

### Introduction

Like all of Vermont's big game species, wild turkeys fell victim to the massive loss of forestland and unregulated market hunting that characterized the settlement era and they were effectively extirpated by the mid-19th century. Today's population of more than 45,000 birds directly descends from 31 New York turkeys that were released by the department in the late 1960s as part of a restoration effort. Although successful reintroduction was initially expected to be limited to the part of the state reported to be historical turkey range (i.e. south of US Route 4), these hardy birds have far exceeded expectations. An established, sustainable population now occurs throughout the state, including Essex County.

The first, modern wild turkey hunting season was held in parts of Addison, Bennington, and Rutland Counties in the spring of 1973 and, by 2004, the entire state was open to hunting. Average annual combined spring and fall harvest of turkeys is now in excess of 7,000 birds per year. Like hunting, viewing opportunities have also expanded tremendously for Vermonters who simply enjoy viewing these unique birds in their natural setting.

Ideal Eastern wild turkey habitat includes a diverse mix of habitat types, forest succession stages and open land. Forests, of course, are important, especially when they consist of mature oak, beech and pine stands that produce abundant hard mast crops and provide large roosting trees. Clearings and openings are also vital. Whether created as farm pastures, hay fields or natural openings within the forest, the herbaceous plants they promote such as grasses and clover provide critical habitat for turkey broods. These open areas also have abundant insects on which young turkeys rely during early growth. Hens nest on the ground and prefer locations with ample lateral cover provided by herbaceous plants and shrubs, such as recent clear cuts and thinned timber stands.

Short-term turkey population fluctuations are common and result from combinations of random environmental conditions, such as high rainfall and prolonged stretches of cold temperatures that can affect nesting success, poult survival and adult winter survival. Long-term trends, however, are primarily influenced by changes in habitat quantity

### 2010-2020 Plan Accomplishments

#### ISSUE 1. Turkey Population

- 1.1 Continued collecting and assessing turkey harvest data throughout the planning period for use in directing turkey management decisions.
- 1.2 Conducted the annual public and staff summer/fall turkey brood surveys.
- 1.3 Completed investigation into the genetic variability and structure of Vermont's turkey population (Romano et al. 2007).

#### ISSUE 2. Public Satisfaction with Current Population Levels

- 2.1 Continued providing statewide spring bearded-bird-only and limited fall either-sex hunting opportunities.
- 2.2 Continued prioritizing high quality spring hunting over fall harvest opportunities:
  - Maintained high hunter satisfaction throughout planning period (92% very or somewhat satisfied in 2007 and 94% in 2018).
  - Four of the five highest spring turkey harvests ever recorded occurred within the 2010-2020 Big Game Plan period.
  - Expanded shooting hours for youth turkey hunting season from noon to 5PM in 2017.
- 2.3 Continued managing fall turkey hunting opportunities in accordance with spring harvest densities with the goal of maintaining/maximizing quality spring hunting.

#### ISSUE 3. Fall Turkey Hunting

- 3.1 Continued providing public opportunity to harvest wild turkeys throughout the planning period.
- 3.2 Continued managing fall turkey hunting opportunities in accordance with spring harvest densities with the goal of maintaining/maximizing quality spring hunting.
- 3.3 The threshold for fall hunting in new WMUs was reduced from 1 bird per square mile to .75 birds per square mile starting 2011.
- 3.4 The fall shotgun season was extended from seven to nine days starting 2011.
- 3.5 The fall shotgun season was expanded to include WMUs HI (Now H), D1, D2 and B with a nine-day shotgun season starting 2011.
- 3.6 The fall archery turkey season was expanded statewide and set to coincide with the opening of archery deer season starting 2011.

and quality. Because active agricultural practices can enhance turkey habitat, trends in agriculture today may affect the distribution and abundance of turkeys in the future (Timmins 1994). As the number of Vermont farms continues to decline while reforestation rates and forest age increase, the availability of open land may become a limiting factor for turkey production in the future.

