. D. Parker, A. A. Royo, M. D. Abrams, D. K. Apsley, B. Blossey, D. H. Boucher, K. L. Caraher, A. DiTommaso, S. E. Johnson, R. Masson, and V. A. Nuzzo. 2017. A regional assessment of white-tailed deer effects on plant invasion. AoB Plants 10(1):plx047.

Bates, S., D. Dawson, and A. Royle. 2005. Vegetation characteristics and breeding bird densities at Catoctin Mountain Park and the Frederick City Watershed. National Park Service, Center for Urban Ecology, Washington D.C.

Beringer, J., L. P. Hansen, J. A. Demand, J. Sartwell, M. Wallendorf, and R. Mange. 2002. Efficacy of translocation to control urban deer in Missouri: costs, efficiency, and outcome. Wildlife Society Bulletin 30(3):767-774.

C. Mason Ross Associates, Inc. 1996. Deer tracks: a survey for the long range planning and management of white-tailed deer populations in the State of Maryland. C. Mason Ross Associates, Inc., Annapolis, MD.

Correll, D. L. 1994. Final environmental assessment: public deer hunting on lands of the Smithsonian Environmental Research Center. Smithsonian Environmental Research Center, Edgewater, MD.

Davidson, W. R., and G. L. Doster. 1997. Health characteristics and white-tailed deer population density in the Southeastern United States. Pages 164–184 *in* W. J. McShea, H. B. Underwood and J. H. Rappole, eds. The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington D.C.

Davidson, W. R., and V. F. Nettles. 2006. Field manual of wildlife diseases in the Southeastern United States (3rd edition). Southeastern Cooperative Wildlife Disease Study, University of Georgia, Athens, GA.

Davis, M. L., J. Berkson, D. Steffen, and M. K. Tilton. 2007. Evaluation of accuracy and precision of Downing population reconstruction. Journal of Wildlife Management 71(7):2297-2303.

DeNicola, A. J., K. C. VerCauteren, P. D. Curtis, and S. E. Hygnstrom. 2000. Managing white-tailed deer in suburban environments: a technical guide. Cornell Cooperative Extension, Ithaca, NY.

Downing, R. L. 1980. Vital statistics of animal populations. Pages 247–267 *in* S. D. Schemintz, ed. Wildlife management techniques manual. Fourth edition (revised). The Wildlife Society, Washington D. C.

Drake, D., J. B. Paulin, P. D. Curtis, D. J. Decker, and G. J. San Julian. 2005. Assessment of negative economic impacts from deer in the northeastern United States. Journal of Extension 43(1), Article Number 1RIB5.

Ebersole, R., J. L. Bowman, and B. Eyler. 2007. Efficacy of a Controlled Hunt for Managing White-tailed Deer on Fair Hill Natural Resource Management Area, Cecil County, Maryland. Proceedings of the Annual Conference of Southeastern Association of Fish and Wildlife Agencies 61:68–75.

Ellingwood, M. R., and S. L. Caturano. 1996. An evaluation of deer management options. Publication No. DR-11. New Hampshire Fish and Game Department, Concord, NH.

Fagerstone, K. A., L. A. Miller, J. D. Eisemann, J. R. O'Hare, and J. P. Gionfriddo. 2008. Registration of wildlife contraceptives in the United States of America, with OvoControl and GonaCon immunocontraceptive vaccines as examples. Wildlife Research 35:586-592.

Haus, J. M. 2013. The impact of CWD on deer harvest and determining methods to estimate deer abundance. Masters thesis. The University of Delaware.

Haus, J. M., T. B. Eyler, M. D. Duda, and J. L. Bowman. 2017. Hunter perceptions toward chronic wasting disease: Implications for harvest and management. Wildlife Society Bulletin 41:294-300.

Haus, J. M., T. B. Eyler, and J. L. Bowman. 2019. A spatially and temporally concurrent comparison of popular abundance estimators for white-tailed deer. Northeastern Naturalist 26(2):305-324.

Hayes, E. B. and J. Piesman. 2003. How can we prevent Lyme disease? The New England Journal of Medicine 348:2424-2430.

Howard County Deer Management Task Force. 2002. Howard County Department of Recreation and Parks comprehensive deer management plan. Howard County Deer Management Task Force, Columbia, MD.

International Association of Fish and Wildlife Agencies. 2005. Potential costs of losing hunting and trapping as wildlife management methods. Association of Fish and Wildlife Agencies, Washington D.C.

Karns, G. R., R. A. Lancia, C. S. DePerno, M. C. Conner, and M. K. Stoskopf. 2009. Intracranial abscessation as a natural mortality factor for adult male white-tailed deer (Odocoileus Virginianus) in Kent County, Maryland, USA. Journal of Wildlife Diseases, 45(1):196–200.

Knapp, W.M. and R. Wiegand. 2014. Orchid (Orchidaceae) decline in the Catoctin Mountains, Frederick County, Maryland as documented by a long-term dataset. Biodiversity and Conservation 23:1965-1976.