## ISSUE 1. Turkey Population Objectives

### GOAL: Maintain a healthy, sustainable turkey population in Vermont.

With their recovery and expansion, turkeys are once again an integral part of the state's ecological and cultural landscape. They are important prey species for many carnivores and provide excellent hunting and viewing opportunities for wildlife watchers. As a reflection of this, the 2019 Big Game Survey found that 62% of Vermonters want the turkey population to remain the same and almost all (94%) hunters are satisfied with the state's turkey hunting, with most (67%) being very satisfied.

While all measures indicate a thriving population here in Vermont, concern is growing for the species nationally. After initial peaks in the 1990s and early 2000s, significant population declines are worrying and confounding biologists across the bird's range, particularly in the Southeast, Midwest and Mid-Atlantic (Casalena et al. 2016; Eriksen, et al. 2015). Potential contributing factors include increases in mammalian and avian predator populations, disease, habitat quality and availability and the influence of the "pioneer effect" -- a population boom that can occur when a new species becomes established in unoccupied habitat. However, no conclusions have been made.

Regardless of the cause, these declines illustrate the need to implement effective population monitoring in coordination with regional partners. At a minimum, the recent declines reported from mid-Atlantic states serve as a stark reminder of the importance of collecting quality population data in accordance with accepted protocols. The ability to analyze comparable data across jurisdictions strengthens the interpretive value of such datasets and allows managers to better understand the "bigger picture" issues that may be driving population trends. A recent study

## 2010-2020 Plan Accomplishments (*continued*)

### ISSUE 4. Wild Turkey/Human Conflicts

- 4.1 Continued working primarily through game wardens to provide direct landowner assistance with nuisance turkey issues throughout the planning period.
- 4.2 Continued working through the USDA Wildlife Services and game wardens to conduct follow-up visits to complaint sites and to provide hazing equipment as necessary.
- 4.5 Compiled and assessed annual nuisance turkey complaint reports to document problems, management approaches and results.
- 4.6 Contributed to the Northeast Upland Game Bird Technical Committee's effort to create a database of wild turkey nuisance abatement strategies and informational resources.

### ISSUE 5. Turkey Habitat Management and Conservation

- 5.1 Continued to advocate for and implement management practices that are beneficial to wild turkeys on department-owned Wildlife Management Areas (WMAs) and other public lands.
  - From 2014- 2018, nearly 2,000 apple trees were released, 3,444 acres of grasslands maintained, and 330 acres of early successional habitat created on department-owned WMAs.
  - Supported the National Wild Turkey Federation's (NWTF) membership-based habitat management activities (i.e. apple tree release, alder regeneration, food plots, etc.) on state-owned lands through a Memorandum of Understanding.
- 5.2 Provided technical information and assistance regarding turkey habitat management to private landowners, town planning commissions and other land managers:
  - Supported the NWTF's outreach and education efforts to promote habitat management on private lands through a Memorandum of Understanding.
- 5.3 "A Landowner's Guide - Wildlife Habitat Management for Lands in Vermont" was updated in 2015 to include a turkey-related section.
- 5.5 Continued the department's close partnership with the NWTF throughout the planning period.

### ISSUE 7. Developing and Maintaining an Informed Public

- 7.1 Continued disseminating wild turkey project related information to the public throughout the planning period through presentations, wildlife-based festivals, press releases, media interviews, big game reporting stations, workshops, and the routine use of various forms of correspondence.

of northeastern turkey populations (Klopfer 2017), for example, outlined recommendations for consistent long-term monitoring across the region including:

1. The collection of all turkey monitoring data at the county scale to facilitate data comparisons across the region;
2. The monitoring of turkey harvest per land area to provide insight into the greatest source of mortality affecting the population;
3. The monitoring of turkeys per unit of effort (i.e. turkeys seen per mile driven, turkeys harvested per days hunted, etc.) with sufficient spatial coverage and sample size; and
4. The monitoring of proxies for turkey productivity such as temperature/precipitation, winter flock surveys, etc.

To be clear, a string of recent record harvests indicates that Vermont's turkey population remains abundant and healthy. Indeed, harvest numbers suggest that some parts of the state may still be experiencing a pioneer effect as turkey continue to expand into available habitat. Nonetheless, the department must remain vigilant in its efforts to monitor the population and be prepared for a timely and informed response to any unexpected and/or drastic population change. Consequently, the department should continue to preemptively evaluate its turkey monitoring and management strategies to enhance the department's ability to confidently detect changes in the turkey population and enable an effective response to such changes as needed. Thorough assessments of turkey harvest, various biological indices and public opinion per WMU will likely be required to inform these strategies and thresholds. The partnership with National Wild Turkey Federation through a long-term Memorandum of Understanding will provide access to many turkey hunters who can provide critical feedback for surveys and other efforts determined necessary by the department for meeting these objectives.

### **Management Objectives and Strategies**

- 1.1 Annually collect and assess turkey harvest data to monitor disease, health and population trends.
- 1.2 Continue conducting turkey brood surveys to assess annual poult production using regionally accepted protocols.
- 1.3 Evaluate and implement new population monitoring methods (i.e. winter flock surveys, hunter sighting surveys, population models, hunter effort surveys) to effectively detect trends in the turkey population and manage it accordingly.
- 1.4 Improve the regional approach to managing turkeys using appropriate population thresholds and indices (i.e. spring toms harvested per square mile of habitat, turkeys harvested per unit of hunter effort, turkeys harvested per number of licensed hunters per WMU, etc.) evaluated at the WMU scale.

## **ISSUE 2. Turkey Management Strategies and Season Structure**

**GOAL: Maximize the ecological and social benefits derived from Vermont's wild turkey population by administering biologically appropriate and sustainable harvest regulations.**

Regulated hunting is the principal tool for wild turkey management. In addition to providing the bulk of the data necessary for monitoring and assessing distribution and abundance, it also serves as the sole mechanism for managing turkeys in accordance with their biological and cultural carrying capacities. In recent years, hunters have routinely achieved success rates in excess of 25%, resulting in a harvest of between 6,000 to 7,000 turkeys a year. Approximately 15,000 hunters purchase turkey tags each year to participate in at least one of the Vermont seasons: spring youth weekend; the month-long spring shotgun season; and the fall shotgun and archery seasons. Despite the general decline in hunter numbers, turkey tag sales have remained remarkably stable over the last decade. But this trend is not likely to continue. A 15% decline observed in youth turkey weekend permits sold since 2015, for example, provides an indication of where participation is likely headed. With this anticipated decline, though, comes an opportunity to liberalize harvest strategies especially where doing so is necessary for effectively managing the turkey population with fewer hunters.

The 2010-2020 Big Game Plan prioritized quality spring hunting over increased opportunities for fall hunting. Hunter support for this strategy was high (68%) in 2007 and remained at 63% in 2019. Indeed, almost half of all tag holders only hunt turkeys in the spring while only 10% solely hunt them in fall. Fall hunting is known to influence abundance in the following spring, thus fall regulations should be conservative and account for any potential population changes (McGhee et al. 2008).

The strong preference for spring hunting did not preclude an increase in fall hunting opportunity during the last plan period. This included the opening of the statewide fall archery season, the expansion of the fall shotgun season from seven to nine days and the lowering of the threshold for considering the expansion of fall harvest opportunities (Healy and Powell 1999) from 1 to .75 spring toms harvested per square mile of forested habitat which resulted in the opening of four additional WMUs to fall shotgun hunting. Importantly, there has been no discernable impact on the turkey population resulting from these expansions or any measurable diminishment of the quality spring hunting experience.

Despite this liberalization, there continues to be an interest among hunters to further expand fall opportunities. When asked about their opinions on the liberalization of various turkey hunting seasons, for example, respondents to the 2019 Big Game Survey expressed more support for expansion of fall opportunities (66% in favor of longer fall season and 62% in favor of increased fall bag limit) than for similar expansions of spring opportunities (54% in favor of all-day spring hunt) indicating an increasing interest in fall turkey hunting. Furthermore, as hunter numbers decline, the standard for quality spring hunts may be overshadowed by the need to control increasing turkey densities that are exceeding cultural and/or biological carrying capacities through the expansion of fall opportunities.