Kugeler, K. J., R. A. Jordan, T. L. Schulze, K. S. Griffith, and P. S. Mead. 2015. Will culling white-tailed deer prevent Lyme disease. Zoonoses and Public Health 63(5):337-345.

Lang, L. M., and G. W. Wood. 1976. Manipulation of the Pennsylvania deer herd. Wildlife Society Bulletin 4(4):159-166.

McCullough, D. R. 1979. The George Reserve deer herd–population ecology of a K-selected species. University of Michigan Press, Ann Arbor, MI.

McShea, W. J., H. B. Underwood, and J. H. Rappole, eds. 1997. The science of overabundance: deer ecology and population management. Smithsonian Institution Press, Washington D.C.

Miller, B. K., G. L. O'Malley, and R. K. Myers. 2001. Electric fences for preventing browse damage by white-tailed deer. Purdue University Cooperative Extension Service. Publication FNR-136.

Montgomery County Deer Management Work Group. 1995. Montgomery County deer plan. The Montgomery County Deer Management Work Group, Silver Spring, MD.

Myers, J. A., M. Vellend, S. Gardescu, and P. L. Marks. 2004. Seed dispersal by white-tailed deer: implications for long-distance dispersal, invasion, and migration of plants in eastern North America. Oecologia 139:35-44.

Ness, E. W. 2017. A Comparison of White-tailed Deer Recruitment Rates to Relative Predator Abundance in Maryland. Masters thesis. University of Delaware.

Ostfeld, R. S., C. D. Canham, K. Oggenfuss, R. J. Winchcombe, and F. Keesing. 2006. Climate, deer, rodents, and acorns as determinants of variation in Lyme-disease risk. Public Library of Science Biology 4(6):e145.

Responsive Management. 2007. The opinions of residents, deer hunters, and landowners on deer management in Maryland. Responsive Management, Harrisonburg, VA.

Responsive Management. 2018. Maryland residents', landowners', and hunters' attitudes toward deer hunting and deer management. Responsive Management, Harrisonburg, VA.

Rhodes, C. L., J. L. Bowman, and B. Eyler. 2010. Home Range and Movement Rates of Female Exurban White-Tailed Deer. Journal of Wildlife Management 74(5):987–994.

Rhoads, C. L., J. L. Bowman, and B. Eyler. 2013. Movements of female exurban white-tailed deer in response to controlled hunts. Wildlife Society Bulletin 37:631–638.

Rossell, Jr., C. R., B. Gorsira, and S. Patch. 2005. Effects of white-tailed deer on vegetation structure and woody seedling composition in three forest types on the Piedmont Plateau. Forest Ecology and Management 210:415-424.

Rutberg, A. T., and R. E. Naugle. 2007. Progress Report: Immunocontraception of white-tailed deer at the National Institute of Standards and Technology, Gaithersburg, MD. The Humane Society of the United States.

Rutberg, A. T., and R. E. Naugle. 2008. Population-level effects of immunocontraception in white-tailed deer (Odocoileus virginianus). Wildlife Research 35(6):494-501.

Southwick Associates. 2007. Hunting in America: an economic engine conservation powerhouse. Produced for the Association of Fish and Wildlife Agencies with funding from Multistate Conservation Grant Program.

Southwick Associates. 2012. Hunting in America: An economic force for Conservation. Produced for the National Shooting Sports Foundation in partnership with the Association of Fish and Wildlife Agencies.

State Farm Insurance. 2018. Deer crashes down [Press Release]. Retrieved from newsroom.statefarm.com/2018-deer-crashes-down/

Stewart, C. M., W. J. McShea, and B. P. Piccolo. 2007. The impact of white-tailed deer on agricultural landscapes in 3 national historical parks in Maryland. Journal of Wildlife Management 71(5):1525-1530.

Telford III, S. R. 2017. Deer Reduction Is a Cornerstone of Integrated Deer Tick Management. Journal of Integrated Pest Management 8(1).

Turner, M. M., C. S. DePerno, M. C. Conner, T. B. Eyler, R. A. Lancia, R. W. Klaver, and M. K. Stoskopf. 2013. Habitat, wildlife, and one health: Arcanobacterium pyogenes in Maryland and Upper Eastern Shore white-tailed deer populations. Infection Ecology & Epidemiology 3:10.3402/iee.v3i0.19175.

U.S. Department of Agriculture, National Agricultural Statistics Service. 2012. Maryland Farmers Estimate $10.0 Million in 2011 Wildlife Related Crop Losses [Press Release]. Retrieved from nass.usda.gov/Statistics_by_State/Maryland/Publications/ Wildlife_Damage/mpr04-12Wildlife.pdf

U.S. Department of Health and Human Services. 2005. Lyme Disease The Facts The Challenge. NIH Publication No. 05-7045.

U.S. Department of the Interior and U.S. Department of Commerce. 2011. National survey of fishing, hunting, and wildlife-associated recreation.

Williams, S. C., and J. S. Ward. 2006. Exotic seed dispersal by white-tailed deer in southern Connecticut. Natural Areas Journal 26:383-390.

Williamson, S. J. 2000. Feeding wildlife…just say no! Wildlife Management Institute, Washington D.C.