Designing and implementing effective management strategies that preserve the long-term health of the turkey population while balancing the various competing public interests, particularly hunter preferences, remains the principal challenge. This requires continuous monitoring of the population and habitat conditions, regular assessments of season structure and public preferences, and evaluating this information in a way that results in the informed implementation of fall harvest regulations.

In an effort to slow or reverse the decline in hunter numbers, wildlife agencies across the country have invested considerable resources into recruiting new hunters and Vermont is no exception. Turkeys are a key species in this effort. New hunters often find them less intimidating than larger game like deer, turkey hunters enjoy a much a higher success rate and the weather is generally more favorable.

In addition to supporting R3 (recruit, retain and reactivate) initiatives, the department should also strategically consider how turkey hunting can be effectively promoted to attract new hunters. At a minimum, the creation of a novice turkey hunting season like that recently implemented for deer would be a logical first step. However, support for this was only marginally favorable among hunters responding to the 2019 Big Game Survey (37% strong support and 16% moderate support) -- a clear indication that the department hasn't effectively emphasized the seriousness of the decline in hunter numbers to hunters themselves.

Of more minor consideration, but of increasing interest among hunters, is the current regulation restricting turkey hunters to shot sizes between 2 and 8. In recent years, the development of non-lead shot suitable for turkey hunting has prompted many states to liberalize their regulations. These alternatives often offer greater efficiency and performance in the field, are lead-free, and allow the use of 28 gauge and .410 shotguns which are known to be less intimidating to prospective hunters and friendlier to older hunters. It is important to note that the current regulations were originally adopted out of concern for public safety at a time when turkey hunting was still new. Today, after decades of turkey hunting and mandatory hunter education efforts, turkey hunting is very safe and hunting-related accidents are rare.

## **Management Objectives and Strategies**

- 2.1 Continue prioritizing quality spring hunting over fall hunting.
- 2.2 Consider liberalizing fall hunting opportunities when it is sustainable and in accordance with public preference.
- 2.3 Evaluate and implement methods for using turkey hunting to recruit new hunters such as, but not limited to, the creation of a "novice season" for turkeys similar to the recently adopted deer novice season.
- 2.4 Liberalize and simplify shot size regulations including the use of non-lead, tungsten shot.

## ISSUE 3. Diseases

**GOAL: Safeguard the health of Vermont’s wild turkey population through the effective surveillance of, and response to, disease outbreaks.**

Biologists around the country are monitoring several diseases believed to have the potential for widespread impacts on wild turkeys. Most notably, the list includes lymphoproliferative disease virus, avian influenza, salmonellosis, avian pox and histoplasmosis (a.k.a. “blackhead disease”). Although the cause, transmission, significance and management of these diseases varies considerably, all are capable of producing rapid illness and mortality. While no outbreaks having population level implications have been documented in Vermont to date, each of these diseases have been previously diagnosed in the state. For example, department staff annually receive several reports of presumed avian pox infected turkeys and, in 2013, 70% of apparently healthy, hunter-harvested turkeys submitted for disease screening (20 of 28 samples) tested positive for lymphoproliferative disease virus (Thomas et al. 2015), suggesting these diseases have been present in the state for some time.

Beyond the currently recognized disease threats to turkeys, one doesn’t need to look far to find examples of previously unknown pathogens exerting their influence on wildlife populations. West Nile Virus in grouse and winter ticks in moose, for example, are just a few of the more recently documented noteworthy cases. As a result, the ever-present risk of both known and unknown pathogens demands managing wildlife disease proactively.

The department’s approach involves four main elements:

### 1) Preparedness

In recent years, the department has taken a number of steps to increase disease response preparedness including joining the Northeast Wildlife Disease Cooperative, entering into a contractual agreement with a local wildlife veterinarian, and establishing a Wildlife Response Team. These actions were specifically taken to improve preparedness through the training of key staff, the dissemination of pertinent information, the establishment of diagnostic and consultation services, the procurement of necessary equipment, and the development of response protocols.

### 2) Protocols

In 2017, the department implemented its first Avian Disease Surveillance Plan which established priority species and thresholds for response. In addition, the plan also serves as a guide for the Wildlife Response Team including specific protocols regarding sample collection and diagnostics, partner organization roles and assistance, and public outreach.

### 3) Surveillance

The department utilizes both passive (i.e. investigations of morbidity and mortality events) and active (i.e. preemptive collection of samples) surveillance techniques as part of its disease response strategy.

### 4) Collaboration

The department partners with various NGOs such as the National Wild Turkey Federation and state/federal agencies (i.e. USDA Wildlife Services, Vermont Department of Health, etc.) to ensure that work is coordinated with regional efforts and ensure an efficient response to any disease outbreak.

While the department is in a better position to respond to an outbreak since the last Big Game Plan, the rising prevalence of disease in turkeys across their range demands a more active approach to evaluating disease risk beyond simply responding to cases of morbidity and mortality. In particular, the department should proactively participate in regional research projects designed to help identify, assess and mitigate disease risks. This would help to ensure that the implications of these diseases are better understood and enhance the ability to respond to any such outbreak. While an effective response is reliant upon a comprehensive understanding of risk, it is equally reliant upon the timely awareness of the occurrence of a disease in the state. In this regard, the public offers the best potential for being able to detect turkey diseases across the state simply due to the sheer number of people out-and-about on the landscape. However, in the absence of a readily accessible and well-designed system for reporting their observations, many of the cases observed by the public are likely never reported or are not effectively routed to the proper staff. Thus, one significant improvement the department can make with respect to disease preparedness for turkeys, and indeed for all wildlife, is the development of an online disease reporting system.

## Management Objectives and Strategies

- 3.1 Participate in regional studies designed to facilitate the understanding of wild turkey disease distribution and significance.
- 3.2 Implement a disease reporting system (i.e. online report form) designed to facilitate the effective monitoring of and response to disease outbreaks in wild turkeys.

## ISSUE 4. Turkey–Human Conflict

**GOAL: Maintain public support for wild turkey conservation by providing technical assistance when conflicts arise and by maintaining the turkey population within its cultural carrying capacity limits.**

The majority of Vermont’s wild turkey conflicts and damage-related complaints are associated with the loss of agricultural products -- primarily silage and garden crops (Tefft et al. 2005; Gregonis et al. 2011). This can occur through direct consumption by turkeys or from spoilage by contamination with their feces and most often occurs in the winter, when deep snow limits turkey mobility and restricts access to natural foods. The problem is further exacerbated because turkeys form large winter flocks and it can be difficult to discourage them once they have established a regular feeding pattern.

Human-turkey conflicts are handled on a case-by-case basis. Complaints are often resolved by simply providing over-the-phone technical assistance about turkey behavior and the various methods that can be used to prevent or minimize turkey-related damage. For the more persistent or extensive problems, however, control methods such as hazing and/or fencing are attempted with the assistance of game wardens, department biologists and the USDA Wildlife Services. Lethal control by shooting is the last option; however, farmers are sometimes granted permission by game wardens to eliminate offending birds in accordance with regulations when all other preventive and deterrence efforts have failed. In the past five years, lethal control was permitted in only five cases.

While the frequency of conflicts appears to be low, the reality is likely more complicated. It is believed that many people, particularly farmers, never report conflicts to the department but instead address conflicts on their own. Furthermore, it is important to note that Vermont’s experience with turkey-related conflicts contrasts sharply with much of the Northeast where conflicts are far more frequent and mostly occur in urban and suburban settings. Especially when coupled with higher densities resulting from milder winters and declining hunter participation, continued suburbanization of the state will likely lead to an increase in conflicts as well as a shift in the distribution and nature of these problems (Miller et al. 2000).

The 2019 Big Game Survey found most Vermont residents (62%) felt the turkey population should remain the same. There were regional differences among survey respondents, however, with over a quarter (26%) of central Vermont residents wanting the population to decrease compared to just 15% overall. This region, which includes Addison, Lamoille, Orange, and Washington counties, is also home to some of the most visible and robust densities of birds in the state. Of those who wanted the population to decrease, 58% cited conflicts with humans and/or agricultural damage as the primary reason.

The collection and assessment of accurate conflict data will be essential for informing the development of an effective conflict mitigation strategy in the coming years. The ability to continually assess the frequency and distribution of turkey-related conflicts will provide the fundamental data required for identifying where critical resources need to be applied, and inform the development of effective outreach and technical assistance and appropriate harvest management. Addressing and minimizing turkey conflicts will help to maintain a positive public appreciation for turkeys which will, in turn, foster an enduring public desire to conserve this species and their habitat through the future.

## Management Objectives and Strategies

- 4.1 Develop standardized protocols for guiding staff response to conflicts caused by wild turkeys.
- 4.2 Develop and disseminate educational materials designed to inform citizens/farmers about techniques for minimizing conflicts.
- 4.3 Strengthen outreach efforts aimed at increasing the public’s awareness of the importance of reporting conflicts with turkeys:

- Develop and implement an online turkey conflict reporting database designed to facilitate the collection, assessment and archiving of conflict data.
- Annually compile and evaluate conflict reports to document problems and inform management decisions.

4.4 Pursue a regional harvest management strategy that strives to minimize conflicts caused by wild turkeys.

## ISSUE 5. Habitat Changes and Conservation

**GOAL: Maintain the productivity of Vermont’s landscape for wild turkeys by working to identify, protect, and enhance key habitats.**

While wild turkeys thrive in a mosaic of habitat types common to Vermont – a patchwork of fields, forests and farmland -- several specific habitat types warrant close consideration. Brood-rearing habitat, for example, is comprised of forest openings where the availability of nutritious herbaceous forage and abundant insect life promotes rapid poult development in the late spring and early summer. And, similarly, soft/hard mast stands provide high caloric food that help prepare the birds for Vermont’s long winter. Also important is the availability of early successional and young forest habitats that offer productive nesting, foraging and protective cover.

A shared trait of these habitats is that they all require active management. Without deliberate and active intervention, their availability on the landscape wanes over time. Unfortunately, that is exactly what is occurring. The US Forest Service’s National Forest Inventory and Analysis Program found that from 1997 to 2015 the percent of Vermont’s forests that are less than 20 years old dropped from 9.5% to 2.0%. This indicates the continued maturation of the state’s forest and the loss of important early successional habitats (USDA Forest Service 2019). Similarly, the Vermont Agency of Agriculture reported the closure of 63 Vermont dairy farms in 2018 leaving the state with only 750 active farms (Vermont Agency of Agriculture, unpublished data). The continued decline of agriculture and the high-quality habitat it supports will surely have a measurable impact on the Vermont turkey population as will the loss of approximately 3,500 acres per year to residential/commercial development (Vermont Agency of Natural Resources, unpublished data). Given these trends and the fundamental importance of habitat to the persistence of turkeys, an effective strategy for ensuring the long-term health, abundance and sustainability of wild turkeys in the state must include habitat conservation and management approaches.

### Management Objectives and Strategies

- 5.1 Develop and maintain habitat demonstration sites designed to promote beneficial commercial and non-commercial land management practices.
- 5.2 Provide information and technical assistance to private landowners and other land managers regarding turkey habitat management.
- 5.3 Collaborate with key partners (i.e. NWTf, GMNF, etc.) to promote turkey habitat management and conservation.

### Competition Between Turkeys and Deer

As wild turkeys have expanded their range and numbers, so too has concern that turkeys are competing with deer.

Anecdotally, the most common belief seems to be that turkeys out-compete deer for hard mast such as acorns or beech nuts. While it’s true that both deer and turkeys concentrate on mast during years of abundance, so do bears, squirrels, grouse, blue jays and many small mammal species. Of these, turkeys often leave the most evidence, but it’s highly unlikely that their feeding comes at a detriment to deer. Autumn is the period of greatest food abundance, including wild apples, corn and other agricultural crops, grasses and forbs, berries and seeds of all kinds used by both species. In fact, a Pennsylvania researcher used fencing to determine that of all the wildlife feeding on red oak acorns, deer consume the greatest proportion of crop (Steiner 1995). Similarly, a Michigan researcher (Rosemier 2005) found that in non-mast years, rodents take the bulk of the beechnut crop. When you consider the fact that two 150-pound deer equal the biomass of a flock of 30 juvenile turkeys (or 15 large adults), it’s easy to see how a few deer could easily consume considerably more mast.

Contrary to high turkey densities having a significant negative impact upon deer numbers, high deer densities have been documented to have a harmful impact upon turkeys, ruffed grouse, and other forest birds because their excessive browsing of shrubs reduces protective cover, food sources, and nesting sites (Witmer and DeCalesta 1991).

## References

- Andreozzi, H.A., P.J. Pekins, and M.L. Langlais. 2014. Impact of moose browsing on forest regeneration in northeast Vermont. *Alces* Vol. 50: 67-79.
- Ballard, W.B., Whitman, J.S. & Reed, D.J. 1991: Population dynamics of moose in south-central Alaska. *Wildlife Monographs* 114: 1-49.
- Casalena, M. J., M. V. Schiavone, A. C. Bowling, I. D. Gregg, and J. Brown. 2016. Understanding the new normal: wild turkeys in a changing northeastern landscape. *Proceedings of the National Wild Turkey Symposium* 11:45-57.
- Côté, S. D., T. P. Rooney, J.-P. Tremblay, C. Dussault, and D. M. Waller. 2004. Ecological impacts of deer overabundance. *Annual Review of Ecology Evolution and Systematics* 35:113–147.
- DeCalesta, D. S. 1994. Effect of white-tailed deer on songbirds within managed forests in Pennsylvania. *Journal of Wildlife Management* 58:711–718.
- Dunfey-Ball, K.R. 2017. Moose density, habitat, and winter tick epizootics in a changing climate. M.S. Thesis, University of New Hampshire, Durham, USA.
- Eriksen, R.E., T. W. Hughes, T. A. Brown, M. D. Akridge, K. B. Scott, and C. S. Penner. 2015. Status and distribution of wild turkeys in the United States: 2014 status. *Proceedings of the National Wild Turkey Symposium* 11:7-18.
- Gasaway, W.C., Boertje, R.D., Grandgard, D.V., Kellyhouse, K.G., Stephenson, R.O. & Larsen, D.G. 1992. The role of predation in limiting moose at low densities in Alaska and Yukon and implications for conservation. *Wildlife Monographs* 120: 1-59.
- Gregonis, M. A., B. C. Tefft, B. J. Hiller and R. E. Eriksen. 2011. Assessment of wild turkey-human conflicts throughout the United States and Canada. *Tenth National Wild Turkey Symposium* 10:31-39.
- Healy, W. M., and S. M. Powell. 1999. Wild turkey harvest management: biology, strategies, and techniques. United States Fish and Wildlife Service, Biological Technical Publication BTP-R5001- 1999.
- Jones, H., P. Pekins, L. Kantar, I. Sidor, D. Ellingwood, A. Lichtenwalner, and M. O’Neal. 2019. Mortality assessment of moose (*Alces alces*) calves during successive years of winter tick (*Dermacentor albipictus*) epizootics in New Hampshire and Maine (USA). *Canadian Journal of Zoology* 97:22-30.”
- Keech, M.A., Bowyer, R.T., Ver Hoef, J.M., Boertje, R.D., Stephenson, T.R. & Dale, B.W. 2000: Life-history consequences of maternal condition in Alaskan moose. *Journal of Wildlife Management* 64(2): 450-462.
- Klopfer, M., 2017. Identifying potential causes of the trends in wild turkey populations in the Northeast. Unpublished report prepared by Pond and Property, LLC for the Northeast Upland Game Bird Technical Committee of the Northeast Wildlife Administrators Association, 70 p.
- Koitzsch, K.B. 2000. Application of a moose habitat suitability index model to wildlife management units in Vermont. M.S. Thesis, University of Vermont, Burlington, Vermont. 84 pp.
- Marquis, D. A., R. L. Ernst, and S. L. Stout. 1992. Prescribing silvicultural treatments in hardwood stands of the Alleghenies. United States Forest Service, Northeast Forest Experiment Station, Radnor, Pennsylvania, USA. General Technical Report NE-96. 108 pp.
- McGhee, J. D., J. M. Berkson, D. E. Steffen, and G. W. Norman. 2008. Density-dependent harvest modeling for the eastern wild turkey. *Journal of Wildlife Management* 72:196–203.
- McGraw, J. B., and M. A. Furedi. 2005. Deer browsing and population viability of a forest understory plant. *Science* 307: 920–922.

- McShea, W. J., and J. H. Rappole. 2000. Managing the abundance and diversity of breeding bird populations through manipulation of deer populations. *Conservation Biology* 14:1161–1170.
- Miller, J. E., B. C. Tefft, R. E. Eriksen, and M. A. Gregonis. 2000. Turkey damage survey: a wildlife success story becoming another wildlife damage problem. *Proceedings of the Wildlife Damage Management Conference* 9:24-32.
- Murray, D.L., 2006. Pathogens, nutritional deficiency, and climate influences on a declining moose population. *Wildlife Monographs* 166: 1–30.
- Robinson, K. F., A. K. Fuller, M. V. Schiavone, B. L. Swift, D. R. Diefenbach, W. F. Siemer, and D. J. Decker. 2017. Addressing wild turkey population declines using structured decision making. *Journal of Wildlife Management* 81(3):393-404.
- Romano, M. A., S. P. Romano, and C. W. Kilpatrick. 2007. Report on genetic analyses of Vermont wild turkey populations. Unpublished report prepared for the Vermont Chapter of the National Wild Turkey Federation by the Department of Biological Sciences, Western Illinois University, Macomb, IL and the Department of Biology, University of Vermont, Burlington, VT 22 p.
- Samuel, W. M. 2007. Factors affecting epizootics of winter ticks and mortality of moose. *Alces* 43:39-48.
- Tefft, B. C., M. A. Gregonis, and R. E. Eriksen. 2005. Assessment of crop damage by wild turkey in the United States and Ontario, Canada. *Wildlife Society Bulletin* 33 (2):590-595.
- Testa, J.W. 2004: Population dynamics and life history trade-offs of moose (*Alces alces*) in south-central Alaska. *Ecology* 85: 1439-1452
- Thomas, J. M., A. B. Allison, E. C. Holmes, J. E. Phillips, E. M. Bunting, M. J. Yabsley, and J. D. Brown. 2015. Molecular surveillance for lymphoproliferative disease virus in wild turkeys (*Meleagris gallopavo*) from the eastern United States. *PloS one*, 10(4), p.e0122644.
- Timmins, A. A., 2003. Seasonal home range, nesting ecology, and survival of eastern wild turkeys in northern New Hampshire. M.S. Thesis, University of New Hampshire, Durham, 87 p.
- USDA Forest Service, Forest Inventory and Analysis Program. 2019. Forest Inventory EVALIDator web-application Version 1.8.0.00. U.S. Department of Agriculture, Forest Service, Northern Research Station, St. Paul, MN [Available only on internet: <http://apps.fs.usda.gov/Evalidator/evalidator.jsp>]
- Vermont Department of Health <https://www.healthvermont.gov/disease-control/tickborne-diseases/lyme-disease>
- Whitlaw, H.A., and M.W. Lankester. 1994. The cooccurrence of moose, white-tailed deer, and *Parelaphostrongylus tenuis* in Ontario. *Canadian Journal of Zoology*, 72(5), 819-825.